Dragon Run Special Area Management Plan

FY06 Task 95

Submitted by:
Sara Stamp
Middle Peninsula Planning District Commission

This project was funded by the Virginia Coastal Zone Management Program at the Department of Environmental Quality through Grant # NA06NOS4190241 of the U.S. Department of Commerce, National Oceanic and Atmospheric Administration, under the Coastal Zone Management Act of 1972, as amended.

Task 1: Land Use Planning

Narrative Summary

During the FY05 grant cycle, a set of Dragon Run Steering Committee recommendations and language were developed in concert with county planning staff with each of the four watershed counties. A timeline for action for each of the localities was also developed.

During the FY06 grant cycle, MPPDC staff continued to coordinate with county staff to get the Dragon Run zoning and comprehensive plan recommendations on the appropriate agendas as the appropriate time arose. Some localities were in a position to move some items forward, others were not. Specifically, King and Queen and Gloucester Counties received technical assistance in addressing the Dragon Run recommendations. The counties not at a point to take forward action were still contacted to discuss the project and staff estimates of revised timelines.

Currently undergoing its Comprehensive Plan Update, Gloucester County planning staff is utilizing language from the recommendations (plus some expansion upon it) to include a more detailed section in the new Comprehensive Plan. MPPDC staff provided a technical overview of the Dragon Run SAMP and the land use recommendations to the Gloucester County Comprehensive Plan Steering Committee.

MPPDC staff also has provided technical assistance to the King and Queen County Planning Commission (July) and Board of Supervisors (August) as they are considering revising their current Dragon Run Conservation District. Although no formal action has been taken, it is anticipated that the county will at least re-affirm additional resource protection of the area within 100 feet of the Dragon Run, including the requirement for silviculture and agriculture best management practices.

geographic boundaries of the study area conform to those of the United States Census Bureau, which established Gloucester Point as a Census Designated Place (CDP) due to its concentrated population density. This sub-area plan is located in Appendix A of the Comprehensive Plan.

Other Planning initiatives for Gloucester Point include the Gloucester Point Gateway Plan which was instigated in part by plans to widen Route 17 to six lanes from the Coleman Bridge to Farm Wood Road. The plan was completed in 2002 and provides direction for future planning and implementation efforts for the southern tip of the County. The widening of Route 17 and the transportation improvements associated with this project may provide other planning opportunities to improve the aesthetic and transportation safety aspects at the Point.

Issues to consider when the Gloucester Point Plan is updated:

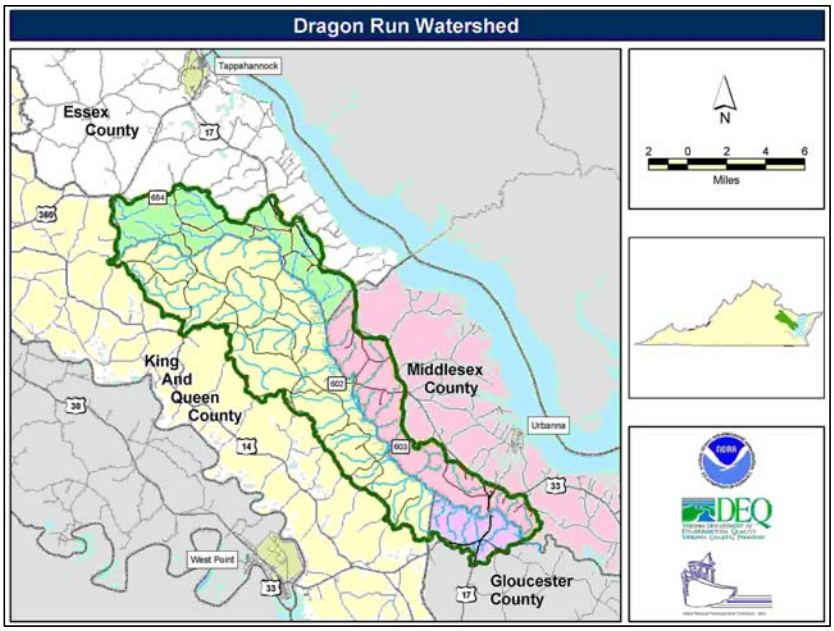
Identify need for two separate village scale sub-area plans in Gloucester Point: one for the areas adjacent to Hayes Road; the other for areas adjacent to Greate Road (both roads run parallel to Rt. 17).

Dragon Run Special Planning Area

As one of the Chesapeake Bay watershed's most pristine waterways, the Dragon Run "encompasses some of the most extensive and unspoiled swamp forest and woodland communities in Virginia"[21]. Effectively bisecting Virginia's Middle Peninsula located between the York and Rappahannock Rivers, this fresh and brackish water stream (Figure ___) meanders forty miles along and through nontidal and tidal cypress swamp. The watershed is mainly undeveloped, almost entirely privately owned, and encompasses approximately 140 square miles (90,000 acres) of rural landscape – mostly forests, farms, and wetlands. The spring-fed Dragon Run flows through portions of Essex, King and Queen, Middlesex, and Gloucester Counties, emptying into the estuarine Piankatank River and ultimately the Chesapeake Bay.

[21] Belden, A. Jr., A.C. Chazal, G.P. Fleming, C.S. Hobson, and K.M. McCoy. 2001. A Natural Heritage Inventory of the Dragon Run Watershed. Second edition. Natural Heritage Technical Report 01-03. Virginia Department of Conservation and Recreation, Division of Natural Heritage, Richmond, VA.

Figure ___. The Dragon Run Watershed



The Dragon Run plays a central role in the Middle Peninsula's culture and identity. Its intriguing name is frequently borrowed by local enterprises and establishments. Since European settlement in the early 1600's and Native American inhabitation up to 10,000 years before that, natural resources have been the bedrock of the watershed's economy. For older generations, forestry, farming, hunting, trapping and fishing were the primary ventures. Today, forestry and farming continue to generate wealth and drive the watershed's economy. Hunters, many involved in organized hunt clubs continue to uphold this ancient tradition throughout land in the watershed. More than 46 percent of the land is leased by hunt clubs and it is estimated that $300,000 is generated due to hunt club activity and over $1.6 million in fishing activity[22]. These land uses, together with extensive swamps, are the main reasons that the Dragon Run remains wild and secluded.

The watershed's wilderness is both expansive and unique. The Dragon Run contains the northernmost example of the Bald cypress-Tupelo Swamp natural community in Virginia and the best example north of the James River. [23] Moreover, 14 rare species and 5 rare natural communities are found here. Based

[22] Dragon Run Watershed Plan, November 2003, Dragon Run Steering Committee, Middle Peninsula Planning District Commission
[23] Belden, Jr. et al., 2001

on his investigations of the watershed's aquatic communities, one researcher observes that the Dragon Run is a "100 year old time capsule," resembling coastal plain streams in the Chesapeake Bay region at the turn of the 20th century[24].

The Dragon Run's unique character evokes strong feelings to protect the pristine watershed in both long-time residents and first-time visitors alike. Although development pressure in the watershed is currently low, the potential for significant land ownership changes (>25% in 10 years due to aging and absentee corporate landowners) threatens to disrupt the rural character and fragment productive farm and forest land. Likewise, habitat fragmentation jeopardizes the Dragon Run's unique natural communities. Landowner opinions about how to address these threats vary widely, ranging from the belief that "the Dragon takes care of itself" by its wild nature and voluntary landowner stewardship to enacting and enforcing regulations with "teeth."

The difference in point of view between property rights advocates and conservationists centers on how to maintain a pristine watershed into the future. The Dragon Run Watershed Special Area Management Plan (SAMP), a partnership between the Virginia Coastal Program and the Dragon Run Steering Committee of the Middle Peninsula Planning District Commission, is a project designed to address both the differing viewpoints and the common ground that exist concerning the future of the watershed. The project began in January 2002 with a grant from the Virginia Coastal Program under authority of the National Oceanic and Atmospheric Administration (NOAA). Enabled by the federal Coastal Zone Management Act of 1972 as amended, SAMPs aim to protect significant coastal resources through a collaborative, multi-level planning process to develop and implement new enforceable policies.

One of the fundamental elements of a SAMP is that a strong regional entity must exist that is willing to sponsor the planning program. In the Dragon Run watershed's case, that regional entity is the Middle Peninsula Planning District Commission through its Dragon Run Steering Committee. Formed in 1985, the Dragon Run Steering Committee consists of landowners and local elected officials and is the key vehicle for cooperation and coordination among the four counties concerning watershed issues. The Steering Committee's approach to the SAMP is to stimulate and coordinate community involvement in the proactive development and implementation of goals, objectives, and action plans for a watershed management plan.

Another major element of a SAMP is that conflict exists concerning the area's proposed uses. The Steering Committee believed that the best approach is to

[24] Garman, G. C. 2003. Aquatic Living Resources Inventories in the Dragon System: Virginia Commonwealth University on-going Activities. Dragon Run natural Resources Symposium, February 11, 2003, Virginia Institute of Marine Science, Gloucester Point, VA.

proactively head off conflict before it grows by enabling stakeholders to openly discuss the issues. Potential conflicts in the Dragon Run watershed are: 1) the differences between conservation and property rights advocates; and 2) the private use of land versus the public use of the water. The Steering Committee felt that the watershed approach was the most effective way to manage natural resources and traditional land uses.

The Dragon Run Watershed SAMP began with public planning forums in December 2001 and January 2002. These planning forums led to two primary outcomes: 1) the development and confirmation of common themes for watershed issues; and 2) the establishment of a SAMP Advisory Group representing a broad cross-section of the community. Building upon the foundation established by the planning forums, the SAMP Advisory Group developed a mission statement and developed a list of three goals, each with several objectives. With minor modifications, the Steering Committee approved the goals and objectives, which were incorporated into a Memorandum of Agreement. Each county – Essex, Gloucester, King and Queen, and Middlesex - and the Middle Peninsula Planning District Commission signed the Agreement during the late summer and fall of 2002 to consider the actions recommended by the Steering Committee.

Mission Statement for the SAMP

To support and promote community-based efforts to preserve the cultural, historic, and natural character of the Dragon Run, while preserving property rights and the traditional uses within the watershed.

- **Goal 1 - Establish a high level of cooperation and communication among the four counties within the Dragon Run Watershed to achieve consistency across county boundaries.**
- **Goal 2 - Foster educational partnerships and opportunities to establish the communities' connection to and respect for the land and water in the Dragon Run.**
- **Goal 3 - Promote the concept of landowner stewardship that has served to preserve the Dragon Run Watershed as a regional treasure.**

With the help of staff, consultants and the Advisory Committee, the Steering Committee completed the "Dragon Run Watershed Management Plan" in November 2003 and recommended that each of the localities adopt the plan as an addendum to their comprehensive plan until specific language could be added to each of the communities' Comprehensive Plan. Gloucester County adopted the Watershed Management Plan as an addendum to its Comprehensive Plan on November 3, 2003.

Only 6% of the Dragon Run Watershed is within Gloucester County and it represents only 3% of the County's land areas. However, as "one of the Chesapeake Bay watershed's most pristine waterways" the Dragon Run is well worthy of individual attention, both from the County's perspective and from a

regional perspective. The purpose of adopting the Watershed Management Plan was to formally acknowledge that the Dragon Run Watershed deserves distinctive treatment.

The uniqueness of the SAMP is that it goes beyond the County's borders. It represents regional collaboration and cooperation in managing this resource. The SAMP process, and its implementation, represents, and requires, partnerships with other localities on the Middle Peninsula, other governmental agencies and non-profit groups as well as with the property owners along the Dragon Run and the hunters, fishermen, boaters, nature lovers and others who enjoy its beauty and abundance. It also sets the stage for regional cooperation in future planning and implementation. By adopting the Watershed Management Plan as part of their Comprehensive Plan, the county adopted the following policies:

- Recognize the overall value of maintaining the traditional rural character and forested and farmed landscape of the Dragon Run watershed.
- Preserve the ecological integrity of the Dragon Run Watershed.
- Acknowledge the community and economic benefits of the Dragon Run watershed: for the production of agricultural and forest products; as a valued natural resource; for wildlife habitat; for maintaining water quality; and for scenic and aesthetic values.
- Continue to fully enforce existing regulations and policies.
- Protect forested and farmed land from fragmentation due to conversion to more intensive development.
- Encourage low-density, clustered pattern of development for new residential development in the watershed to protect open space and natural resources.
- Seek techniques to protect open space in the watershed without infringing upon landowner rights to maintain an economic return from their property.
- Identify land uses that are incompatible or competitive with traditional resource-based land uses (e.g. forestry, farming, hunting, fishing) and consider limiting them within the watershed.
- Limit or deny future rezoning approvals from existing zoning (i.e. *Agricultural or Rural Business zoning)* to more intensive uses in order to protect the rural character and integrity of farming and forestry resources in the watershed.
- Limit the extension of public utilities and central water and sewer in the watershed.
- Explore the feasibility of limiting major residential development in the watershed by aligning the Comprehensive Plan and Zoning Ordinance with provisions in the Subdivision Ordinance that limit major subdivisions.
- Publish citizen stewardship materials that explain pertinent ordinances, policies, and regulations in easy-to-understand language.

Many of these policies are similar to those established to protect the rural areas and character of the County. The Watershed Plan further recommends that Gloucester Planning Commission and Board of Supervisors amend their Comprehensive Plan include a “Dragon Run Planning Area.” Once the Comprehensive Plan has been updated to include recommendations for the Dragon Run Planning Areas, the plan recommends implementation of Comprehensive Plan by changes to the Zoning Map and Ordinances to incorporate “Dragon Run Protection Zone.” Through the SAMP funding, the MPPDC hired a consultant to work with staff and commissioners from each of the four affected Counties to develop draft language to consider in the Comprehensive Plan and subsequent zoning ordinances.

In addition to land use recommendations, the Watershed Management Plan includes tools to preserve forest, farm and natural resources, recommendations to address concerns regarding public access, and suggestions for controlling invasive species in the watershed. Additional recommendations involve education and landowner stewardship, ideas to encourage and support sustainable economic development, and recommendations to monitor the implementation of the Watershed Management Plan. Many of these recommendations are meant to be carried out by other agencies or entities and therefore will not likely be incorporated into the Comprehensive Plan update. Adoption of the plan shows support for the other recommended actions that may not be in the purview of local government, but will help to achieve the goals and objectives agreed to by all the Counties.

“Dragon Run Conservation District” and Other Amendments for the Gloucester County Comprehensive Plan:

<To be inserted before “and rural landscapes” in the first paragraph of the “Quality of the Natural Environment” section on page 12>

, Dragon Run

<To be inserted after the “Resource Conservation District” section on page 46>

DRAGON RUN CONSERVATION DISTRICT

The Dragon Run is a special regional resource worthy of protection in Gloucester County. The Dragon Run Watershed is in the Rural Countryside District and includes the Glenns Rural Service Center, a portion of the Highway Corridor Overlay District along U.S. Route 17, and shorelines and tributary streams protected by the Resource Conservation District. The Dragon Run and its surrounding landscape owe their extraordinary state of preservation to the landowners in the area that have pursued for generations the compatible land uses of farming and forestry on their land. Recent scientific study of the stream has also highlighted its critical ecological importance, including the purity of the water, the wealth of rare and unusual natural species it harbors, and the rural character of its watershed that has helped to keep it pristine. The rural way of life and traditional landscape in the Dragon Run Watershed are valued by the residents of the area and are worthy of conservation.

In 2002, the County signed a Memorandum of Agreement, in concert with the other counties in the Dragon Run Watershed, to protect the natural resources and rural qualities of the area by participating in the Dragon Run Watershed Special Area Management Plan. In particular, one of the objectives of the Memorandum was to “Achieve consistency across county boundaries among land use plans and regulations in order to maintain farming and forestry and to preserve natural heritage areas by protecting plants, animals, natural communities, and aquatic systems.”

The overall intent for the Dragon Run Conservation District in this Comprehensive Plan is for it to remain largely rural, with low intensity uses, and to protect its key natural areas and its water quality. Specifically, the intent of this District is to:

- Maintain the health and quality of the Dragon Run stream system and associated natural areas.
- Achieve the objectives of the Memorandum of Agreement and reinforce the existing shared values for preserving the Dragon Run.
- Support the compatible economic base of the Dragon Run area and its rural businesses such as farming and forestry that are compatible with preserving the natural health of the stream system.
- Support new rural economic development and businesses that are compatible with the traditional pattern of rural land uses in the Dragon Run area.

The boundaries of the Dragon Run Conservation District are generally defined as the boundaries of the watershed of the Dragon Run. The watershed of the Dragon Run is the area where precipitation collects and funnels to end up in the Dragon Run stream. Conditions throughout the watershed affect the water quality of the Dragon Run.

The intent of the policies for this District is not to prevent development of those areas, but through policies and standards, to ensure that they are developed in ways that are compatible with the basic intent of preserving the Dragon Run’s natural resources and low-intensity rural character.

The following policies are intended to apply to the entire watershed of the Dragon Run and will guide the development of the District. Gloucester County Comprehensive Plan has previously identified the Glenns area within the watershed as a Rural Service Center and U.S. Route 17 as a Highway Corridor Overlay District. The following District policies should be applied to the Glenns area in concert with the policies for Rural Service Centers and that portion of the U.S. Route 17 corridor within the

District in concert with the policies for Highway Corridor Overlay Districts.

- The District should maintain its rural character through integrating new development with the existing rural economy and settlement patterns.

- Low intensity land uses that are consistent with the conservation of the area’s natural resources should be the dominant land uses in the District and new development should be compatible with surrounding rural areas as well as incorporate development standards and management practices that ensure protection of the area’s natural resources.

- The extension of central sewer and water is not considered consistent with preserving the area’s rural character and land uses. The district shall not be served by public water and sewer facilities. Any new development within the district must be supported in the absence of public water and sewer and without exceeded the capacity of existing natural resources and infra-structure.

- The County should enact policies, economic development plans, and ordinances that support the cornerstone rural businesses in the District, such as farming and forestry, and that encourage compatible new supportive businesses such as value-added farming and timber products, local specialties, handicrafts, small-scale workshops, and craft industries, while ensuring that these businesses are practiced in ways that are compatible with protecting the health of the natural resources.

- The County should protect the key natural resources in the District, including the ground and surface water quality, wetlands, and sensitive environmental features; native plant and animal species and their natural habitats; and the productive soils that support farming and forestry uses.

- The County should discourage the extensive use of the District for public recreation and large-scale tourism and encourage small scale and controlled tourism and recreation uses that preserve natural areas, respect property rights, and limit opportunities for trespassing on private properties in the District such as bed and breakfasts, private hunt clubs and preserves, and private tours.

- The County should implement programs and exhibits that interpret the natural and cultural heritage of the Dragon Run for both residents and visitors, without encouraging intense or incompatible recreational use of the District’s sensitive resources.

- The County should consider implementation strategies that conserve existing land uses and protect the natural resources in the District such as conservation zoning and subdivision approaches, additional stream buffers and setbacks, the purchase of development rights, donation of private easements, landowner compacts, and land use taxation.

It should be noted that these policies for the Dragon Run Conservation District are generally in concert with Gloucester County’s existing policies for the Rural Countryside District, Resource Conservation District, Rural Service Centers, and Highway Corridor Overlay Districts.

“Dragon Run Conservation District” and Other Amendments for the Gloucester County Comprehensive Plan:

<To be inserted in **Objective 2** of **APPENDIX B** on page 71>

- Protect the key natural resources in the Dragon Run Conservation District, including the ground and surface water quality, wetlands and sensitive environmental features, native plant animal species and their natural habitats and the productive soils that support farming and forestry use.

<To be inserted in **Objective 2** of **APPENDIX B** on page 71>

- Encourage small-scale and controlled tourism and recreational uses of the Dragon Run Conservation District that preserve natural areas, respect property rights, and limit opportunities for trespassing on private properties in the area.

<To be inserted in **Objective 3** of **APPENDIX B** on page 72>

- Allow only low intensity rural land uses that are consistent with the protection of the area’s natural resources in the Dragon Run Conservation District.

<To be inserted in **Objective 5** of **APPENDIX B** on page 72>

- Utilize strategies that conserve existing agricultural and forest land uses in the Dragon Run Conservation District and protect the environmental resources of the stream system, such as conservation zoning and subdivision approaches, additional stream buffers and setbacks, the purchase of development rights, donation of private easements, landowner compacts, and land use taxation.

Notes from Paige:

Should each policy have a specific strategy to explain how to achieve the policy? For example, the first policy – rural character, include specifics like preserve tree cover in new development, encourage cluster to preserve specific rural features, etc. The policies are very general.

Or are the specifics to be listed in the goals and objectives section? As indicated above?

Task 2: Code of Conduct

Narrative Summary

MPPDC staff researched and developed a guidance document detailing the public and private rights for use of the Dragon Run and similar waterways. The Public Trust Doctrine served as the guiding principle behind the information conveyed in the brochure. MPPDC staff presented this code of conduct information to several organizations, including the Middle Peninsula Chesapeake Bay Public Access Authority, and included the guide as a part of the management plans which were developed for adoption under task 4 of this grant. The Middle Peninsula Chesapeake Bay Public Access Authority adopted the code of conduct, which is termed the "Public Access Guide" at its October, 2007 meeting.

What can the public do on rivers that are navigable for title purposes?
The three activities that the courts have traditionally mentioned are navigation, fishing, and commerce. The public can fish, from the river or from the shore below the "ordinary low water line." (Note that the fish and wildlife are owned by the state in any case.) But the courts have ruled that any and all non-destructive activities in these areas are legally protected.

What about getting to and from the river?
Normally there is no right to cross private land to get to or from a river. For example, there is no right to walk across a farmer's field to get from a public highway to a river.

However, the state has a duty to maintain public access routes to rivers under certain conditions, as part of its public trust duties. Courts have found it unlawful for a state to close off an existing public access route when there are no other public access routes nearby.

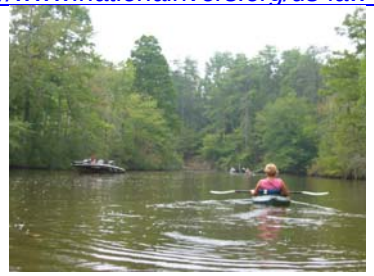
What about river pollution and leaving trash?
Local, state and federal regulations limit or prohibit water pollution. Hefty fines can apply.

Balancing private property and public rights through a Code of Conduct in the Dragon Run
The sense of being invaded by trespassers strikes a deep emotional chord in many a landowner who has a river flowing through his property. Some Dragon Run landowners tend to lump all river users together - those who canoe quietly down the middle of the river, those who stand quietly below the ordinary low water line to fish, those who stay on or near the river but litter and make noise, and those who proceed well away from the river onto private land. However, the right of the public for the use of title navigable waterways soundly exists in the Public Trust Doctrine. This right may be compared to the right to use a public roadway. Individuals have the right to use the roadway in its defined boundaries, but not drive through adjacent private yards or throw litter out of the window as they are passing through.

Additionally, while public roadways are generally well defined, the line between navigable and non-navigable waterways becomes increasingly vague as one travels further from the natural and ordinary Dragon Run mainstem, thereby increasing the potential for conflict between landowners and users.

Ultimately, the practice of responsible recreation coupled with an awareness of the public and private rights, including its vagueness in some locations, is the key to reducing conflict.

Acknowledgement: Adapted from *Who Owns the River?* From the National Rivers Website:
http://www.nationalrivers.org/us-law-who-



This work was funded by the Virginia Coastal Zone Management Program at the Department of Environmental Quality through Grant # NA06NOS4190241 Task 95 of the National Oceanic and Atmospheric Administration, Office of Ocean and Coastal Resource Management, under the Coastal Zone Management Act of 1972, as amended. The views expressed are those of the author(s) and do not necessarily reflect the views of NOAA or any of its subagencies.

Public Use Guide

Mission: To support and promote community-based efforts to preserve the cultural, historic, and natural character of the Dragon Run, while preserving property rights and the traditional uses within the watershed.

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DRAGON RUN SPECIAL AREA MANAGEMENT PROGRAM

DRAGON RUN SPECIAL AREA MANAGEMENT PROGRAM

What is the Dragon Run Special Area Management Program (SAMP)?
This partnership between the Virginia Coastal Zone Management Program and the Dragon Run Steering Committee of the Middle Peninsula Planning District Commission is designed to address both the differing viewpoints and common ground that exist concerning the future of the watershed.

What is the Dragon Run Steering Committee?
Formed in 1985, the Dragon Run Steering Committee consists of landowners and local elected officials and is the key vehicle for cooperation and coordination among the four counties concerning watershed issues.

What counties are in the watershed?
The counties of Essex, Gloucester, King and Queen, and Middlesex contain the watershed.

STEERING COMMITTEE

Essex County – Prue Davis (Chair)(S), Fred Hudson (P), Dorothy Miller (L), M. Scott Owen (L)
Gloucester County – Charles "Rick" Allen (S), Dr. Eric Weisel (P), Terry DuRose (L), Dr. Willy Reay (L)
King and Queen County – Keith Haden (S), Kempton Shields (P), Robert Gibson (L), William "Frank" Herrin (L)
Middlesex – John D. "Jack" Miller (S), John England (P), R. D. Johnson (L), William Bagby (L)

(S) denotes Supervisor
(P) denotes Planning Commissioner
(L) denotes Land Interest

Staff – Sara Stamp

PUBLIC RIGHTS FOR USE OF THE DRAGON RUN

Which rivers are owned by the public?
The U.S. Supreme Court has held that the bed and banks under all rivers, lakes, and streams that are navigable, for title purposes, are owned by the states, held in trust for the public through the Public Trust Doctrine. Title in this context means ownership. In Virginia, this public-trust ownership extends up to the ordinary low water line, (or ordinary low water mark,) encompassing what is commonly referred to as the submerged and submersible land, as opposed to the upland.

What does navigability, for title purposes, mean?
Through various court cases, federal courts have articulated the following test, which is known as the federal test of navigability for title purposes:

* Navigability is determined as of the date of statehood
* Waters must be navigable in their natural and ordinary condition;
* The waterway must be usable for transportation conducted in customary modes of trade and travel on water; and
* The waterway must be capable of or susceptible to use as a highway for the transportation of people or goods.

The courts have determined that the use or potential for use by almost any type of watercraft is sufficient to determine this type of navigability.

Do shallows, rapids, and other obstacles make a river non-navigable for title purposes?
No. The courts make no requirements that a river be uniformly deep, or flat, or that navigation be practical going upstream as well as downstream. The presence of rapids, even numerous rapids and waterfalls, or blockages does not disqualify a river.

What if the river is only physically navigable during the wet season of the year?
It still qualifies as navigable for title purposes. But a normally dry creek bed or "wash" that is only temporarily navigable during extreme weather does not qualify. (If it's normally dry because of upstream dams, then it does qualify. The legal test is based on the river's natural condition.)

What if the current property owner's deed reads to the middle of a river, or seems to surround and include the river?

If the physical characteristics of the river are such that it meets the federal test of title navigability, it is public land up to the ordinary low water line. Since a deed can only convey interests actually owned by the seller, and since the bed and banks of all navigable rivers passed to the states at the time of statehood, it is likely that the state is the true owner. The state's ownership is a "prior existing right" and is frequently mentioned as such on deeds. Somewhere along the chain of property transactions, a deed may have been changed to include the riverbed. If this happened it was likely done incorrectly.

Task 3: Dragon Run Steering Committee Technical Assistance

Narrative Summary

During the FY 06 Dragon Run SAMP grant cycle, MPPDC staff coordinated two Dragon Run Steering Committee meetings. The May 2007 meeting focused primarily on a biodiesel update and an informational presentation on purchase of development rights. The August 2007 meeting served as the annual picnic and the primary topic of the meeting was a presentation by Lewie Lawrence of the Middle Peninsula Chesapeake Bay Public Access Authority (PAA) on public access in the Dragon Run. Mr. Lawrence provided an update on the PAA, its goals, and its pending acquisitions.

MPPDC staff also provided staff support to the Dragon Run Day Planning Sub-committee. Staff supported the goals of the committee primarily by coordinating monthly meetings and developing requested documentation. While staff support coordinated the purchase of t-shirts and tent rentals, the planning sub-committee members coordinated the inclusion of exhibitors, vendors and most sponsors. Dragon Run Day occurred on October 13th at Thousand Trails and was a tremendous success with attendance estimated to be approximately five to six times the numbers in previous years' events.

MPPDC staff represented the Dragon Run Steering Committee by attending several other committees' meetings, including those of the Middle Peninsula Chesapeake Bay Public Access Authority (June and August) and the Coastal Planning District Commission (July).

MPPDC staff has also prepared a position statement for the Dragon Run Steering Committee on the proposed Naval Outlying Landing Field (OLF) in the King and Queen portion of the Dragon Run Watershed. A request for development of a similar position statement has been submitted to the Middle Peninsula Planning District Commission and other project partners.

Dragon Run Steering Committee
Middle Peninsula Planning District Commission
Steering Committee Meeting Minutes
May 9, 2007 7:00pm
Saluda, Virginia

Agenda

1. Welcome and Introductions
2. Biodiesel Feasibility Study and Pilot Program
3. Purchase of Development Rights, Melvin Atkinson, Coordinator, Agricultural Reserve Program, City of Virginia Beach, Virginia
4. Other Business
5. Adjourn

Attendance

Steering Committee: Frank Herrin (King and Queen County), Prue Davis (Essex County), Dorothy Miller (Essex County), Terry DuRose (Gloucester County), Eric Weisel (Gloucester County), William Bagby (Middlesex County)******

Others: Sara Stamp, Melvin Atkinson, Chelsea Jenkins, and Al Christopher

Welcome and Introductions

Chair Prue Davis called the meeting to order and began introductions. Sara Stamp also noted that Mr. William "Bill" Bagby is the newly appointed landowner representative from Middlesex County.

Biodiesel Feasibility Study and Pilot Program

Mr. Christopher and Ms. Jenkins supplied the Steering Committee with the following presentation to provide an update and overview of the current status and findings of the biodiesel feasibility study:

U.S. Department of Energy
Energy Efficiency
and Renewable Energy

Clean Cities

Clean Cities
Virginia

Dragon Run Steering Committee Meeting
Biodiesel Project Update

Al Christopher
Chelsea Jenkins

May 9, 2007

VIRGINIA CLEAN CITIES

Purpose

The overall purpose of the project was to identify and explore economic development activities and opportunities that sustain traditional land uses while enhancing the natural resource base or at least minimizing adverse impacts.

The purpose of this feasibility study is to characterize and quantify potential capacity, will and market for biodiesel end users, including farmers, local governments, school bus and commercial fleets and other diesel powered equipment operators, and possible cooperative approaches to the traditional retail sales of fuel.

Why biodiesel?

VIRGINIA CLEAN CITIES

Background

- **Energy Security:** “DOE study estimated U.S. oil dependence has already cost the country $3.4 trillion from 1970 to 1999. According to the report, “the present value of these losses is close to $7 trillion, almost an entire year’s GDP… Clearly, oil dependence ranks among the most significant economic problems the United States has faced over the past thirty years”

- **Air Quality:** Biodiesel burns cleaner; Fuel produced closer to its end use contributes less to air pollution.

- **Preserve Farmland:** Just as buying local, organic food helps preserve farmland and open space by keeping local farmers in business, buying locally produced fuel from locally grown crops helps preserve farmland.

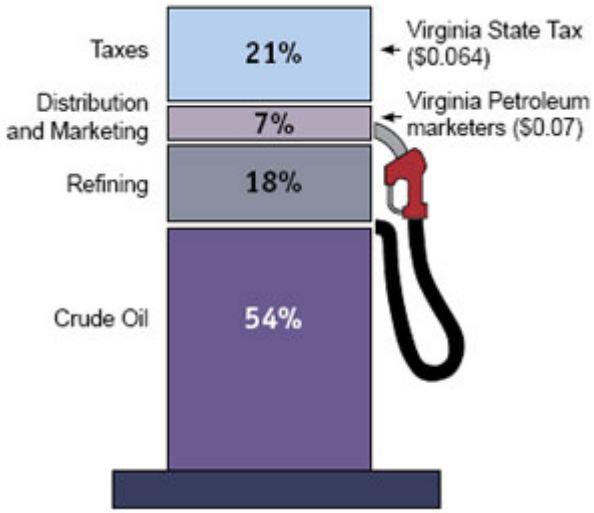
  Or does it?

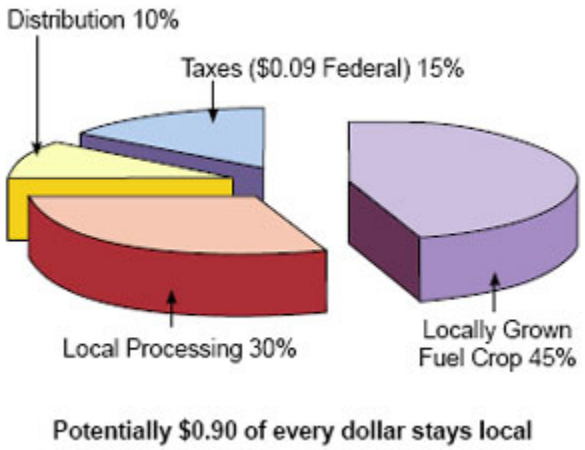
VIRGINIA CLEAN CITIES

Background

Virginia Tech Extension:

"The use of biodiesel in Virginia can have positive benefits for the state economy. Currently, for every $1 spent buying diesel in Virginia, large portion of the premium goes to crude oil with only $.134 staying locally through state tax and local distributor income. If locally produced biodiesel was used, for every $1 spent, potentially 90 cents would stay in the local or state economy."





VIRGINIA CLEAN CITIES

Back to the Purpose

The purpose of this study is to characterize and quantify potential capacity, will and market for biodiesel end users, including farmers, local governments, school bus and commercial fleets and other diesel powered equipment operators, and possible cooperative approaches to the traditional retail sales of fuel.

<u>Assess the market:</u>

- Characterize potential fleets and retail market for biodiesel in the Dragon Run Watershed
- Define the market's geographic boundaries
- Refine the roles of strategic partners
- Evaluate options for biodiesel use and or production
  - Evaluate markets for oilseed crops, and byproducts of oil extraction
- Assess factors impacting biodiesel market penetration

Determining the potential for biodiesel market penetration by characterizing potential fleets and retail markets for biodiesel

Fleet Surveys

1. How many vehicles and pieces of equipment are currently operating in your fleet?
2. Please help us characterize your fleet by breaking down the number of:
    - Light-duty gasoline vehicles:
    - Light-duty diesel vehicles:
    - Heavy-duty gasoline vehicles:
    - Heavy-duty diesel vehicles:
    - Off-road gasoline vehicles:
    - Off-road diesel vehicles:
3. How much fuel does your fleet use on a monthly or annual basis?
    - Gasoline
    - Diesel
    - Other fuel
4. Who is your fuel distributor?
5. Are you using any biofuels (biodiesel blend or ethanol blend)?
6. Would you like to learn more about biodiesel, or are you interested in possibly using a biodiesel blend?

VIRGINIA CLEAN CITIES

Characterize Potential Fleets and Retail Markets

Oil Distributor Survey

As part of the Dragon Run Special Area Management Plan managed by the Middle Peninsula Planning District Commission (MPPDC), a study was conducted ["Opportunities for Sustainable Natural Resource-Based Development in the Dragon Run Watershed"] in order to identify and explore economic development activities and opportunities that sustain traditional land uses while enhancing the natural resource base. The Dragon Run Steering Committee selected seven areas for further exploration, including biodiesel utilization for municipal vehicles.

To that end, Virginia Clean Cities is working with the MPPDC to establish the possible boundaries of potential biodiesel usage in the six counties that comprise the Middle Peninsula area (Essex, Gloucester, King and Queen, Middlesex, King William, and Mathews). Right now we are identifying stakeholders, and conducting fleet and oil distributor surveys.

A couple notes about this survey:

This is a blind survey meaning no oil company will be identified. The numbers received will be aggregated with all other results, and oil companies will be represented by a letter of the alphabet. There will be no way of identifying companies (i.e. county).

While we are trying to establish the maximum potential use of biodiesel, it would never equal the total amount of diesel sold in the Middle Peninsula.

If possible, could we please get the following information concerning your sales in the Middle Peninsula area of Virginia?

VIRGINIA CLEAN CITIES

Characterize Potential Fleets and Retail Markets

Oil Distributor Survey (cont.)

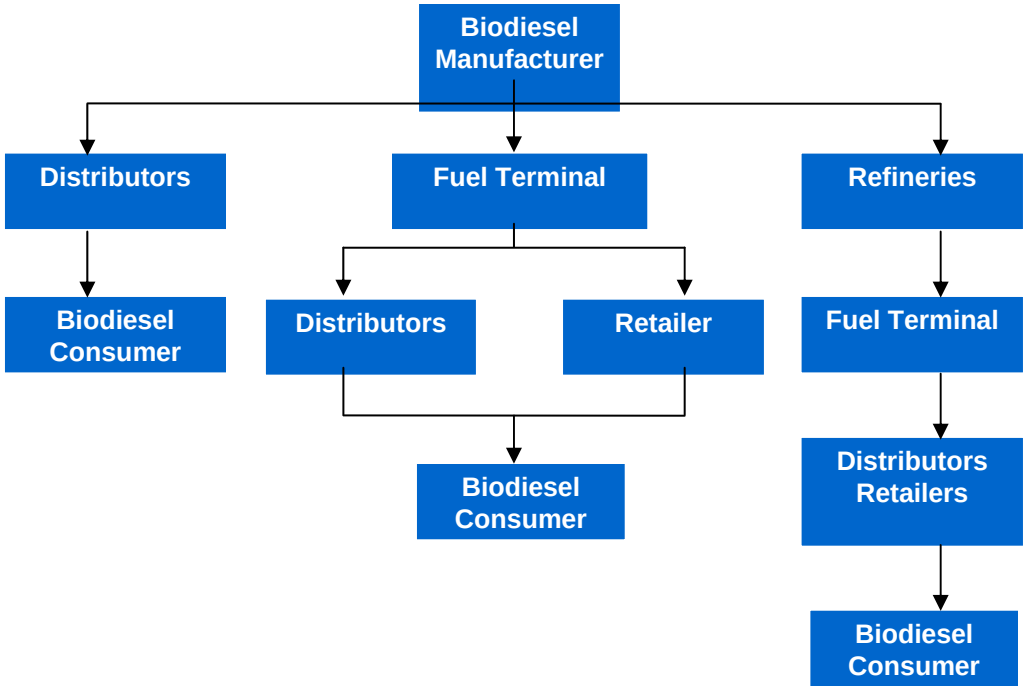
If possible, could we please get the following information concerning your sales in the Middle Peninsula area of Virginia?

Company Name:
Commercial Highway Diesel Sales:
Retail Highway Diesel Sales:
Number of Retail Highway Diesel Locations:
Total Off-Road Diesel Sales:
Retail Off-Road Diesel Sales:
Number of Retail Off-Road Diesel Locations:
Total #2 Heating Fuel Oil Sales:
Biodiesel Sales and Locations (if sell biodiesel):
Areas in Middle Peninsula you serve (Essex, Gloucester, King and Queen, Middlesex, King William, and Mathews):

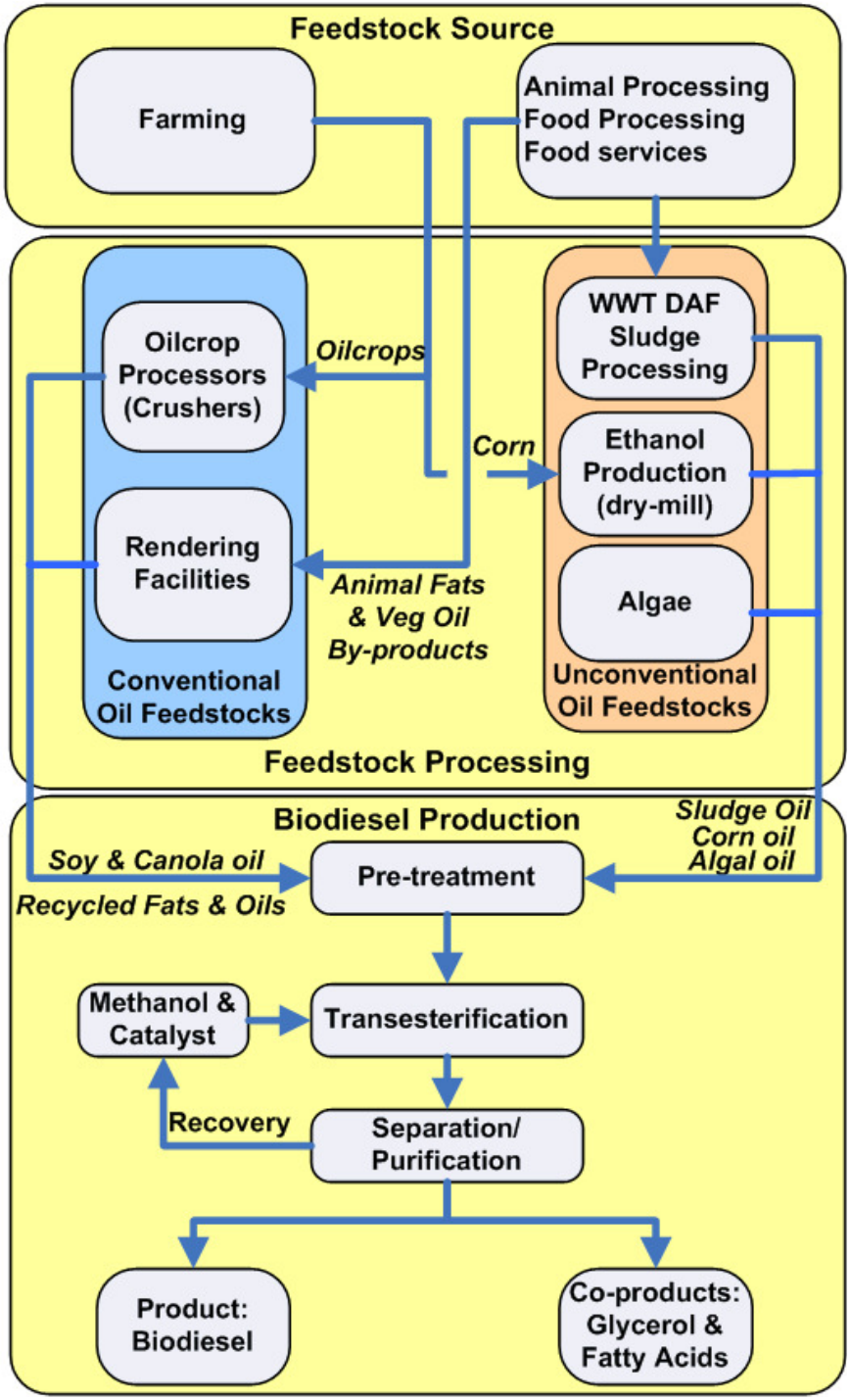
VIRGINIA CLEAN CITIES

Refine the Roles of Strategic Partners

Biodiesel Distribution Infrastructure



Biodiesel Production Process and Feedstock Sources



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Refine the Roles of Strategic Partners

- Biodiesel Manufacturer (refinery)
- Biodiesel Distributor
- Biodiesel Retailer
- Biodiesel Users/Fleets
- Farmers

Biodiesel Manufacturers

Virginia Biodiesel: 7475 Ready Mix Drive in West Point, Virginia
RECO Biotechnology: Richmond, Virginia

VIRGINIA CLEAN CITIES

Refine the Roles of Strategic Partners

Biodiesel Distributor

- Phillips Energy Inc
- June Parker Oil Company
- Thrift Oil (biodiesel dist)
- Atkins Petroleum
- Papco Energy Inc. (biodiesel dist)
- Frederick Northrup Inc.
- Northern Neck Oil Co.
- TCH Oil Co. (biodiesel distributor)
- WF Parker Oil
- ET Lawson (bioheat dist)
- Massey Oil Co.
- Milby Oil Co.
- Sears Oil Co.
- Wroten Oil Co. (biodiesel dist)

National Biodiesel Board Distributor Database:
http://www.nbb.org/buyingbiodiesel/distributors/showstate_bycity.asp?st=VA

VIRGINIA CLEAN CITIES

Refine the Roles of Strategic Partners

Biodiesel Retailer

If biodiesel is to become mainstream in the Middle Peninsula area, retailers must become interested stakeholders.

National Biodiesel Board Buyinig Biodiesel Guide:
http://www.nbb.org/buyingbiodiesel/retailfuelingsites/showstate.asp?st=VA

VIRGINIA CLEAN CITIES

Refine the Roles of Strategic Partners

Biodiesel Fleets/Users

Any diesel vehicle or piece of equipment can use biodiesel, which is one of its advantages. Below is a list of potential fleet types which can take advantage of a biodiesel blend.

Fleet Types

- "Niche Markets": Ag, Forestry, Recreation (i.e. ferry)
- Airport vehicles
- Taxis
- Shuttle buses
- Transit buses
- School buses
- Refuse haulers
- Delivery vehicles
- Long-haul trucks
- Government fleets
- Off-road equipment

VIRGINIA CLEAN CITIES

Characterize Potential Fleets and Retail Markets

Fleet Identified for Survey

King and Queen County Schools
Middlesex County Schools
Gloucester County Schools
King William County Schools
Lancaster County Schools
Essex County Schools
Mathews County Schools
Essex County
King and Queen County
Gloucester County
King William
Mathews County
Middlesex County
Town of Tappahanock
Town of Urbanna
Town of West Point
Bay Transit

Any others??

VIRGINIA CLEAN CITIES

Refine the Roles of Strategic Partners

Farmers

"Like many of my fellow soybean farmers, after the first Gulf War, I saw the development of a biodiesel industry as a way for farmers to contribute to our nation's energy supply." *– Biodiesel Magazine, March 2006 Guest Editorial*

- Use biodiesel
- Sell grain for oil extraction
- Form cooperative

Which, if any, of these make sense?

VIRGINIA CLEAN CITIES

Refine the Roles of Strategic Partners

Farmers

The USDA National Agricultural Statistics Service reports that Essex, Gloucester, Middlesex, Mathews, King and Queen, and King William Counties collectively have 593 farms total, comprising 145,409 acres. Looking at this farmland from a biomass perspective, or more specifically an oilseed perspective, soybean appears to be the primary oilseed crop grown in the Middle Peninsula area. The NASS reported 227 soybean farms with production of 1.44 million bushels.

Total Cropland (farms)	593
Total Cropland (acres)	145,409
Total soybean for grain (farms)	227
Total soybean for grain (acres)	62,146
Total soybean for grain (bushels)	1,436,714
Other oilseed crops or potential?	

VIRGINIA CLEAN CITIES

Factors Affecting Biodiesel Market Penetration

Fuel quality issues: proper biodiesel handling practices, blending, cold weather prep

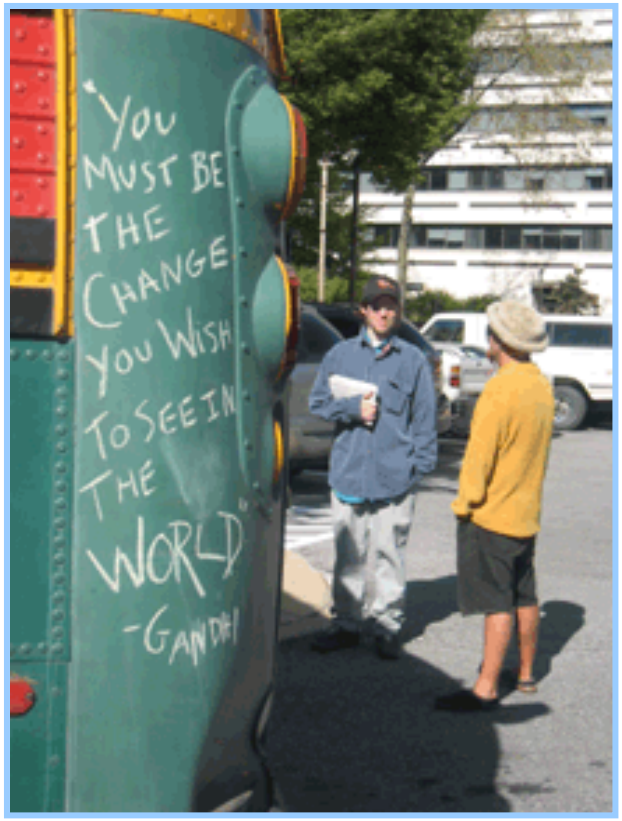
Costs associated with transition and fuel

Environmental (clean air pressures, federal and state mandate), technical (# of diesel vehicles, and social factors (reason compelled to use biodiesel) of fleet

Limitations of biodiesel manufacturing (production costs, feedstock limitations)

VIRGINIA CLEAN CITIES

Contact Information



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Purchase of Development Rights

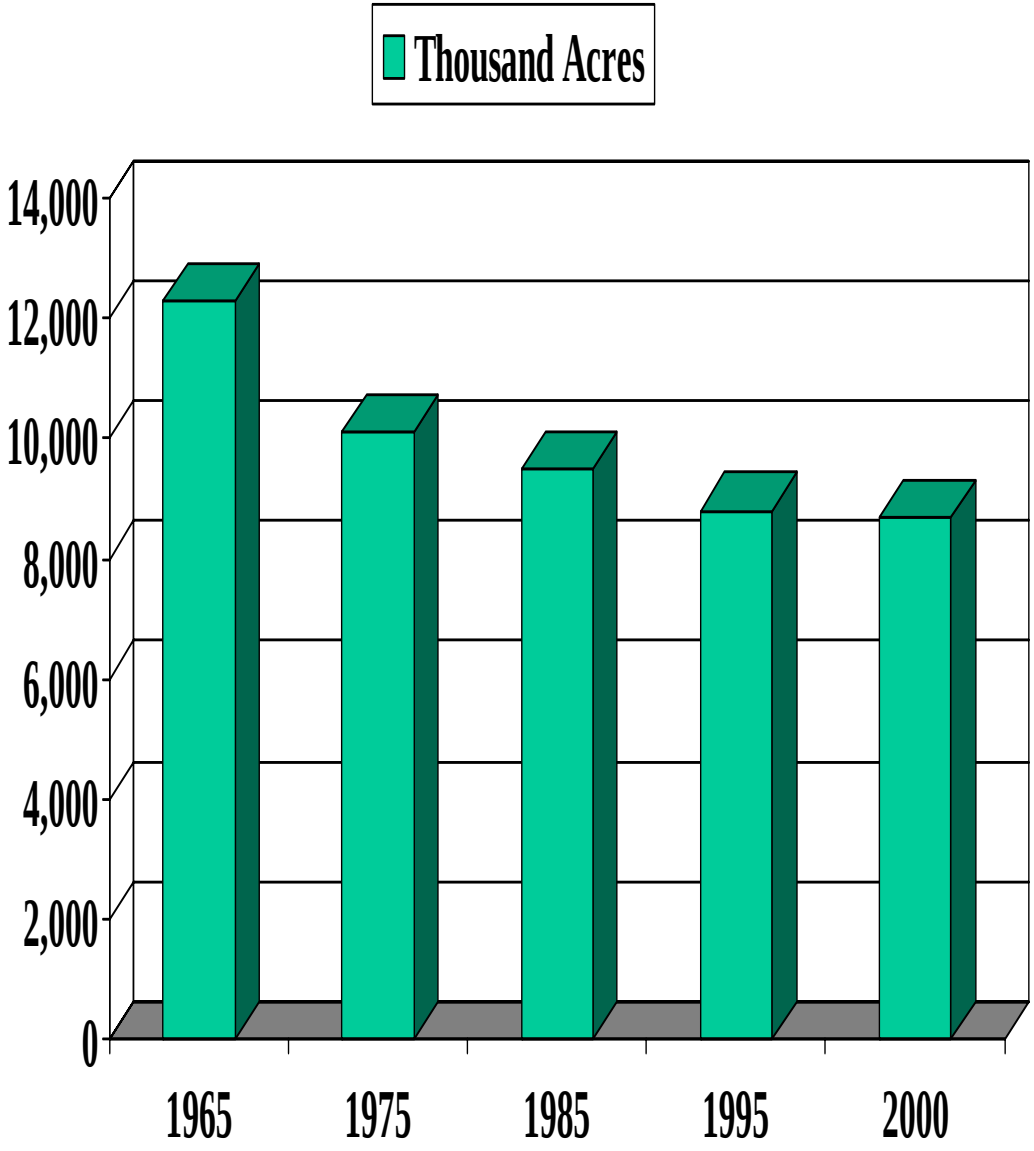
Mr. Melvin Atkinson, Coordinator, Agricultural Reserve Program, City of Virginia Beach, provided the following presentation to the Steering Committee to give an overview of the purchase of development rights program currently being utilized by Virginia Beach:

Purchase of Development Rights Programs (PDRs)

Melvin Atkinson

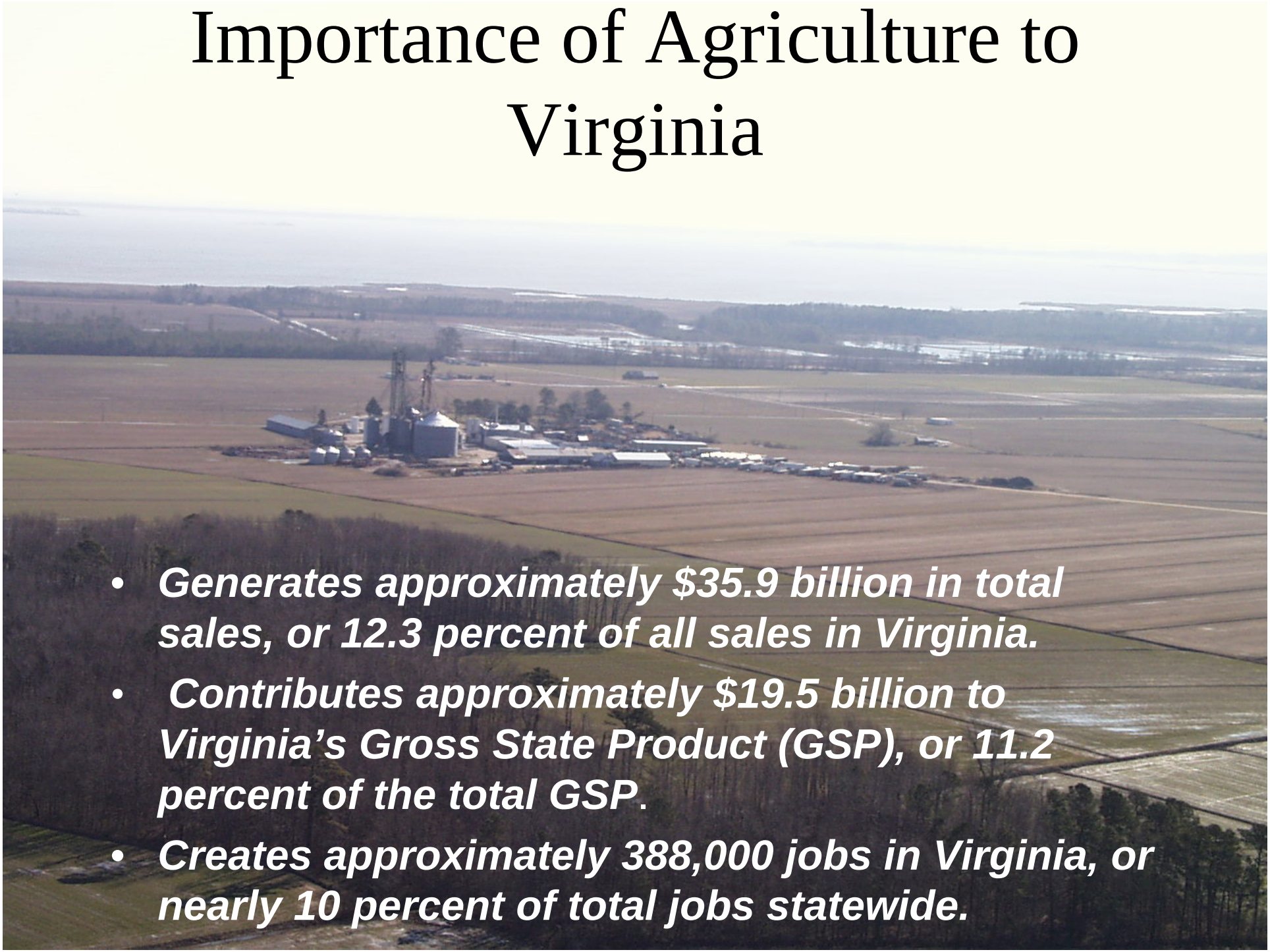
Rural Community Coordinator
Agriculture Department
City of Virginia Beach

Virginia Farmland



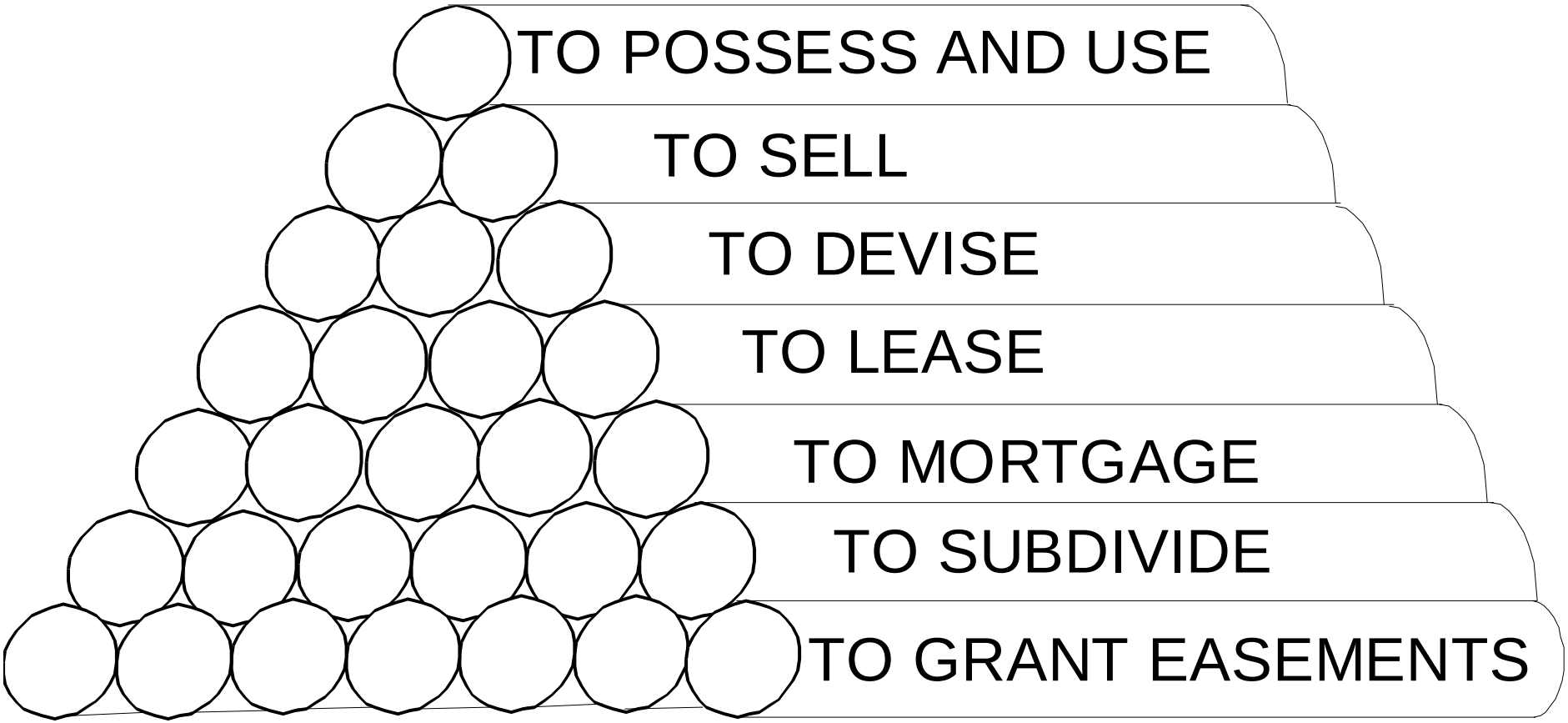
- Acreage of farmland has fallen to just over 8 million acres in Virginia. Around 66% of the over 12 million, in 1965.

Importance of Agriculture to Virginia



- ***Generates approximately $35.9 billion in total sales, or 12.3 percent of all sales in Virginia.***
- ***Contributes approximately $19.5 billion to Virginia's Gross State Product (GSP), or 11.2 percent of the total GSP.***
- ***Creates approximately 388,000 jobs in Virginia, or nearly 10 percent of total jobs statewide.***

YOUR BUNDLE OF RIGHTS



Separable <u>Rights</u> of Fee Simple Ownership

PDRs

- Purchase the development potential of the property.
- In exchange for placing an easement on the property that limits the development potential of the property

Conservation Easements

- Deed restriction that landowners voluntarily place on their property to protect resources such as
  - Productive agricultural land
  - Ground and surface water
  - Wildlife habitat
  - Historic sites
  - Scenic views

Restrictions

In general, agricultural conservation easements limit subdivision, non-farm development and other uses that are inconsistent with commercial agriculture.

Term of Restrictions

- Most conservation easements are permanent.
- Term easements impose restrictions for a specified number of years.
- Agreement is legally binding on future landowners.

Types of Easements

- Donated
- Purchased

Donated Easements

- Treated as charitable gifts
  - Term easements do not qualify
- Landowner can deduct up to 30% of their adjusted gross income in the year of the gift.
- Donations in excess of the limit can be applied for the next five years.

Purchased

- Compensates property owners for the easement.

- If value of development rights is less than the fair market value the difference can be taken as a charitable gift

Valuation

- The value of an agricultural conservation easement is generally the fair market value of the property minus its restricted value, as determined by a qualified appraiser.
  - Before and after appraisals
  - Predetermined value of development rights
  - Predetermined Agricultural Value
  - Points system

Virginia Beach Example

- The city contracts with an independent appraiser to conduct a fair market appraisal based on comparable sales
  - The value of the development rights are determined by subtracting the agricultural value ($900/acre) from the fair market value
  - The price per development unit is determined by the fair market price divided by the total number of development units on the property

EXAMPLE:

- Market Value:

  100 ac. X $4,000/ac = $400,000

- Agricultural Value:

  100 ac/ x $900/ac = $ 90,000

- Value of Development Rights:

  = $310,000

Benefits to the Landowner

- Still own the land fee simple
  - Farm it
  - Rent it
  - Sell it
  - Hunt on it
  - Cut timber
- Land will always be taxed based on usage because of the easement.
- Some lots can be reserved for future home-sites.

Benefits to Landowner

- Reduces the value of land for estate tax purposes.
  - The estate will be subject to a lower tax because the value is less than the fair market value
  - In some cases, an easement can reduce the value of an estate below the level that is taxable, effectively eliminating any estate tax liability.

Benefits to Landowner

- Permanently protect important farmland while keeping the land in private ownership.
- Flexible, and can be tailored to meet the needs of individual farmers an unique properties
- Provide owners with several tax benefits including income, estate and property tax reductions.
- Help owners transfer their operations to the next generation.

Installment Purchase Agreement (IPA)

- Innovative financing tool
- Uses an Agricultural Conservation easement to extinguish the residential and commercial development rights on property in perpetuity.
- In return the City agrees to pay the purchase price in one lump sum installment after 25 years.
- City also agrees to pay interest on the purchase price twice a year.
- The Purchase Price is a general obligation of the City, and the full faith and credit and the unlimited taxing power of the City are irrevocably pledged.

IPA Benefits

- Same benefits as other conservation easements.
- Separates the value of the land from the actual land thus giving you two instruments.
- Semi-annual TAX EXEMPT interest payments.
- Deferral of taxes on capital gains because principal is not paid until the end of the purchase
- IPA is an asset of the estate and is willable or transferable
- The paper can be sold after one year.

Added Benefits of VA Beach ARP

- The number of development rights is based on the maximum number of lots under a conditional use permit
  - 1 house for every 5 acres of well drained and 1 house for every 10 acres of somewhat poorly drained soil vs. 1 for 15 by right.
- 1 existing house and 1 existing mobile home are established as part of the farm operation and does not reduce the number of development rights.

INSTALLMENT PURCHASE AGREEMENT

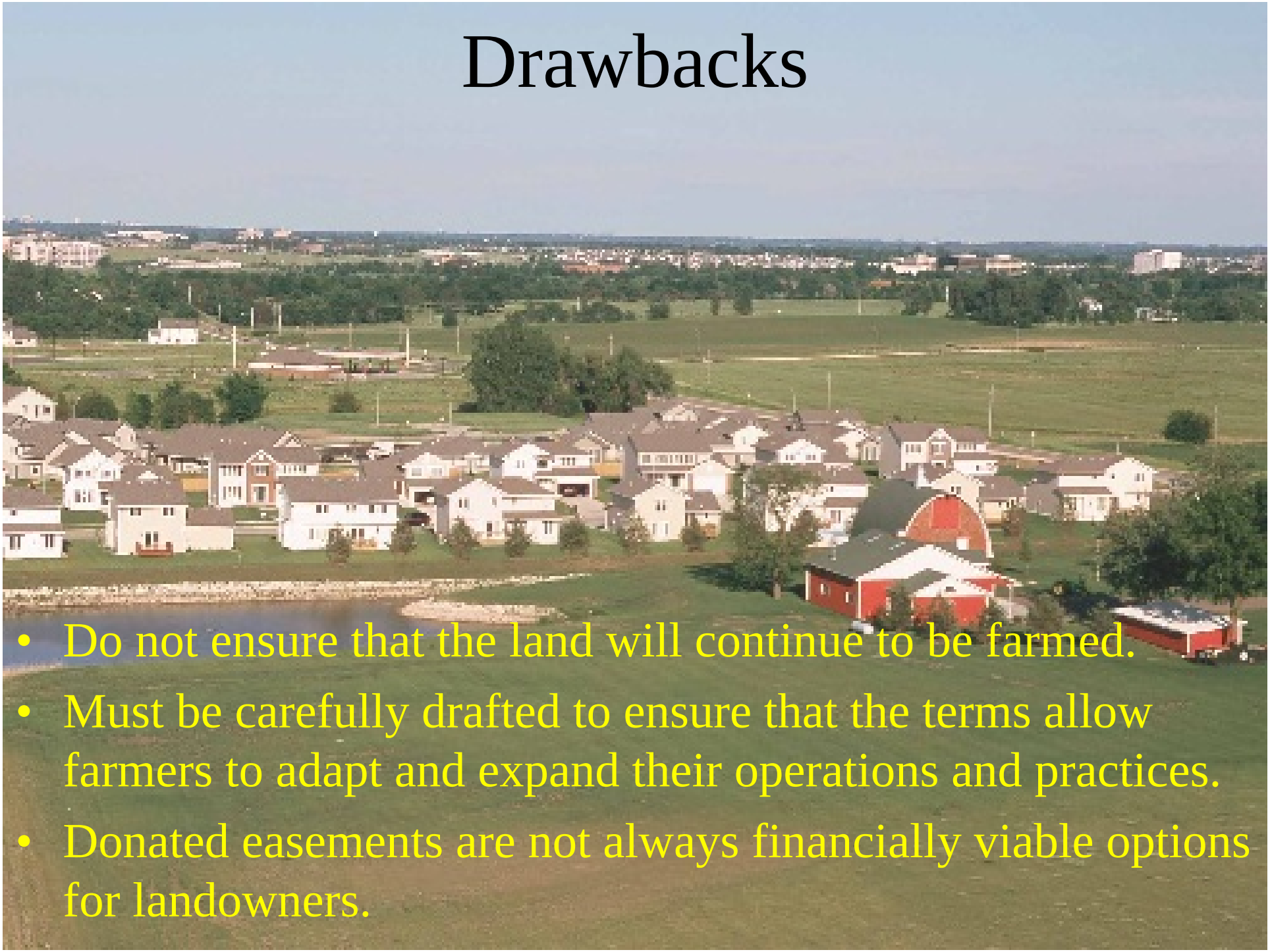
Purchase Price: $310,000

Interest Rate: Rate on U.S. Treasury STRIPS - 6%

Other: Estimated cost of STRIPS = $55,800

Estimated yearly interest = $18,600

Drawbacks



- Do not ensure that the land will continue to be farmed.
- Must be carefully drafted to ensure that the terms allow farmers to adapt and expand their operations and practices.
- Donated easements are not always financially viable options for landowners.

Drawbacks

- Subsequent landowners are not always interested in upholding easement terms.
- Not protected from eminent domain.
  - If land is take both landowner and easement holder must be compensated.

Drawbacks

- Rarely protect enough land to eliminate development pressure on unrestricted farms.
- PDRs usually are unable to keep up with demand to sell easements (long waiting lists).
- Time consuming.
- PDRs are expensive.

Drawbacks

- Monitoring and enforcing easements requires an ongoing investment of time and resources.

Benefits to the Locality

Offset infrastructure costs

- Schools
- Roads
- Water/sewer
- EMS
- Libraries
- Parks and recreation
- Solid waste

- Preservation of open space
- Preservation of rural character
- Land remains on the tax roll

Issues to address

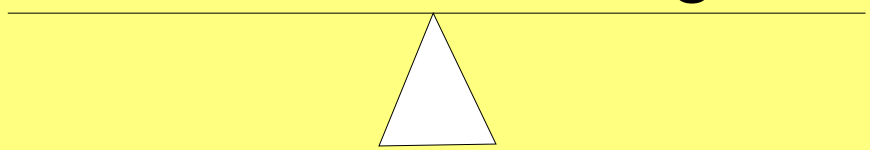
- What is the target area to protect.
- Funding
- How to pay for easements
  - Lump sum
  - Installment purchase
- Monitoring
- Administration

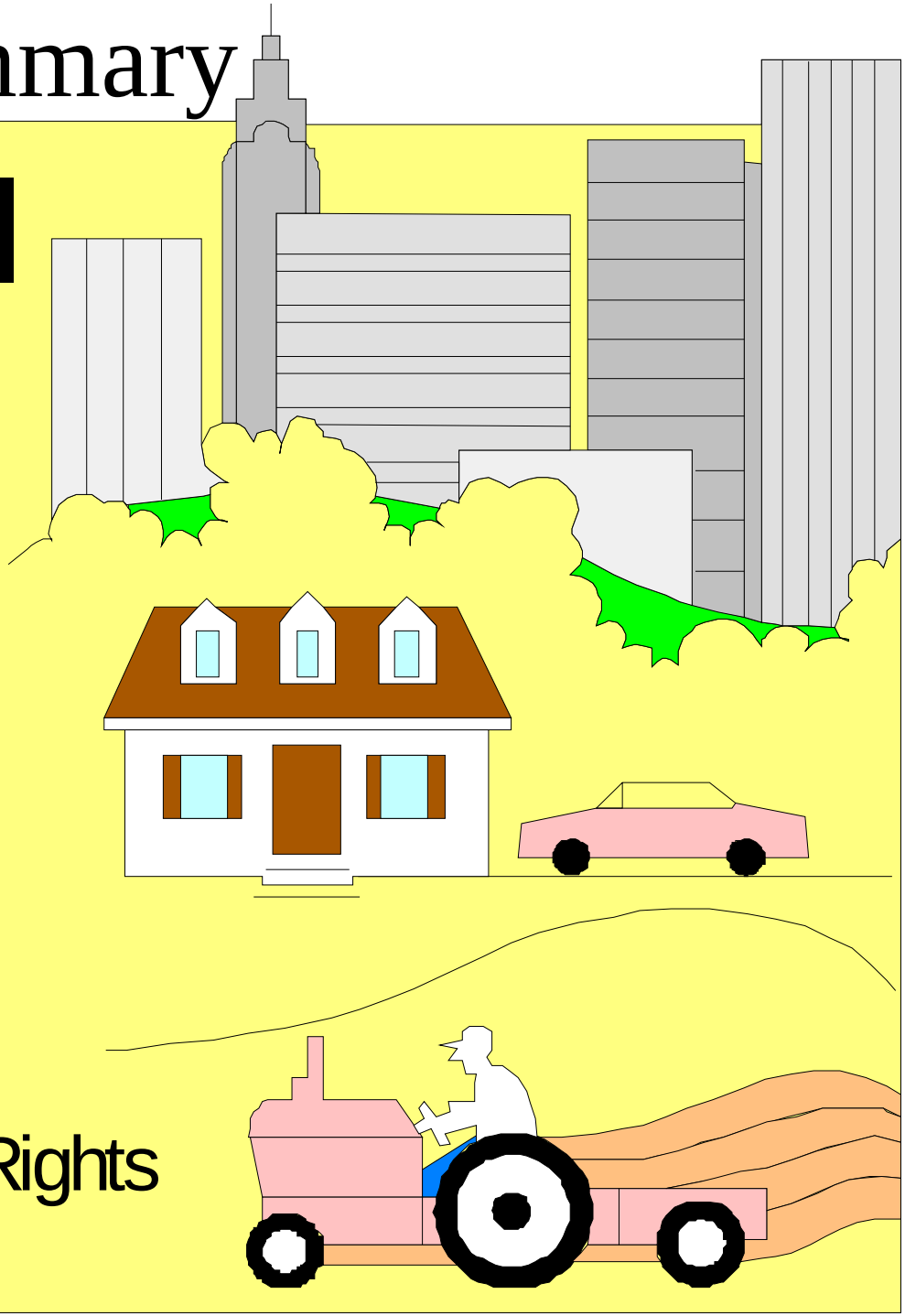
Summary

There must be Balance

Public Good

Private Property Rights





Purchase of Development Rights

LOCAL
AND

Other Business

No other business

Adjourn

The next meeting is scheduled for August 8th, 2007.

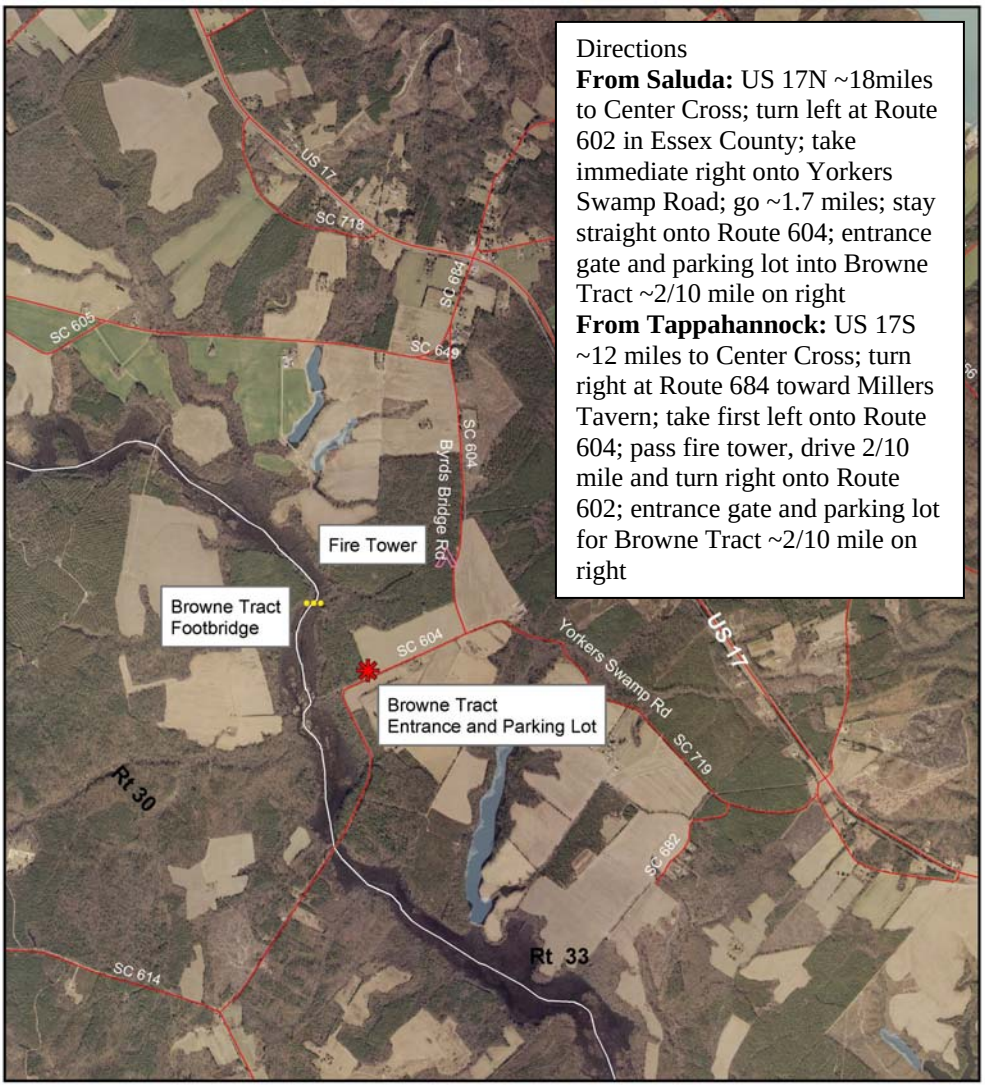
The Dragon Run Steering Committee
cordially invites you to attend their
Annual Picnic

Wednesday, August 15, 2007 at 6:00 pm
at the
Browne Tract Public Access Site

Come on out to eat, drink, mingle and discuss the happenings of the Dragon Run Watershed! The main topic of the evening will be a discussion on public/private access, including a presentation by Mr. Lewie Lawrence from the Middle Peninsula Chesapeake Bay Public Access Authority.

Family and friends are welcome!

Please RSVP to Sara Stamp by August 13th
(804) 758-2311



Directions

From Saluda: US 17N ~18miles to Center Cross; turn left at Route 602 in Essex County; take immediate right onto Yorkers Swamp Road; go ~1.7 miles; stay straight onto Route 604; entrance gate and parking lot into Browne Tract ~2/10 mile on right

From Tappahannock: US 17S ~12 miles to Center Cross; turn right at Route 684 toward Millers Tavern; take first left onto Route 604; pass fire tower, drive 2/10 mile and turn right onto Route 602; entrance gate and parking lot for Browne Tract ~2/10 mile on right

Task 4: Conservation Acquisition Management Plans

Narrative Summary

During the FY05 grant cycle, a set of Dragon Run Steering Committee recommendations were developed to convey expectations for the appropriate management of site acquired by public and non-governmental organizations (NGOs) in the Dragon Run Watershed for conservation purposes. These recommendations were presented to most public bodies and NGOs currently operating in the Dragon Run. MPPDC staff determined interest from several of these bodies, including Chesapeake Bay National Estuarine Research Reserve in Virginia (CBNERR), The Nature Conservancy (TNC), Friends of Dragon Run (FODR) and the Middle Peninsula Chesapeake Bay Public Access Authority (PAA). MPPDC staff additionally contacted state agencies regarding no and low cost services available to assist in the development of site management plans.

During the FY06 grant cycle, MPPDC staff led visioning sessions with CBNERR and TNC and associated partners. A survey form was used to guide discussion regarding managing entity site goals and priorities. A standard management plan format was agreed upon. This format is based on a Virginia Department of Conservation and Recreation Management Plan management plan for Goodwin Islands. Site surveys and analyses for the CBNERR site (Dragon Bridge Tract) and TNC site (Dragon Flats) were completed in conjunction with a representative from the Virginia Department of Game and Inland Fisheries.

This data was utilized and combined with other report information into a comprehensive site management plan that addressed the key priorities of the site manager in addition to the natural aspects of the site. Draft management plans were submitted to each managing entity for review. Final input will be incorporated in FY08 and it is expected that the managing entities will formally adopt the management plans in early 2008.

Dragon Run Conservation Acquisition Management Survey

**Note: This instrument is to be used to guide discussion during visioning session **

Site Priorities

1. Is there an overarching management approach already developed for this type of site for the managing entity? If so, is there documentation? Please generally describe.

2. Please rank the following site priorities (write NA next to priorities whose associated activities that will not be permitted on the site):

___ Wildlife habitat value
___ Sport species habitat value
___ Water quality protection
___ Wetlands protection
___ Wetlands restoration
___ Forest timber value
___ Forest habitat value
___ Invasive species management
___ Wildfire threat management
___ Endangered/threatened species protection
___ Recreation access and use value
___ Limited recreation access and use value
___ Research/education access and use value
___ Sport species management

Site Activities

Forestry	Hunting	Open public access	Passive recreation
Agriculture	Fishing	Limited public access	Research/education
Nothing	Recreation	Leases for timbering, farming, hunting, etc	Other

3. Activities that will be permitted on the site: Will all others be prohibited?

4. Activities that will be prohibited on the site: Will all others be permitted?

5. Will the site (all/part) be used or leased for forestry, agricultural or other economic purposes (ie hunt clubs)?

6. Will the site have a private or public access component?

7. What would best described the managing entity's desired level of site management?

For habitat:
Active, regular/proactive (ie prescribed burns, site clean-ups, hardwood planting, etc)
Reactive (ie reforestation after natural burn, removal of invasive species if found, etc)
Passive (ie let nature take care of itself)

For use:
Active, regular/proactive (ie user sign-ins, trash removal, trail maintenance, provision of amenities, posting of permitted, prohibited activities with enforcement potential, etc)
Reactive (ie responds to user demand/site problems as they arise)
Passive (ie use of site "as is")

8. Are there any obvious significant ecological features on the site that should be considered for protection? Endangered/threatened species?

9. Are there any obvious historic or archeological features on the site that should be considered for protection?

10. Is there/will there be a conservation easement placed on all or part of the site?

11. Would the managing be interested in participating in a regional conservation acquisition holding network to maximize opportunities for all?

12. Is there a plan for management sustainability and/or funding? Management plan implementation?

13. What are the greatest needs to fully implement a management plan that addresses the DRSC recommendations?

Management Plan for Dragon Bridge Tract: Virginia Estuarine and Coastal Research Reserve

Prepared by:
Middle Peninsula Planning District Commission
Dragon Run Special Area Management Plan

Modeled after:
Erdle, S. Y. and K. E. Heffernan. 2005. Management Plan for Goodwin Islands: Chesapeake Bay National Estuarine Research Reserve -Virginia. Natural Heritage Technical Report #05-03. Virginia Department of Conservation and Recreation, Division of Natural Heritage. Richmond, Virginia. 45 pp. plus appendices.

Management Plan for Dragon Bridge Tract: Virginia Estuarine and Coastal Research Reserve

2007

Dragon Run Special Area Management Plan Technical Report 07-01

Middle Peninsula Planning District Commission
Dragon Run Special Area Management Plan
125 Bowden Street
PO Box 286
Saluda, Virginia 23149
(804) 758-2311

This document may be cited as follows:

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G. Chinese Lespedeza Management Guide
H. Deer Hunting Plan Samples
I. Public Use Guide
J. Federal and State Natural Resource Laws
K. Glossary of Technical Terms and Abbreviations

***At the time of publication, a management plan nor a public access plan for the Virginia Estuarine and Coastal Research Reserve system had not been developed. As the policies of this system are consistent with the CBNERRVA system, the CBNERRVA Management Plan 2007and CBNERRVA Public Access Plan has been utilized in the interim.*

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SECTION 1: Management Framework

MANAGING ENTITY

The Dragon Bridge Tract is owned (fee simple) by the Virginia Institute of Marine Science (VIMS), College of William and Mary (W&M). The Virginia Estuarine and Coastal Research Reserve System (VECRRS), of which the Dragon Bridge Tract is a part, is administered by VIMS and coordinated with the Chesapeake Bay National Estuarine Research Reserve of Virginia (CBNERRVA). The primary point of contact for this site is Willy Reay, Director, Chesapeake Bay National Estuarine Research Reserve, (804) 684-7119, wreay@vims.edu, P.O. Box 1346, Gloucester Point, VA 23062.

MANAGEMENT STRATEGY FOR DRAGON BRIDGE TRACT

Program Overview

The VECRRS was created in 1999 by the General Assembly of Virginia (Code of Virginia 28.2-1103 and 28.1-1104; see Appendix A). Reserve efforts to date have focused on two geographic areas, the Dragon Run Swamp watershed and the tidal freshwater region of the James River. The mission of VECRRS is to establish a system of protected sites representative of the Commonwealth's estuarine and coastal lands in which research and long-term monitoring can be conducted in support of the Commonwealth's coastal resource management efforts. In this context, Dragon Bridge Tract, part of one of Virginia's most extensive and relatively unimpacted swamp forest communities, was selected as a site representing one of the Chesapeake Bay's most pristine waterways (Figure 1).

Site Purpose

All lands within VCERR shall be used primarily for research and education. Natural resources on this site that make it representative of the ecosystems of the coastal plain include its uniquely pristine swamp habitat and its upland component with significant ecological value potential.

Policy and Management Approach

The purpose of this management plan is to guide an adaptive resource management process that protects key natural resources on Dragon Bridge Tract and thereby provides for superlative research and educational opportunities.

SECTION 2: Site Background and Resources

INTRODUCTION

Description and Location

The Dragon Bridge Tract is located west of the New Dragon Bridge on Route 603 (Figure 2). The site is an estimated 121.54 acres and includes pine plantations, quality riparian buffer forest and pristine swamp habitat.

The Dragon Run, headwaters to the Piankatank River, is one of the Chesapeake Bay's most pristine waterways. The Dragon Run watershed remains largely undeveloped and represents one of Virginia's most extensive and relatively unimpacted swamp forest communities. The Dragon Run contains the northernmost example of Baldcypress-Tupelo Swamp community in Virginia and four other natural communities (e.g. Fluvial terrace woodland, Tidal Baldcypress-Tupelo Swamp, Tidal Baldcypress-Woodland/Savanna, and Tidal freshwater marsh) and up to fourteen state rare species (Belden, Jr. et al., 2001; Belden, Jr. et al., 2003).

Climate

While detailed climatic data are not specifically available for Dragon Bridge Tract, data for nearby Urbanna, VA describe an average annual minimum temperature of (48.7° F) and an average annual maximum temperature of (68.5° F) from 1971 – 2000. Average monthly maximum temps for the same time period are in July (87.8° F) and the average minimum monthly temps are in January (29.8°F). Precipitation is generally well distributed throughout the year with slightly more than average rainfall in the summer and slightly less in the autumn. Average total precipitation for the same period is (42.22 inches) (Southeast Regional Climate Center, 2007). Soils tend to be wettest in winter and early spring due to reduced evaporation and evapotranspiration. Snow can be expected any time from November to April. The average growing season length is approximately 197 days, and although variable, first fall frosts usually occur in late October and the last spring frosts are often in early to mid-April.

As with most parts of Virginia's coastal plain, the Dragon Bridge Tract is vulnerable to hurricanes, tropical storms, ice storms and northeasters that affect the Chesapeake Bay and surrounding shores. Northeasters tend to occur in the autumn, winter, and spring. Hurricanes and tropical storms are less frequent, generally more severe, and usually occur in late summer through autumn. Some northeasters may reach the strength of a tropical storm. These storm events can cause drastic changes to the physiography of the site and surrounding area. Most recently, many coastal forests lost a considerable number of trees, many of which remain where they fell, during Hurricane Isabel in September 2003. While the Dragon Bridge Tract received little damage from Hurricane Isabel, the site was significantly impacted by an ice storm several years prior.

Geology, Landforms, Soils

As one of the Chesapeake Bay watershed's most pristine waterways, the Dragon Run "encompasses some of the most extensive and unspoiled swamp forest and woodland communities in Virginia" (Belden, Jr. et al, 2001). Effectively bisecting Virginia's Middle

Peninsula located between the York and Rappahannock Rivers, this fresh and brackish water stream meanders forty miles along and through nontidal and tidal cypress swamp.

During the site survey, it was noted that much of the upland area consisted of primarily sandy soils. Richer soils were found in the riparian buffer area and the lands adjacent to the Run itself.

Geological features are described by the following excerpt from *A Natural Heritage Inventory of the Dragon Run Watershed* (Belden, Jr. et al., 2001):
Surficial deposits of riverine terraces bordering Dragon Run from the vicinity of the Essex-Middlesex county line to Meggs Bay belong to the Shirley Formation and the Sedgefield Member of the Tabb formation. The middle Pleistocene Shirley Formation consists of light- to dark-gray, bluish-gray and brown sand, gravel, silt, clay, and peat; the Sedgefield Member is of upper Pleistocene age and consists of pebbly to bouldery, clayey sand and fine to medium, shelly sand grading upward to sandy and clayey silt. Somewhat higher topography away from the waterway is underlain by the Chesapeake Group. This consists of fine to coarse quartzose sand, silt, and clay (variably shelly and diatomaceous) deposited in shallow waters of the upper Pliocene and lower Miocene periods. At still higher elevations, the Windsor Formation is found, consisting of gray and yellowish to reddish-brown sand, gravel, silt, and clay of lower Pleistocene or upper Pliocene age. At higher elevations southwest of Dragon Run, two other formations are prevalent, both of upper Pliocene age. The Bacons Castle Formation is characterized by gray, yellowish-orange, and reddish-brown sand, gravel, silt, and clay and the Moorings Unit by white, light gray, and grayish-yellow quartzose sand and clay to grayish-brown clayey silt and silty clay.

Watershed elevation ranges from 180 feet to near sea-level. Detailed soils information can be found in the Soil Survey for each county (Note: King and Queen County does not have a published Soil Survey). Many of the soils in the watershed are considered prime farmland and are suitable for silviculture.

Hydrologic Conditions, Water Quality and Water Quality Monitoring
Hydrologic Conditions. The Dragon Run watershed, state hydrologic unit CO2, is a fourth-order stream system that is nontidal freshwater above the U.S. Route 17 bridge and tidal freshwater from the U.S. 17 bridge to its mouth at Meggs Bay. There it forms the Piankatank River, where it becomes estuarine, and eventually drains into the Chesapeake Bay. Underground springs, feeder swamps, and surface waters support streamflow in the Dragon Run. Significant tributaries include Dragon Swamp, Yonkers Swamp, Exol Swamp, Timber Branch Swamp, Briery Swamp, Holmes Swamp, White Marsh, Zion Branch, Carvers Creek, Mill Stream, and Meggs Bay (MPPDC, 2001).

According to the National Wetland Inventory, wetlands along the Dragon Run are Palustrine, mostly Forested Wetlands except for Emergent Wetlands in Meggs Bay. U.S. Route 17 is the approximate demarcation between tidal wetlands and nontidal wetlands. The hydrologic regime of most Dragon Run wetlands is Seasonally Flooded, Seasonally Flooded-Saturated, or Temporarily Flooded (Belden, Jr. et al., 2001).

The U.S. Geological Survey (USGS) maintained a streamflow gaging station at Church View (Route 602) from 1943 to 1981 that received drainage from 60% of the watershed (84 square

miles) and has maintained a streamflow gaging station at Mascot (Route 603) since 1981 that receives drainage from 75% of the watershed (105 square miles). Median daily streamflow at Mascot from 1981 to 1999 was 79 ft3/sec and varied between 0.01-6050 ft3/sec. Median daily streamflow at Church View from 1943 to 1981 was 57 ft3/sec and varied from 0-3790 ft3/sec. Compared to other coastal plain stream systems such as the Chickahominy River (New Kent County), the Mattaponi River (King William County), and Cat Point Creek (Richmond County), the Dragon Run exhibits lower median daily streamflow per square mile of drainage area. Base flow, fed primarily by groundwater discharge, accounts for two-thirds of the Dragon Run's total streamflow, with the remaining third attributable to surface water runoff. Of the annual\ precipitation, only one-third becomes streamflow, with two-thirds lost to evapotranspiration. Seasonally, streamflow is highest in the spring and lowest in the fall (MPPDC, 2001).

Water Quality. The primary water contaminant sources in the Dragon Run are point source discharges and nonpoint source pollution from precipitation (atmospheric deposition), residential land use, agricultural land use, and forested lands (MPPDC, 2002). According to the Virginia Department of Environmental Quality (DEQ), the Dragon Run generally exhibits medium nutrient levels and is listed as "impaired" for pH, fecal coliform bacteria, mercury, and lead (DEQ, 2002). Based on agricultural, urban, and forested pollution loadings potential determined by DCR, however, the overall nonpoint source pollution potential rating is low for the Dragon Run (DCR, 2002).

Point source discharges, which are permitted and monitored by the Virginia Department of Environmental Quality, are relatively easy to quantify and, in turn, control or track. Point source discharges to the Dragon Run include: stormwater runoff from a wood treatment facility (arsenic, chromium, copper) at Pitts Lumber Company, Inc. to an intermittent stream adjacent to U.S. Route 17 in Middlesex County (Permit #VA0083011); discharge from a sewage treatment plant (biological oxygen demand, total suspended solids, ammonia nitrogen, total residual chlorine, pH, fecal coliform) at Rappahannock Community College to an intermittent stream near Glenns in Gloucester County (Permit #VA0028461); and discharge from a wellwater treatment plant (pH, total suspended solids) at the Miller's Square Subdivision to an intermittent stream near Miller's Tavern in Essex County (Permit #VA0075302). According to the Shoreline Sanitary Survey (Smither et al., 2003), there are 9 other indirect sources of pollution, including five animal pollution sources (Middlesex County near Saluda and Stormont and Gloucester County near Glenns); a solid waste dumpsite in Middlesex County near Stormont; and a potential pollution source in Middlesex County in Saluda. Furthermore, a network of water quality monitoring wells is maintained at the Browning-Ferris Industries landfill in King and Queen County.

Throughout the Chesapeake Bay, atmospheric deposition (e.g. precipitation) contributes a significant amount of the total nutrient loadings in coastal waters (MPPDC, 2001). Air quality is not currently monitored in the watershed.

More than 90% of residents in Gloucester, King and Queen, and Middlesex Counties use on-site wastewater treatment systems, commonly known as septic systems (MPPDC, 2001). When operated properly, conventional septic systems remove nutrients and fecal coliform. Conventional septic systems can pose potential environmental and health risks due to

inappropriate design, poor maintenance, poor soils, or inefficient nitrogen removal. Driven by changes to Department of Health regulations for on-site wastewater treatment systems (12 VAC 5-610-10 et seq. effective July 2000), the popularity of non-conventional on-site wastewater treatment systems is increasing. These alternative systems, when properly maintained, can be effective at removing nutrients and fecal coliform in areas where conventional septic systems are ineffective. Regardless of the type, however, improperly maintained or failing septic systems pose significant environmental and health risks by contributing nutrients, pathogenic bacteria, and viruses to groundwater.

Forested lands, representing a significant land area, yield low nutrient input to streams relative to other land uses in the watershed. Best Management Practices (BMPs) are designed to minimize these inputs. For example, forested riparian buffers provide effective protection for water quality. The watershed currently exhibits intact riparian buffers. By contrast, agricultural land use in rural and semirural areas in Virginia can be the source of significant sediments, fecal coliform bacteria, and nutrients such as nitrogen and phosphorus. Nitrogen is transported through the groundwater, whereas phosphorus is generally transported on soil particles in surface water. BMPs such as fencing cattle out of streams, conservation tillage, and expanded riparian buffers are designed to minimize these inputs.

Residential and commercial land uses typically contribute less nutrients and sediments than agriculture, but more than forestry. These residential and commercial contributions are mainly attributable to reduced or no riparian buffers, chemical application for landscaping, and stormwater runoff.

Water Quality Monitoring. Water quality data sets in the watershed are sparse in quantity, duration, and parameters measured. Existing data sets include: STORET, a database managed by the Virginia Department of Environmental Quality (DEQ); data collections during fish surveys by the Virginia Department of Game and Inland Fisheries (DGIF) and Virginia Commonwealth University (VCU); data collections by the Chesapeake Bay National Estuarine Research Reserve in Virginia at the Virginia Institute of Marine Science (VIMS); and a now-defunct volunteer water quality monitoring program in the watershed (MPPDC, 2001).

Two stations are currently sampled regularly by the DEQ. Station DRN003.40 is located at the U.S. Route 17 bridge and Station DRN010.48 is located at the Route 603 bridge near Mascot. Data are available from DRN003.40 for the period 1968-1974 and 1992- present and from DRN010.48 for the period 1992-present. Samples are evaluated bimonthly for nutrients, fecal coliform, suspended solids, dissolved oxygen, pH, salinity, and temperature and are occasionally evaluated for pesticides, toxic metals, and other harmful compounds (MPPDC, 2001). The data sets collected at these sampling stations were used by the DEQ to list the Dragon Run as “impaired” for pH and fecal coliform bacteria. Fish tissue samples were used by the DEQ to list the Dragon Run as “impaired” for mercury and lead. The Virginia Department of Health issued a health advisory for the Dragon Run for mercury contamination in largemouth bass (DOH, 2003). The DEQ attributes the pH impairment to natural causes, citing the acidic nature of water in swamps. The DEQ lists the cause of the fecal coliform and mercury and lead impairments as unknown. Potential sources of fecal coliform bacteria include: wildlife; failing septic systems;

and livestock. Potential sources of metals include: atmospheric deposition; automobile and roadway deposits; and industrial operations.

Data collected by the DGIF in 1995-1996 and 1998 includes temperature, Secchi depth, pH, dissolved oxygen, conductivity, salinity, alkalinity, hardness, and total dissolved solids. Nutrient data are very limited and were frequently below detection limits. Dissolved oxygen at sampling stations with no or low flow frequently violated daily minimum standards to support aquatic life (MPPDC, 2001).

VIMS data from 2000-2001 measured temperature, salinity, total dissolved solids, pH, dissolved inorganic nitrogen, and fecal coliform bacteria. Of specific note, samples from Briery Swamp exhibited high nitrate and fecal coliform levels, indicating the presence of subsurface agricultural or wastewater drainage (MPPDC, 2001).

A weekly volunteer water quality monitoring program collected data throughout the watershed during the period 1994-1997, although monitoring was not continuous at all eight sites. Measurements included dissolved oxygen, Secchi depth, water and air temperature, pH, and water color. The findings indicated: low dissolved oxygen during warm temperatures and high dissolved oxygen during cold temperatures; low Secchi depth values during the summer associated with algal blooms and storm events; and acidic pH values in the upper Dragon Run with slightly more basic pH values in the tidal waters (MPPDC, 2001).

Site History

The Dragon Run plays a central role in the Middle Peninsula's culture and identity. Its intriguing name is frequently borrowed by local enterprises and establishments and is often overheard in community conversations. Since European settlement in the early 1600's and Native American inhabitation up to 10,000 years before that, natural resources have been the bedrock of the watershed's economy. For older generations, forestry, farming, hunting, trapping and fishing were the primary ventures. Today, forestry and farming continue to generate wealth and drive the watershed's economy. Upholding an ancient tradition, hunters range over prime hunting grounds stalking prized game. These land uses, together with extensive swamps, are the main reasons that the Dragon Run remains wild and secluded.

While no archeological artifacts have been found for the site according to the Virginia Department of Historic Resources, the New Dragon Bridge is considered to be a point of navigational significance. In the mid 1800s, the Dragon Swamp Navigation Company attempted to construct a navigational channel to allow for transportation (primarily of timber) from the Dragon Run to the Piankatank and on to the Chesapeake Bay. This channel was not utilized and considered to be a failure. The channel has since returned to its natural state and is virtually undistinguishable from the surrounding landscape.

Surrounding Land Use

The watershed is mainly undeveloped, almost entirely privately-owned, and encompasses approximately 140 square miles (90,000 acres) of rural landscape – mostly forests, farms, and wetlands. The spring-fed Dragon Run flows through portions of Essex, King and Queen,

Middlesex, and Gloucester Counties, emptying into the estuarine Piankatank River and ultimately the Chesapeake Bay.

Land cover data (Figure 5) indicate that the watershed is 80.3-83.9% forested and wetlands, 15.1-18.4% agricultural, and 1.0-1.3 % commercial and residential (MPPDC, 2002; DCR, 2003). The Dragon Run watershed lies within the transitional Oak-Pine vegetation region where dominant oaks share the forest with Virginia pine, shortleaf pine, and loblolly pine. Although loblolly pine originally appeared in the forest as scattered associates of oaks and other hardwoods, loblolly pine plantations are increasingly common.

In recent years, several public and non-governmental organizations have been actively acquiring land in the Dragon Run watershed for conservation or conservation-compatible purposes. These entities include the Middle Peninsula Chesapeake Bay Public Access Authority, the Friends of Dragon Run, the Nature Conservancy and VIMS. Other conservation holdings in the vicinity of the Dragon Bridge Tract can be seen on Figure 6.

Associated Natural Resources

The watershed's wilderness is both expansive and unique. The Dragon Run contains the northernmost example of the Baldcypress-Tupelo Swamp natural community in Virginia and the best example north of the James River (Belden, Jr. et al., 2001). Natural Heritage Areas are numerous throughout the Dragon Run. Moreover, 14 rare species and 5 rare natural communities are found here (Appendix D). Based on his investigations of the watershed's aquatic communities, one researcher observes that the Dragon Run is a "100 year old time capsule," resembling coastal plain streams in the Chesapeake Bay region at the turn of the 20th century (Garman, 2003).

NATURAL HERITAGE RESOURCES

Overview

Natural heritage resources are defined in the Virginia Natural Area Preserves Act (Section 10.1-209 through 217, Code of Virginia), as "the habitat of rare, threatened, or endangered plant and animal species, rare or state significant natural communities or geologic sites, and similar features of scientific interest benefiting the welfare of the citizens of the Commonwealth." Natural heritage resources are the most likely natural resources to be lost without conservation action in the near future. DCR-DNH inventories and compiles lists of the natural heritage resources of the state.

Since the watershed is relatively intact, it contains many unique resources. Natural heritage resources are abundant in the Dragon Run. Several rare natural communities occur in the Dragon Run, including Baldcypress-Tupelo Swamp, Tidal Baldcypress-Tupelo Swamp, Tidal Baldcypress Woodland/Savanna, Fluvial Terrace Woodland, and Tidal Freshwater Marsh.

Biodiversity Significance

A variety of rarity patterns exist based on the geographic range, habitat specificity and local abundance of species (Rabinowitz, 1981). Standard Natural Heritage methodology ranks plants, animals, and natural communities on two scales of rarity. The global rank (G-rank) and state rank (S-rank) are based on the number of occurrences of a species at a global scale and state

scale, respectively (see Appendix E). G- and S-ranks help direct conservation actions to the rarest species and communities since these are usually the most vulnerable to extinction.

Natural Communities

The inventory and classification of natural communities constitute an important "coarsefilter" approach to biological conservation that ensures the protection of diverse organisms. The identification and protection of excellent examples of all natural community types facilitates the protection of the majority of component native plant and animal species, including a host of taxa too cryptic, poorly known, or numerous to receive individual management strategies.

At present DCR-DNH classifies communities principally at the level of *ecological community group*, which represents a broadly defined unit based on combinations of topographic, edaphic, physiognomic, and gross floristic similarities (Fleming et al., 2004).

Given below are brief descriptions of the primary ecological community groups and their respective ecological community type(s) occurring in the Dragon Run.

Baldcypress-Tupelo Swamp. Forests in this group occupy seasonally to semipermanently flooded backswamps, sloughs, and first bottoms of Coastal Plain rivers and streams. These swamp forests occur throughout the Coastal Plain from Delaware south to Florida and west to eastern Texas, and in the Mississippi River alluvial basin north to Kentucky. They are distributed throughout southeastern Virginia, north to Dragon Swamp (Gloucester, King and Queen, and Middlesex Counties). Habitats are deeply flooded (up to 1.3 m) for part of the year; many retain at least some standing water throughout the growing season. Microtopography is often pronounced with small channels, swales, tree-base hummocks, and numerous bald cypress "knees." Overstory composition varies from mixed stands of bald cypress (*Taxodium distichum*), water tupelo (*Nyssa aquatica*), and/or swamp tupelo (*Nyssa biflora*) to nearly pure stands of one species or another. The three dominants have complex competitive and successional relationships. As a rule, the two tupelos are less shade-tolerant than bald cypress and regenerate more readily by sprouting in cut-over stands. Thus, tupelos tend to become dominant when bald cypress stands are heavily logged. In addition, swamp tupelo appears to be most abundant in organic swamp soils, while water tupelo appears to prefer mineral soils with high silt content.

Green ash (*Fraxinus pennsylvanica*), overcup oak (*Quercus lyrata*), American elm (*Ulmus americana*), and red maple (*Acer rubrum*) are occasional overstory associates and frequent understory trees; swamp cottonwood (*Populus heterophylla*) is also an occasional overstory associate and often abundant in disturbed or cut-over stands. Carolina ash (*Fraxinus caroliniana*) is often dominant in the small tree and shrub layers, while vines of climbing hydrangea (*Decumaria barbara*) and red-berried greenbrier (*Smilax walteri*) are often abundant.

Herb layers vary from sparse to seasonally lush. Most herbaceous plants of bald cypress-tupelo swamps are tolerant of muck soils and fluctuating water levels, or are capable of becoming established on tree hummocks, stumps, and logs. A few of the typical herbs are lizard's-tail (*Saururus cernuus*), false nettle (*Boehmeria cylindrica*), Walter's St. John's-wort (*Triadenum walteri*), swamp beggar-ticks (*Bidens discoidea*), weak stellate sedge (*Carex seorsa*), giant sedge (*Carex gigantea*), taperleaf bugleweed (*Lycopus rubellus*), catchfly cutgrass (*Leersia*

lenticularis), and pale mannagrass (*Torreyochloa pallida*). Draw-down zones may support large populations of false pimpernel (*Lindernia dubia* var. *dubia*), marsh fleabane (*Pluchea camphorata*), horse-tail paspalum (*Paspalum fluitans*), Carolina boltonia (*Boltonia caroliniana*), and other fast-growing herbs. This group differs from Coastal Plain / Piedmont Swamp Forests in the clear dominance or co-dominance of bald cypress and tupelos (vs. dominance of mixed hardwoods) and apparently by longer hydroperiods and more deeply flooded habitats. It is distinguished from Non-Riverine Swamp Forests, which are also dominated by bald cypress and tupelos, by habitat (floodplains vs. non-riverine peatlands) and lower-strata floristics.

Although community types in this group are relatively common, high-quality examples are scarce and all stands provide valuable wildlife habitat and resources. Mature, hollow specimens of the dominant trees are known to provide nesting habitats for the globally uncommon, state-rare eastern big-eared bat (*Corynorhinus rafinesquii macrotis*) and southeastern myotis (*Myotis austroriparius*). Old-growth stands of bald cypress-dominated swamp with trees up to 800 years old occur along the Blackwater River in Surry and Isle of Wight Counties. However, the largest individuals of both bald cypress and water tupelo occur in swamps along the Nottoway River in Southampton County.

References: Fleming and Moorhead (1998), Parker and Wyatt (1975), Plunkett and Hall (1995).

Tidal Baldcypress Woodland. Coniferous or mixed swamp forests and woodlands dominated by bald cypress (*Taxodium distichum*) are known only from the upper tidal reaches of rivers in Maryland, southeastern Virginia and North Carolina. Examples are documented in Virginia from the lunar-tidal Dragon Swamp / Piankatank River (Gloucester, King and Queen, and Middlesex Counties), Chickahominy River (Charles City, James City, and New Kent Counties), and James River (Isle of Wight and Surry Counties); and the wind-tidal Northwest and North Landing Rivers (City of Chesapeake and Virginia Beach). At some sites, these communities occur in ecotones between tidal marshes and non-tidal backswamps or uplands.

In lunar-tidal stands, Bald cypress (*Taxodium distichum*) dominates an open to very open overstory, with or without hardwood associates such as swamp tupelo (*Nyssa biflora*), water tupelo (*Nyssa aquatica*), and green ash (*Fraxinus pennsylvanica*). Stand structure and canopy cover range from closed forest to very open woodland. Shrub and herb layers are variable but generally contain a mixture of species characteristic of both marshes and swamps. Some well-developed tidal bald cypress forests appear floristically similar to palustrine Bald Cypress-Tupelo Swamps. Other stands have a nearly monospecific herb dominance by shoreline sedge (*Carex hyalinolepis*). In a unique, possibly fire-influenced, savanna-like stand on the Northwest River, the herbaceous dominants, in rough seasonal order, are silvery sedge (*Carex canescens* ssp. *disjuncta*), spikerushes (*Eleocharis fallax and Eleocharis rostellata*), marsh rattlesnake-master (*Eryngium aquaticum* var. *aquaticum*), and wild rice (*Zizania aquatica* var. *aquatica*).

A distinctive, mixed tidal swamp forest in extreme southeastern Virginia is subject to irregular wind-tidal flooding. As currently defined, this community type appears to be a globally rare endemic of the Embayed Region of southeastern Virginia and northeastern North Carolina; similar communities, however, may also occur in Maryland and Delaware. In Virginia, stands

are confined to the North Landing and Northwest Rivers (Cities of Virginia Beach and Chesapeake), estuarine tributaries of Currituck Sound. Although these systems are no longer influenced by lunar tides because of inlet closures, they are subject to wind-driven currents that produce as much as 1 m (3 ft) of variation in water levels and contribute to a salinity regime that fluctuates between completely fresh and about 5 ppt. This forest borders the wind-tidal marshes along the lower portions of the two rivers, extending well upstream of the limit of marshes in narrowing channel-side belts. It appears to represent a long-term seral stage in succession from marsh to swamp forest. Habitats have a pronounced hummock-and-hollow microtopography, with an average flooding depth 40 cm (16 in) above the hollow bottoms. Soils are coarse, fibric peats that appear indistinguishable from adjacent marsh peats. Bald cypress (*Taxodium distichum*), swamp tupelo (*Nyssa biflora*), and loblolly pine (*Pinus taeda*) are the dominant overstory trees in variable combinations. Spanish moss (*Tillandsia usneoides*) is locally abundant, festooning the trees in some stands. Sweetbay (*Magnolia virginiana*) and red bay (*Persea palustris*) are scattered understory trees, while southern bayberry (*Myrica cerifera* var. *cerifera*) dominates the shrub layer. The herb layer is diverse, containing species characteristic of both marshes and swamps, but royal fern (*Osmunda regalis* var. *spectabilis*) often dominates. This type differs from vegetation of the Maritime Wet Pine Forests group, which also contains loblolly pine, southern bayberry, and royal fern, in its tidally flooded hydrologic regime (vs. non-tidal saturated hydrology, the co-dominance of bald cypress,) and the prevalence of numerous, flood-tolerant swamp species.

The environmental dynamics, compositional variation, and state-wide distribution of Tidal Bald Cypress Forests and Woodlands are not well known and need intensive study.

Reference: Fleming and Moorhead (1998).

Fluvial Terrace Woodland. This is a somewhat enigmatic group of communities occurring on flat, sandy terraces and islands along Coastal Plain rivers in eastern Virginia. These habitats are elevated well above the level of adjacent swamps and are characterized by xeric, sandy soils and open forest or woodland vegetation. Single occurrences have been documented along the Nottoway River (Sussex County), Chickahominy River (New Kent County), Dragon Swamp (Middlesex County), and Mattaponi River (Caroline County). At all four sites, hickories (*Carya pallida* and *Carya alba*) are the dominant trees, with drought-tolerant oaks (*Quercus falcata*, *Quercus nigra*, *Quercus marilandica*, *Quercus alba*) and pines (*Pinus taeda*, *Pinus virginiana*) present in smaller numbers. Shrubs occurring at all or most sites include sand post oak (*Quercus margarettiae*), sweetleaf (*Symplocos tinctoria*), American holly (*Ilex opaca* var. *opaca*), and eastern red cedar (*Juniperus virginiana* var. *virginiana*). Typical herbs include sedges (*Carex albicans* var. *australis* , *Carex pensylvanica* , and *Carex tonsa*), Canada frostweed (*Helianthemum canadense*), butterfly-pea (*Clitoria mariana*), late goldenrod (*Solidago tarda*), and prickly-pear (*Opuntia humifusa* var. *humifusa*). The Dragon Run site is anomalous in the presence (despite low soil pH and base status) of several calciphiles such as eastern redbud (*Cercis canadensis* var. *canadensis*), wild columbine (*Aquilegia canadensis*), smooth rock-cress (*Arabis laevigata* var. *laevigata*), robin's-plantain (*Erigeron pulchellus* var. *pulchellus*), and elm-leaved goldenrod (*Solidago ulmifolia* var. *ulmifolia*). A full understanding of the status and compositional relationships of this group will require additional inventory and assessment.

Tidal Freshwater Marsh. This is a diverse group of herbaceous wetlands subject to regular diurnal flooding along the upper tidal reaches of inner Coastal Plain rivers and tributaries. Ranging from New York to North Carolina, freshwater marshes occur in the uppermost portion of the estuarine zone, where the inflow of saltwater from tidal influence is diluted by a much larger volume of freshwater from upstream. In Virginia, tidal freshwater marshes are best developed on sediments deposited by large meanders of the Pamunkey and Mattaponi Rivers, although outstanding examples also occur along the Potomac, Rappahannock, Chickahominy, and James Rivers. Strictly speaking, freshwater conditions have salt concentrations < 0.5 ppt, but pulses of higher salinity may occur during spring tides or periods of unusually low river discharge.

The most common species are arrow-arum (*Peltandra virginica*) dotted smartweed (*Polygonum punctatum* var. *punctatum*), wild rice (*Zizania aquatica* var. *aquatica*), pickerelweed (*Pontederia cordata*), rice cutgrass (*Leersia oryzoides*), tearthumbs (*Polygonum arifolium* and *Polygonum sagittatum*), and beggar-ticks (especially *Bidens laevis* and *Bidens coronata*). Locally, sweetflag (*Acorus calamus*), waterhemp pigweed (*Amaranthus cannabinus*), marsh senna (*Chamaecrista fasciculata* var. *macrosperma*), and southern wild rice (*Zizaniopsis miliacea*) may form dominance patches. Species diversity and vegetation stature vary with salinity, duration of inundation, and disturbance; the most diverse marshes occupy more elevated surfaces in strictly freshwater regimes. Mud flats that are fully exposed only at low tide support nearly monospecific stands of spatterdock (*Nuphar advena*), although cryptic submerged aquatic species may also be present.

Tidal freshwater marshes provide the principal habitat for the globally rare plant sensitive joint-vetch (*Aeschynomene virginica*) and are important breeding habitats for a number of birds, *e.g.*, the least bittern (*Ixobrychus exilis*) . Chronic sea-level rise is advancing the salinity gradient upstream in rivers on the Atlantic Coast, leading to shifts in vegetation composition and the conversion of some tidal freshwater marshes into oligohaline marshes. Tidal Freshwater Marshes are also threatened by the introduced invasive plant marsh dewflower (*Murdannia keisak*). Several communities in this group are chiefly restricted to the Chesapeake Bay drainage basin and are likely globally rare or uncommon.

References: Ahnert (1960), Coulling (2002), McCoy and Fleming (2000), Megonigal and Darke (2001), Parker and Wyatt (1975), Perry and Atkinson (1997), Perry and Hershner (1999).

Rare Plant and Animal Species. The Baldcypress-Tupelo Swamp community also harbors a number of rare plant and animal species. Rare animals include bald eagle, great purple hairstreak, blackwater bluet, robust baskettail, cypress sphinx, Selys' sunfly, fine-lined emerald and Southern pitcher-plant mosquito. Rare plants include cuckooflower, red turtlehead, Parker's pipewort, pineland tick-trefoil, river bulrush, Northern purple pitcher-plant, and cypress-knee sedge (Belden, Jr. et al., 2001; Belden, Jr. et al., 2003). The Dragon Run also harbors a number of rookeries for colonial water birds, such as egrets and herons. Other natural communities that occur in the Dragon Run include: Coastal Plain/Piedmont Bottomland Forest; Coastal Plain/Piedmont Acidic Seepage Swamp; and Coastal Plain Semipermanent Impoundment (Belden, Jr. et al., 2003).

In addition to natural heritage resources, the Dragon Run supports a diversity of freshwater and estuarine fishes, aquatic macroinvertebrates, freshwater bivalves (primarily unionid mussels), and herptefauna (amphibians and reptiles) (McIninch et al., 2003). At least forty-five fish species from nineteen families have been collected in the Dragon Run, representing a mixed assemblage of mostly lowland freshwater forms that is highly dynamic spatially and temporally. At least sixty-five macroinvertebrate species from fourteen orders and forty-seven families have been recorded from the Dragon Run.

SECTION 3: Management Guidance

RESOURCE STEWARDSHIP

Goals and Objectives

The primary goal of management at Dragon Bridge Tract is to maintain a pristine ecosystem with a matrix of communities native to the site that will provide opportunities for long-term habitat-focused research. The philosophy and policy direction for management of VECRR sites are similar to those outlined for the CBNERRVA in Appendix B. Reserve-level management and monitoring actions, as well as cooperative management initiatives and protection strategies, are planned based on the best current information and available resources.

Management objectives for Dragon Bridge Tract include:

- Maintain and protect key pristine swamp habitat and manage upland component of parcel to create high quality ecosystem with significant riparian buffer value as necessary.
- Foster research and educational opportunities to accomplish conservation goals and contribute to the body of knowledge on flora, fauna, and natural communities of Virginia.
- Manage habitat and uses to ensure long-term quality of environment.
- Manage habitat to benefit the array of natural resources, scenic resources, and historic resources.
- Monitor and evaluate effects of management on plants, animals, and natural communities.
- Maintain populations of rare or uncommon plants and animals.
- Foster consistency with surrounding parcel land uses.
- Ensure site-security and visitor safety.

SITE MANAGEMENT GUIDE

Aquatic and Wildlife Habitat Management Issues

Biological resource management actions shall be taken to preserve and maintain the pristine nature of the swamp community and to utilize the upland area of the site as quality riparian buffer habitat. Due to the current pristine state of the ecosystem of the swamp community on the site, preventing ecosystem degradation is more applicable than ecosystem restoration. Regarding the upland portion of the site, the primary goal is to manage the area to be a high quality habitat that provides superior buffer qualities to protect the swamp portion of the site. Figure 3 displays the current composition of the Dragon Bridge Tract.

Major threats to biodiversity generally include: habitat degradation/loss, invasive non-native species, pollution, overexploitation, disease, land conversion to development, water development (e.g., dams, drainage projects), some agricultural practices, livestock grazing, some outdoor recreation (e.g. off-road vehicles), pollutants, infrastructure development (e.g. roads), disruption of fire regimes, logging, and mining activities (Wilcove et al., 1998). After habitat loss, invasive non-native species are the greatest threat to terrestrial species. For aquatic species, water pollution is the most significant threat after habitat loss (Richter et al., 1997). Because of these

threats to biodiversity, active management is often needed to restore and maintain natural resources (Wilcove and Chen, 1998).

Biological issues of greatest concern and most likely to cause negative impacts to natural resources at Dragon Bridge Tract are potential invasive species introduction/expansion, use and development pressures outside the reserve, and native animal populations lacking natural abundance controls. Due to the permission-only use management schema of the site, habitat degradation by users should be relatively limited.

Upland/riparian buffer management.
The establishment and maintenance of riparian buffers is recognized as a significant protection mechanism of both water quality and key swamp ecosystems. One of the principle components of the site management goals includes the establishment of a riparian buffer along Dragon Run and associated riparian zones, including the tributary creek at the entrance to the property. The most obvious line is the transition from planted pines to a mixed pine hardwood forest. The DGIF site surveyor recommendation is to leave the mixed hardwood forest in the bottomland as your riparian buffer. This leaves the upland planted pines as the area for management activities. Based on discussions between the site manager and the DGIF site surveyor, the exact direction of management activities had not been decided so several options have been included with an attempt at the pros and cons of each.

The planted pines appear to be in excellent condition and were thinned at the appropriate time, allowing a lot of understory growth that is excellent for early successional species. As the trees continue to mature, the site manager will have a couple of options. The trees should reach a harvestable size (consultation with a certified forester is recommended) in the next 10-15 years. At that point, a decision to harvest the timber or allow the pine trees to continue growing past their prime and eventually die must be made. As the pines die off, the forest will change into a mixed pine hardwood forest (most likely with more of a pine component since oak, beech or hickory species were not found in abundance in the understory. There were, however, a few yellow poplar saplings in certain areas).

If the management goal is to eventually have an old growth forest, then the only option is to allow the forest to change over time. The decision to maintain existing logging decks as open areas is dependent upon the species you are managing for. Many neotropical migrants will not use fragmented forest habitat and other species will utilize the edge transition created around the open areas. The managing entity must decide which direction to take.

The DGIF site surveyor recommendation is to manage the existing pine forest in similar fashion to neighboring pine forests on different properties. It appears that most of them are naturally regenerated pine forests that are harvested at different periods. If this option is selected, then maintaining the log decks in an early successional state would fit with management goals. They can be planted in clover or a similar perennial species or allow them to revegetate naturally and mechanically set it back every three years or so. This method would also allow the harvest of different stands of timber for a monetary income that can be reinvested into conserving wetland habitat of performing management activities.

Road corridors.
The DGIF site surveyor identified road maintenance as an immediate priority. Routine road maintenance will serve multiple purposes in the future, other than access for educational groups and for habitat maintenance.

The existing roads are covered in *Lespedeza cuneata* (sericea lespedeza), a non-native weed that is considered invasive. There is very little food value for wildlife associated with this plant due to the high tannin content of the seeds and very little cover value for small mammal and bird species. Overall, it is recommended that it be controlled using a chemical treatment. If a glyphosate product is used, all vegetation along roads will be killed, which may be beneficial depending on your goals. (See Appendix G for information on Chinese Lespedeza control.)

If the manager intends to utilize the road network for fire breaks as well, then it is recommended that the area be cleared 10 ft from the center to each side of the road. Roads will also have be to extended to completely surround the upland forested acres. As they exist now, they will not work as fire breaks. Road sides can then be planted in a perennial clover to serve as erosion control and a wildlife food source. Burning can be an important tool for promoting early successional growth in a pine ecosystem, especially once the pines grow large enough to shade out the understory.

Road maintenance should be performed regardless of the timber management method to allow access in specific cases as described. As an aside to overall road maintenance, the spillway at the entrance needs to be rebuilt to allow the water level to be controlled so the road does not continue to flood out. The wetland habitat created by the beavers is excellent for water quality and wildlife, but it must be managed to maintain the utility of the property.

Key habitat and Natural Heritage Resource protection zones. Areas identified as key habitat, such as the swamp habitat and its riparian buffer should be prevented from being impacted by site activities. Most, if not all, of the Natural Heritage Communities may be found in these zones. Therefore, protection of these zones (Figure 4) is equivalent to protection of the Natural Heritage Communities. Any activities that may damage these habitats should be prohibited and this guidance establishing this prohibition should be enforced.

Threat mitigation.
Invasive, non-native species. The watershed contains only limited examples of invasive, or non-native, species, again emphasizing a relatively intact natural system. Currently, blue catfish, common reed, Asiatic dayflower, Chinese Lespedeza and Japanese stiltgrass occur in the Dragon Run in limited quantities. Nationwide, however, invasive species have been identified as the second highest threat to biological diversity, second only to loss of species and habitat from development and urban sprawl (Stein et al., 2000). Control of invasive non-native plants is expensive, resources are limited, and management efforts must be prioritized (Hiebert and Stubbendieck, 1993). The goal of management at Dragon Bridge Tract is to prevent the worst invasive species from becoming established in its high-quality natural communities. Because of minimal infestations of invasive species at the site, eradication of the primary invasive identified at the site, Chinese Lespedeza, is potentially a practical option. Other management efforts

should focus on preventing or reducing abundance of the most problematic invasive plants in the highest quality natural communities.

At Dragon Bridge Tract, the following invasive species was noted: Chinese Lespedeza (*Lespedeza cuneata* (sericea lespedeza)).

Chinese Lespedeza (*Lespedeza cuneata* (sericea lespedeza)). Chinese lespedeza, sometimes called sericea lespedeza, is primarily a threat to open areas such as meadows, prairies, open woodlands, wetland borders and fields. Once it gains a foothold, it can crowd out native plants and develop an extensive seed bank in the soil, ensuring its long residence at a site. Established dense stands of lespedeza suppress native flora and its high tannin content makes it unpalatable to native wildlife as well as livestock. See sericea lespedeza management guidance (Appendix G) for information and management regime.

Native animal problem species. Due to overabundance, certain native species of animals have become problematic – from both ecological and economic perspectives. While these species are native to Virginia, recent population increases have resulted in negative effects on habitat. Overabundance of some species is often incompatible with a broad array of resource management objectives. For ecological and/or economic reasons, natural resource managers must sometimes control burgeoning populations of native animals. The primary native species of impact at the Dragon Bridge Tract is the white-tailed deer.

White-tailed deer (*Odocoileus virginianus*). A large body of research (Russell et al., 2001) presents evidence that dense populations of deer in many eastern U.S. ecosystems can negatively impact tree and herb regeneration, recruitment and composition (Alverson and Waller, 1997, Horsley et al., 2003), alter natural community composition (Rooney and Dress, 1997), eliminate certain plant species from areas (Augustine and Frelich, 1998), and disrupt bird populations (deCalesta, 1994; McShea and Rappole, 1997). Deer also avoid browsing on the invasive non-native plants, such as Japanese stilt grass (Tu, 2000) further exacerbating the nefarious effects of these weeds on native flora. Of particular concern for natural areas management are negative effects of high deer densities on herbaceous plants (Balgooyen and Waller, 1995; Augustine and Frelich, 1998) and rare plants (Miller et al., 1992). At the end of the 19th century, deer were over-hunted to the point of near extirpation from Virginia. Since then, implementation of strict game laws, elimination of natural predators, and the changing landscape (with more edge habitat) has given rise to a burgeoning deer population that today, in most areas of the state, exceeds estimated presettlement deer densities (Knox, 1997).

Monitoring programs can be designed to estimate and track deer population densities and deer impacts in order to guide management actions. Additional information on white-tailed deer monitoring and control can be found in Appendix H.

Urban interface factors. Increasing development in the Dragon Run watershed, and specifically along the mainstem itself, has immediate and long-term impacts on natural resource quality and thereby natural resource-based industries. In particular, both large scale development and the placement of sporadic single family homes negatively impact these watershed values.

The network of roads that accompanies larger scale new development creates negative ecological impacts beyond just the effect of construction of new buildings. Increased impervious surfaces alter surface water flow and aquifer recharge, in addition to increased soil loss and sedimentation, which contribute to water quality degradation. Even more distantly located emissions from motor vehicles, power plants, industry, and other fossil-fuel producers have negative air and water quality impacts in the Dragon Run.

While the development of single family homes along the Dragon Run may leave a smaller footprint with regard to impervious surfaces and infrastructure requirements, it contributes significantly to the fragmentation of key habitat. Most of the traditional uses, ie farming and forestry, which have been practiced in the Dragon Run require large tracts of land to operate. These large holdings have been the key to keeping the watershed primarily intact. The patchy placement of new single family homes, especially close to the mainstem itself, reduces the cohesiveness of the ecosystem, as well as the capacity of the traditional industries to operate effectively in the future.

To help mitigate and plan for the impacts of the urban interface factors, VIMS should continue to support the Dragon Run Steering Committee and the Dragon Run Special Area Management Plan (Appendix F) in its efforts to work with the watershed counties to develop land-use planning recommendations that balance growth demands and the protection of traditional uses of the Dragon Run.

Fire management. Fire management is frequently an important facet of natural areas management in Virginia. Fire management activities include both prescribed fire implementation and wildfire management. While some wildfires are potentially destructive and should be suppressed, some situations – such as in the case of the Dragon Bridge Tract - should be explored as an opportunity to realize the benefits of fire in a natural setting.

To prepare for and provide guidance in the event of a wildfire in the future, a wildfire contingency plan should be developed for Dragon Bridge Tract. Such a plan should explore the past role of fire on the site, clearly state the potential benefits and disadvantages of wildfire under current landowner and management contexts, outline management objectives, and provide a viable set of management options should a wildfire occur. Development of a wildfire contingency plan would best be accomplished by VIMS staff working closely with agencies and organizations that frequently deal with fire management issues, including DCR, Department of Forestry (DOF), DGIF and The Nature Conservancy.

Cultural/Historic Site Protection

A Virginia Department of Historic Resources review was conducted and there do not appear to be any applicable archeological or architectural artifacts located on the site.

Use, Public Access, and Enforcement Plan

Operations management is a crucial aspect of natural area management, especially on lands where recreational uses by members of the public may conflict with the primary management objectives of research and natural resource protection. Policies have been developed for the CBNERRVA program that may apply to the Dragon Bridge Tract (Appendix C). Managers

must design and maintain infrastructure such as signs to best protect resources from adverse human effects. Routine operations management activities include boundary line maintenance, permitted/prohibited activity posting, and law enforcement. Since VIMS lacks its own law enforcement staff, it will be necessary to partner with other natural resource agencies such as VDGIF when law enforcement issues affecting natural resource protection arise.

Visitor management. All requests for access to and use of the Dragon Bridge Tract must be submitted to the CBNERRS Director for review, processing and permission. Any permitted access or usage must be consistent and compatible with the management strategies and goals outlined in this management plan. Failure to comply with approved visitation permission stipulations shall result in the cessation of all activities by that entity. Trespass or failure to request permission for an activity shall result in cessation of use by that entity until such time as the activity is approved by the CBNERR Director.

Code of conduct. Site users should receive a copy of the Public Use Guide (Appendix I), which provides information regarding the public and private rights associated with waterways in Virginia. This brochure provides an overview of the Public Trust Doctrine and how it is applied. This use of this document may help to reduce conflicts between individuals exercising their public trust rights and landowners, and vice versa.

Federal and state natural resource laws. Laws potentially affecting management of the Dragon Bridge Tract are noted in Appendix J. The conservation emphasis of management at VCERRS sites means that VIMS will rarely engage in land or water modifications subject to regulation. Decisions to permit fishing or hunting will comply with all federal and state game laws. At all VCERRS sites, efforts to control invasive species, protect rare and endangered species, and protect existing natural and historic resources fulfill the requirements of several natural resource laws.

Waterfowl Hunting. Virginia law provides that any appropriately licensed person can hunt waterfowl in public waters during established seasons and using legal methods so long as they are not within 457 meters (500 yards) of an existing licensed stationary waterfowl blind. Therefore, if VIMS does not license, establish, and use (for the purpose of hunting) stationary waterfowl blinds on Dragon Bridge Tract, then members of the public may obtain a license and build a stationary hunting blind in public waters surrounding and adjacent to the site. Where stationary blinds are not established, hunters could also legally hunt from licensed floating blinds in the waters adjacent to the site.

Monitoring. A wide variety of monitoring techniques are used to assess change in natural community composition and rare species population status. Monitoring can determine if natural processes essential to natural resource health are occurring and whether or not management actions have been effective. Monitoring is also needed to document effects of human visitation and public use patterns on resources and other natural features protected within natural areas and reserves. The term “monitoring” describes several different types of data collection related to resource management and includes inventory, natural history study, research, implementation monitoring, trend measurement, baseline measurement, and longterm ecological studies. Monitoring in a strict sense is “the collection and analysis of repeated observation or

measurements to evaluate changes in condition and progress towards meeting a management objective" (Elzinga et al., 1998).

Research. Research to improve understanding of natural history, biology, and population dynamics of rare species and ecosystem functions is needed for sound and defensible management planning. Scientific studies are conducted by VIMS or sponsored through funding support to answer basic natural history questions, and to inform management decisions and actions. Studies conducted on all VCERRS sites require submission of an application, which must be reviewed and subsequently approved by VIMS staff.

Plan for Consistency with Surrounding Properties and Participation with Regional Conservation Area Coordination Efforts

There are several sites in the vicinity of the Dragon Bridge Tract that also are conservation acquisitions held by public and non-governmental organizations, yet have varying goals and management schema than the Dragon Bridge Tract. It is recommended that the site managers communicate as needed to maximize opportunities that become available and to ensure consistency and compatibility across the watershed.

Establishment of Conservation Easements

Although the site is owned by a public entity, it is recommended that a conservation easement be placed on the property, especially the swamp habitat and its riparian buffer to permanently protect the key natural habitats of this property.

Plan for Management Sustainability and Funding

As with most state entities, sustainability of funding is variable and subject to change. However, as a part of the VCERRS, the Dragon Bridge Tract does provide more definite sustainability of management. With its purpose identified by the Code of Virginia, § 28.2-1103, the goals of research and education are firmly acknowledged, as are uses, such as conservation, which are compatible with those goals.

IN SUMMARY

Summarized below are Action Items identified by this management plan to fulfill the Management Objectives listed in Section 3:

Action Items

- Adopt "do-not-disturb" approach to management of riparian buffers/swamp/Natural Heritage Communities
- Roadway and drainage/spillway improvements
- Select forest management approach from discussed options and consult with Virginia Department of Forestry to implement
- Take prescribed measures to eradicate Chinese Lespedeza; monitor for other invasive species that may move into the area
- Consider managed deer hunts to control white-tailed deer populations
- Continue with Dragon Run Steering Committee participation and input, especially regarding land-use planning in King and Queen and the surrounding counties
- Adopt Public Use Guide

- Erect signage internal to the site with management contact information, use restrictions and guidance and other information, such as the Public Use Guide.
- Post boundary markers to differentiate the site from surrounding lands
- Continue with permission-based management approach for site use
- Coordinate with surrounding public and non-governmental entities regarding conservation site management goals and opportunities

CONCLUSION

Contrary to the management of many conservation sites in more populated areas, the isolation and currently pristine key habitats of the Dragon Bridge Tract require minimal active management. Because the swamp and primary riparian buffer of the site currently reflects the "natural" landscape of pre-industrial/pre-urban expansion America 500 years ago, a "do-not-disturb" management strategy will go a long way to conserve natural resources. By addressing several key management issues, including road corridor maintenance, removal of invasive species, management of the upland forest, and by controlling activities and enforcing the prohibition of incompatible uses, it is likely that successful stewardship of natural resources will be attained.

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REFERENCES

Alverson, W. S. and D. M. Waller. 1997. Deer populations and the widespread failure of hemlock regeneration in northern forests. Pp. 280-297. In: W. J. McShea, H. B. Underwood, and J. H. Rappole (eds.). The science of overabundance: deer ecology and population management. Smithsonian Institution Press, Washington, D.C.

Augustine, D. J. and L. E. Frelich. 1998. Effects of white-tailed deer on populations of an understory forb in fragmented deciduous forests. Conservation Biology 12:995-1004.

Augustine, D. J., L. E. Frelich and P. A. Jordan. 1998. Evidence for two alternate stable states in an ungulate grazing system. Ecological Applications 8:1260-1269.

Balgooyen, C. P. and D. M. Waller. 1995. The use of Clintonia borealis and other indicators to gauge impacts of white-tailed deer on plant communities in northern Wisconsin. Natural Areas Journal 15:308-318.

Belden, A. Jr., A.C. Chazal, G.P. Fleming, C.S. Hobson, and K.M. McCoy. 2001. A Natural Heritage Inventory of the Dragon Run Watershed. Second edition. Natural Heritage Technical Report 01-03. Virginia Department of Conservation and Recreation, Division of Natural Heritage, Richmond, VA. 64 pp. plus appendix.

Belden, A. Jr., A.C. Chazal, and C.S. Hobson. 2003. A Natural Heritage Inventory of Fourteen Headwater Sites in the Dragon Run Watershed. Natural Heritage Technical Report 03-16. Virginia Department of Conservation and Recreation, Division of Natural Heritage, Richmond, VA.

DeCalesta, D. S. 1994. Impact of white-tailed deer on songbirds within managed forests in Pennsylvania. Journal of Wildlife Management 58:711-718.

Department of Conservation and Recreation. 2002. The Biennial Nonpoint Source Pollution Water Quality Assessment Report. Virginia Department of Conservation and Recreation, Division of Soil and Water Conservation, Richmond, VA.

Department of Conservation and Recreation. 2003a. Natural Heritage Resources Maps. Virginia Department of Conservation and Recreation, Division of Natural Heritage, Richmond, VA.

Department of Conservation and Recreation. 2003b. Virginia 2002 Nonpoint Source (NPS) Assessment Landuse/Area web site. Virginia Department of Conservation and Recreation, Division of Soil and Water Conservation, Richmond, VA. http://192.206.31.52/cfprog/dswc/lutype.cfm.

Department of Environmental Quality. 2002. 2002 303(d) Report on Impaired Waters. Virginia Department of Environmental Quality, Richmond, VA. http://www.deq.state.va.us/water/303d.html.

Elzinga, C. L., D. W. Salzer, and J.W. Willoughby. 1998. Measuring and monitoring plant populations. Bureau of Land Management, Denver, Colorado

Fleming, G.P., P.P. Coulling, D.P. Walton, K.M. McCoy, and M.R. Parrish. 2001. The natural communities of Virginia: classification of ecological community groups. First approximation. Natural Heritage Technical Report 01-1. Virginia Department of Conservation and Recreation, Division of Natural Heritage, Richmond, VA. Unpublished report. January 2001. 76 pp.

Garman, G.C. 2003. Aquatic Living Resources Inventories in the Dragon System: Virginia Commonwealth University On-going Activities. Dragon Run Natural Resources Symposium, February 11, 2003, Virginia Institute of Marine Science, Gloucester Point, VA.

Hiebert, R. and J. Stubbendieck. 1993. Handbook for ranking exotic plants for management control. USDI National Park Service, Midwest Regional Office, Omaha

Horsley, S. B., S. L. Stout and D. S. DeCalesta. 2003. White-tailed deer impact on the vegetation dynamics of a northern hardwood forest. Ecological Applications 13:98-118.

Knox, W. M. 1997. Historical changes in the abundance and distribution of deer in Virginia. Pp. 27-36 *in* W.J. McShea, H.B. Underwood and J.H. Rappole (eds.). The science of overabundance: Deer ecology and population management. Smithsonian Institution Press, Washington, D.C.

McShea, W. J. and J. H. Rappole. 1997. Herbivores and the ecology of understory birds. Pp. 298-309. In: W. J. McShea, H. B. Underwood and J. H. Rappole (eds.). The science of overabundance: deer ecology and population management. Smithsonian Institution Press, Washington, D.C.

McIninch, S.P., G.C. Garman, L. Smock, and W. Shuart. 2003. Preliminary Aquatic Living Resources Inventory. Virginia Commonwealth University, Center for Environmental Studies, Richmond, VA. Prepared for Middle Peninsula Planning District Commission.

Middle Peninsula Planning District Commission. 2001. Dragon Run Watershed Land-Water Quality Preservation Project. Middle Peninsula Planning District Commission, Saluda, Virginia.

Middle Peninsula Planning District Commission. 2002. Dragon Run Management Framework. Middle Peninsula Planning District Commission, Saluda, Virginia. Prepared by Anderson and Associates, Richmond, Virginia.

Miller, S. G., S. P. Bratton, and J. Hadidian. 1992. Impacts of white-tailed deer on endangered and threatened vascular plants. Natural Areas Journal 12:67-74.

Rabinowitz, D. 1981. Seven forms of rarity. Pp. 205-218 *in* H. Synge (ed.). The biological aspects of rare plant conservation. Wiley and Sons, New York.

Richter, B. D., D. P. Braun, M.A. Mendelson, and L. L. Master. 1997. Threats to imperiled freshwater fauna. Conservation Biology 11:1081-1093.

Rooney, T. P. and W. J. Dress. 1997. Species loss over sixty-six years in the ground-layer vegetation of Heart's Content, an old-growth forest in Pennsylvania, USA. Natural Areas Journal 17:297-305.

Russell, F. L., D. B. Zippin, and N. L. Fowler. 2001. Effects of white-tailed deer (Odocoileus virginianus) on plants, plant populations and communities: a review. American Midland Naturalist 146:1-26.

Smither, J.M., R.M. Thomas, D.B. Geeson, and R.S. Morris. 2003. Shoreline Sanitary Survey: Piankatank River, Upper; Gloucester, Mathews, and Middlesex Counties. Virginia Department of Health, Division of Shellfish Sanitation, White Stone, VA

Southeast Regional Climate Center. 2007. Climatic summaries for Virginia stations. Available at Website: http://www.dnr.state.sc.us/climate/sercc/services.html.

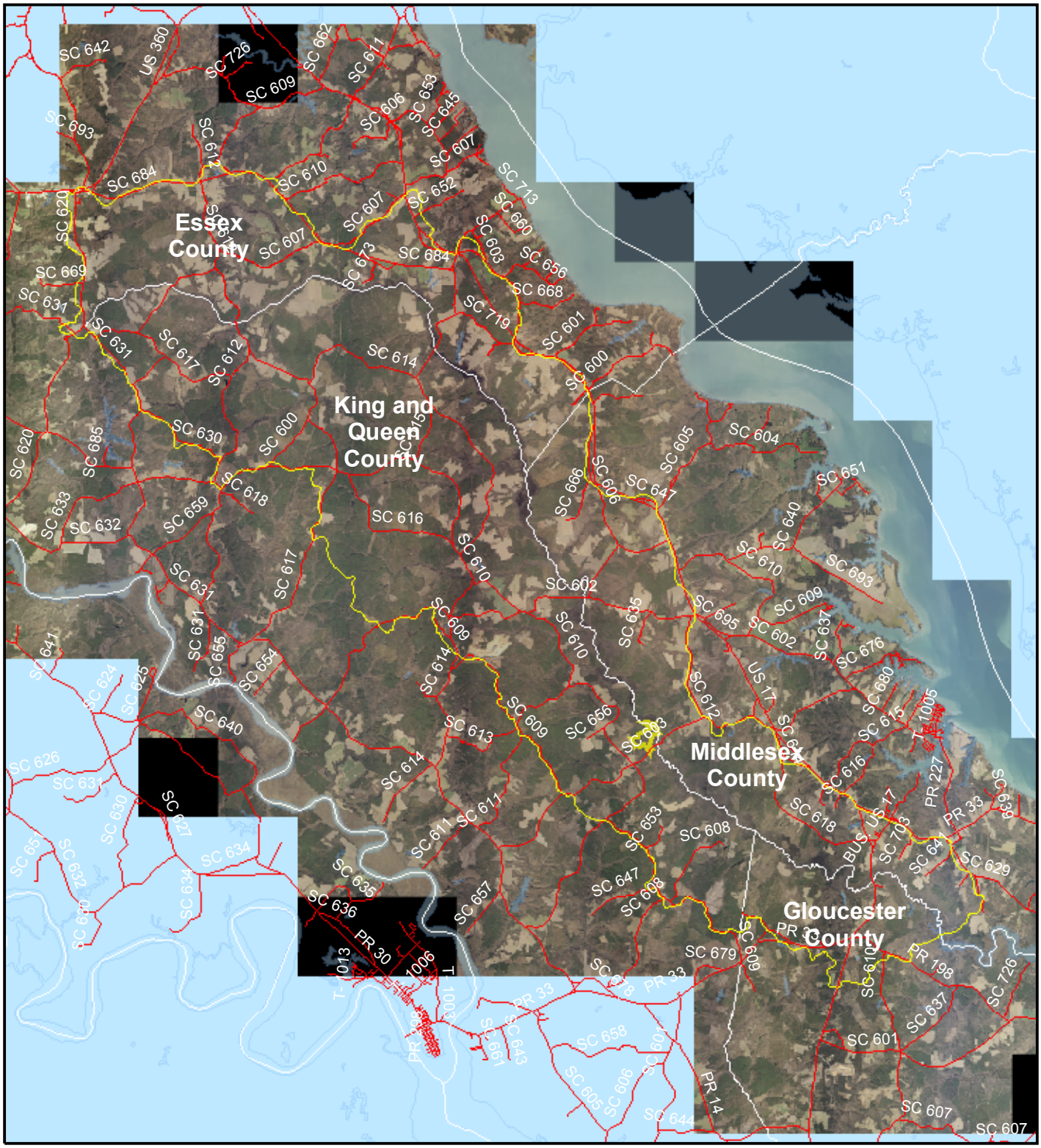
Stein, B. A., L. S. Kruner, and J. S. Adams. 2000. Precious Heritage: The Status of Biodiversity in the United States. Oxford University Press, Oxford, New York. 399 pp.

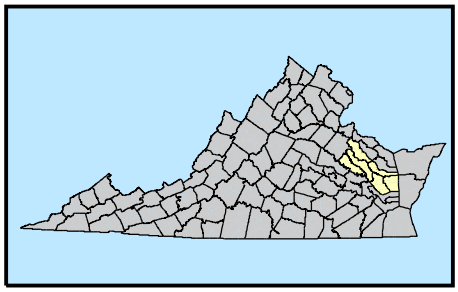
Tu, M. 2000. Element Stewardship Abstract for *Microstegium vimineum*, stilt grass. The Nature Conservancy's Wildland Invasive Species Program.

Wilcove, D.S. and L.Y. Chen. 1998. Management costs for endangered species. Conservation Biology 12:1405-1407.

Wilcove, D.S., D Rothstein, J. Dubow, A. Phillips, and E. Losos. 1998. Quantifying threats to imperiled species in the United States. BioScience 48:607-615.

Figure 1: Dragon Run Watershed





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Virginia Coastal Zone
MANAGEMENT PROGRAM

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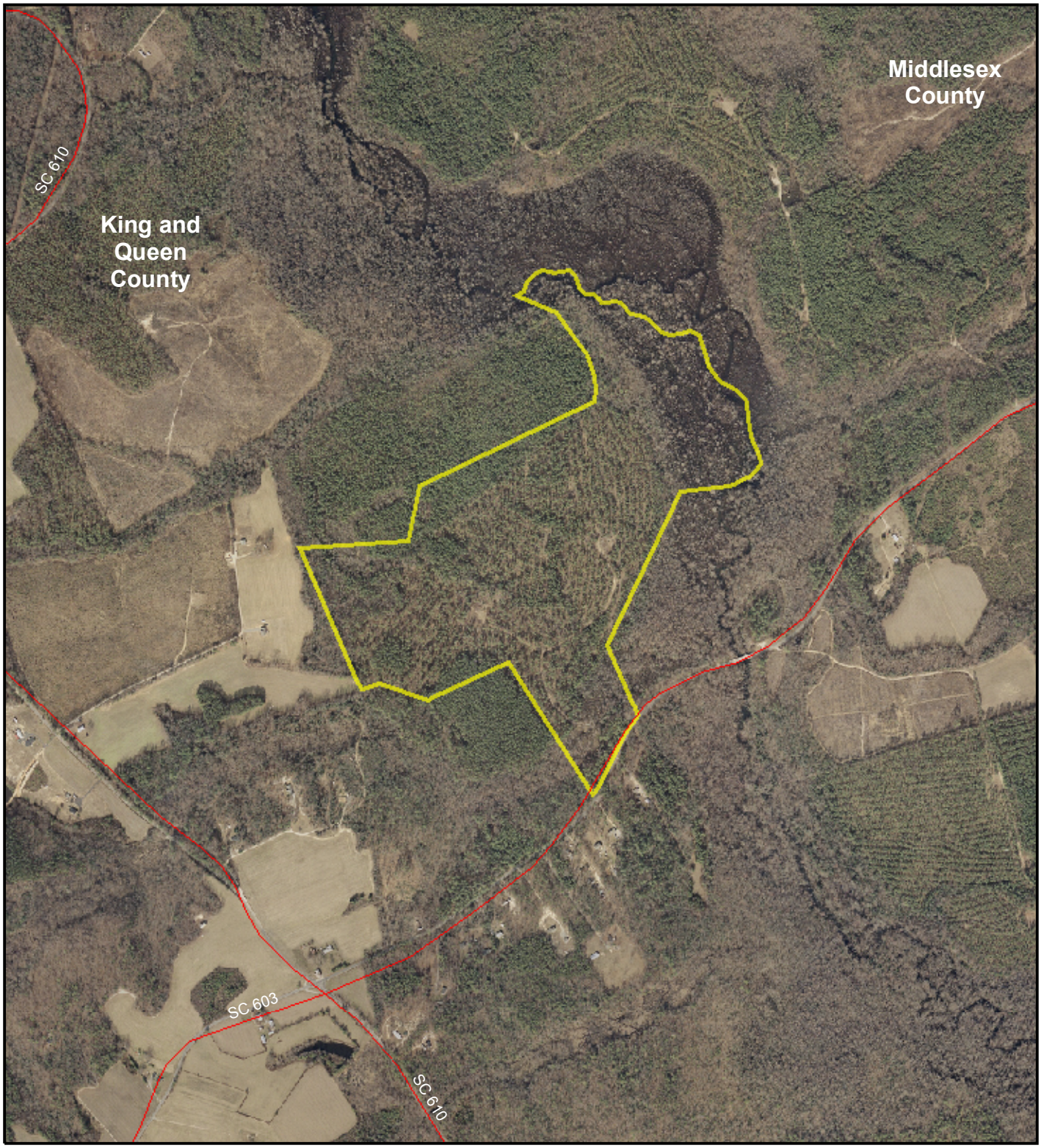
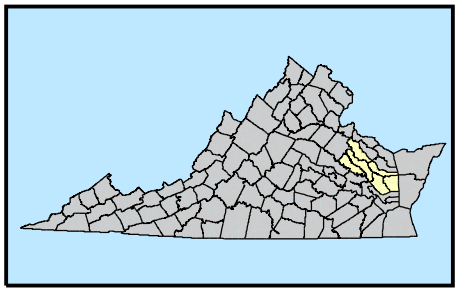
Dragon Run WATERSHED

Middle Peninsula Planning District Commission - 2004

Figure 2: Dragon Bridge Tract - Site Boundary and Location





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Dragon Run WATERSHED

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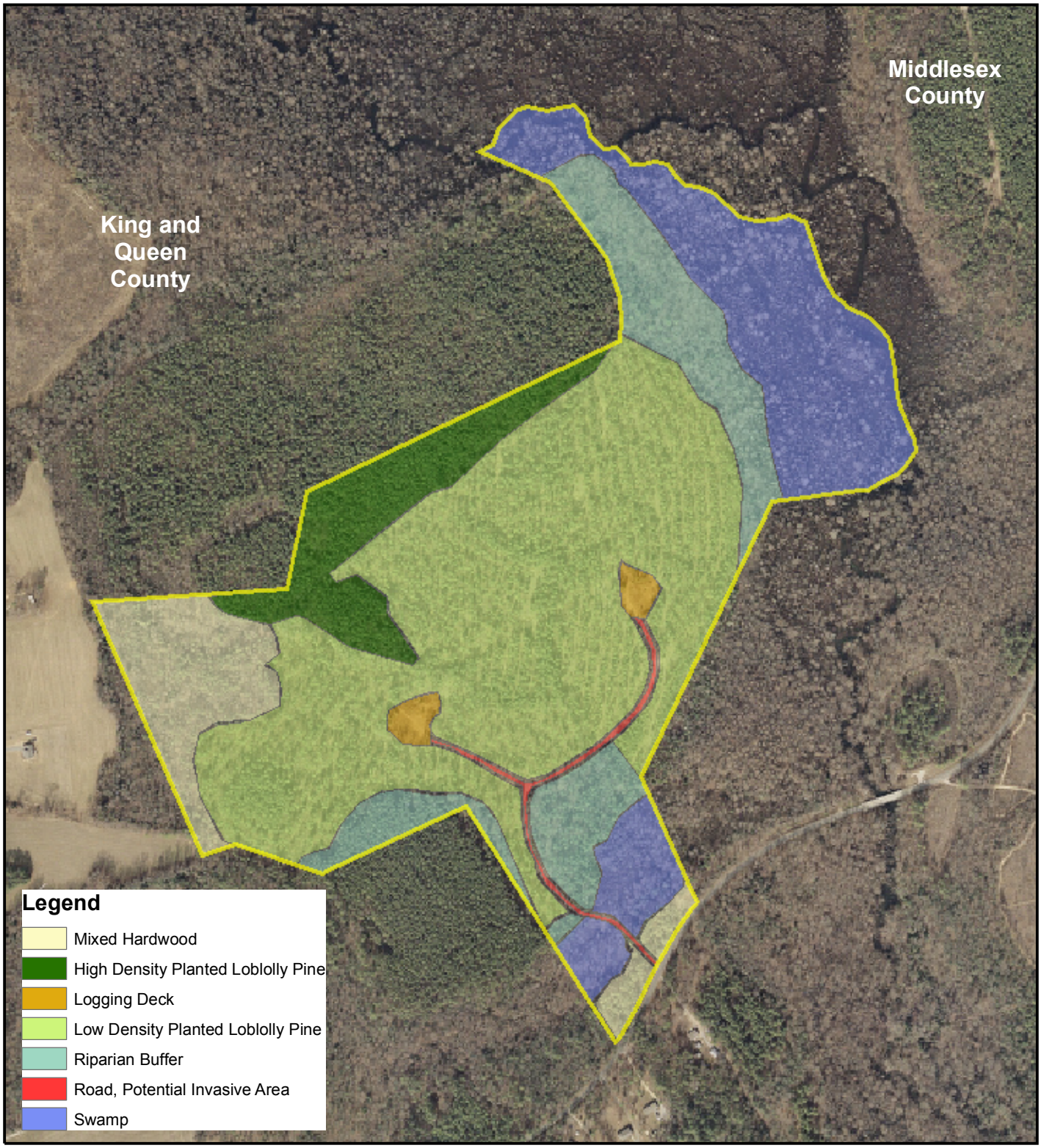
Figure 3: Dragon Bridge Tract - Site Survey



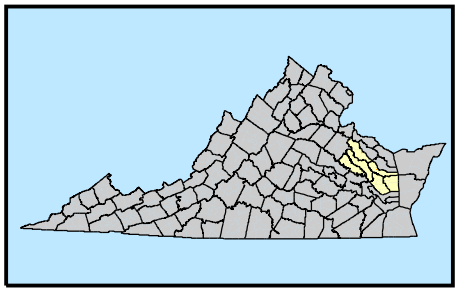


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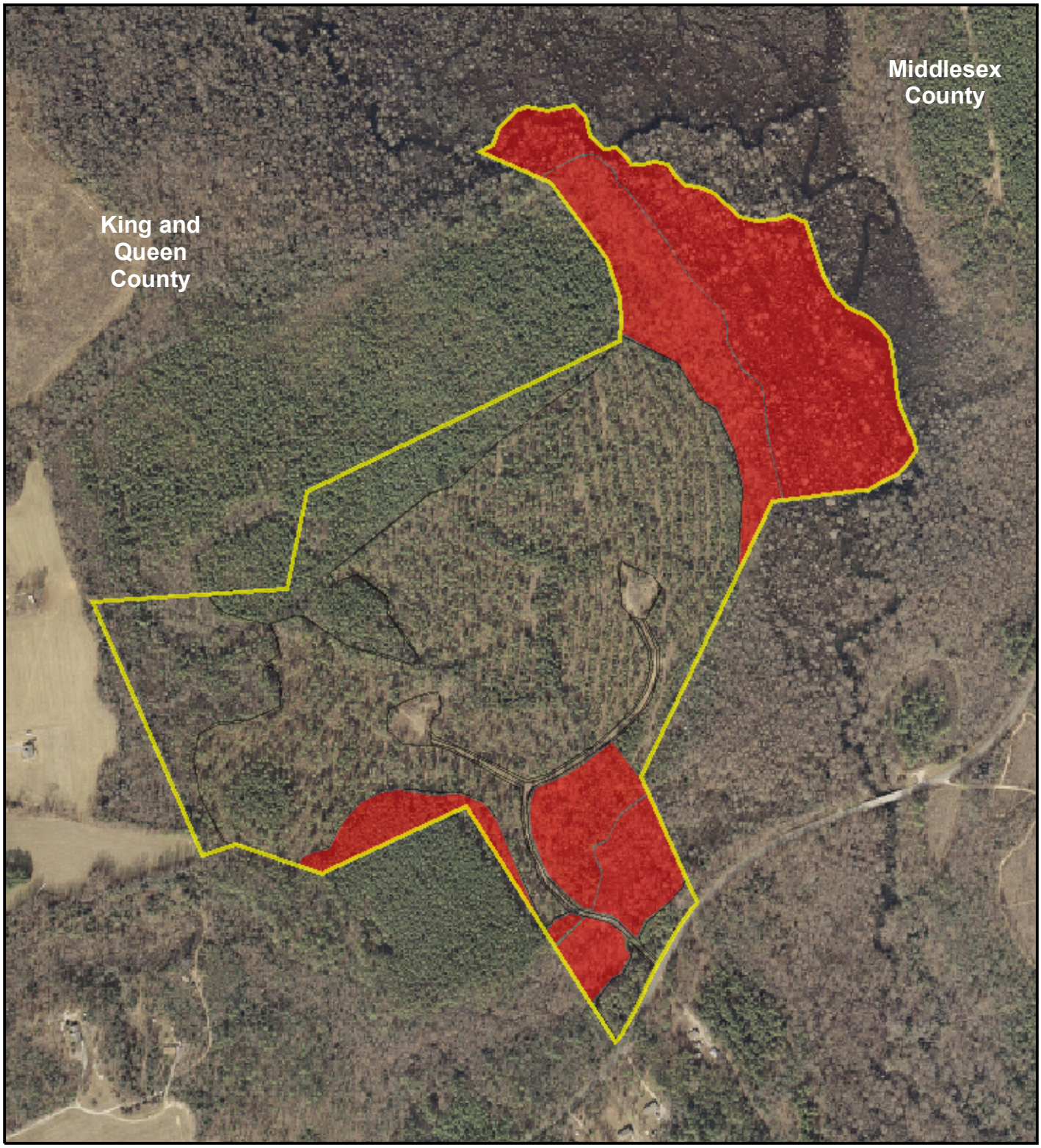
Figure 4: Dragon Bridge Tract - High Priority Conservation Areas



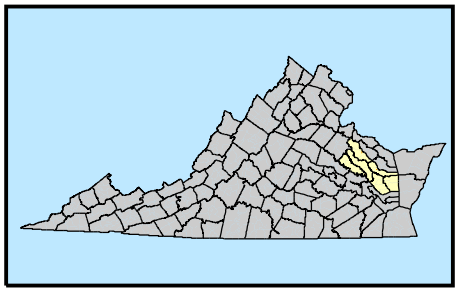


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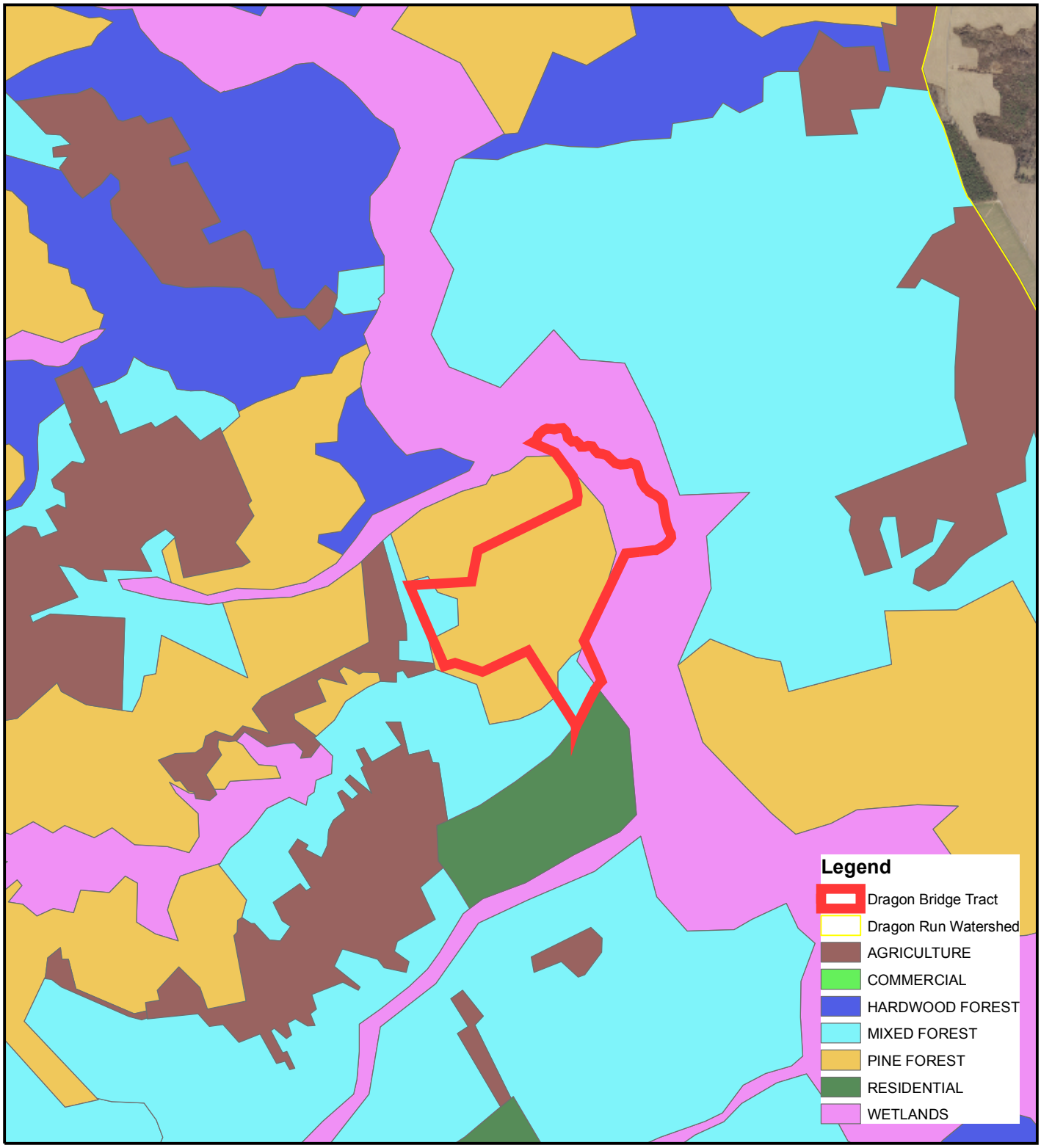
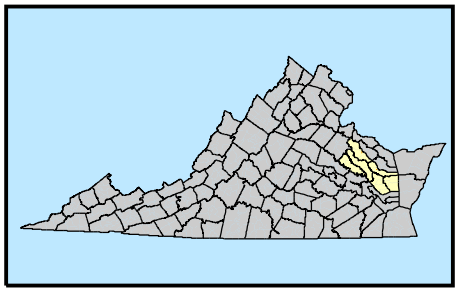
Figure 5: Dragon Bridge Tract - Surrounding Landcover





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Virginia Coastal Zone
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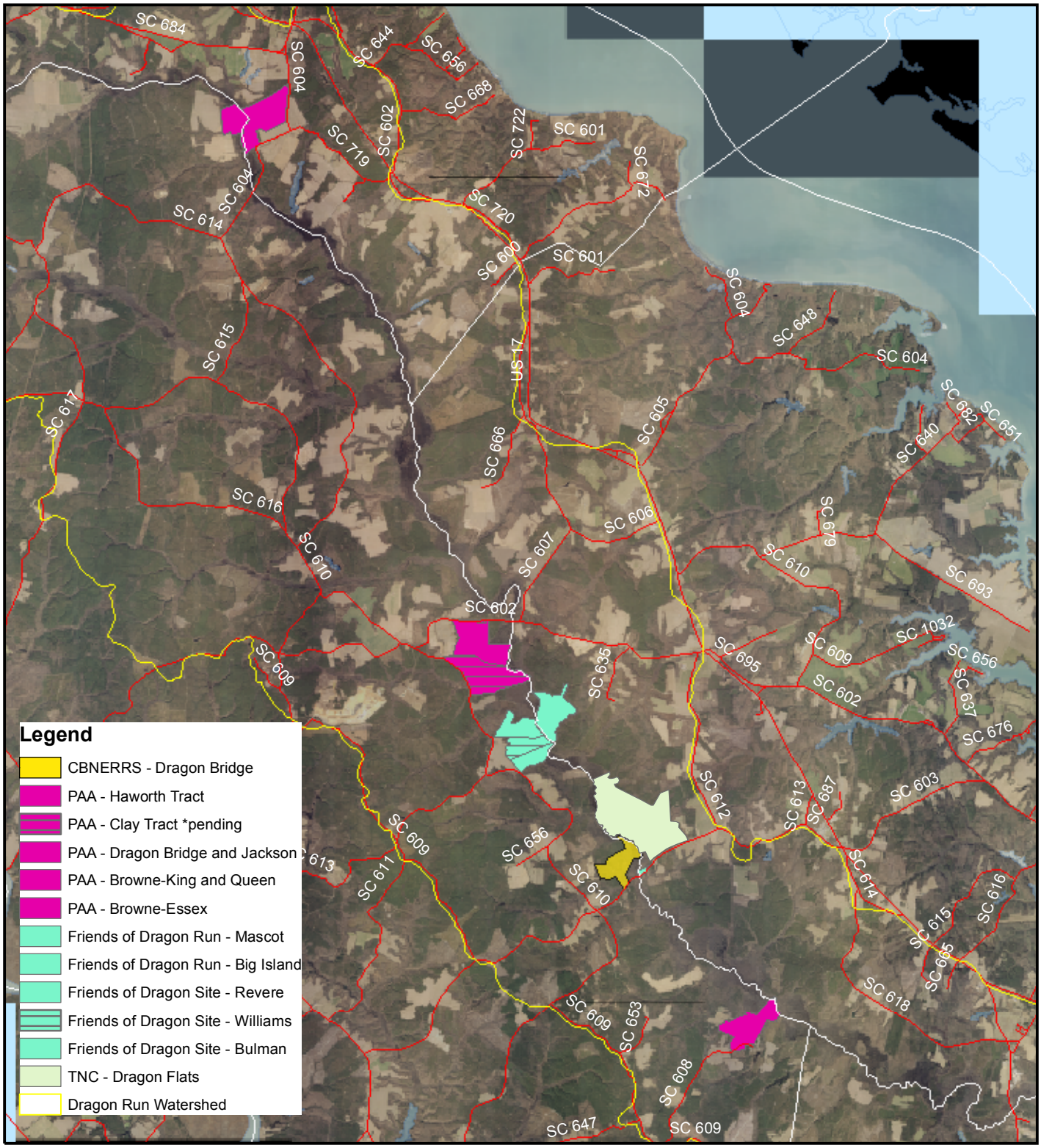
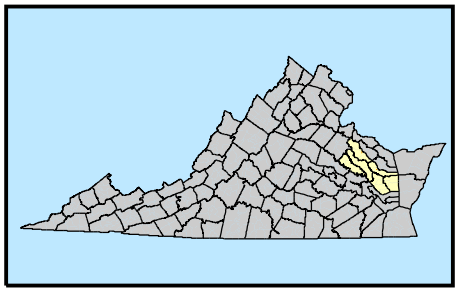
Figure 6: Dragon Bridge Tract - Surrounding Conservation Holdings





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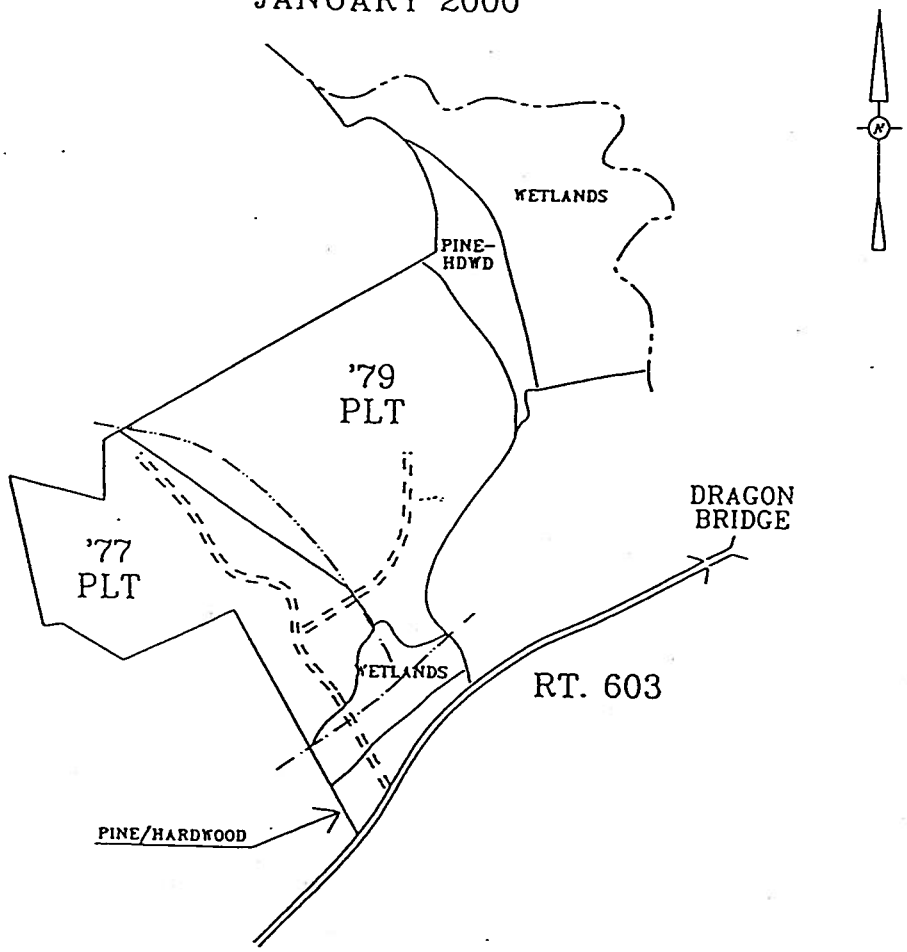
Site Plan

DRAGON BRIDGE #2

KING AND QUEEN COUNTY, VA.
JANUARY 2000



1977 LOBLOLLY PINE	30 ACRES
1979 LOBLOLLY PINE	45
PINE–HARDWOOD	3
WETLAND	43.5
TOTAL	121.5*

SCALE: 1" = 660'

FOREST RESOURCES MANAGEMENT, INC.
(804)769-3948

*STAND ACRES FROM CCV MAP 5-74

APPENDICES

A. VCERRS in the Code of Virginia
B. CBNERRVA Management Plan 2007**
C. General Public Access Plan – CBNERRVA**
D. Rare Species and Community List
E. Natural Heritage Rarity Ranks and Status Explanation
F. Invasive Species / Native Problem Species Information
G. Chinese Lespedeza Management Guide
H. Deer Hunting Plan: Dragon Bridge Tract
I. Public Use Guide
J. Federal and State Natural Resource Laws
K. Glossary of Technical Terms and Abbreviations
L. Dragon Run Watershed Management Plan

***At the time of publication, a management plan nor a public access plan for the Virginia Estuarine and Coastal Research Reserve system had not been developed. As the policies of this system are consistent with the CBNERRVA system, the CBNERRVA Management Plan 2007and CBNERRVA Public Access Plan has been utilized in the interim.*

Appendix A. Virginia Coastal Estuarine Research Reserve System enabled by the Code of Virginia

Code of Virginia - Title 28.2 - FISHERIES AND HABITAT OF THE TIDAL WATERS.

§ 28.2-1103. Virginia Estuarine and Coastal Research Reserve System created; purpose; Virginia Institute of Marine Science to administer.

A. There is hereby created the Virginia Estuarine and Coastal Research Reserve System (the System) for the purpose of establishing a system of protected sites representative of the Commonwealth's estuarine and coastal lands in which research and long-term monitoring will be conducted in support of the Commonwealth's coastal resource management efforts.

B. The System shall be established and administered by the Virginia Institute of Marine Science of The College of William and Mary. The Institute shall consult with and seek the advice of the Virginia Coastal Program and of those state agencies responsible for administering programs of the Virginia Coastal Program; the Marine Resources Commission; the Department of Game and Inland Fisheries; the Department of Conservation and Recreation; the Department of Health; and the Department of Environmental Quality.

C. Sites included within the System shall be within any jurisdiction included in Tidewater Virginia as defined in § 10.1-2101.

D. The Institute may accept the dedication, by voluntary act of the owner, of areas it deems suitable for the System. Dedication may include transfer of fee simple title or other interest in land to the Commonwealth or may be in the form of voluntary agreement with the owner to include the area within the System. Estuarine and Coastal Research Reserve System sites may also be acquired by gift, grant, or purchase.

E. The instrument of dedication may:

1. Contain restrictions and other provisions relating to management, use, development, transfer, and public access, and may contain any other restrictions and provisions as may be necessary or advisable to further the purposes of this article;

2. Define, consistent with the purposes of the article, the respective rights and duties of the owner and of the Commonwealth and provide procedures to be followed in case of violations of the restriction;

3. Recognize and create reversionary right, transfers upon conditions or with limitations, and gifts over; and

4. Vary in provisions from one System site to another, in accordance with differences in the characteristics and conditions of the several areas.

F. Public departments, commissions, boards, counties, municipalities, corporations, colleges, universities and all other agencies and instrumentalities of the Commonwealth and its political

subdivisions may enter into agreements with the Institute to dedicate suitable areas within their jurisdictions as Estuarine and Coastal Research Reserve System sites.

G. Subject to the approval of the Governor and the Attorney General, the Commonwealth may enter into amendments to the instrument of dedication upon finding that the amendment will not permit an impairment, disturbance, use, or development of the area that is inconsistent with the provisions of this article. If a fee simple estate in the Estuarine and Coastal Research Reserve System is not held by the Institute under this article, no amendment may be made without the written consent of the owner of the other interests therein.

H. The Institute is empowered to enter into agreements with federal agencies holding title to lands within Tidewater Virginia to include suitable portions of agency holdings in the Virginia Estuarine and Coastal Research Reserve System.

I. All lands within the system shall be used primarily for research and education. Other public uses such as hunting and recreation on those research reserve lands owned by the Institute shall be allowed, consistent with these primary uses. Improvements and alterations to research reserve lands owned by the Institute shall be limited to those consistent with these uses.

(1999, c. 553; 2005, c. 41.)

§ 28.2-1104. Coordination.

A. To the extent feasible, this system shall be carried out in coordination with the National Estuarine Research Reserve System established by 16 U.S.C. § 1461.

B. To the extent feasible, lands within the Virginia Estuarine and Coastal Research Reserve System shall be dedicated as part of the Commonwealth's natural area preserves components pursuant to § 10.1-213.

(1999, c. 553.)

Appendix B. Mission of CBNERRVA – from draft CBNERRVA Management Plan 2007-2011

5.1 Mission Statement

The mission of CBNERRVA is to:

> *preserve a network of reserves that represent the diversity of coastal ecosystems found within the York River estuary and its principal tidal tributaries and manage these reserves to support informed management of coastal resources through, estuarine research, education, stewardship, and advisory service*.

The Reserve's mission complements the three-part mission of the VIMS to conduct interdisciplinary research in coastal ocean and estuarine science, educate students and citizens, and provide advisory service to policy makers, industry, and the public.

5.2 Chesapeake Bay Management Issues and CBNERRVA Focus Areas (2007-2011)

Degradation of marine and estuarine environments is of global concern and the Chesapeake Bay system is no exception. A growing population along with associated land use changes are primary factors causing water quality and habitat degradation in the Bay's watershed, it's tributaries and the Bay proper. Key management issues and threats to the Bay system include:

Figure 5.1. Episodic large storms (Tropical Storm Ernesto, 9/1/2006) impact Bay resources and coastal communities. *Photo credit: William Reay.*

- excess nutrients, both nitrogen and phosphorus, that stimulate algal blooms and lead to oxygen deprived waters and reduced water clarity;
- excess sediments which result in degraded habitat, reduce water clarity, and serve to transport toxic materials, pathogens and nutrients to water resources;
- introduction of toxic chemicals (e.g., mercury, PCBs, pesticides) and associated health impacts on wildlife and humans;
- loss and/or degradation of key habitats (e.g., submerged aquatic vegetation, wetlands, riparian forests, oyster reefs) that provide critical services to a wide variety of residential and migratory species; and
- declining finfish and shellfish populations due to over-fishing and disease issues.

The CBNERRVA has developed focus areas that address national, regional and local issues. Cutting across specific program boundaries, issue focus areas allow the Reserve to address key management concerns in a more integrated and comprehensive manner. Primary focus areas directing Reserve programs include:

- Ecology of coastal shallow water environments;
- Watershed and atmospheric processes and material flux;
- Episodic storm events and climate change;
- Shoreline management;
- Integrated coastal and ocean observing systems; and
- Advisory service.

5.3 Reserve Goals and Objectives

5.3.1 Management Plan Framework

The CBNERRVA Management Plan has been developed to address specific goals and objectives within the Administration, Research and Monitoring, Education and Stewardship programs in order to support the Reserve's mission over the next five years (2007-2011). The Reserve's goals and objectives outlined in this management plan align with the goals and objectives of the NOAA/NERRS 2005-2010 Strategic Plan (see Section II.B3); see italicized text following CBNERRVA programmatic goals and objectives. The Reserve's management plan has been subdivided into basic responsibilities and activities associated with primary Reserve programs and operational responsibilities. Individual plans include:

- Administration
- Research and Monitoring;
- General Education and Outreach;
- Coastal Training Program;
- Stewardship and Public Access;
- Boundary and Acquisition;
- Facilities, Site Infrastructure and Equipment Support; and
- Special Programs.

Specific strategies have been developed to address each Reserve goal and objective. Serving as action items, these strategies provide focused guidance and allow for Reserve performance to be monitored.

5.3.2 Overview of Goals and Objectives

Goals and associated objectives to support the Reserve's mission are provided in Table 5.1. Specific strategies addressing Reserve goals and objectives are presented in the individual plan sections based on programs and operational responsibilities. A complete summary table of Reserve goals, objectives and strategies is provided in Appendix 2. In some cases, Reserve goals and objectives target specific programs (e.g., Administration, Research and Monitoring, General Education and Outreach, CTP and Stewardship). Whereas in other cases, activities and strategies associated with specific goals and objectives are integrated across programs. To aid in understanding Reserve operations and clarify program areas of emphasis and responsibility, lead and supporting Reserve programs have been identified for each goal and strategy.

Table 5.1. Summary of 2007-2011 CBNERRVA goals and objectives. Linked NOAA/NERRS 2005-2010 Strategic Plan goals and objectives, and CBNERRVA programmatic responsibilities are presented as italicized text.

Goal 1. Recognition of CBNERRVA as a regional leader in applying science and education to support coastal resource management and literacy. *(NERRS Strategic Plan Goal #2; all Programs)* **Objective 1.** Foster mutually supportive relationships internally between Reserve programs and externally with academic institutions, governmental agencies, nongovernmental organizations and communities. *(NERRS Strategic Plan Goal #2, Objective 1; all Programs)* **Objective 2.** Increase CBNERRVA and NERRS visibility among academic, governmental agencies, nongovernmental organizations and the general public. *(NERRS Strategic Plan Goal #2, Objectives 2 and 3; all Programs)*
Goal 2. Enhance scientific understanding of coastal ecosystems, surrounding environments and the natural and human processes influencing such systems. *(NERRS Strategic Plan Goals #1 and #2)* **Objective 1.** Characterize and monitor coastal ecosystems and surrounding environments to describe reference conditions and quantify spatial and temporal changes. *(NERRS Strategic Plan Goal #1, Objective 2; Goal #2, Objectives 1,2 and 3)* **Objective 2.** Determine linkages within and between coastal ecosystems and how linkages affect those systems. *(NERRS Strategic Plan Goal #1, Objective 2; Goal #2, Objectives 1,2 and 3)* **Objective 3.** Promote, coordinate and support research and monitoring activities within Reserve boundaries and the York River system. *(NERRS Strategic Plan Goal #2, Objective 1)*
Goal 3. Promote the effective management and conservation of natural and cultural coastal resources through informed decision-making. *(NERRS Strategic Plan Goals #2 and #3)* **Objective1.** Communicate results of research, environmental monitoring and best available science-based information to assist in improved coastal resource management. *(NERRS Strategic Plan Goal #2, Objectives 2 and 3; Goal #3, Objectives 1,2 and 3)*
Goal 4. Increase public awareness, understanding and appreciation of coastal environments. *(NERRS Strategic Plan Goal #3)* **Objective 1.** Increase student and teacher knowledge and understanding of coastal environments through formal education programs. *(NERRS Strategic Plan Goal #3, Objectives 1 and 2)* **Objective 2.** Increase general public awareness and appreciation of the Chesapeake Bay and other coastal environments through public outreach and interpretation programs. *(NERRS Strategic Plan Goal #3, Objectives 1 and 2)*
Goal 5. Provide administrative leadership and resources necessary to fulfill the Reserve's mission. . *(NERRS Strategic Plan Goals #1, #2 and #3)* **Objective 1.** Provide staffing, resources and a structured organization framework that allow for attainment of program goals and objectives. *(NERRS Strategic Plan Goal #1, Objective 3)* **Objective 2.** Manage Reserve components to fulfill mission and ensure representation of the diverse ecosystems found within the York River estuary. *(NERRS Strategic Plan Goal #1, Objective 3)* **Objective 3.** Support staff professional development to assure competence in current positions and allow for preparation for more advanced positions. **Objective 4.** Provide facilities, equipment and other infrastructure support that allow for attainment of program goals and objectives. *(NERRS Strategic Plan Goal #2, Objective 1; Goal #3, Objectives 1 and 2)* **Objective 5.** Maintain Reserve designation and fulfill grant-reporting requirements.
Goal 6. Strengthen the protection and management of Reserve coastal resources to ensure long-term integrity and diversity of its ecosystems and archaeological/cultural sites. *(NERRS Strategic Plan Goals #1, #2 and #3; Lead Program: Stewardship; Supporting Programs: All)* **Objective 1**. Support land and water conservation efforts that ensure representation of the diverse ecosystems found within the York River estuary and protect/conserve the larger landscape ecosystem that impact existing Reserve components. *(NERRS Strategic Plan Goal #1, Objective 3)* **Objective 2**. Provide for natural resource protection and management within Reserve boundaries. *(NERRS Strategic Plan Goal #1, Objective 3)* **Objective 3**. Provide for historical and archaeological resource protection and management within Reserve boundaries. *(NERRS Strategic Plan Goal #3, Objective 1)*

Objective 4. Manage public access within Reserve boundaries in order to protect the integrity of natural and historical/archaeological resources and provide for non-conflicting traditional uses. *(NERRS Strategic Plan Goal #1, Objective 3; Goal #3, Objectives 1 and 2)*
Goal 7. Promote and support special state and federal programs that identify CBNERRVA as a key partner entity. **Objective 1.** Increase awareness, use, and support of the Virginia Estuarine and Coastal Research Reserve System. **Objective 2.** Promote and support the U.S.-Republic of China Tianjin Palaeocoastal and Wetland National Nature Reserve Sister Reserve Program.

5.3.3 Relevant CBNERRVA Goals, Objectives and Strategies

CBNERRVA Goal 1 is an overarching goal that serves as a unifying target for all Reserve programs and for the Reserve, as a single entity, to strive towards. The Reserve has made significant progress towards this goal and anticipates further advancement through additional science, education and stewardship contributions of local, regional and national significance.

Goal 1. Recognition of CBNERRVA as a regional leader in applying science and education to support coastal resource management and literacy. *(NERRS Strategic Plan Goal 2; Lead Program: All)*

Objective 1. Foster mutually supportive relationships internally between Reserve programs and externally with academic institutions, governmental agencies, nongovernmental organizations and communities.
(NERRS Strategic Plan Goal #2, Objective 1)

Strategies:

- Establish and maintain contact with academic institutions, governmental agencies and nongovernmental organizations involved in coastal and Chesapeake Bay focused research, education and resource management. (All Programs)
- Support, and where appropriate, coordinate local, regional and national research, general and technical education, and stewardship initiatives. (All Programs)
- Integrate site-based research, environmental monitoring, and natural resource stewardship into Reserve education programs. (All Programs)

Objective 2. Increase CBNERRVA and NERRS visibility among academic, governmental agencies, nongovernmental organizations and the general public. *(NERRS Strategic Plan Goal #2, Objectives 2 and 3)*

Strategies:

- Publish and/or communicate contributions of Reserve to appropriate audiences using a variety of formats including a Reserve annual report, peer-reviewed manuscripts, technical and education reports, newsletters (e.g., The Crest, Virginia Coastal Zone Management Magazine) and program fact sheets. (All Programs)
- Maintain and update CBNERRVA home and associated (e.g., VECOS, VIMS, NOAA/NERRS) websites to highlight Reserve associated opportunities, activities, and accomplishments and to provide data and information directly to users. (All Programs)
- Encourage news releases of Reserve activities and accomplishments. (All Programs)
- Establish and maintain an effective mechanism to communicate Reserve accomplishments and needs to the Institute, the State and to NOAA. (All Programs)

Appendix C. General Public Access Plan of CBNERRVA – from draft CBNERRVA Management Plan 2007-2011

X. Stewardship and Public Access Plan

10.1 Introduction

Stewardship is a functional role at each reserve, involving aspects of research, monitoring, education, policy and implementation of resource management actions. CBNERRVA, along with partner managing entities, is responsible for the long-term management of natural resources and antiquities found within Reserve boundaries. The Reserves are managed to ensure long-term integrity and diversity of it's ecosystems and archaeological/cultural sites while providing long-term research, monitoring and education opportunities. In some cases, the Reserve component can be managed to meet this objective while still supporting some level of public use. Land and resource management challenges are numerous and time-consuming, ranging from the mundane chore of maintaining visible boundary lines, to the on-going challenge of balancing public use with science and education efforts, to the complexities of maintaining and monitoring habitats for invasive and species of concern, to facilitating land acquisition. Reserve-level management and monitoring actions, as well as cooperative management initiatives and protection strategies developed with partner land and resource managing entities, are planned based on the best current information and available resources.

10.2 Relevant CBNERRVA Goals, Objectives and Strategies

CBNERRVA strives to achieve its natural and archaeological/cultural resource management responsibilities by implementing a variety of strategies in support of CBNERRVA programmatic goals and objectives listed below. All proposed actions are subject to funding and staff capabilities.

Goal 2. Enhance scientific understanding of coastal ecosystems, surrounding environments and the natural and human processes influencing such systems. *(NERRS Strategic Plan Goals 1 and 2; Lead Program: Research; Supporting Program: Stewardship)*

Objective 1. Characterize and monitor coastal ecosystems and surrounding environments to describe reference conditions and quantify spatial and temporal changes. *(NERRS Strategic Plan Goal 1, Objective 2; Goal 2, Objectives 1,2 and 3)*

Strategies:

- Conduct flora and faunal baseline surveys to fill information gaps and to better characterize Reserve living resources and environments with an emphasis on species and habitats of concern. (Stewardship)
- Support biological monitoring of critical habitats (e.g., emergent wetlands, submerged aquatic vegetation) and biological communities (e.g., benthic, nekton, plankton). (Research and Stewardship)
- Map current and historic coastal habitats, land-use and coastlines within the York River system. (Stewardship)
- Complete Reserve site profile. (Research and Stewardship)

Objective 2. Determine linkages within and between coastal ecosystems and how linkages affect those systems. *(NERRS Strategic Plan Goal #1, Objective 2; Goal #2, Objectives 1,2 and 3)*

Strategies:

- Examine how upland, shoreline and water management changes affect material flux and coastal ecosystems. (Research and Stewardship)
- Examine rates and patterns of sea-level rise, subsidence and shoreline erosion and ecosystem responses to these processes within the York River system. (Research and Stewardship)

Objective 3. Promote, coordinate, track and support research and monitoring activities within Reserve boundaries and the York River system. *(NERRS Strategic Plan Goal #2, Objective 1)*

Strategies:

- Establish and maintain contact, and where appropriate, coordinate activities among groups with estuarine research interests. (Research and Stewardship)
- Identify research priority focus areas and encourage their investigation within Reserve components and the broader York River and Chesapeake Bay system. (Research and Stewardship)
- Seek external funding to advance research and monitoring activities. (Research and Stewardship)

Goal 3. Promote the effective management and conservation of natural and cultural coastal resources through informed decision-making. *(NERRS Strategic Plan Goals 2 and 3; Lead Program: CTP; Supporting Programs: All)*

Objective1. Communicate results of research, environmental monitoring and best available science-based information to assist in improved coastal resource management. *(NERRS Strategic Plan Goal #2, Objectives 2 and 3; Goal #3, Objectives 1,2 and 3)*

Strategies:

- Serve in an advisory capacity to national, regional, state and local coastal resource management, research and education agencies, organizations and interest groups. (All Programs)
- Provide the best available science-based information and skill building opportunities, with respect to identified focus areas, to coastal resource decision-makers and other appropriate audiences. (CTP, Research and Stewardship)
- Develop, maintain and/or link to web-based data and information portals to manage and disseminate Reserve associated science and education information products, environmental databases, and associated metadata. (All Programs)
- Support the development and implementation of Bay-wide and specific tributary strategies and contaminant reduction plans in support of protection and restoration of water quality and habitats of concern. (Research, Stewardship and CTP)

Goal 6. Strengthen the protection and management of Reserve coastal resources to ensure long-term integrity and diversity of it's ecosystems and archaeological/cultural sites. *(NERRS Strategic Plan Goals #1, #2 and #3; Lead Program: Stewardship; Supporting Programs: Administration)*

Objective 1. Support land and water conservation efforts that ensure representation of the diverse ecosystems found within the York River estuary and protect/conserve the larger landscape ecosystem that impact existing Reserve components. *(NERRS Strategic Plan Goal #1, Objective 3)*

Strategies:

- Develop a Reserve Boundary Protection and Land Acquisition Plan. (Administration and Stewardship)
- Where appropriate, communicate and coordinate land and water conservation activities with neighboring private landowners, non-governmental organizations (e.g., land trusts) and local, state and federal government agencies. (Administration and Stewardship)

Objective 2. Provide for natural resource protection and management within Reserve boundaries. *(NERRS Strategic Plan Goal #1, Objective 3)*

Strategies:

- Implement developed Reserve component specific Natural Resource Management Plans. (Stewardship)
- Monitor and evaluate the effects of control strategies and restoration efforts. (Stewardship)
- Update Reserve component specific Natural Resource Management Plans ever 5 years. (Stewardship)
- Enforce prosecution of offenders of natural resource protection laws and regulations. (Administration and Stewardship)

Objective 3. Provide for historical and archaeological resource protection and management within Reserve boundaries. *(NERRS Strategic Plan Goal #3, Objective 1)*

Strategies:

- Encourage, and when possible support, initial survey/inventory of historical/archaeological resource survey within Reserve boundaries and assure proper stewardship of such resources. (Research and Stewardship)
- Enforce prosecution of offenders of historical and archaeological resource protection laws and regulations. (Administration and Stewardship)

Objective 4. Manage public access within Reserve boundaries in order to protect the integrity of natural and historical/archaeological resources and provide for non-conflicting traditional uses. *(NERRS Strategic Plan Goal #1, Objective 3; Goal #3, Objectives 1 and 2)*

Strategies:

- Clearly identify Reserve boundaries, public use sites, and appropriate public activities at each Reserve component. (Stewardship).
- Maintain and enhance, where appropriate, structures to provide for safe public access and support permitted wildlife watching and hunting activities. (Stewardship)

- Develop public access schedules, where appropriate, to minimize or eliminate user conflict. (Stewardship)
- Monitor and evaluate public use, and other user impacts at existing access points and throughout the Reserve. (Stewardship)
- Honor formal agreements and informal understandings with private property owners and public lands managers. (Administration and Stewardship)
- Enforce prosecution of trespass and vandalism, and offenders of plant and wildlife, antiquities and hunting and fishing regulations. (Administration and Stewardship)
- Develop and make available information material (e.g. York River State Park trail guides, species inventories) to enhance the public visitor's outdoor experience (Stewardship).

10. 3 Reserve Natural and Antiquities Resource Management

10.3.1 Management Guidelines

Management guidelines are intended to explain the general rationale for managing natural communities and rare species, to clarify the reasons for restricting public use and visitation, and to state principles and ideas that guide management of CBNERRVA natural areas. The primary and over-riding objective of natural areas stewardship is to provide for the continued presence of the diverse habitats and associated flora and fauna found within the boundaries of CBNERRVA. Reserve natural area management guidelines were adapted from the natural area preserve management guidelines developed by the VaDCR, Division of Natural Heritage (VaDCR 2000) and are provided in Appendix V.1. Archeological and historic resources within Reserve boundaries will be protected to the best of the Reserve's ability and follow general state management guidelines.

10.3.2 Directed Natural Resource Management

Management to protect and maintain natural resources, biological diversity and antiquities at Reserve components require ongoing actions and assessments to ensure that resources are conserved. The complexity of ecosystems and a general shortfall of staff time and funds usually preclude a full understanding of the effects on ongoing biological change and a sufficiency of management actions to direct and monitor that change. By taking an active and adaptive management approach, by using and building upon existing inventory baseline data, and by monitoring trends in natural communities and/or species populations following management actions, it is likely that successful stewardship of natural resources can be attained.

CBNERRVA in partnership with VaDCR/ Division of Natural Heritage have prepared natural resource management plans for Goodwin and Catlett Islands (Erdle and Heffernan 2005a and 2005b) and are currently preparing plans for the Taskinas Creek and Sweet Hall Marsh components of the Reserve. Expected date of completion for the Taskinas Creek and Sweet Hall Marsh Natural Resource Management Plans is Spring 2007. The purpose of these plans is to guide an adaptive management process that supports the research and education mission of the Reserve and protects the natural resources associated with the Reserve. The natural resource management plans incorporate the policy and management approach of the Reserve, background information (e.g. location, climate, geologic and hydrologic conditions, surrounding land use, site history), an inventory of natural resources derived from field surveys and review of literature, identified resource stewardship and research needs, and land acquisition and protection needs. The plans serve as the Reserve's principal resource to guide natural resource management within Reserve boundaries and have an intended timeline of approximately five years. Copies of completed plans are available upon request from CBNERRVA.

Identified Biological Management Issues

In the context of natural areas stewardship, biological resources management actions are taken to either maintain natural conditions or to return human-altered land or vegetation to a condition that supports continued existence of natural communities and/or key species. Threats to biodiversity include: (1) habitat degradation or loss, (2) land conversion to development, (3) water development (e.g. drainage, dams and water withdrawal projects), (4) some agricultural, silviculture and mining practices, (5) non-native invasive species, (6) disease, (7) air, land and water pollution, and (8) overexploitation. Habitat loss and non-native invasive species represent the greatest threats to terrestrial species. For aquatic species, habitat loss and water pollution are the most significant threats. Because of these threats to biodiversity, management actions are sometimes needed to restore and maintain natural resources (Wilcove and Chen 1998). Information derived from directed research and environmental and biological monitoring programs are at the foundation of developing and implementing natural resource management strategies. Details regarding natural resource management issues at specific Reserve component has been provided earlier in this report (Section III C) and are summarized in Table 10.1. CBNERRVA will strive to promote and support research that targets Reserve natural resource stewardship needs.

Table 10.1. Summary of identified biological/physical management issues regarding natural resource management of the Reserve components.

	Reserve Component			
Management Issue	Goodwin Islands	Catlett Islands	Taskinas Creek	Sweet Hall Marsh
Control of known invasive plant species	•	•		
Control of known invasive animal species				•
Control of known native plant species				
Control of known native animal species	•	•		
Assessment, protection and restoration of known finfish and shellfish spawning and nursery habitat	•	•	•	•
Assessment, protection and restoration of known bird breeding and nesting habitat	•	•	•	•
Assessment of sea level rise and shoreline erosion on critical habitats and geomorphic features	•	•	•	•
Determination of water clarity status for surrounding waters and assess the potential for submerged aquatic vegetation restoration		•		
Assessment of long-term reductions in stream flow on salinity patterns and the impacts on plant communities and fish spawning grounds				•
Source identification of mercury and other contaminant inputs and impacts upon the ecosystem				•

10.3.3 Archaeological, Historical and Cultural Resources Management

The immediate region occupied by the four components of CBNERRVA is rich in archaeological, historical and cultural resources. It is the aim of the Reserve to encourage, and where possible support, initial survey and inventory of objects possessing prehistoric and/or historic significance and to develop plans to protect such sites and objects within its boundaries. Reserve policy as related to archaeological, historical and cultural resources is:

- Archaeological investigations and removal of historic artifacts from federal lands requires an Archaeological Resources Protection Act permit.

- As with Commonwealth historical preservation laws, CBNERRVA forbids the unauthorized excavation and collection of upland and underwater archaeological and cultural sites.

- The collection of historic or archaeological artifacts for research purposes will be allowed only with approved collecting permits. Permits are required by VADHR, VaDCR (Taskinas Creek) and CBNERRVA.

- Non-disruptive research and educational use of archaeological and cultural sites requires approval by VaDCR (Taskinas Creek) and CBNERRVA.

- Collection of prehistoric, historic and cultural artifacts by the general public is prohibited within Reserve boundaries, as is the use of metal detectors.

- Archaeological and cultural sites will be protected and care will be taken not to draw public attention to these sites.

10.3.4 Fire Management

Fire management is frequently an important facet of natural areas management and involves both control and suppression of wildfires and prescribed fire implementation. A two-phased approach to prevent, manage and suppress wildfires will be encouraged. It is understood that fire is a natural process in landscape ecology and the Reserve may not seek to control all wildfires. Protection of structures and other significant resources that are sensitive to fire damage, and protection of human safety will require active fire suppression. The Reserve will utilize the expertise of other agencies and organizations that frequently deal with fire issues, including VaDOF, VaDCR and VaDGIF. If deemed necessary for resource management purposes, prescribed burns will be conducted only under the supervision of certified burners and in close coordination with local fire departments and relevant state agencies.

10.3.5 Hunting, Fishing and Other Traditional Uses

Details regarding regulation of hunting, fishing and other traditional uses, varies by Reserve component; details are provided in Section 10.4.2.

10.3.6 Oil and Toxic Substance Spill Response

Given the level of activity by Giant Oil Refinery and U.S. Naval operations within the York River, and the close proximity of the Reserve's Goodwin and Catlett Islands components to these operations, contingency plans for an oil or other toxic materials spill have been developed and are ready to implement on an emergency basis. Key federal (e.g., USCG, USDOD) and state agencies (VaDEQ) and other groups (Giant Refinery) are the lead entities if a spill were to occur. CBNERRVA will participate as a stakeholder and along with VIMS can provide specified expertise and other resources to compliment lead agencies efforts. A Reserve oil spill response plan has been developed and is provided in Appendix V.3.

10.3.7 Operations Management Issues and Law Enforcement

Operations management is a critical element of natural areas management, especially on lands where recreational uses by members of the public or commercial uses may conflict with the primary management objectives of research, education and natural resource protection. Routine operations management activities include boundary line maintenance, site security, and law enforcement. Boundary line maintenance at Reserve components is the responsibility of CBNERRVA. Site security is provided by the principal managing entities at each Reserve component, they are: CBNERRVA for Goodwin and Catlett Islands, VaDCR and CBNERRVA for Taskinas Creek, and Tacoma Hunt Club and CBNERRVA for Sweet Hall Marsh.

Because VIMS and CBNERRVA lacks its own law enforcement staff, it is necessary for the Reserve to partner with other natural resource agencies such as VaDGIF and VaMRC when law enforcement issues affecting natural resource protection arise. Likewise, CBNERRVA relies on local and state law enforcement for all other criminal matters. A summary of local and state law enforcement agencies assisting in Reserve operations is provided in Appendix V.4. CBNERRVA will request to be notified of all warnings and citations occurring within Reserve boundaries.

10.4 Public Access

10.4.1 Introduction and General Policy

CBNERRVA is responsible for the long-term management of its Reserve components in order to protect the ecological integrity of the natural system and provide a stable environment to support research, monitoring and education missions. In some cases, the Reserve component can be managed to meet this objective while still supporting some level of public use. Public access to the four Reserve components is managed on a site-specific basis. The objective of managed access is to maintain each site's integrity for research and education while permitting traditional uses which do not conflict with Reserve goals or agreements with private landowners and public lands managers. CBNERRVA and site property owners/managers reserve the right to impose additional restrictions to curtail any activity threatening to disturb natural conditions or ongoing research and education activities. It should be noted that some specific public uses are not compatible, for example bird and wildlife watching is not compatible with concurrent waterfowl hunting. In such cases, The Reserve and property managers will strive to minimize conflicts through spatial and temporal separation strategies. If negative public access impacts are observed, the causative public use(s) will be determined and re-evaluated. When warranted, the assistance of local and state law enforcement agencies may be called upon to enforce access regulations. Prosecution of violators will serve as a deterrent against vandalism, littering, arson and other violations.

10.4.2 Public Access Rules and Schedules

<u>Goodwin Islands</u>

CBNERRVA maintains a limited-use public access policy for the Goodwin Islands component of the Reserve. In accordance with that policy, Goodwin Islands are managed exclusively for research and education while allowing for some traditional uses. Goodwin Islands are only accessible by shallow draft boats and there are no docking facilities or designated trails on Goodwin Islands. The following access rules apply to Goodwin Islands:

- Public access is limited from dawn to dusk and therefore overnight camping is prohibited.
- Beach areas can be used for picnicking, beachcombing and other non-destructive activities if visitors do not willingly or negligently disturb the environment or scientific experiments/equipment.
- Bicycles, off-road vehicles, and horses are prohibited.

- Building of any type of fire is prohibited.
- Waterfowl hunting from floating blinds is allowed, however, a Reserve issued permit is required. No stationary blinds are allowed. Upland and wetland hunting activities are not permitted.
- Fishing, crabbing and collection of shellfish is allowed if in accordance with applicable state laws and regulations.
- Collection of plants, animals (other than that allowed by applicable state laws and regulations), minerals, or artifacts is strictly prohibited.
- Dogs or other domestic animals accompanying visitors must be kept on a leash at all times.

Table 4 indicates the rare species and natural communities that have been found in the Dragon Run watershed, according to the Virginia Division of Natural Heritage (Belden, Jr. et al., 2001; Belden, Jr. et al., 2003).

SCIENTIFIC NAME	COMMON NAME	STATUS
Animals		
Atlides halesus	Great purple hairstreak	S2, S3
Enallagma weewa	Blackwater bluet	S1
Epitheca spinosa	Robust baskettail	S2
Haliaeetus leucocephalus	Bald eagle	S2
Helocordulia selysii	Selys' sunfly	S2
Isoparce cupressi	Cypress sphinx	S1, S3
Somatochlora filosa	Fine-lined emerald	S2
Wyeomyia haynei	Southern pitcher-plant mosquito	S1
Plants		
Bolboschoenus fluviatillis	River bulrush	S2
Cardamine pratensis	Cuckooflower	S1
Carex decomposita	Cypress-knee sedge	S2
Chelone oblique	Red turtlehead	S1
Desmodium strictum	Pineland tick-trefoil	S2
Eriocaulon parkei	Parker's pipewort	S2
Sarracenia purpurea var. purpurea	Northern purple pitcher-plant	S2
**Hottonia inflata	Featherfoil	S3
**Ranunculus flabellaris	Yellow water crowfoot	S3
Natural Communities		
Baldcypress-Tupelo Swamp		
Fluvial Terrace Woodland		
Tidal Baldcypress-Tupelo Swamp		
Tidal Baldcypress Woodland/Savanna		
Tidal Freshwater Marsh		

S1 = Extremely rare; usually 5 or fewer occurrences in the state; or may have a few remaining individuals; often especially vulnerable to extirpation.

S2 = Very rare; usually between 5 and 20 occurrences; or few occurrences with many individuals; often susceptible to becoming endangered.

S3 = Rare to uncommon; usually between 20 to 100 occurrences; may have fewer occurrences, but with a large number of individuals in some populations; may be susceptible to large-scale disturbances

** = No longer tracked by the Division of Natural Heritage; placed on watchlist due to an increased number of documented occurrences within the state since 2001

Table 4. Rare species and natural communities in the Dragon Run watershed.

The following descriptions of natural communities are taken from *The Natural Communities of Virginia* (Fleming et al., 2001).

Bald Cypress-Tupelo Swamps

Seasonally to semipermanently flooded forests of backswamps, sloughs, and low terraces of Coastal Plain rivers and large streams. These swamp forests are distributed throughout southeastern Virginia, north to Dragon Swamp (Gloucester, King and Queen, and Middlesex Counties). Habitats are deeply flooded (up to 1m) for part of the year; most retain at least some standing water throughout the growing season. Microtopography is often pronounced with small channels, swales, tree-base hummocks, and numerous bald cypress "knees." Tree canopies vary from mixed stands of bald cypress (Taxodium distichum), water tupelo (Nyssa aquatica), and swamp tupelo (N. biflora) to nearly pure stands of one species or another. The three dominants have complex competitive and successional relationships. As a rule, the two tupelos are less shade-tolerant than bald cypress and regenerate more readily by sprouting in cut-over stands. Thus, tupelos tend to become dominant when bald cypress stands are heavily logged. Green ash (Fraxinus pennsylvanica) and red maple (Acer rubrum) are occasional canopy associates and frequent understory trees. Carolina ash (F. caroliniana) is often dominant in the small tree and shrub layers, while vines of climbing hydrangea (Decumaria Barbara) are often abundant. Herb layers vary from sparse to rather lush. Most herbaceous plants of bald cypress-tupelo swamps are tolerant of muck soils and fluctuating water levels, or are capable of becoming established on tree hummocks, stumps, and logs. A few of the typical herbs are lizard's tail (Saururus cernuus), false nettle (Boehmeria cylindrical), Walter's St. John's-wort (Triadenum walteri), swamp beggar-ticks (Bidens discoidea), weak stellate sedge (Carex seorsa), giant sedge (Carex gigantean), taperleaf bugleweed (Lycopus rubellus), and pale mannagrass (Torreyochloa pallida). Although community types in this group are relatively common, high-quality specimens of the dominant trees are known to provide nesting habitats for the globally uncommon, state-rare eastern big-eared bat (Corynorhinus rafinesquii macrotis) and southern myotis (Myotis austroparius). Old-growth stands of bald cypress-tupelo swamp with trees up to 800 years old occur along the Blackwater River in Surry and Isle of Wight Counties. References: Fleming and Moorhead (1998), Parker and Wyatt (1975), Plunkett and Hall (1995).

Tidal Bald Cypress Forests and Woodlands

Coniferous or mixed swamp forests and woodlands occurring along the upper tidal reaches of rivers in southeastern Virginia. Examples are documented from the Dragon Swamp/Piankatank River (Gloucester, King and Queen, and Middlesex Counties), the Chickahominy River (Charles City, James City, and New Kent Counties), the James River (Isle of Wight and Surry Counties), and the wind-tidal Northwest River (City of Chesapeake). At some sites, these communities occur in ecotones between tidal marshes and non-tidal backswamps or uplands. Bald cypress (Taxodium distichum) dominates the open to very open canopy, with or without hardwood associates such as swamp tupelo (Nyssa biflora), water tupelo (Nyssa aquatica), and green ash (Fraxinus pennsylvanica). Stand structure and canopy cover range from closed forest to very open woodland. Shrub and herb layers are variable but generally contain a mixture of species characteristic of both marshes and swamps. Some well-developed tidal bald cypress forests appear floristically similar to palustrine bald cypress-tupelo swamps. Other stands have a nearly monospecific herb dominance by shoreline sedge (Carex hyalinolepis). In a unique, possibly fire-influenced, savanna-like stand on the Northwest River, the herbaceous dominants, in rough seasonal order, are silvery sedge (Carex canescens spp. Disjuncta), spikerushes (Eleocharis fallax and E. rostellata), marsh rattlesnake-master (Eryngium aquaticum var. aquaticum), and wild rice (Zizania aquatica var. aquatica). The environmental dynamics, compositional variation,

and state-wide distribution of this group are poorly known and need intensive study. Reference: Fleming and Moorhead (1998).

Fluvial Terrace Woodlands

A somewhat enigmatic group of communities occurring on flat, sandy terraces and islands along Coastal Plain rivers in eastern Virginia. These habitats are elevated well above the level of adjacent swamps and are characterized by xeric, sandy soils and open forest or woodland vegetation. Single occurrences have been documented along the Nottoway River (Sussex County), Chickahominy River (New Kent County), Dragon Swamp (Middlesex County), and Mattaponi River (Caroline County). At all four sites, hickories (Carya pallida and C. alba) are dominant trees, with drought-tolerant oaks (Quercus falcate, Q. nigra, Q. marilandica, Q. alba) present in smaller numbers. Shrubs occurring at all or most sites include sand post oak (Q. margarettiae), horse-sugar (Symplocos tinctoria), American holly (Ilex opaca var. opaca), and eastern red cedar (Juniperus virginiana var. virginiana). Typical herbs include sedges (Carex albicans var. australis, C. pensylvanica, and C. tonsa), Canada frostweed (Helianthemum canadense), butterfly-pea (Clitoria mariana), late goldenrod (Solidago tarda), and prickly-pear (Opuntia humifusa). The Dragon Run site is anomalous in the presence (despite low soil pH and base status) of several calciphiles such as eastern redbud (Cercis canadensis var. canadensis), wild columbine (Aquilegia canadensis), smooth rock-cress (Arabis laevigata var. laevigata), robin's-plantain (Erigeron pulchellus var. pulchellus), and elm-leaved goldenrod (Solidago ulmifolia var. ulmifolia). A full understanding of the status and compositional relationships of this group will require additional inventory and assessment.

Tidal Freshwater Marshes

A diverse group of herbaceous wetlands subject to regular diurnal flooding along upper tidal reaches of inner Coastal Plain river and tributaries. Freshwater marshes occur in the uppermost portion of the estuarine zone, where the inflow of saltwater from tidal influence is diluted by a much larger volume of freshwater from upstream. Strictly speaking, freshwater conditions have salt concerntrations <0.5 ppt, but pulses of higher salinity may occur during spring tides or periods of unusually low river discharge. The most common species are arrow-arum (Peltandra virginica), dotted smartweed (Polygonum punctatum), wild rice (Zizania aquatic var. aquatica), pickerelweed (Pontederia cordata), rice cutgrass (Leersia oryzoides), tearthumbs (Polygonum arifolium and P. sagittatum), and beggar-ticks (Bidens spp.). Locally, sweetflag (Acorus calamus) and southern wild rice (Zizaniopsis miliacea) may form large dominance patches. Species diversity and vegetation stature vary with salinity, duration of inundation, and disturbance; the most diverse marshes occupy more elevated surfaces in strictly freshwater regimes. Mud flats that are fully exposed only at low tide support nearly monospecific stands of spatterdock (Nuphar advena), although cryptic submerged aquatic species may also be present. Tidal freshwater marshes are best developed on sediments deposited by large meanders of the Pamunkey and Mattaponi Rivers, although outstanding examples also occur along the Potomac, Rappahannock, Chickahominy, and James Rivers. These communities provide the principal habitat for the globally rare plant sensitive joint-vetch (Aeschynomene virginica). Chronic sea-level rise is advancing the salinity gradient upstream in rivers on the Atlantic Coast, leading to shifts in vegetation composition and the conversion of some tidal freshwater marshes into oligohaline marshes. Tidal Freshwater Marshes are also threatened by the invasive exotic marsh dewflower (Murdannia keisak). Several communities in this group are chiefly restricted to the Chesapeake Bay drainage basin and are considered globally rare or uncommon. References: Parker and Wyatt (1975), Perry and Atkinson (1997), Perry and Hershner (1999), McCoy and Fleming (2000).

Appendix E. Natural Heritage Rarity Ranks and Status Explanation

Natural Heritage Rarity Ranks and Status Explanation

Each of the significant natural features (species, community type, etc.) monitored by DCR-DNH is considered an element of natural diversity, or simply an element. Each element is assigned a rank that indicates its relative rarity on a five-point scale (1 = extremely rare; 5 = abundant; Table 1). The primary criterion for ranking elements is the number of occurrences, i.e., the number of known distinct localities or populations. Also of great importance is the number of individuals at each locality or, for highly mobile organisms, the total number of individuals. Other considerations include the condition of the occurrences, the number of protected occurrences, and threats. However, the emphasis remains on the number of occurrences, so that ranks essentially are an index of known biological rarity. These ranks are assigned in terms of the element's rarity within Virginia (its State or S-rank), the element's rarity within a Nation (its National or N-rank), and the element's rarity across its entire range (its Global or G-rank). Subspecies and varieties are assigned a Taxonomic (T-) rank in addition to their G-rank. A Q indicates taxonomic uncertainty. Taken together, these ranks give an instant picture of an element's rarity. For example, a designated rank of G5S1 indicates an element which is abundant and secure range-wide, but rare in Virginia. In some cases, ranks are provisional or lacking, due to ongoing efforts by the Natural Heritage network to classify community syntaxa and cryptic plants or animals. Rarity ranks used by DCR-DNH are not legal designations, and they are continuously updated to reflect new information.

Table E-1. Definition of Natural Heritage state rarity ranks. Global ranks are similar to state ranks, but refer to a species' range-wide status. Note that GA and GN are not used and GX means extinct. GM and GW are ranks used only for communities, and refer to highly modified (GM) and ruderal (GW) vegetation respectively. National ranks are similar as well, and refer to a species' rarity within a nation, such as the United States or Canada. Sometimes ranks are combined (e.g., S1S2) to indicate intermediate or somewhat unclear status. Elements with uncertain taxonomic validity are denoted by the letter Q, after the global rank. These ranks should not be interpreted as legal designations.

S1 Extremely rare; usually 5 or fewer occurrences in the state, or in the case of communities, covering less than 50 hectares in aggregate; or may have a few remaining individuals; often especially vulnerable to extirpation.

S2 Very rare; usually between 5 and 20 occurrences, or in the case of communities, covering less than 250 hectares in aggregate; or few occurrences with many individuals; often susceptible to becoming endangered.

S3 Rare to uncommon; usually between 20 and 100 occurrences; may have fewer occurrences, but with a large number of individuals in some populations; may be susceptible to large-scale disturbances.

S4 Common; usually more than 100 occurrences, but may be fewer with many large populations; may be restricted to only a portion of the state; usually not susceptible to immediate threats.

S5 Very common; demonstrably secure under present conditions.

SA Accidental in the state.

SH Historically known from the state, but not verified for an extended period, usually more than 15 years; this rank is used primarily when inventory has been attempted recently.

SM Applied to vegetation extensively modified by disturbance but considered recoverable by management, time, or restoration of ecological processes.

SN Regularly occurring migrants or transient species which are non-breeding, seasonal residents. (Note that congregation and staging areas are monitored separately).

SU Status uncertain, often because of low search effort or cryptic nature of the element.

SW Applied to vegetation dominated by ruderal or exotic species.

SX Apparently extirpated from the state.

The spot on the landscape that supports a natural heritage resource is an element occurrence. DCR-DNH has mapped over 7,500 element occurrences in Virginia. Information on the location and quality of these element occurrences is computerized within the Division's BCD system, and additional information is recorded on maps and in manual files.

In addition to ranking each element's rarity, each element occurrence is ranked to differentiate large, outstanding occurrences from small, vulnerable ones. In this way, protection efforts can be aimed not only at the rarest elements, but at the best examples of each. Species occurrences are ranked in terms of quality (size, vigor, etc.) of the population; the condition (pristine to disturbed) of the habitat; the viability of the population; and the defensibility (ease or difficulty of protecting) of the occurrence. Community occurrences are ranked according to their size and overall natural condition. These element occurrence ranks range from A (excellent) to D (poor). Sometimes these ranks are combined to indicate intermediate or somewhat unclear status, (e.g., AB or CD). In a few cases, especially those involving cryptic animal elements, field data may not be sufficient to reliably rank an occurrence. In such cases a rank of E (extant) may be given. A rank of H (historical) is used to indicate an historical occurrence that could not be relocated by recent survey. Element occurrence ranks reflect the current condition of the species' population or community. A poorly-ranked element occurrence can, with time, become highly-ranked as a result of successful management or restoration.

Element ranks and element occurrence ranks form the basis for ranking the overall significance of sites. Site biodiversity ranks (B-ranks) are used to prioritize protection efforts, and are defined in Table E-2.

Table E-2. Biodiversity ranks used to indicate site significance.

B1 Outstanding Significance: only site known for an element; an excellent occurrence of a G1 species; or the world's best example of a community type.

B2 Very High Significance: excellent example of a rare community type; good occurrence of a G1 species; or excellent occurrence of a G2 or G3 species.

B3 High Significance: excellent example of any community type; good occurrence of a G3 species.

B4 Moderate Significance: good example of a community type; excellent or good occurrence of state-rare species.

B5	General Biodiversity Significance: good or marginal occurrence of a community type or state-rare species.

The U.S. Fish and Wildlife Service (USFWS) is responsible for the listing of endangered and threatened species under the Endangered Species Act of 1973, as amended. Federally listed species (including subspecific taxa) are afforded a degree of legal protection under the Act, and therefore sites supporting these species need to be highlighted. USFWS also maintains a review listing of potential endangered and threatened taxa known as candidate species. Table E-3 illustrates the various status categories used by USFWS and followed in this report. The status category of candidate species is based largely on the Service's current knowledge about the biological vulnerability and threats to a species.

As of February 27, 1996, species formerly referred to as Category 2 (C2) candidates for listing as threatened or endangered are no longer considered "candidates" under the Endangered Species Act. The USFWS no longer maintains a formal, comprehensive list of such species. However, the Virginia Field Office of the USFWS intends to maintain an informal list of these and other "Species of Concern" that may warrant future consideration as candidates. These "Species of Concern" can be regarded as species for which the Service has insufficient scientific information to support a listing proposal. Former Category 1 (C1) species are now considered "candidates" (C) for listing. "Candidate" species are species for which the USFWS has enough scientific information to warrant a proposal for listing. The designation of Category 3 species (3A, 3B, 3C) has been discontinued. However, the USFWS will continue to maintain its files on these species in case new information indicates a need for reevaluation.

Table E-3. U.S. Fish and Wildlife Service species status codes, with abbreviated definitions

LE	Listed endangered
LT	Listed threatened
PE	Proposed to be listed as endangered
PT	Proposed to the listed as threatened
C	Candidate: status data supports listing of taxon as endangered or threatened
SOC	Species of Concern: no official status, evidence of vulnerability, but insufficient data exists.

In Virginia, two acts have authorized the creation of official state endangered and threatened species lists. One act (Code of Virginia ' 29.1-563 through 570), administered by the Virginia Department of Game and Inland Fisheries (DGIF), authorizes listing of fish and wildlife species, not including insects. The other act (Code of Virginia ' 3.1-1020 through 1030), administered by the Virginia Department of Agriculture and Consumer Services (VDACS), allows for listing of plant and insect species. In general, these acts prohibit or regulate taking, possessing, buying, selling, transporting, exporting, or shipping of any endangered or threatened species appearing on the official lists. Species protected by these acts are indicated as either listed endangered (LE) or listed threatened (LT). Species under consideration for listing are indicated as candidates (C).

DRAGON RUN WATERSHED MANAGEMENT PLAN

NOVEMBER 2003

Photo credit: Teta Kain

This project was funded by the Virginia Coastal Program of the Department of Environmental Quality through Grants #NA17OZ1142-01 and #NA17OZ2355 of the National Oceanic and Atmospheric Administration, Office of Ocean and Coastal Resource Management, under the Coastal Zone Management Act of 1972, as amended. The views expressed herein are those of the authors and do not necessarily reflect the views of NOAA or any of its subagencies.

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DRAGON RUN WATERSHED MANAGEMENT PLAN

NOVEMBER 2003

DRAGON RUN STEERING COMMITTEE,
MIDDLE PENINSULA PLANNING DISTRICT COMMISSION

MARGARET DAVIS, CHAIR
WILLIAM F. HERRIN, VICE-CHAIR

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DIRECTOR, DRAGON RUN SPECIAL AREA MANAGEMENT PLAN
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Essex	M. “Prue” Davis	Dorothy Miller	M. Scott Owen
Gloucester	Rick Allen	Elizabeth DeHardit	Jerry Horner
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The Dragon Run Steering Committee

The Steering Committee would also like to thank all of the citizens who participated in any of the meetings that led to the production of this watershed management plan. Participants are listed below:

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Executive Summary

As one of the Chesapeake Bay watershed's most pristine waterways, the spring-fed Dragon Run flows forty miles along and through nontidal and tidal cypress swamp situated in portions of Essex, King and Queen, Middlesex, and Gloucester Counties. The Dragon Run plays a central role in the Middle Peninsula's culture and identity. Natural resources - forestry and farming - have been the bedrock of the watershed's economy. These land uses, together with extensive swamps and unique natural resources, are the main reasons that the Dragon Run remains wild and secluded.

The Dragon Run's unique character evokes strong feelings to protect the pristine watershed in both long-time residents and first-time visitors alike. Yet, opinions differ about how to address the threats of encroaching development and habitat fragmentation. An innate difference in point of view between property rights advocates and conservationists centers on how to maintain a pristine watershed into the future. Yet, substantial common ground exists for proactively preserving the Dragon Run for future generations that safeguards both natural resources and traditional uses of the land and water, including the property rights of landowners.

The Dragon Run Watershed Special Area Management Plan (SAMP), a partnership between the Virginia Coastal Program and the Dragon Run Steering Committee of the Middle Peninsula Planning District Commission, is designed to address both the differences of opinion and the common ground that exist concerning the future of the watershed. The Steering Committee believes that the best approach is to bring stakeholders to the table for proactive discussions of the issues. The Steering Committee and its Advisory Group, representing a broad cross-section of the community, have proactively developed a mission, goals, objectives, and action plans to address the priority issues facing the Dragon Run.

This watershed management plan for the Dragon Run watershed represents a body of work by citizens, stakeholders, and decision-makers to achieve a common vision for the future – the preservation of the traditional uses and unique resources in the pristine Dragon Run. It is a symbol of regional cooperation and coordination that crosses jurisdictional boundaries. It is not a static document. Rather, it is a modifiable guidebook that harnesses the passion and energy for the Dragon Run of those who live, work, and play in its watershed.

MISSION

To support and promote community-based efforts to preserve the cultural, historic, and natural character of the Dragon Run, while preserving property rights and the traditional uses within the watershed.

GOALS

1. Establish a high level of cooperation and communication among the four counties within the Dragon Run Watershed to achieve consistency across county boundaries.
2. Foster educational partnerships and opportunities to establish the community's connection to and respect for the land and water of the Dragon Run.
3. Promote the concept of landowner stewardship that has served to preserve the Dragon Run Watershed as a regional treasure.

ACTIONS

Underway/Completed
1. Memorandum of Agreement
2. Establish Baseline Watershed Information
3. SAMP Project Awareness Campaign
Recommended
1. Land Use and Resource Preservation
A. Designate a Unified "Dragon Run Planning Area"
B. Implement Tools to Preserve Farm, Forest, and Natural Resources
C. Address Public and Landowner Access Issues
D. Control Invasive Species
2. Education and Landowner Stewardship
3. Encourage and Support Sustainable Economic Development
4. Monitor Plan Implementation

PART I

SECTION 1: Watershed Description

Section 1 describes the Dragon Run watershed's setting, its role in local history and culture, and its unique natural resources. The potential source of conflict is change in land ownership that threatens to fragment productive farm and forest land and natural habitat. The community's vision for the watershed is to preserve the traditional land uses – forestry, farming, hunting – and the unique natural resources. This section highlights both the differences of opinion on how to address the threat to the watershed and the common ground that defines the community's vision.

As one of the Chesapeake Bay watershed's most pristine waterways, the Dragon Run "encompasses some of the most extensive and unspoiled swamp forest and woodland communities in Virginia" (Belden, Jr. et al, 2001). Effectively bisecting Virginia's Middle Peninsula located between the York and Rappahannock Rivers, this fresh and brackish water stream (**Figure 1**) meanders forty miles along and through nontidal and tidal cypress swamp. The watershed is mainly undeveloped, almost entirely privately owned, and encompasses approximately 140 square miles (90,000 acres) of rural landscape – mostly forests, farms, and wetlands. The spring-fed Dragon Run flows through portions of Essex, King and Queen, Middlesex, and Gloucester Counties, emptying into the estuarine Piankatank River and ultimately the Chesapeake Bay.

Figure 1. The Dragon Run

The Dragon Run plays a central role in the Middle Peninsula's culture and identity. Its intriguing name is frequently borrowed by local enterprises and establishments and is often overheard in community conversations. Since European settlement in the early 1600's and Native American inhabitation up to 10,000 years before that, natural resources have been the bedrock of the watershed's economy. For older generations, forestry, farming, hunting, trapping and fishing were the primary ventures. Today, forestry and farming continue to generate wealth and drive the watershed's economy. Upholding an ancient tradition, hunters range over prime hunting grounds stalking prized game. These land uses, together with extensive swamps, are the main reasons that the Dragon Run remains wild and secluded.

The watershed's wilderness is both expansive and unique. The Dragon Run contains the northernmost example of the Baldcypress-Tupelo Swamp natural community in Virginia and the best example north of the James River (Belden, Jr. et al., 2001). Moreover, 14 rare species and 5 rare natural communities are found here (**Appendix A**). Based on his investigations of the watershed's aquatic communities, one researcher

observes that the Dragon Run is a “100 year old time capsule,” resembling coastal plain streams in the Chesapeake Bay region at the turn of the 20th century (Garman, 2003).

The Dragon Run’s unique character evokes strong feelings to protect the pristine watershed in both long-time residents and first-time visitors alike. Although development pressure in the watershed is currently low, the potential for significant land ownership changes (>25% in 10 years due to aging and absentee corporate landowners) threatens to disrupt the rural character and fragment productive farm and forest land. Likewise, habitat fragmentation jeopardizes the Dragon Run’s unique natural communities. Landowner opinions about how to address these threats vary widely, ranging from the belief that “the Dragon takes care of itself” by its wild nature and voluntary landowner stewardship to enacting and enforcing regulations with “teeth.”

The difference in point of view between property rights advocates and conservationists centers on how to maintain a pristine watershed into the future. Yet, as the Dragon Run Special Area Management Plan unfolds, the community is learning that substantial common ground exists for proactively preserving the Dragon Run for future generations that safeguards both natural resources and traditional uses of the land and water, including the property rights of landowners.

SECTION 2: Planning Approach

Section 2 describes the Dragon Run Steering Committee's planning approach. The Dragon Run Watershed Special Area Management Plan (SAMP), a partnership between the Virginia Coastal Program and the Dragon Run Steering Committee of the Middle Peninsula Planning District Commission, is designed to address both the differing viewpoints and the common ground that exist concerning the future of the watershed. The Steering Committee's approach to the SAMP is to stimulate and coordinate community involvement in the proactive development and implementation of goals, objectives, and action plans for a watershed management plan. The Steering Committee finds that the watershed approach is the most effective way to manage natural resources and traditional land uses. A Memorandum of Agreement describing the goals and objectives of the SAMP was signed by Essex, Gloucester, King and Queen, and Middlesex Counties and the Middle Peninsula Planning District Commission. The Steering Committee and its Advisory Group then developed watershed action plans designed to achieve those goals and objectives.

The Dragon Run Watershed Special Area Management Plan (SAMP), a partnership between the Virginia Coastal Program and the Dragon Run Steering Committee of the Middle Peninsula Planning District Commission, is designed to address both the differing viewpoints and the common ground that exist concerning the future of the watershed. The project began in January 2002 with a grant from the Virginia Coastal Program under authority of the National Oceanic and Atmospheric Administration (NOAA). Enabled by the federal Coastal Zone Management Act of 1972 as amended, SAMPs aim to protect significant coastal resources through a collaborative, multi-level planning process to develop and implement new enforceable policies.

One of the fundamental elements of a SAMP is that a strong regional entity must exist that is willing to sponsor the planning program. In the Dragon Run watershed's case, that regional entity is the Middle Peninsula Planning District Commission through its Dragon Run Steering Committee. Formed in 1985, the Dragon Run Steering Committee consists of landowners and local elected officials and is the key vehicle for cooperation and coordination among the four counties concerning watershed issues. The Steering Committee's approach to the SAMP is to stimulate and coordinate community involvement in the proactive development and implementation of goals, objectives, and action plans for a watershed management plan.

Another major element of a SAMP is that conflict exists concerning the area's proposed uses. The Steering Committee believes that the best approach is to proactively head off conflict before it grows by enabling stakeholders to openly discuss the issues. Potential conflicts in the Dragon Run watershed are: 1) the differences between conservation and property rights advocates; and 2) the private use of land versus the public use of the water. The Steering Committee finds that the watershed approach is the most effective way to manage natural resources and traditional land uses.

In this spirit, the Dragon Run Watershed SAMP (**Figure 2**) began with public planning forums in December 2001 and January 2002. Newspaper announcements were published and representatives from many sectors of the community were specifically invited. These planning forums led to two primary outcomes: 1) the development and confirmation of common themes for watershed issues; and 2) the establishment of a SAMP Advisory Group representing a broad cross-section of the community.

Building upon the foundation established by the planning forums, the SAMP Advisory Group developed a mission statement (see **Section 3**). The Advisory Group developed a list of three goals, each with several objectives. With minor modifications, the Steering Committee approved the goals and objectives, which were incorporated into a Memorandum of Agreement (**Appendix B**). Each county – Essex, Gloucester, King and Queen, and Middlesex - and the Middle Peninsula Planning District Commission signed the Agreement during the late summer and fall of 2002 and will consider the actions (see **Section 4**) recommended by the Steering Committee. The actions address the goals and objectives in the Memorandum of Agreement.

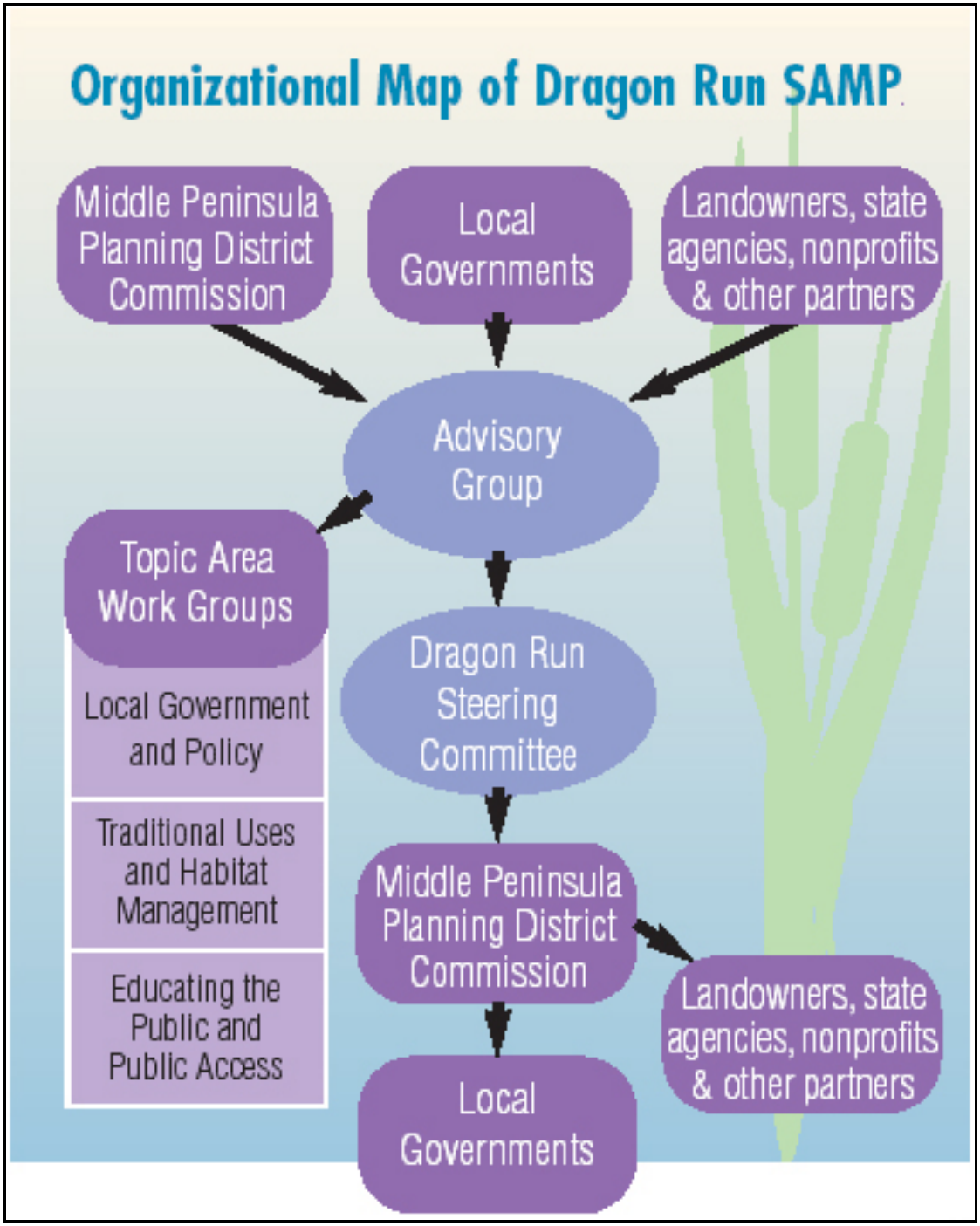


Figure 2. Organizational Map of the Dragon Run SAMP

SECTION 3: Goals and Objectives

Section 3 contains the mission, goals and objectives featured in the Memorandum of Agreement. This section serves as the basis for the proposed actions in Section 4.

MISSION
To support and promote community-based efforts to preserve the cultural, historic, and natural character of the Dragon Run, while preserving property rights and the traditional uses within the watershed.

GOAL I
Establish a high level of cooperation and communication among the four counties within the Dragon Run Watershed to achieve consistency across county boundaries.

> **OBJECTIVE A**
> Develop a plan to address the inevitable future development pressure to change the traditional use of land in the Dragon Run Watershed.
>
> **OBJECTIVE B**
> Achieve consistency across county boundaries among land use plans and regulations in order to maintain farming and forestry and to preserve natural heritage areas by protecting plants, animals, natural communities, and aquatic systems.
>
> **OBJECTIVE C**
> Provide ongoing monitoring of existing plans and planning tools in order to assess traditional land uses and watershed health and take action necessary to preserve the watershed.
>
> **OBJECTIVE D**
> Comprehensively implement Best Management Practices (BMPs) for water quality, wildlife habitat, and soil conservation.

GOAL II
Foster educational partnerships and opportunities to establish the community's connection to and respect for the land and water of the Dragon Run.

> **OBJECTIVE A**
> Encourage experience-based education consistent with the Stewardship and Community Engagement goals of the Chesapeake 2000 Agreement.
>
> **OBJECTIVE B**
> Promote the community and economic benefits of the Dragon Run derived from its natural characteristics and traditional uses such as farming, forestry, hunting and fishing.

GOAL III
Promote the concept of landowner stewardship that has served to preserve the Dragon Run Watershed as a regional treasure.

OBJECTIVE A
Address the potential dilemma of preserving the watershed's sense of peace and serenity by protecting open space and reducing fragmentation of farms, forests, and wildlife habitat versus the landowners' rights in determining or influencing future land use.

OBJECTIVE B
Educate landowners about the regional importance of the Dragon Run.

SECTION 4: Actions

Section 4 explains and justifies the actions proposed to achieve the goals and objectives in Section 3. The proposed actions are:

Underway/Completed
1. Memorandum of Agreement
2. Establish Baseline Watershed Information
3. SAMP Project Awareness Campaign
Recommended
1. Land Use and Resource Preservation
A. Designate a Unified “Dragon Run Planning Area”
B. Implement Tools to Preserve Farm, Forest, and Natural Resources
C. Address Public and Landowner Access Issues
D. Control Invasive Species
2. Education and Landowner Stewardship
3. Encourage and Support Sustainable Economic Development
4. Monitor Plan Implementation

The actions in this **Section** address the Goals and Objectives in **Section 3**. Notations after each action indicate links to goals and objectives and responsibilities.

ACTIONS UNDERWAY OR COMPLETED

1. Memorandum of Agreement

The Middle Peninsula Planning District Commission entered into an agreement (**Appendix B**) with the Counties of Essex, Gloucester, King and Queen, and Middlesex to participate in the Dragon Run SAMP. The agreement established the signatories' acceptance of the goals and objectives of the SAMP (see **Section 3**) and willingness to consider the Steering Committee's recommendations for actions (**Section 4**).

This action addresses Goal I(B), II
Responsibility: Middle Peninsula Planning District Commission, Local Governments

2. Establish Baseline Watershed Information

The Dragon Run Steering Committee has identified the following studies that have been completed or are underway to help to establish baseline watershed information:

Title (citation)	Description
Natural Areas of the Chesapeake Bay Region: Ecological Priorities (Jenkins, 1974)	Natural area survey throughout the Chesapeake Bay watershed; Dragon Run ranks 2nd of 232 in importance
County comprehensive plans, land use policies and ordinances	Maps and narratives addressing environmental and land use policies
Dragon Run Access Plan (MPPDC, 1994)	Describes access to the Dragon Run and factors influencing its availability
Dragon Run Watershed Management Plan (DeHardit et al., 1996)	Evaluates watershed and land use issues; offers recommendations; not implemented
Dragon Run Land/Water Quality Preservation Project (MPPDC, 2001)	Comprehensive evaluation of water quality using historical and recent data
A Natural Heritage Inventory of the Dragon Run Watershed (Belden, Jr. et al., 2001)	Survey of rare species and natural communities for the main stem and adjacent wetlands
Dragon Run Management Framework (MPPDC, 2002)	GIS CD-ROM and report with 18 data sets; evaluates economic contributions of traditional uses
Dragon Run Watershed Land Use Policy Audit (MPPDC, 2003)	Evaluates existing land use policies; recommends improvements to protect natural resources and traditional uses
Living Resources Inventory of the Dragon Run (Garman et al., 2003)	Survey and analysis of fish and benthic macroinvertebrate communities
A Natural Heritage Inventory of 14 Headwater Sites in the Dragon Run Watershed (Belden, Jr. et al., 2003)	Survey of rare species and natural communities for headwaters

Title	Description
Virginia Dept. of Environmental Quality Water Quality Monitoring (ongoing)	Ambient water quality monitoring at U.S. 17 and Rt. 603
U.S. Geological Survey Gaging Station (ongoing)	Real-time gage height and discharge by volume at Mascot, Virginia

This action addresses Goal I(A,C)
Responsibility: Middle Peninsula Planning District Commission, universities, state and federal agencies

3. SAMP Project Awareness Campaign
Middle Peninsula Planning District Commission staff delivered presentations, brochures, and fact sheets to Boards of Supervisors, Planning Commissions, and community groups that explained key components of the SAMP project and critical watershed issues.

This action addresses Goal II(B), III(B)
Responsibility: Middle Peninsula Planning District Commission, Dragon Run Steering Committee

RECOMMENDED ACTIONS

1. Land Use and Resource Preservation
Currently, the watershed is 99% wetlands, forests, and farms (MPPDC, 2002) that support a variety of unique natural resources, including rare and threatened species (Belden, Jr. et al., 2001). To protect the unique natural resources and traditional land uses of the Dragon Run, it is crucial to work proactively to implement strong land use policies while development pressure and land use intensity are still low, rather than wait to react to intensifying development pressure (MPPDC, 2003). The Dragon Run Steering Committee **recommends** that counties proactively strengthen and better coordinate their land use policies within the watershed.

A. Designate a Unified "Dragon Run Planning Area"
All of the four counties share the goals of protecting traditional uses, rural character, and natural resources in the Dragon Run. Yet, none of the counties identifies the Dragon Run watershed as a distinct planning area. Based on the Dragon Run Land Use Policy Audit (MPPDC, 2003), the Dragon Run Steering Committee **recommends** a watershed approach to achieve better coordination of land use policies by designating the Dragon Run as a special planning area with a step-by-step implementation strategy.

Step 1	Adopt Watershed Management Plan
Step 2	Amend Comprehensive Plan
Step 3	Amend Zoning Ordinance

Step 1. Each county would adopt the Dragon Run Watershed Management Plan as an addendum to its comprehensive plan, requiring a simple amendment and a public hearing. This action would **not** require an amendment to the future land use maps. The purpose of Step 1 would be to formally acknowledge that the Dragon Run watershed deserves distinctive treatment.

By adopting the Watershed Management Plan, the counties would agree to the following policies:

- Recognize the overall value of maintaining the traditional rural character and forested and farmed landscape of the Dragon Run watershed
- Preserve the ecological integrity of the Dragon Run watershed
- Acknowledge the community and economic benefits of the Dragon Run watershed: for the production of agricultural and forest products; as a valued natural resource; for wildlife habitat; for maintaining water quality; and for scenic and aesthetic values
- Continue to fully enforce existing regulations and policies
- Protect forested and farmed land from fragmentation due to conversion to more intensive development
- Encourage a low-density, clustered pattern of development for new residential development in the watershed to protect open space and natural resources
- Seek techniques to protect open space in the watershed without infringing upon landowner rights to maintain an economic return from their property
- Identify land uses that are incompatible or competitive with traditional resource-based land uses (e.g. forestry, farming, hunting, fishing) and consider limiting them within the watershed
- Limit rezoning to more intense uses in order to protect the rural character and integrity of farming and forestry resources in the watershed
- Limit extension of public utilities and central water and sewer in the watershed
- Explore the feasibility of limiting major residential development in the watershed by aligning the Comprehensive Plan and Zoning Ordinance with provisions in the Subdivision Ordinance that limit major subdivisions
- Publish citizen stewardship materials that explain pertinent ordinances, policies, and regulations in easy-to-understand language

Step 2. Each county would create and map a specially designated “Dragon Run Planning Area” within its comprehensive plan. Placing detailed land use policies such as permitted uses, development density, and utility service into the plan text and the official Future Land Use map would stress that protection of the Dragon Run is an important priority in each county.

Specific goals, policies, and actions, based on a thorough review and analysis by the Dragon Run Steering Committee and its SAMP Advisory Group, would be summarized in a proposed “Model Comprehensive Plan Amendment for the Establishment of the Dragon Run Planning Area.” Considerable staff and public input (e.g. public hearings) would address inconsistencies in land use policies across jurisdictions.

Step 3. Each county would adopt a model "Dragon Run Protection Zone" within its zoning ordinance involving both zoning map and zoning text amendments. The Dragon Run Protection Zone would apply beyond the main channel to the entire watershed.

This step would require considerable staff and public input (e.g. public hearings) to devise a unified set of standards (e.g. permissible uses, acceptable densities, development standards) that integrates with the existing regulatory scheme and that meets the goals of the Special Area Management Plan (see **Section 3**).

This action addresses Goal I(A,B,C), III(A)
Responsibility: Middle Peninsula Planning District Commission, Dragon Run Steering Committee, Local Governments

B. Implement Tools to Preserve Forest, Farm, and Natural Resources

A variety of tools exist with which to preserve forest and farmland (**Figure 3**) and unique natural resources within the Dragon Run watershed. These tools are highly flexible, rely mostly upon voluntary actions, and can provide ecological and cultural benefits. The Dragon Run Steering Committee **recommends** the implementation of an appropriate combination of the following tools (see **Appendix C** for description):

Tool	**Responsibility**
Conservation Easements	Landowners, non-profits, state and local governments
Purchase of Development Rights (PDR)	Local governments
Purchase of Agricultural Conservation Easements	Non-profits and federal, state and local governments
Enforcement of Chesapeake Bay Preservation Act and Other Ordinances	Local governments
Agricultural and Forestal Districts	Local governments
Land Use Assessment	Local governments
Utilize Farm Programs and Forest Stewardship Plans	State and federal agencies; local governments; landowners
Sliding Scale Property Tax Rate	Local governments
Sliding Scale Zoning	Local governments
Local "Right-to-Farm"	Local governments
State Forest	Department of Forestry
Virginia Natural Area Preserves System	Landowners, Natural Heritage Program
Virginia Estuarine and Coastal Research Reserve System	Chesapeake Bay National Estuarine Research Reserve

The Dragon Run Steering Committee also **recommends** the conservation of natural heritage resources and associated conservation sites as designated by the Virginia Natural Heritage Program (DCR, 2003a).

This action addresses Goal I(A,B,C), III(A)

Figure 3. Farming in the Dragon Run watershed.

C. Address Public and Landowner Access Issues

Public access to the Dragon Run is limited because property adjacent to the navigable stream is almost entirely privately owned. In most cases, access must be arranged by landowner consent. While generally effective, this informal arrangement has sometimes frustrated landowners and recreation-seekers alike. Private landowners express frustration with trespassers and with users who do not practice “leave no trace” recreation. In contrast, those seeking recreation are hindered by sparse access to the pristine river.

Landowners have expended time and money to resolve trespassing and vandalism problems, ranging from posting signs to instituting a formal program requiring verbal or written permission prior to visitation. Liability is often cited as a landowner concern. Virginia’s landowner liability law (Code of Virginia §29.1-509), however, dismisses a landowner’s liability when recreational users access their property with permission, express or implied, if no fee is charged to the user. Furthermore, if a landowner grants an access easement to a government agency or authority, then the landowner is held harmless from all liability and the easement holder is responsible for providing and paying for the cost of all legal services required as a result of a claim or suit.

As demand for public access has increased, recreation-seekers have encountered access limitations. Land-based public access exists at three locations: 1) Rappahannock Community College in Glenns (hiking); 2) Virginia Coastal Reserve in Mascot (education); and 3) Friends of Dragon Run property in Mascot (hiking/birding) with parking on a Virginia Department of Transportation unpaved lot. Fishing spots are limited to traditional access points, such as bridges. Also, the boating distance between traditional access points equates to nearly an entire day, causing logistical problems for novice paddlers. Occasionally, the sheriff’s department must dispatch a rescue team to retrieve boaters who are lost in the dark. Organizations that offer guided paddling trips effectively manage access with trip planning and suitability, proper equipment and safety information, appropriate consideration for private property, and response to the unexpected (e.g. medical emergencies, cold water immersion).

The Dragon Run Steering Committee seeks to balance reasonable public access to publicly owned waters with private property rights, preservation of the watershed's sense of peace and seclusion, and the watershed's ecological integrity that are highly prized by landowners and visitors alike. The following is a list of **proposed** actions:

- Erect signage notifying boaters/recreationists of trespassing issues and the physical dangers of boating in a wilderness area
  Responsibility: Dragon Run Steering Committee
- Provide land-based access as an alternative to boat-based access
  Responsibility: Middle Peninsula Chesapeake Bay Public Access Authority, Virginia Coastal Reserve (Virginia Institute of Marine Science), Virginia Dept. of Forestry, local governments, non-profit organizations
- Supervise or manage public access sites
  Responsibility: Middle Peninsula Chesapeake Bay Public Access Authority, Virginia Coastal Reserve (Virginia Institute of Marine Science), Virginia Dept. of Forestry, Virginia Dept. of Transportation, local governments, non-profit organizations
- Assess recreational carrying capacity/access to determine appropriate recreational "load"
  Responsibility: Dragon Run Steering Committee

This action addresses Goal I(A,C), II(A), III(A)

D. Control Invasive Species

Recent state legislation establishing the policy-setting Virginia Invasive Species Council signifies an era of formal concern about invasive or non-native species and their impacts on the integrity of Virginia's native ecosystems. Invasive species are purposely or accidentally introduced from other regions or countries and often physically displace or consume native species because they have few competitors or predators. The Dragon Run Steering Committee **recommends** that a Dragon Run Invasive Species Initiative be established in the watershed.

This initiative could include the following elements:

1. Form Dragon Run Invasive Species Initiative with scientific and policy experts
   Responsibility: Dragon Run Steering Committee staff, state and federal agencies, universities, non-profit conservation organizations
2. Assess status of existing invasive species or potential for new invasive species
   Responsibility: Dragon Run Invasive Species Initiative
3. Encourage the creation of state-level policies by seeking representation on the Virginia Invasive Species Council's Advisory Committee
   Responsibility: Virginia Invasive Species Council, Dragon Run Invasive Species Initiative

4. Establish education program to reduce the potential for species introduction
   Responsibility: Dragon Run Invasive Species Initiative
5. Establish monitoring and control program
   Responsibility: Dragon Run Invasive Species Initiative

Examples of common or potentially devastating invasive species that could affect the relatively intact natural communities in the Dragon Run are: blue catfish (*Ictalurus furcatus*); common reed (*Phragmites australis*); zebra mussel (*Dreissena polymorpha*); Asiatic dayflower (*Murdannia keisak*); and Japanese stiltgrass (*Microstegium vimineum*). Blue catfish, common reed, Asiatic dayflower and Japanese stiltgrass occur in the Dragon Run. These invasive species should be monitored and, to the extent practicable, controlled or excluded from the watershed.

This action addresses Goal I(C), II, III(B)

2. Education and Landowner Stewardship

In order to enhance and solidify the community's connection to and respect for the land and water of the Dragon Run, public education must be a central element of the Special Area Management Plan. Education should target citizens and stakeholders and focus on the unique ecological and recreational values in the watershed, the community and economic benefits of traditional land uses, and the need to preserve both through exemplary stewardship and proactive planning for the watershed's future. The Dragon Run Steering Committee **recommends** that a comprehensive education program be established to communicate the regional importance of the Dragon Run watershed to its citizens and to demonstrate the link between decisions about land management and the watershed's integrity and quality.

Education Program Components	Responsibility
Hands-on Experiences	Dragon Run Steering Committee
Community Watershed Festival	Dragon Run Steering Committee
Watershed Stewardship Awards	Dragon Run Steering Committee
Watershed Boundary Signs	Dragon Run Steering Committee
Promote Use of Forest Stewardship Plans	Dragon Run Steering Committee; local governments; Dept. of Forestry
Promote Use of Farm Programs	Natural Resources Conservation Service; Virginia Cooperative Extension; Soil and Water Conservation Districts; Farm Service Agency; Virginia Farm Bureau
Promote Action-based Projects	Dragon Run Steering Committee; local governments; citizens

Hands-on Experiences
The Dragon Run Steering Committee **recommends** the use of hands-on experiences to produce an understanding and appreciation of the Dragon Run, targeting:

- State and federal legislators, Boards of Supervisors, Planning Commissions, and county staff
- Landowners, hunt clubs, land management consultants, and farmers and foresters who rent or lease land
- Chamber of Commerce, service clubs, civic and church groups, and non-profit organizations
- State and federal agency representatives
- Schools, 4-H Club, Scouts, class projects
- General public

The recommended approach encompasses a variety of methods and materials. Education would focus on field experiences that incorporate activities designed to address critical watershed issues (e.g. wetland and habitat values, biodiversity, water quality and quantity, riparian buffers).

This action addresses Goal II(A,B), III(B)

Community Watershed Festival
A component of the education program should be a community watershed festival as a celebration of the watershed's natural, cultural, and historic heritage. The festival would **not** serve as a promotional tool to attract visitors. Displays and activities highlighting natural and cultural heritage would be featured. The Dragon Run Steering Committee **recommends** the festival as a way to increase citizen awareness of watershed issues and as an opportunity to acknowledge citizens for exemplary watershed stewardship.

This action addresses Goal II(B), III(B)

Watershed Stewardship Awards
The Dragon Run Steering Committee **recommends** the establishment of watershed stewardship awards that would honor landowners and land managers who have demonstrated commendable stewardship within the watershed. Awards would be bestowed annually at the watershed festival for a variety of categories that may include: forestry; farming; hunting; commercial enterprises; conservation; education; planning; and science. The awards program should serve as an incentive to implement exemplary land stewardship practices.

This action addresses Goal II(B), III(B)

Watershed Boundary Signs
The Dragon Run Steering Committee **recommends** placing watershed boundary signs along frequently traveled highway and secondary roads to increase community awareness of the location and importance of the Dragon Run watershed. By indicating

the watershed boundary, the signs would alert citizens that they are in the watershed. Teamed with other educational efforts, the signs should lead to citizen awareness that their land management practices influence the health of the watershed.

This action addresses Goal II, III(B)

Promote Forest Stewardship Plans
The watershed is more than 80% forested and has intact riparian buffers. Since forested riparian buffers provide effective water quality protection and wildlife habitat, forested lands exhibit low nutrient input to adjacent streams relative to other land uses in the watershed (MPPDC, 2001). Therefore, forest stewardship plans have the potential to significantly influence the health and profitability of the watershed's forests. To benefit landowners and the local economy and to preserve the rural landscape and the natural resources in the watershed, the Dragon Run Steering Committee **recommends** promotion and implementation of forest stewardship plans prior to timber harvesting.

Forest stewardship plans are ecosystem management plans that combine ecological function with landowner goals to attain a vision for a particular property. The Department of Forestry's Forest Stewardship Plans leverage professional resources across disciplines to provide an inventory, recommendations and reference information that address landowners' specific goals and objectives, which may include: wildlife enhancement; aesthetics; recreation; water quality protection; forest regeneration; financial investment and incentives; and fire, pest, and disease control. The Virginia Department of Forestry prepares Forest Stewardship Plans for up to 200 acres at no cost to landowners. Beyond 200 acres, the Department charges fees, so it may be cost-effective for a consulting forester to develop a Forest Stewardship Plan.

This action addresses Goal I(A,B,D), II(B), III(A)

Promote Farm Programs
Agricultural lands make up 18% of the watershed and have the potential to contribute sediments, nutrients, and bacteria to ground and surface water. Existing state and federal farm programs (see **Appendix D** for description) can positively influence the health and profitability of the watershed by providing incentives for employing Best Management Practices or for taking marginal land out of agricultural production. To benefit farming operations, water quality, wildlife habitat, and the rural landscape and character of the watershed, the Dragon Run Steering Committee **recommends** promotion and implementation of programs, such as:

Program	**Responsibility**
Conservation Reserve Program (CRP)	Natural Resources Conservation Service
Conservation Reserve Enhancement Program (CREP)	Natural Resources Conservation Service, Soil and Water Conservation Districts, Farm Service Agency
Environmental Quality Incentives Program (EQIP)	Natural Resources Conservation Service

Program	Responsibility
Farm and Ranch Lands Protection Program	Natural Resources Conservation Service
FarmLink Program	Virginia Farm Bureau
Forest Land Enhancement Program (FLEP)	Natural Resources Conservation Service; Dept. of Forestry
Wetland Reserve Program	Natural Resources Conservation Service
Wildlife Habitat Incentives Program (WHIP)	Natural Resources Conservation Service

It should be noted that the existence and availability of these programs changes depending on funding. Also, Virginia Cooperative Extension provides considerable technical assistance to farmers and actively promotes these programs.

This action addresses Goal I(A,B,D), II(B), III(A)

Promote Action-based Projects

Action-oriented projects can sustain enthusiasm for watershed activities by involving community members in active resource stewardship. For example, James City County's program entitled "Protecting Resources in Delicate Environments" strives "to improve water quality…by teaching residents about the importance of watershed protection while providing residents and neighborhoods with specific watershed restoration and protection tools (James City County, 2003)." The Dragon Run Steering Committee **recommends** encouraging action-based projects, such as:

- Trash pickup (e.g. Adopt-a-Highway, Adopt-a-Stream)
- Development of nature trails
- Construction of rain gardens to capture roof runoff
- Stream bank stabilization
- Stream restoration

This action addresses Goal I(C,D), II(A), III(B)

3. Encourage and Support Sustainable Economic Development

While natural resource-based industries have been and continue to be at the core of the watershed's economy, external economic forces threaten to fragment these traditional uses and alter the rural landscape. The Dragon Run Steering Committee **recommends** that sustainable natural resource-based development be pursued to strengthen the region's economy and boost the quality of life, while supporting the traditional land uses that preserve the Dragon Run watershed and its resources.

Support Sustainable Forestry and Farming

Agriculture is Virginia's top sales industry, makes up 11.2% of Virginia's Gross State Product, and creates about 10% of the state's jobs (DACS, 2003). Similarly, forestry supports "one of the largest manufacturing industries in the state ranking first in employment, first in wages and salaries, and accounts for $1 out of every $8 of value added through manufacturing (DOF, 2003)." Forestry (**Figure 4**) and farming are key industries in the Dragon Run watershed.

Figure 4. Forestry in the Dragon Run watershed.

As the tax base expands with rapid population growth (>14.4% in 3 of 4 watershed counties), the demands for public services also grow, often at a faster rate than tax revenues. Many rapidly growing counties have found their ability to provide adequate public services outstripped by the rapid demand for those services.

In contrast, agricultural and forestal land have been shown to demand a low cost of public services ($0.23 relative to $1.00 generated in taxes in Northampton County, VA [American Farmland Trust, 2002]). Yet, farm and forest land continue to disappear at a rapid rate, giving way to suburban-style development.

For the natural resource-based industries to continue to thrive, the watershed communities **should** develop a regional capacity to produce value-added forest and farm products to capture additional value locally. With funding from the Virginia Coastal Program, the Dragon Run Steering Committee is sponsoring a study of potential sustainable economic development opportunities within the watershed. The study will involve local and regional experts in natural resource-based industries and demonstrate how sustainable natural resource-based development can generate wealth within the community.

This action addresses Goal I(A,B,C), II(B), III(A)
Responsibility: Dragon Run Steering Committee, local governments, business/industry

Encourage Sustainable Nature-based Tourism
Nature-based tourism and agritourism can help to diversify and strengthen the economy of a region that is rich in natural resources, such as the Middle Peninsula. Nature-based tourism is the fastest growing sector of the U.S. tourism industry and Virginia is one of the top 10 destinations for travelers (DGIF, 2002b). The Dragon Run Steering Committee **recommends** encouraging and supporting appropriate nature-based tourism and agritourism to benefit from these trends.

The Dragon Run watershed contains several sites on the newly established Virginia Birding and Wildlife Trail that is designed for car travel (DGIF, 2002a). In addition, the Virginia Ecotourism Association has developed a certification course using standards that avoid negative impacts on the resources that attract tourism. Supporting these initiatives in nature-based tourism could benefit the economy and, in turn, the natural resources of the watershed. For example, surveys along the Great Texas Coastal Birding Trail indicate that travelers spend ~$1,000 per person per trip, two-thirds of which flows directly into the local economy. More importantly, rural communities that are not able to promote their destinations are gaining economic stimulation from their assocation with the Trail. Meanwhile, the Trail increased awareness of the importance of the region's natural resources and the need to conserve them (DGIF, 2002b).

This action addresses Goal I(A,B,C), II(B), III(A)
Responsibility: Dragon Run Steering Committee, local governments, business/industry

4. Monitor the Implementation of the Watershed Management Plan

An important element of any planning effort is monitoring plan effectiveness. The Dragon Run Steering Committee **recommends** that a monitoring program be developed that assesses the results of watershed management plan implementation to ensure that the plan is effectively implemented.

The monitoring program should assess factors and parameters that are easily compared to the baseline information in the watershed management plan. Examples include: designation of watershed planning area; acres enrolled in farm and forest programs; land use/land cover; water quality; number of educational trips; invasive species; amount and type of public access; and number of action-based projects. Furthermore, the Dragon Run Steering Committee should coordinate and provide oversight for the monitoring program. For instance, the Steering Committee could draft an agreement with localities whereby the Committee reviews development applications in the watershed and offers advisory comments to the localities. Stable funding for staff support will continue to be a key component of Steering Committee activities.

The results of the monitoring program should be used to refocus efforts on actions that have not been fully implemented. The monitoring program may also highlight successes and identify new or unforeseen needs (e.g. funding for new projects).

This action addresses Goal I(C)
Responsibility: Dragon Run Steering Committee, local governments

HOW DO ACTIONS SUPPORT GOALS AND OBJECTIVES?

Actions in this **Section** support the goals and objectives stated in **Section 3** as shown in **Table 1**. For example, Recommended Action 1A: *Land Use: Designate a Unified "Dragon Run Planning Area"* (pp. 16-18) supports:

- Goal I (p. 12): Establish a high level of cooperation and communication between the four counties within the Dragon Run Watershed to achieve consistency across county boundaries.
  - Objective A: Develop a plan to address the inevitable future development pressure to change the traditional use of land in the Dragon Run Watershed.
  - Objective B: Achieve consistency across county boundaries among land use plans and regulations in order to maintain farming and forestry and to preserve natural heritage areas by protecting plants, animals, natural communities, and aquatic systems.
  - Objective C: Provide ongoing monitoring of existing plans and planning tools in order to assess traditional land uses and watershed health and take action necessary to preserve the watershed.
- Goal III (p. 13): Promote the concept of landowner stewardship that has served to preserve the Dragon Run Watershed as a regional treasure.
  - Objective A: Address the potential dilemma of preserving the watershed's sense of peace and serenity by protecting open space and reducing fragmentation of farms, forests, and wildlife habitat versus the landowners' rights in determining or influencing future land use.

Action [Section 4]	**Goal (Objective)** [Section 3]
Completed/Underway	
1	I (B); II
2	I (A, C)
3	II (B); III (B)
Recommended	
1A	I (A, B, C); III (A)
1B	I (A, B, C); III (A)
1C	I (A, C); II (A); III (A)
1D	I (C); II; III (B)
2	I (A, B, C, D); II (A, B); III (A, B)
3	I (A, B, C); II (B); III (A)
4	I (C)

Table 1. How actions support the Dragon Run SAMP's goals and objectives.

PART II

SECTION 5: Framework of Institutional and Regulatory Responsibility

Section 5 describes the responsibilities of federal, state, and local government agencies for mandatory and voluntary programs, policies, and regulations.

Neither the MPPDC nor its Dragon Run Steering Committee has regulatory authority. Rather, they serve to encourage and facilitate local-local and state-local government cooperation in addressing regional issues. Consisting of elected officials and citizens appointed by member local governments, the MPPDC and the Dragon Run Steering Committee offer recommendations and technical assistance to the localities. The MPPDC's purpose is "to promote the orderly and efficient development of the physical, social and economic elements of the Planning District by planning, and encouraging, and assisting governmental subdivisions to plan for the future" (MPPDC, 1972).

The Virginia Coastal Program is a system of state laws and policies administered by a network of core agencies and coastal localities that manage a variety of coastal resources. The Department of Environmental Quality (DEQ) serves as the lead agency for Virginia's networked Coastal Program and helps agencies and localities to develop and implement coordinated coastal policies.

Within the context of the SAMP, county governments are responsible for long-range planning of public facilities, utilities, transportation, and land use, and for developing, implementing, reviewing and updating the local Comprehensive Plan, Zoning Ordinance and other ordinances. Through Boards of Supervisors, Planning Commissions, and staff, counties process and review rezoning, conditional use permits, special exceptions, site plans, and subdivisions. Therefore, counties implement land use policies and regulations.

Counties also have responsibility for implementing the Chesapeake Bay Preservation Act (Bay Act). The Chesapeake Bay Local Assistance Department (CBLAD) is charged with oversight of local implementation of the Bay Act and the Chesapeake Bay Preservation Area Designation and Management Regulations. The Bay Act (§10.1-2100 et seq.) requires that localities protect water quality by establishing and protecting Chesapeake Bay Preservation Areas, including wetlands, shorelines, and a 100-foot buffer.

The Virginia Department of Conservation and Recreation (DCR) administers: 1) the Coastal Nonpoint Source Pollution Control Program under authority of Section 6217 of the Coastal Zone Act Reauthorization Amendments of 1990; 2) the Nonpoint Source Pollution Management Program under authority of Section 319 of the Clean Water Act of 1987; 3) the Virginia Stormwater Management Program; 4) the Erosion and Sediment Control Program; 5) the Nutrient Management Program; and 6) and the Chesapeake Bay and Tributary Strategies Programs. DCR's Natural Heritage Program reviews development proposals that might affect the state's natural heritage resources (e.g. rare species and natural communities). DCR's Shoreline Erosion Advisory Service offers assistance to landowners experiencing erosion problems.

The authority to issue National Pollutant Discharge Elimination System (NPDES) permits lies with the DEQ. Furthermore, the DEQ regulates air quality, waste management (e.g. landfills), ground water management, water withdrawal, and petroleum storage tanks. The DEQ is also responsible for setting state water quality

standards and preparing the 305(b) Water Quality Assessment Report and the 303(d) Report on Impaired Waters. Impaired waters do not meet water quality standards and usually require the development of a Total Maximum Daily Load (TMDL) report. The implementation of TMDLs may require regulations governing discharges and nonpoint source pollution to impaired waters.

The Virginia Department of Game and Inland Fisheries (DGIF) regulates hunting, freshwater fishing, and boating. Furthermore, the DGIF maintains public boating access sites. The DGIF also regulates threatened and endangered species.

The U.S. Army Corps of Engineers' Norfolk District Regulatory Branch (ACOE) regulates waters and wetlands under the authority of Section 404 of the Clean Water Act and Section 10 of the Rivers and Harbors Act of 1899.

The Virginia Marine Resources Commission's Habitat Management Division (MRC) regulates physical encroachment into bottomlands, tidal wetlands, and coastal primary sand dunes under Subtitle III of Title 28.2 of the Code of Virginia. The permit process is the joint responsibility of local wetlands boards, the MRC, the DEQ (Section 401 certification), and the ACOE. Additionally, the MRC regulates saltwater fishing.

The Virginia Department of Forestry (DOF) has authority to regulate forestry operations throughout the state. Silvicultural activities are exempt from most laws such as the Clean Water Act, the Chesapeake Bay Preservation Act, and Erosion and Sediment Control. In exchange for these exemptions, silvicultural activities must comply with Best Management Practices designated by DOF in *Virginia's Forestry Best Management Practices for Water Quality, 4th Edition* (2002). DOF has responsibility for inspecting forestry operations, reporting violations, and enforcing regulatory requirements.

The Natural Resources Conservation Service (NRCS) of the U.S. Department of Agriculture administers: the Conservation Reserve Program; the Conservation Reserve Enhancement Program; the Environmental Quality Incentives Program; the Farm and Ranch Lands Protection Program; the Forest Land Enhancement Program; the Wetland Reserve Program; and the Wildlife Habitat Incentives Program. The NRCS helps private landowners conserve soil, water, and other natural resources through technical assistance, cost sharing, and financial incentives. The NRCS also provides assistance to local, state, and federal agencies.

SECTION 6: Watershed Characterization

Section 6 describes the watershed in detail to establish the Dragon Run's current status. Physical and environmental features are characterized. Land use policies and recreational and educational activities are assessed. This information is designed to serve as a baseline to which to compare the success or failure of the watershed management plan in achieving its goals and objectives. Finally, gaps in the baseline information are identified.

Physical and Environmental Factors

Located entirely within the coastal plain physiographic province, Virginia's Middle Peninsula is bracketed by the Rappahannock River to the north, the York River to the south, and the Chesapeake Bay to the east. The Dragon Run watershed is the Middle Peninsula's geographic centerpiece, expanding outward from its 40-mile fresh and brackish water stream that runs through Essex, Gloucester, King and Queen, and Middlesex Counties. The watershed encompasses 90,000 acres or 140 square miles and exhibits topography typical of coastal plain stream systems in Virginia (**Figure 5**). Watershed area by locality is shown in **Table 2**.

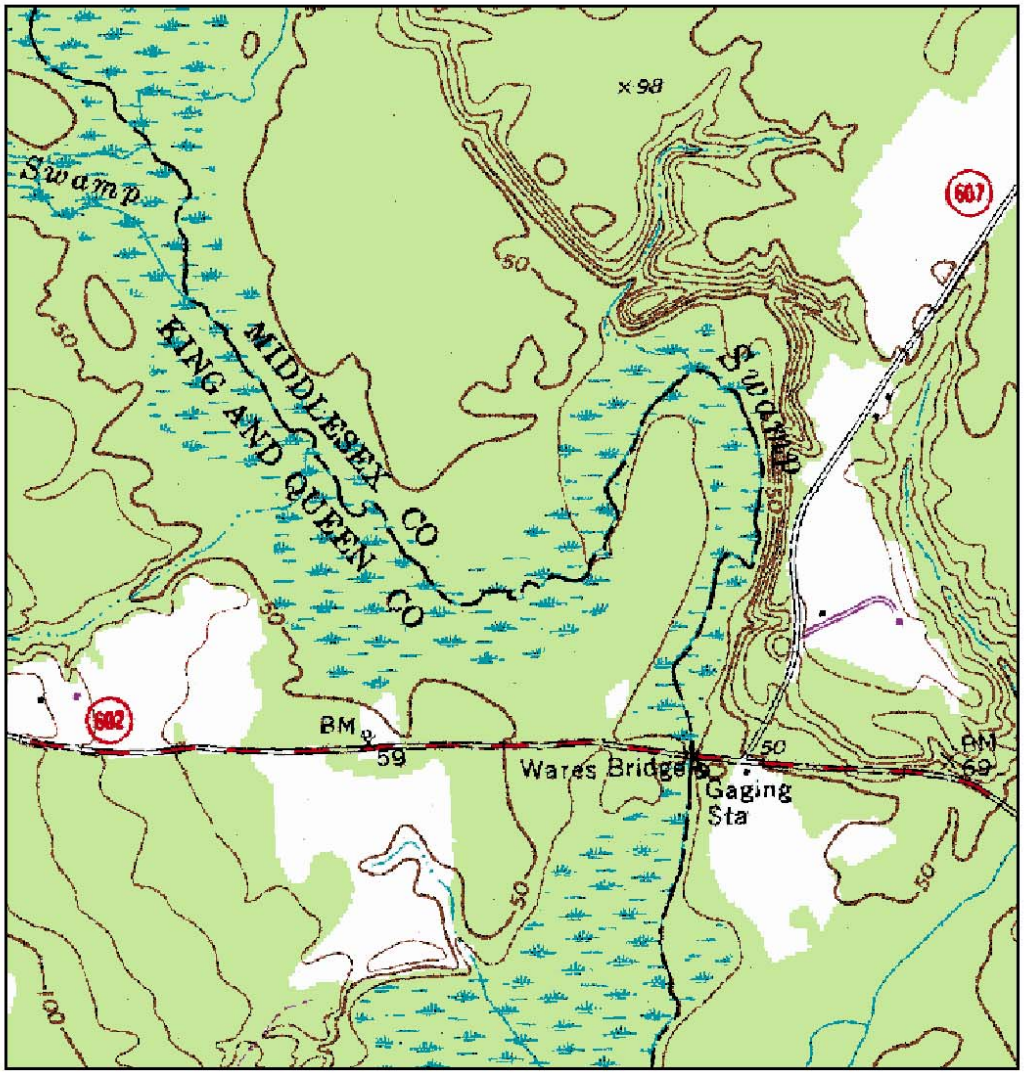
County	Area within Locality (acre)	% of Total Watershed	% of Locality within Watershed
Essex	18466.6	20.6	10.1
Gloucester	5671.7	6.3	3.1
King and Queen	46425.1	51.7	22.2
Middlesex	19207.7	21.4	16.3
Total	89771.1	100	

Table 2. Dragon Run watershed statistics by locality (from MPPDC, 2001).

The Dragon Run watershed, state hydrologic unit CO2, is a fourth-order stream system that is nontidal freshwater above the U.S. Route 17 bridge and tidal freshwater from the U.S. 17 bridge to its mouth at Meggs Bay (**Figure 6**). There it forms the Piankatank River, where it becomes estuarine, and eventually drains into the Chesapeake Bay (**Figure 7**). Underground springs, feeder swamps, and surface waters support streamflow in the Dragon Run. Significant tributaries include Dragon Swamp, Yonkers Swamp, Exol Swamp, Timber Branch Swamp, Briery Swamp, Holmes Swamp, White Marsh, Zion Branch, Carvers Creek, Mill Stream, and Meggs Bay (MPPDC, 2001).

Land cover data indicate that the watershed is 80.3-83.9% forested and wetlands, 15.1-18.4% agricultural, and 1.0-1.3 % commercial and residential (**Figure 8**) (MPPDC, 2002; DCR, 2003). The Dragon Run watershed lies within the transitional Oak-Pine vegetation region where dominant oaks share the forest with Virginia pine, shortleaf pine, and loblolly pine. Although loblolly pine originally appeared in the forest as scattered associates of oaks and other hardwoods, loblolly pine plantations are increasingly common.

Since the watershed is relatively intact, it contains many unique resources. For example, the Baldcypress-Tupelo Swamp community is extensive and is the northernmost example of this community type in Virginia and the best example north of the James River (Belden, Jr. et al., 2001). Natural heritage resources are abundant in the Dragon Run (**Figure 9**). Several rare natural communities occur in the Dragon Run, including Baldcypress-Tupelo Swamp, Tidal Baldcypress-Tupelo Swamp, Tidal



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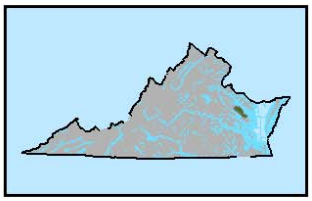
This map production is a product of the MPPDC's Dragon Run SAMP and was funded by the Virginia Department of Environmental Quality's Coastal Program through Grant #NA17OZ1142-01 of the National Oceanic and Atmospheric Administration, Office of Ocean and Coastal Resources Management, under the Coastal Zone Management Act of 1972, as amended.



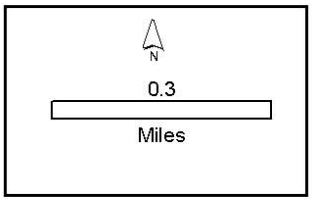


Figure 5. U.S. Geological Survey topographic map of the Dragon Run watershed in Middlesex and King and Queen Counties.

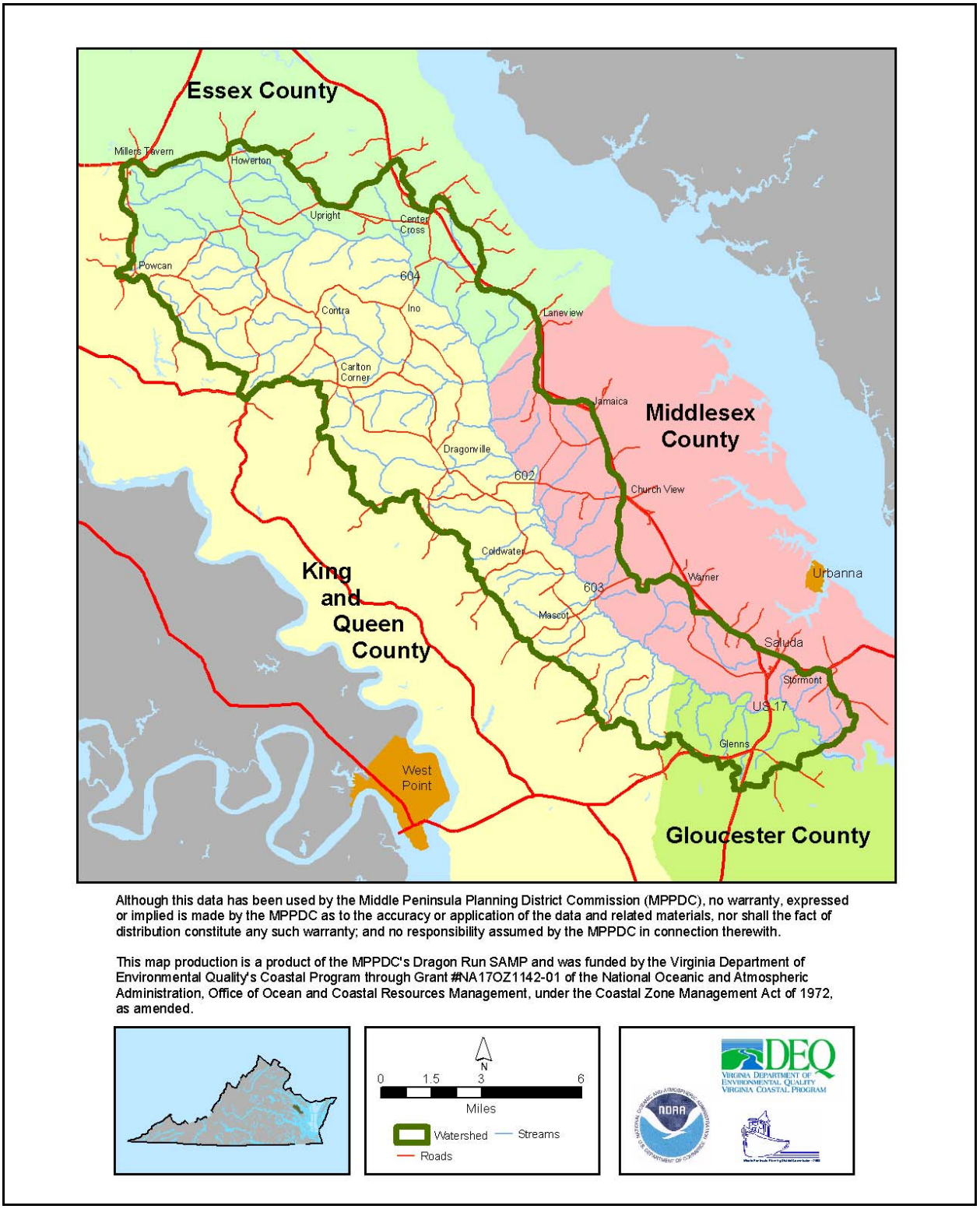


Figure 6. Map of the Dragon Run watershed boundary showing villages and towns.

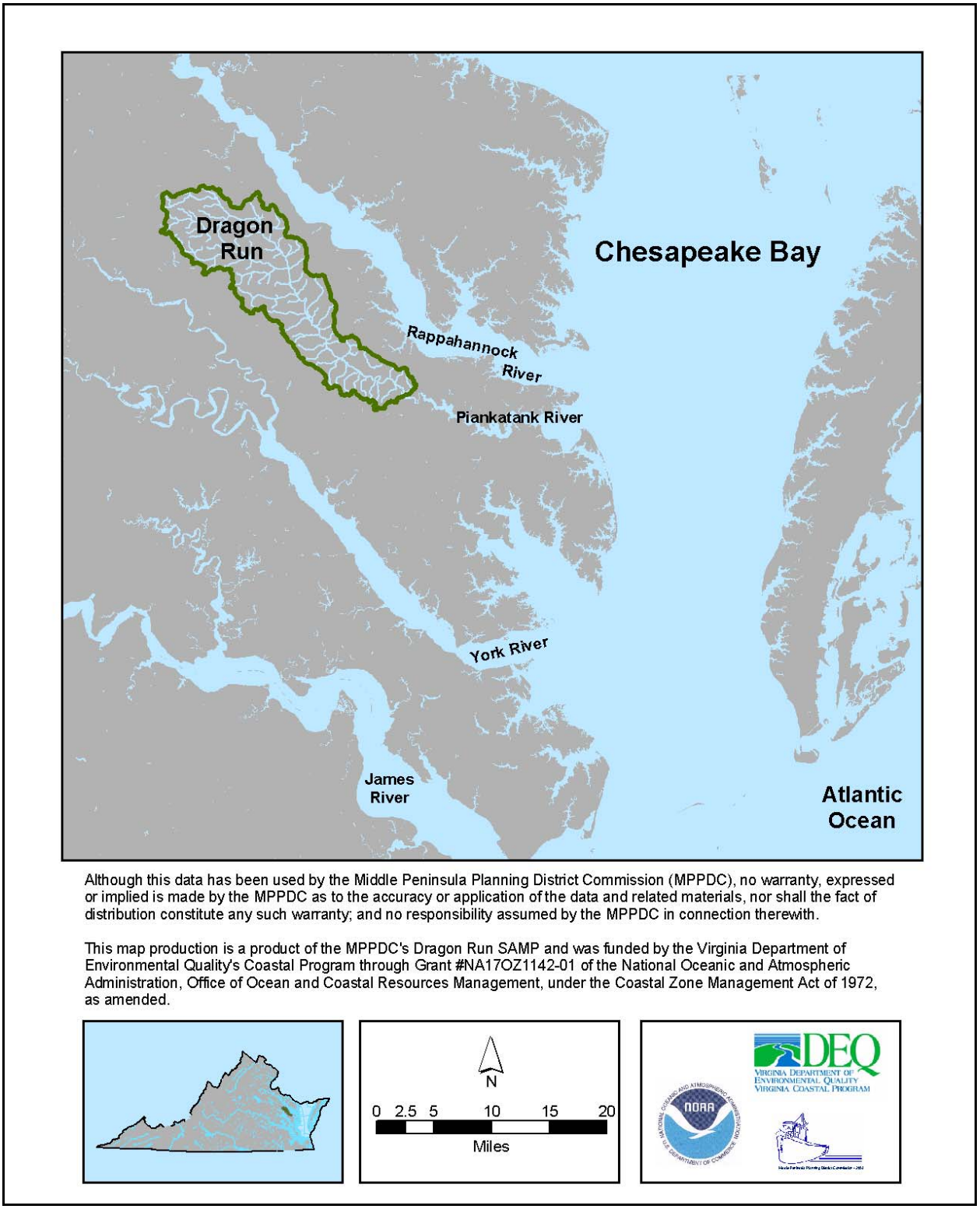


Figure 7. Map showing the Dragon Run watershed (in green) flowing into the Piankatank River and ultimately into the Chesapeake Bay.

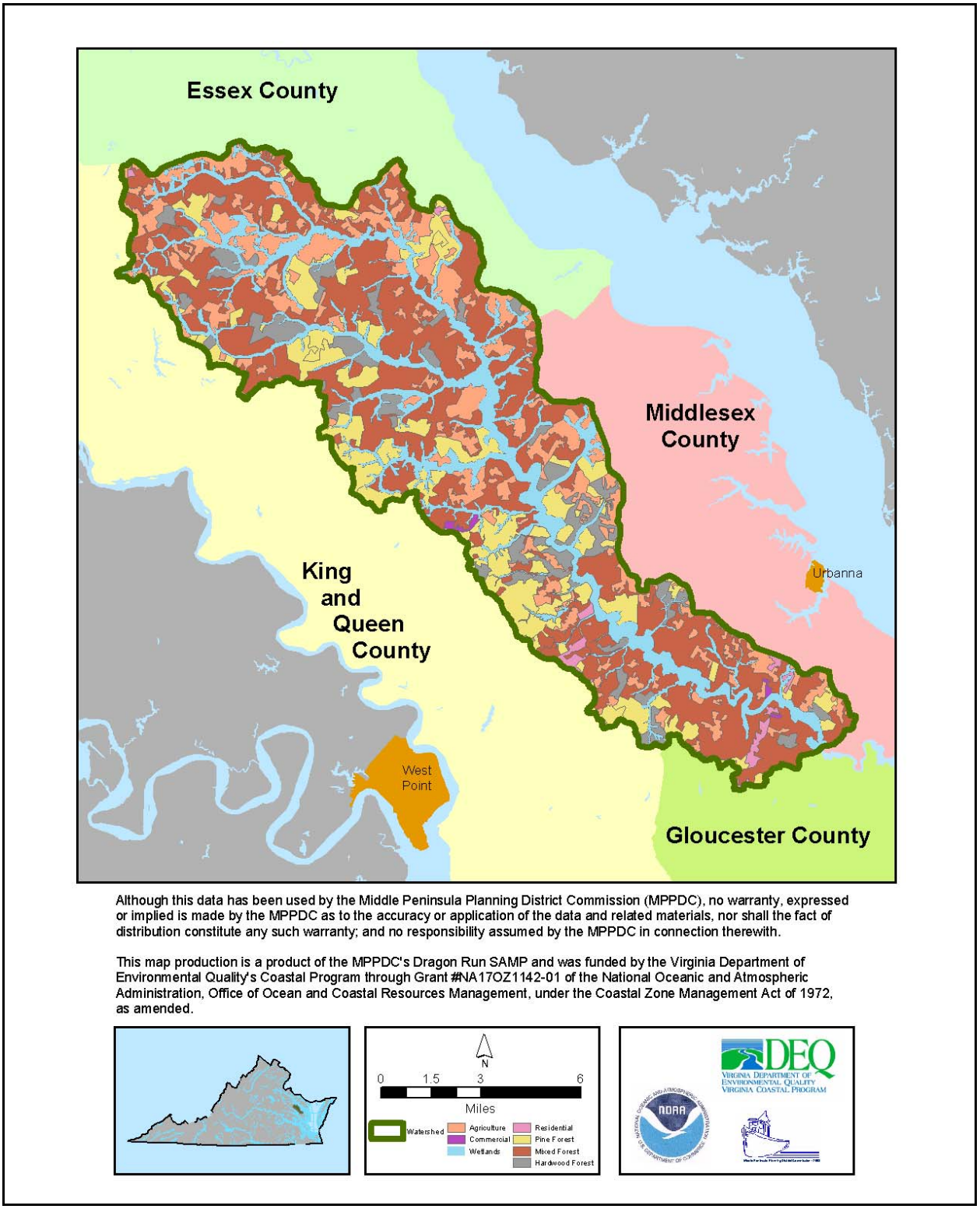


Figure 8. Land cover designations in the Dragon Run watershed.

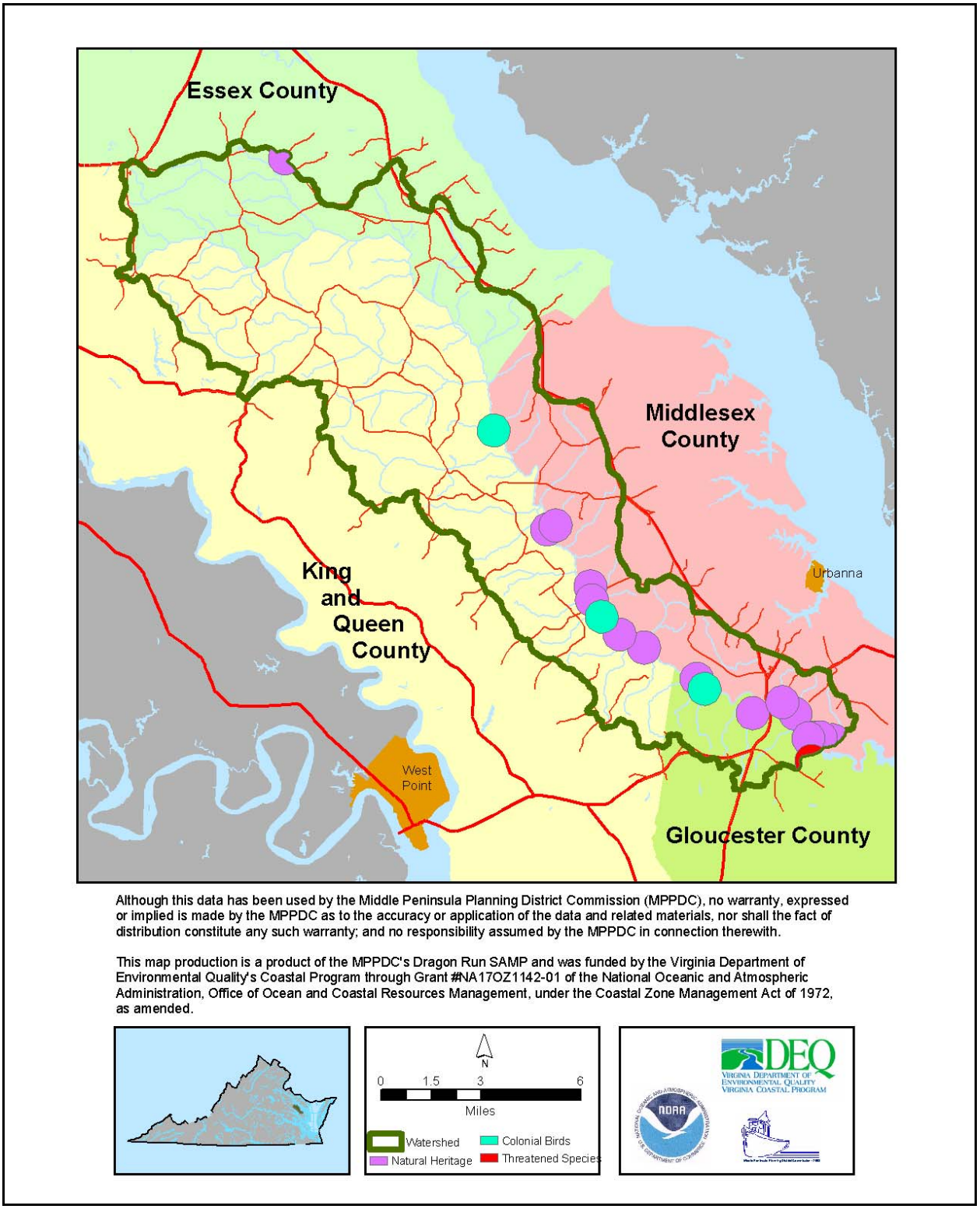


Figure 9. Occurrences of natural heritage resources in the Dragon Run watershed.

Baldcypress Woodland/Savanna, Fluvial Terrace Woodland, and Tidal Freshwater Marsh (see **Appendix A** for descriptions). The Baldcypress-Tupelo Swamp community (**Figure 10**) also harbors a number of rare plant and animal species. Rare animals include bald eagle, great purple hairstreak, blackwater bluet, robust baskettail, cypress sphinx, Selys' sunfly, fine-lined emerald and Southern pitcher-plant mosquito. Rare plants include cuckooflower, red turtlehead, Parker's pipewort, pineland tick-trefoil, river bulrush, Northern purple pitcher-plant, and cypress-knee sedge (Belden, Jr. et al., 2001; Belden, Jr. et al., 2003). The Dragon Run also harbors a number of rookeries for colonial water birds, such as egrets and herons. Other natural communities that occur in the Dragon Run include: Coastal Plain/Piedmont Bottomland Forest; Coastal Plain/Piedmont Acidic Seepage Swamp; and Coastal Plain Semipermanent Impoundment (Belden, Jr. et al., 2003).

Figure 10. Baldcypress-Tupelo Swamp community.

In addition to natural heritage resources, the Dragon Run supports a diversity of freshwater and estuarine fishes, aquatic macroinvertebrates, freshwater bivalves (primarily unionid mussels), and herptefauna (amphibians and reptiles) (McIninch et al., 2003). At least forty-five fish species from nineteen families have been collected in the Dragon Run, representing a mixed assemblage of mostly lowland freshwater forms that is highly dynamic spatially and temporally. At least sixty-five macroinvertebrate species from fourteen orders and forty-seven families have been recorded from the Dragon Run.

The watershed contains only limited examples of invasive, or non-native, species, again emphasizing a relatively intact natural system. Currently, blue catfish, common reed, Asiatic dayflower and Japanese stiltgrass occur in the Dragon Run in limited quantities (**Figure 11**).

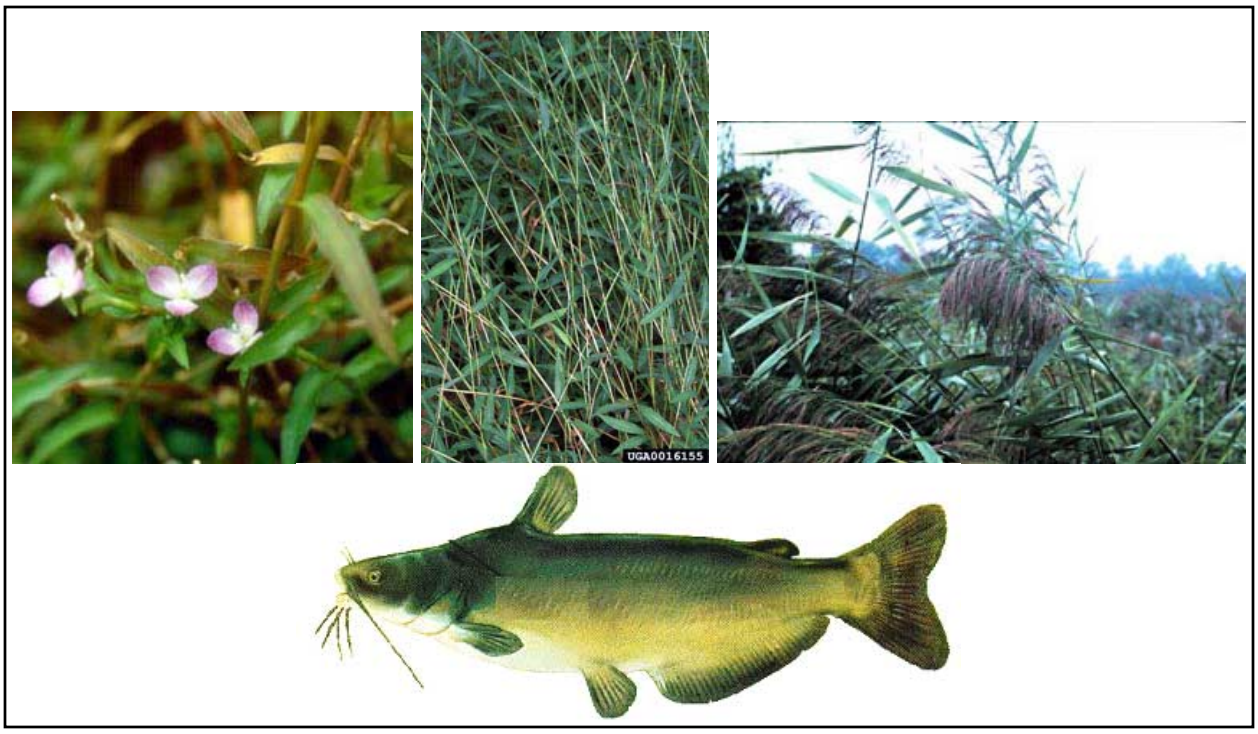


Figure 11. Invasive species of the Dragon Run - clockwise: Asiatic dayflower (Brent Steury, NPS); Japanese stiltgrass (Ted Bodner); Common reed (Joseph McCauley, USFWS); Blue catfish (www.landbigfish.com)

According to the National Wetland Inventory, wetlands along the Dragon Run (**Figure 12**) are Palustrine, mostly Forested Wetlands except for Emergent Wetlands in Meggs Bay. U.S. Route 17 is the approximate demarcation between tidal wetlands and non-tidal wetlands. The hydrologic regime of most Dragon Run wetlands is Seasonally Flooded, Seasonally Flooded-Saturated, or Temporarily Flooded (Belden, Jr. et al., 2001).

The U.S. Geological Survey (USGS) maintained a streamflow gaging station at Church View (Route 602) from 1943 to 1981 that received drainage from 60% of the watershed (84 square miles) and has maintained a streamflow gaging station at Mascot (Route 603) since 1981 that receives drainage from 75% of the watershed (105 square miles). Median daily streamflow at Mascot from 1981 to 1999 was 79 ft^3/sec and varied between 0.01-6050 ft^3/sec. Median daily streamflow at Church View from 1943 to 1981 was 57 ft^3/sec and varied from 0-3790 ft^3/sec. Compared to other coastal plain stream systems such as the Chickahominy River (New Kent County), the Mattaponi River (King William County), and Cat Point Creek (Richmond County), the Dragon Run exhibits lower median daily streamflow per square mile of drainage area. Base flow, fed primarily by groundwater discharge, accounts for two-thirds of the Dragon Run's total streamflow, with the remaining third attributable to surface water runoff. Of the annual precipitation, only one-third becomes streamflow, with two-thirds lost to evapotranspiration. Seasonally, streamflow is highest in the spring and lowest in the fall (MPPDC, 2001).

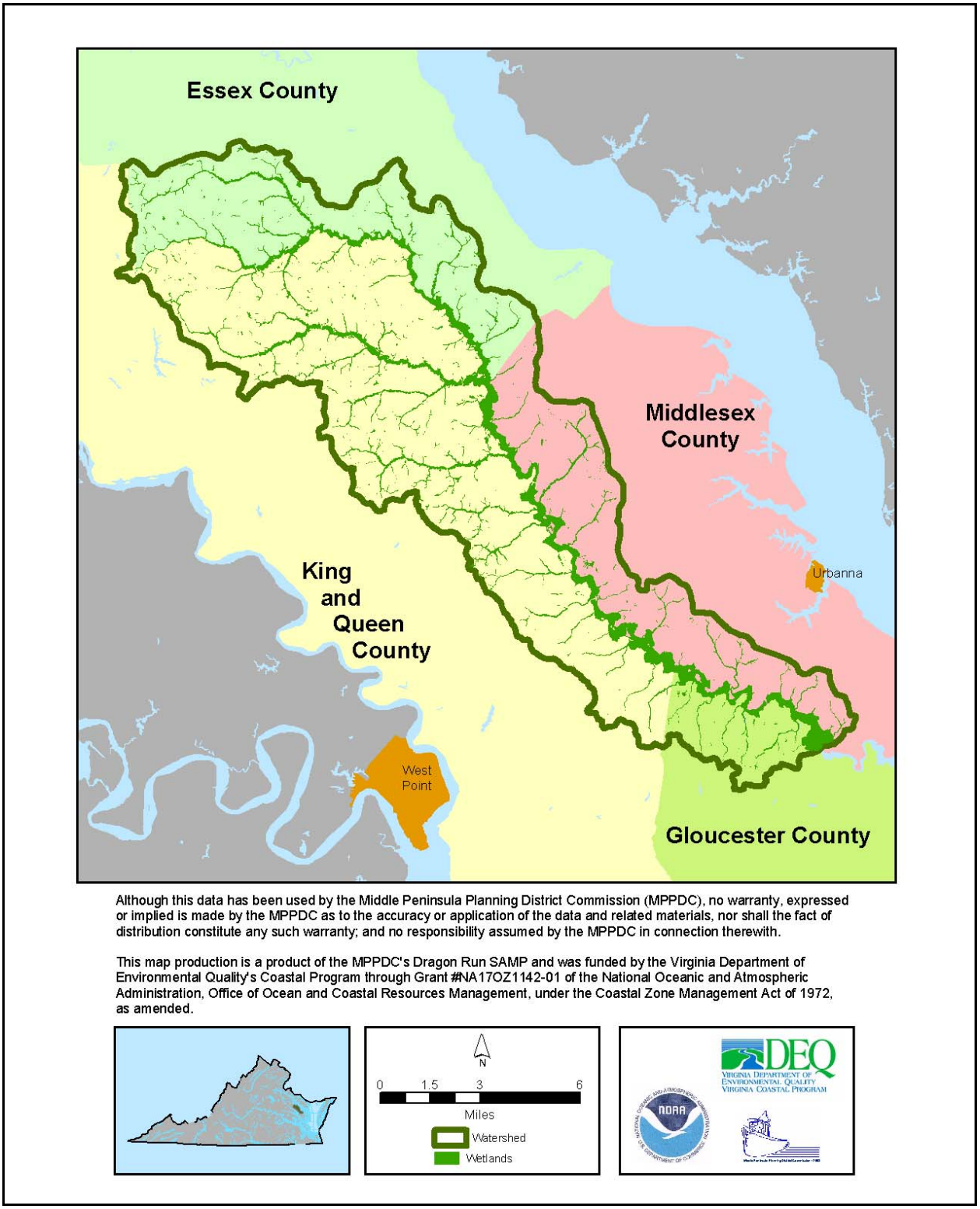


Figure 12. Wetlands in the Dragon Run watershed.

Geological features are described by the following excerpt from *A Natural Heritage Inventory of the Dragon Run Watershed* (Belden, Jr. et al., 2001):

Surficial deposits of riverine terraces bordering Dragon Run from the vicinity of the Essex-Middlesex county line to Meggs Bay belong to the Shirley Formation and the Sedgefield Member of the Tabb formation. The middle Pleistocene Shirley Formation consists of light- to dark-gray, bluish-gray and brown sand, gravel, silt, clay, and peat; the Sedgefield Member is of upper Pleistocene age and consists of pebbly to bouldery, clayey sand and fine to medium, shelly sand grading upward to sandy and clayey silt. Somewhat higher topography away from the waterway is underlain by the Chesapeake Group. This consists of fine to coarse quartzose sand, silt, and clay (variably shelly and diatomaceous) deposited in shallow waters of the upper Pliocene and lower Miocene periods. At still higher elevations, the Windsor Formation is found, consisting of gray and yellowish to reddish-brown sand, gravel, silt, and clay of lower Pleistocene or upper Pliocene age. At higher elevations southwest of Dragon Run, two other formations are prevalent, both of upper Pliocene age. The Bacons Castle Formation is characterized by gray, yellowish-orange, and reddish-brown sand, gravel, silt, and clay and the Moorings Unit by white, light gray, and grayish-yellow quartzose sand and clay to grayish-brown clayey silt and silty clay.

Watershed elevation ranges from 180 feet to near sea-level. Detailed soils information can be found in the *Soil Survey* for each county (Note: King and Queen County does not have a published *Soil Survey*). Many of these soils are considered prime farmland and are suitable for silviculture. Generally, soil associations are as follows:

<u>Essex County</u>

Emporia-Slagle-Atlee; Rumford-Suffolk-Emporia - somewhat excessively drained to moderately well drained loamy and sandy soils (Hoppe, 1989)

<u>Middlesex County</u>

Suffolk-Eunola-Remlik; Kempsville-Suffolk-Kinston; Emporia-Slagle-Nevarc - deep, well drained to poorly drained loamy or clayey soils (Newhouse et al., 1985); Pocaty-Kinston-Bibb - deep, very poorly to poorly drained organic and loamy soils that are flooded by fresh and brackish water (Newhouse et al., 1985)

<u>Gloucester County</u>

Suffolk-Eunola-Kenansville; Emporia-Hapludults-Wrightsboro - deep, well drained to moderately well drained loamy or clayey soils (Newhouse et al., 1980)

DCR's Shoreline Erosion Advisory Service identified five areas of streambank erosion in the lower Dragon Run (Vanlandingham, 2003). The lower Dragon Run undergoes an average of less than one foot per year of erosion that is mostly attributable to high water flow undercutting the stream bank during storms. These erosion "hot spots" are relatively few and small and are unlikely to cause impairment to the stream.

Water Quality

<u>Water Quality Assessment</u>

The primary water contaminant sources in the Dragon Run are point source discharges and nonpoint source pollution from precipitation (atmospheric deposition), residential land use, agricultural land use, and forested lands (MPPDC, 2002). According to the Virginia Department of Environmental Quality (DEQ), the Dragon Run generally exhibits

medium nutrient levels and is listed as “impaired” for pH, fecal coliform bacteria, mercury, and lead (DEQ, 2002). Based on agricultural, urban, and forested pollution loadings potential determined by DCR, however, the overall nonpoint source pollution potential rating is low for the Dragon Run (DCR, 2002).

Point source discharges, which are permitted and monitored by the Virginia Department of Environmental Quality, are relatively easy to quantify and, in turn, control or track. Point source discharges to the Dragon Run include: stormwater runoff from a wood treatment facility (arsenic, chromium, copper) at Pitts Lumber Company, Inc. to an intermittent stream adjacent to U.S. Route 17 in Middlesex County (Permit #VA0083011); discharge from a sewage treatment plant (biological oxygen demand, total suspended solids, ammonia nitrogen, total residual chlorine, pH, fecal coliform) at Rappahannock Community College to an intermittent stream near Glenns in Gloucester County (Permit #VA0028461); and discharge from a wellwater treatment plant (pH, total suspended solids) at the Miller’s Square Subdivision to an intermittent stream near Miller’s Tavern in Essex County (Permit #VA0075302). According to the Shoreline Sanitary Survey (Smither et al., 2003), there are 9 other indirect sources of pollution, including five animal pollution sources (Middlesex County near Saluda and Stormont and Gloucester County near Glenns); a solid waste dumpsite in Middlesex County near Stormont; and a potential pollution source in Middlesex County in Saluda. Furthermore, a network of water quality monitoring wells is maintained at the Browning-Ferris Industries landfill in King and Queen County.

Throughout the Chesapeake Bay, atmospheric deposition (e.g. precipitation) contributes a significant amount of the total nutrient loadings in coastal waters (MPPDC, 2001). Air quality is not currently monitored in the watershed.

More than 90% of residents in Gloucester, King and Queen, and Middlesex Counties use on-site wastewater treatment systems, commonly known as septic systems (MPPDC, 2001). When operated properly, conventional septic systems remove nutrients and fecal coliform. Conventional septic systems can pose potential environmental and health risks due to inappropriate design, poor maintenance, poor soils, or inefficient nitrogen removal. Driven by changes to Department of Health regulations for on-site wastewater treatment systems (12 VAC 5-610-10 et seq. effective July 2000), the popularity of “engineered” on-site wastewater treatment systems is increasing. These alternative systems, when properly maintained, can be effective at removing nutrients and fecal coliform in areas where conventional septic systems are ineffective. Regardless of the type, however, improperly maintained or failing septic systems pose significant environmental and health risks by contributing nutrients, pathogenic bacteria, and viruses to groundwater.

Forested lands, representing a significant land area, yield low nutrient input to streams relative to other land uses in the watershed. Best Management Practices (BMPs) are designed to minimize these inputs. For example, forested riparian buffers provide effective protection for water quality. The watershed currently exhibits intact riparian buffers.

By contrast, agricultural land use in rural and semirural areas in Virginia can be the source of significant sediments, fecal coliform bacteria, and nutrients such as nitrogen and phosphorus. Nitrogen is transported through the groundwater, whereas phosphorus is generally transported on soil particles in surface water. BMPs such as fencing cattle out of streams, conservation tillage, and expanded riparian buffers are designed to minimize these inputs.

Residential and commercial land uses typically contribute less nutrients and sediments than agriculture, but more than forestry. These residential and commercial contributions are mainly attributable to reduced or no riparian buffers, chemical application for landscaping, and stormwater runoff.

Water Quality Monitoring

Water quality data sets in the watershed are sparse in quantity, duration, and parameters measured. Existing data sets include: STORET, a database managed by the Virginia Department of Environmental Quality (DEQ); data collections during fish surveys by the Virginia Department of Game and Inland Fisheries (DGIF) and Virginia Commonwealth University (VCU); data collections by the Chesapeake Bay National Estuarine Research Reserve in Virginia at the Virginia Institute of Marine Science (VIMS); and a now-defunct volunteer water quality monitoring program in the watershed (MPPDC, 2001).

Two stations are currently sampled regularly by the DEQ. Station DRN003.40 is located at the U.S. Route 17 bridge and Station DRN010.48 is located at the Route 603 bridge near Mascot. Data are available from DRN003.40 for the period 1968-1974 and 1992-present and from DRN010.48 for the period 1992-present. Samples are evaluated bimonthly for nutrients, fecal coliform, suspended solids, dissolved oxygen, pH, salinity, and temperature and are occasionally evaluated for pesticides, toxic metals, and other harmful compounds (MPPDC, 2001). The data sets collected at these sampling stations were used by the DEQ to list the Dragon Run as “impaired” for pH and fecal coliform bacteria. Fish tissue samples were used by the DEQ to list the Dragon Run as “impaired” for mercury and lead. The Virginia Department of Health issued a health advisory for the Dragon Run for mercury contamination in largemouth bass (DOH, 2003). The DEQ attributes the pH impairment to natural causes, citing the acidic nature of water in swamps. The DEQ lists the cause of the fecal coliform and mercury and lead impairments as unknown. Potential sources of fecal coliform bacteria include: wildlife; failing septic systems; and livestock. Potential sources of metals include: atmospheric deposition; automobile and roadway deposits; and industrial operations.

Data collected by the DGIF in 1995-1996 and 1998 includes temperature, Secchi depth, pH, dissolved oxygen, conductivity, salinity, alkalinity, hardness, and total dissolved solids. Nutrient data are very limited and were frequently below detection limits. Dissolved oxygen at sampling stations with no or low flow frequently violated daily minimum standards to support aquatic life (MPPDC, 2001).

VIMS data from 2000-2001 measured temperature, salinity, total dissolved solids, pH, dissolved inorganic nitrogen, and fecal coliform bacteria. Of specific note, samples from Briery Swamp exhibited high nitrate and fecal coliform levels, indicating the presence of subsurface agricultural or wastewater drainage (MPPDC, 2001).

A weekly volunteer water quality monitoring program collected data throughout the watershed during the period 1994-1997, although monitoring was not continuous at all eight sites. Measurements included dissolved oxygen, Secchi depth, water and air temperature, pH, and water color. The findings indicated: low dissolved oxygen during warm temperatures and high dissolved oxygen during cold temperatures; low Secchi depth values during the summer associated with algal blooms and storm events; and acidic pH values in the upper Dragon Run with slightly more basic pH values in the tidal waters (MPPDC, 2001).

Impervious Cover

One key indicator of water quality status and stream health is the percentage of impervious surface in a watershed. The Dragon Run watershed exhibits a very low level of impervious cover and, in turn, is in good condition (e.g. natural heritage resources).

Impervious surfaces (e.g. paved streets and parking lots, rooftops) are hardened areas that do not allow infiltration of rainwater and promote runoff to streams. This runoff often occurs at a higher volume and velocity than normal stream flow and can lead to stream erosion and instability. Runoff also carries pollutants that are not absorbed by soil and plants and can lead to degraded water quality. The Center for Watershed Protection (2002) has developed a watershed vulnerability analysis that relies on an impervious cover model. The model indicates that watersheds are generally in good condition when impervious cover is less than 10%. From 10-25% impervious cover, watersheds are generally impacted, which means that they only partially support their intended uses (e.g. drinking, swimming, shellfish harvest). Above 25% impervious cover, watersheds generally do not support their intended uses at all.

Impervious cover can be estimated for the Dragon Run watershed. Based on the 1994 aerial photography, we learn that 1.3% of the watershed is commercial or residential development. Assuming 100% imperviousness, a highly conservative estimate, the watershed is approximately 1.3% impervious surface. The sparse road network is likely to add modestly to this estimate. Since the Dragon Run watershed exhibits less than 10% impervious cover, the Center for Watershed Protection's model (2002) predicts that it is in good condition, which is confirmed by the MPPDC's Dragon Run Watershed Land-Water Quality Preservation Project (MPPDC, 2001).

Recreation and Access

Significant recreational activities and opportunities exist in the Dragon Run watershed, including hunting, fishing, hiking, and boating. Educational opportunities and activities also exist. Meanwhile, access often requires landowner permission; public access is limited.

Hunting represents a significant recreational activity that generates at least $300,000 per year in the watershed. Seventeen hunt clubs lease approximately 42,000 acres, or 46%, of land in the watershed for hunting - mainly deer, turkey, and waterfowl (MPPDC, 2002). Hunt club leases provide income to landowners and offer hunting access to many acres of private lands.

Fishing is also a significant recreational activity in the Dragon Run. According to the DGIF, the Dragon Run's share of the state's fishing value is more than $1.6 million, including trip related expenses such as food and lodging and transportation (MPPDC, 2002). Fishing by boat is popular in the lower Dragon, while bank and fly fishing are more common in the upper Dragon. Fishermen regularly use the public, unpaved lot at Route 603 near Mascot, and a public boat ramp exists at Harcum in the Piankatank River (Gloucester County). Otherwise, landowner permission is generally required.

The Virginia Birding and Wildlife Trail for the Coastal Area, published in 2002 (DGIF, 2002a), describes two sites within the Dragon Run watershed. First, Rappahannock Community College (public), located in Glenns on State Route 33 in Gloucester County, offers wooded trails adjacent to a tributary to the Dragon Run. Second, the Friends of Dragon Run (private) offer a birding trail with views of the Dragon Run and the Baldcypress-Tupelo Swamp community. The site is located near Mascot on Route 603 with parking in a public, unpaved lot. It is important to note that the Friends' site and adjacent properties are privately owned.

Additionally, a 121-acre tract on Route 603 near Mascot is part of the Virginia Estuarine and Coastal Research Reserve System (public). The site can be accessed with permission and is used for research, long-term monitoring and education.

Besides the sites near Route 603, the Dragon Run Access Plan (MPPDC, 1994) indicates other traditional access sites in the watershed. Landowner permission is generally required at these sites, which include: Route 604 at the Essex/King and Queen county line (Byrd's Bridge); Route 602 at the Middlesex/King and Queen county line (Ware's Bridge); and U.S. Route 17 at the Middlesex/Gloucester county line (James Vincent Morgan Bridges).

Boating is also a significant recreational activity in the watershed. Motorized pleasure craft seasonally utilize the lower Dragon. Self-propelled boating is common from Route 602 to Meggs Bay. For example, waterfowl hunters often make short trips in canoes or jon boats, while guided and unguided paddling trips also occur. Several organizations offer guided paddling trips on the Dragon Run (**Figure 13**), including Gloucester County Parks and Recreation (2 trips/summer; ~30 people/summer); Chesapeake Bay Foundation (since 1995, 56 trips; 1080 people; for middle and high school students in Middlesex and Gloucester Counties); Rappahannock Community College (1 3-day trip/year; ~20 people); and Friends of Dragon Run (15-20 trips/year; ~200 people/year). Some outdoor outfitters offer guided trips by appointment.

Figure 13. Guided paddling trip on the Dragon Run.

Watershed Education

Limited watershed education efforts include workshops, field trips, and publications. Soil and Water Conservation Districts, Virginia Cooperative Extension, and the Natural Resources Conservation Service offer a variety of workshops, seminars, and publications related to watersheds, nonpoint source pollution, agriculture, and forestry. These programs mainly target those involved in agriculture and forestry activities. Rappahannock Community College and the Chesapeake Bay Foundation both lead students on paddle trips. The Friends of Dragon Run offer paddle trips to citizens and decision-makers. Finally, local governments provide publications explaining land use regulations. For example, King and Queen and Middlesex Counties distribute fact sheets about pertinent ordinances to new and prospective property owners.

Infrastructure and Planning

To effectively characterize the watershed's landscape and how it may change in the future, existing infrastructure and plans guiding future development must be assessed.

Future Land Use

Local comprehensive plans are intended to serve as the county's guide to its vision for the future. One of the most important elements of a comprehensive plan is future land use designation. In general, future land use throughout the Dragon Run watershed is primarily designated as rural in the comprehensive plans of the four counties. There exists, however, a wide range of specific land use designations within the watershed, ranging from industrial to commercial to town-like development, rural residential and rural preservation (**Figure 14**).

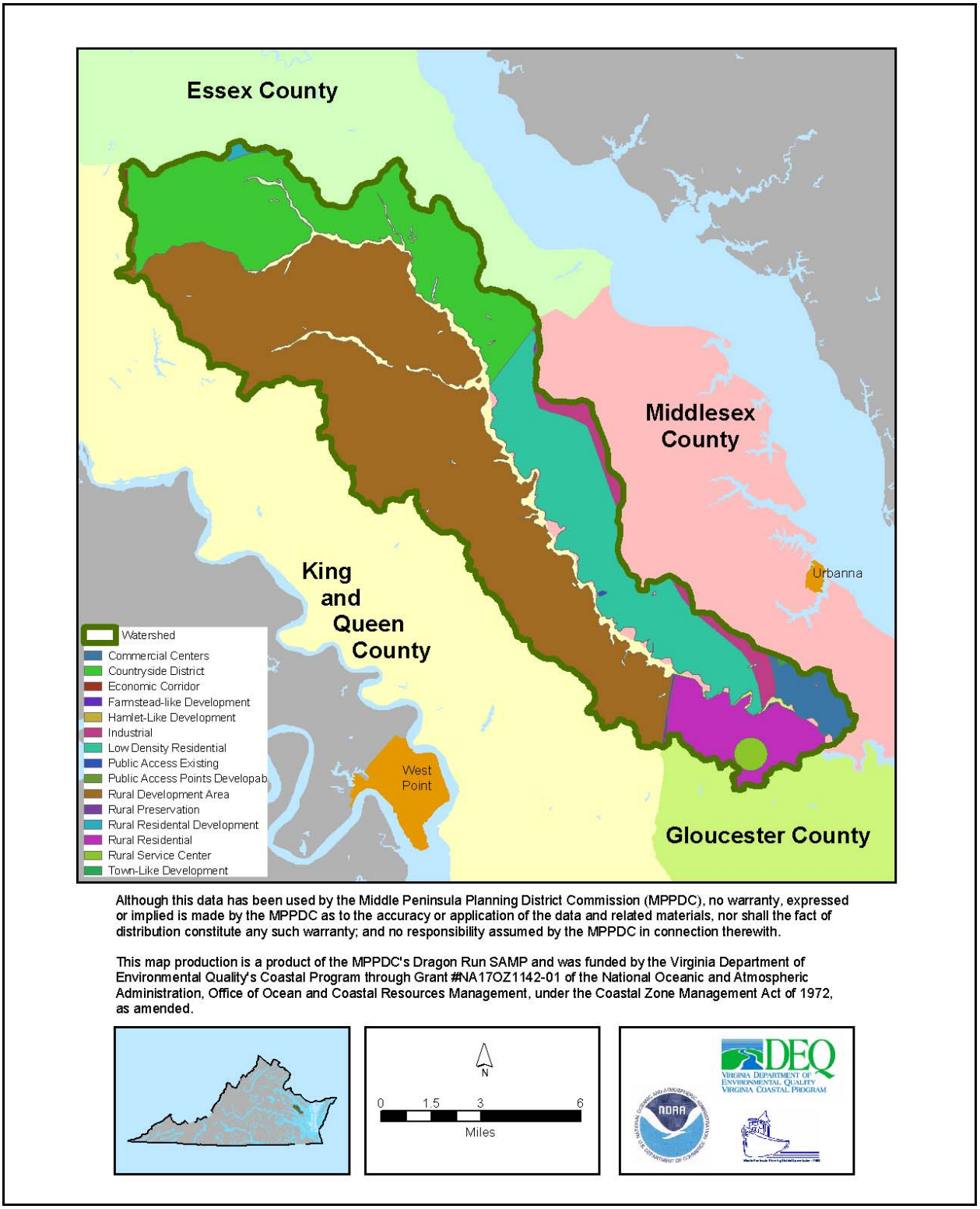


Figure 14. Future land use in the Dragon Run watershed.

Land use designations are tied to existing land uses, infrastructure, and anticipated growth patterns. It is clear through the comprehensive plans that localities expect that the majority of the watershed will remain rural, dominated by farming and forestry. Specific areas, like those along major roadways such as U.S. Route 17 and VA Route 33, are more suited to industrial and commercial development. Conversely, the swamps and streams of the Dragon Run do not lend themselves to development.

Zoning

Zoning is designed to regulate the use of land to ensure land use compatibility. Logically, then, zoning is the regulatory implementation of provisions in the comprehensive plan. Therefore, the Dragon Run watershed is zoned primarily in rural districts, with limited areas in conservation, industrial, commercial and residential districts (**Figure 15**).

The majority of the watershed is zoned for agricultural uses, with varying restrictions and allowances across county boundaries. Significant commercial and industrial zoning occurs along U.S. Route 17 throughout Gloucester and Middlesex Counties. Furthermore, the landfill in King and Queen County owned by Browning-Ferris Industries is zoned industrial. Both King and Queen and Middlesex Counties maintain the Dragon Run Conservation District along the main channel of the Dragon Run. King and Queen's Dragon Run Conservation District is not mapped.

Distinctions between major and minor subdivisions, density requirements, and permitted uses vary widely across zoning district types and among counties. As a result, on-the-ground conditions can and do vary considerably across county boundaries. For instance, the maximum number of lots permitted by right (e.g. minor subdivisions) in agricultural and conservation districts ranges from 2-6 lots.

Other Ordinances and Regulations

The counties also employ other ordinances and regulations. These include Chesapeake Bay Preservation Act provisions or ordinances, wetlands ordinances, erosion and sediment control provisions and ordinances, subdivision ordinances, and site plan review. Some of the major effects of these regulations include land use restrictions and development standards in Chesapeake Bay Preservation Areas and the prohibition of major subdivisions in agricultural zoning districts.

A major difference between the counties is how the Resource Management Areas (RMA) are defined. Gloucester County defines RMA as any area outside of the Resource Protection Area (RPA) countywide. Essex County effectively applies RMA restrictions countywide, while King and Queen and Middlesex Counties apply a buffer landward of the RPA.

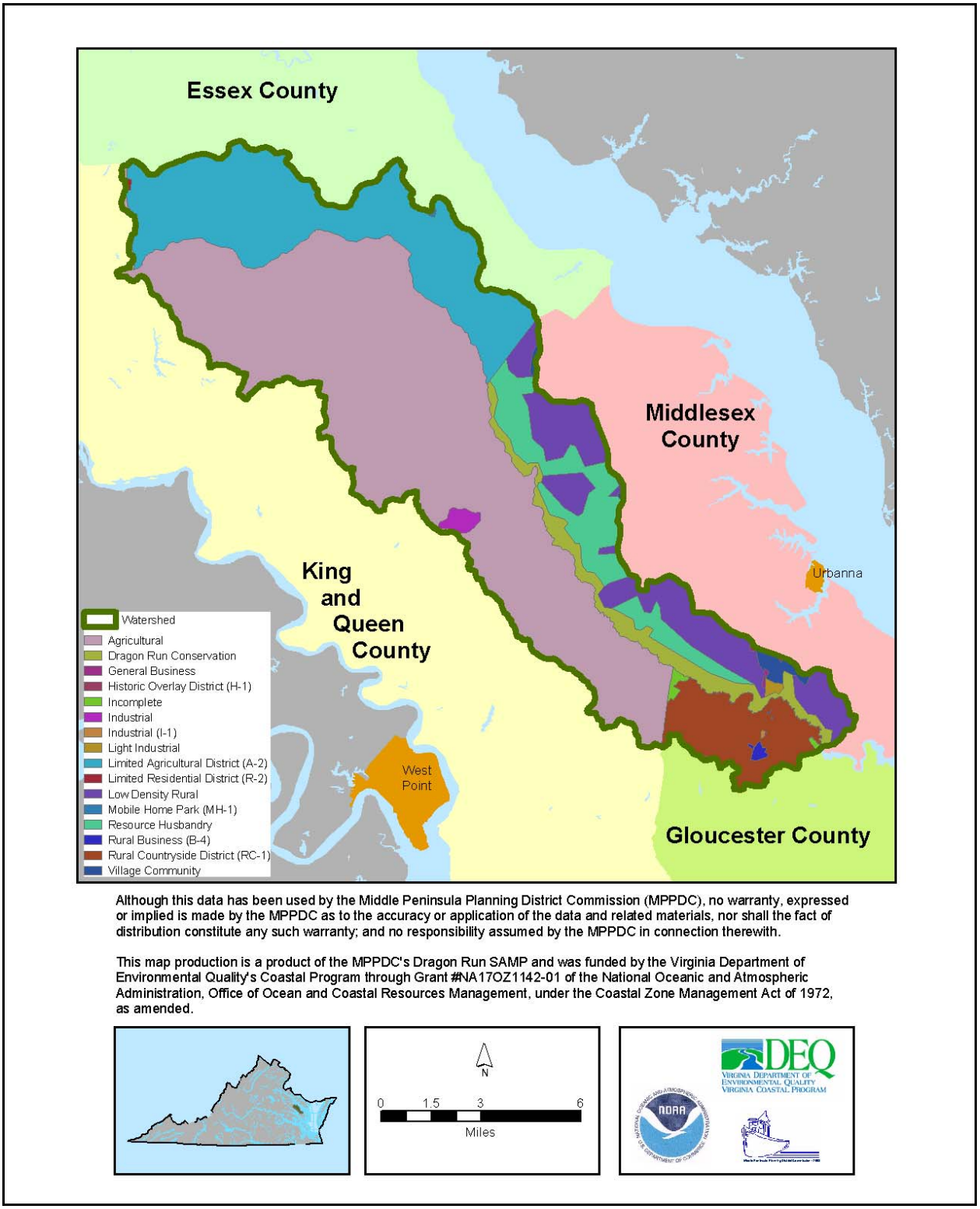


Figure 15. Zoning classifications in the Dragon Run watershed.

Road Network

The road network within the watershed could be described as sparse (**Figure 16**), with few primary highways. The primary highways are U.S. Route 17, which runs north and south through Gloucester, Middlesex, and Essex Counties, and State Route 33, which runs east and west through King and Queen, Gloucester, and Middlesex Counties. Logically, these highways contain the most development within the watershed and are designated for that purpose in the comprehensive plans. These two highways intersect at Glenns in Gloucester County and Saluda in Middlesex County, which are both designated as rural business districts. A short length of State Route 198, a primary highway, runs east from Glenns in Gloucester County before leaving the watershed.

There is a sparse network of secondary roads, some of which serve as connectors along the road network. Route 603 and Route 602 both cross the middle Dragon Run and connect King and Queen and Middlesex Counties. Route 604 and Route 612 both cross the upper Dragon Run and connect Essex and King and Queen Counties. Route 684 serves as a connector between U.S. Route 17 and U.S. Route 360 in Essex County. Several other secondary roads serve as significant links within the road network. Examples of these are: Route 644 in Middlesex County; Routes 609, 610, 616, and 617 in King and Queen County; and Route 607 in Essex County. Finally, there is a network of unpaved logging, farm, and residential roads that access the more remote parts of the watershed.

Land Parcels

According to data collected in 2001, there are 3,073 parcels of land in the Dragon Run watershed (**Figure 17**) (MPPDC, 2002). The distribution of parcels is: Essex (25%); Gloucester (11%); King and Queen (38%); and Middlesex (26%). The land area within the watershed is distributed as follows: Essex (21%); Gloucester (6%); King and Queen (52%); and Middlesex (21%). Comparing the distribution of parcels to the distribution of land area within the watershed, we find that Essex, Gloucester, and Middlesex Counties have a higher percentage of parcels than of land area, meaning that they have smaller average parcel sizes than King and Queen County. King and Queen County has a much higher percentage of land area than of parcels, indicating a much larger average parcel size than the other three counties.

Land ownership is almost entirely private. A considerable amount of private land is owned by timber interests. For example, the single largest owner, John Hancock Life Insurance Company, owns approximately 26,000 acres (28.9% of the watershed). Much of this timber land is, in turn, leased to hunt clubs. Public ownership includes the College of William and Mary (121 acres) and the Virginia Department of Transportation (fee simple and prescriptive easements for roads and right-of-way).

Conservation

The Virginia Division of Natural Heritage has established conservation planning boundaries (**Figure 18**) around natural heritage resources - rare species and natural communities - based on their habitat needs to ensure their preservation. These conservation sites represent the ideal conservation scenario for these state and globally

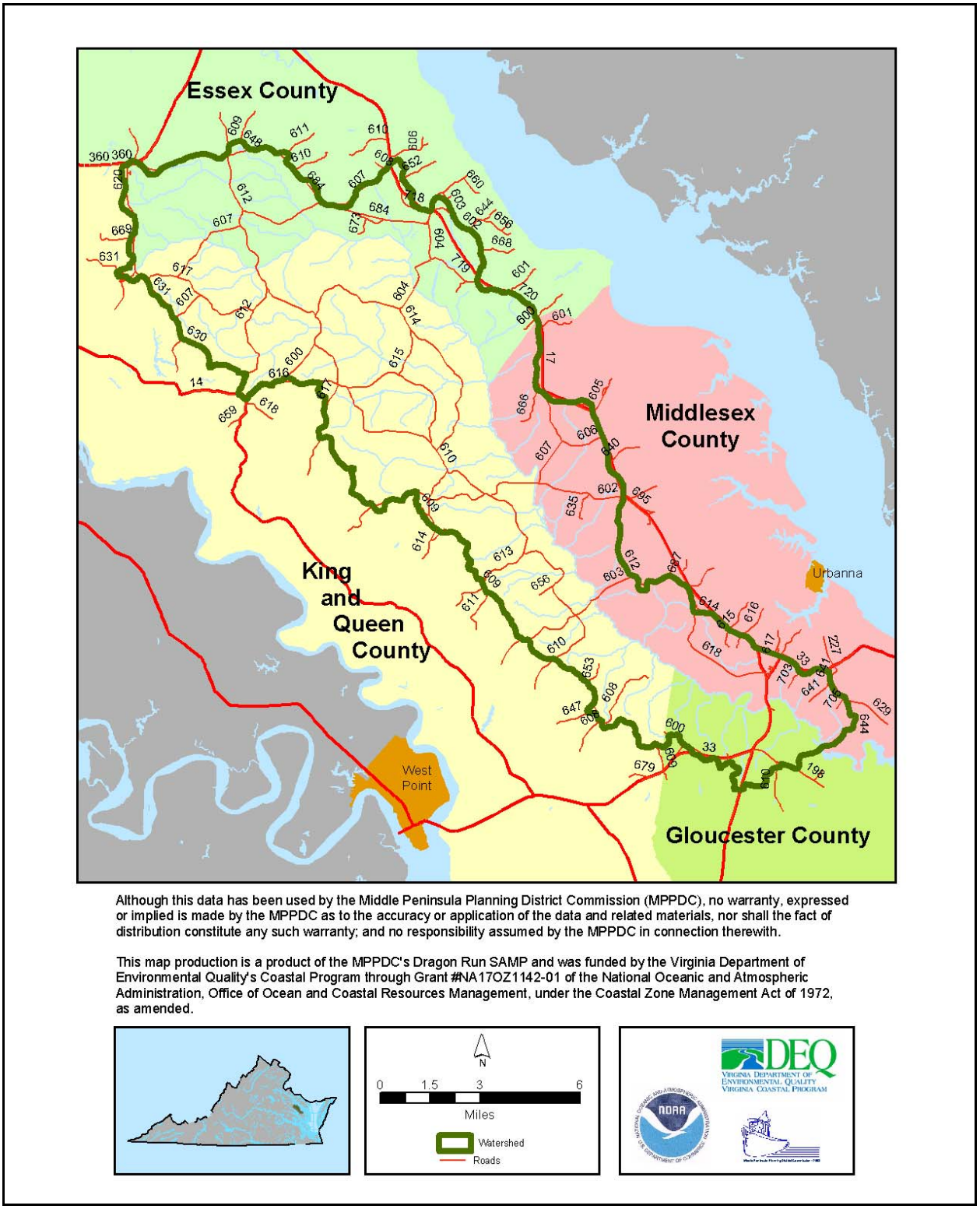


Figure 16. Road network in the Dragon Run watershed.

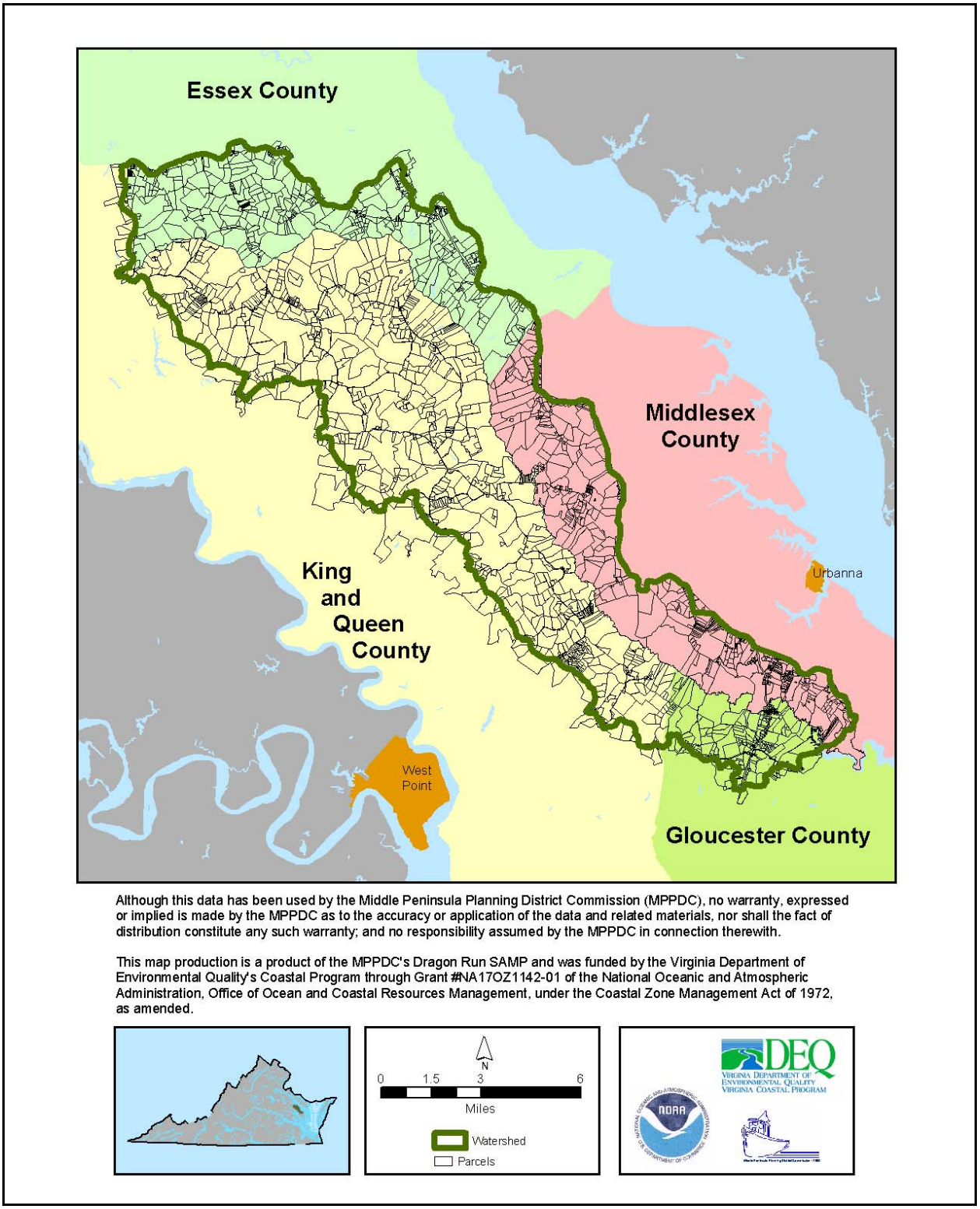


Figure 17. Parcels of land in the Dragon Run watershed.

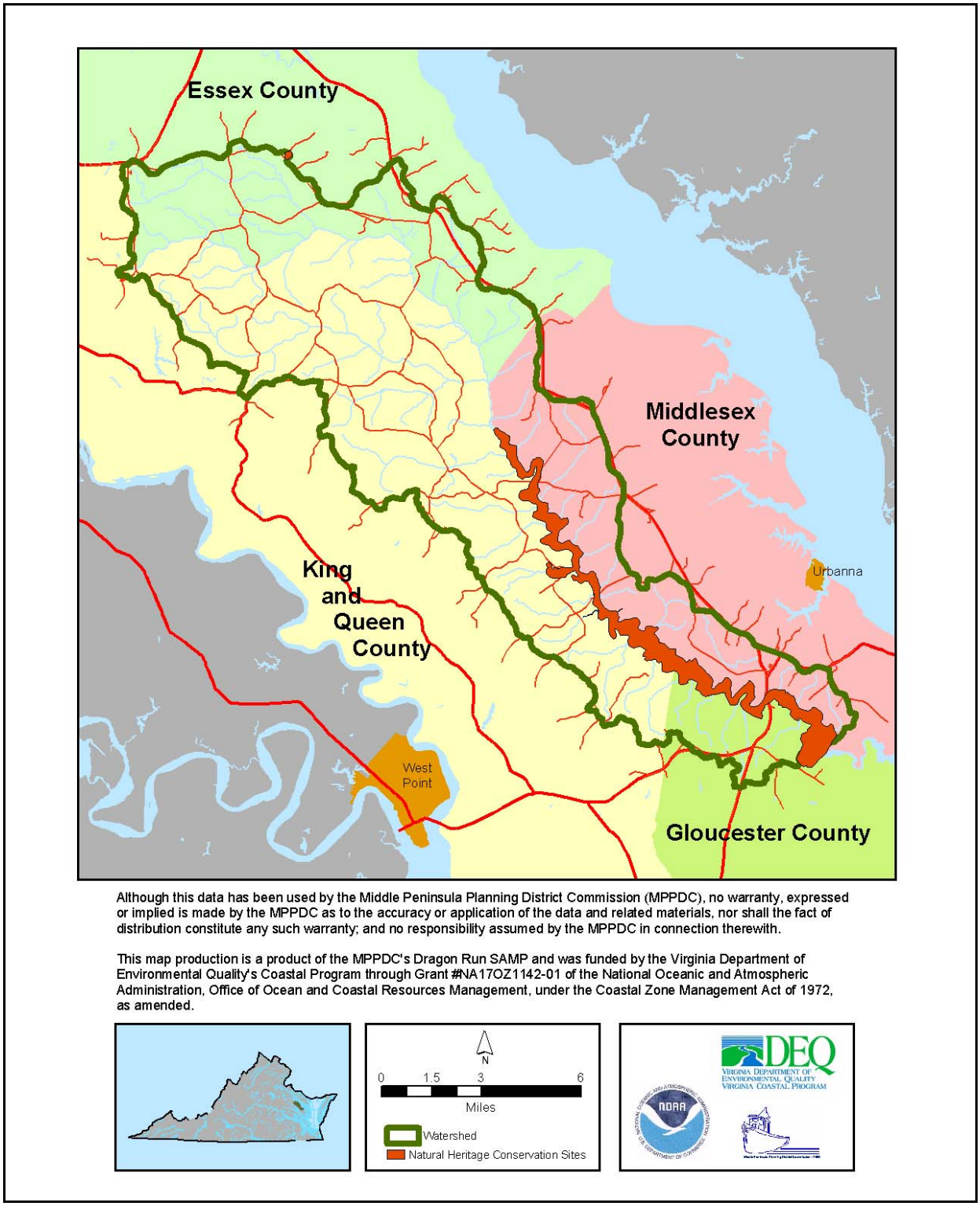


Figure 18. Natural heritage conservation sites for the Dragon Run watershed.

rare resources. Some of these resources have been conserved, either through fee simple purchase or purchase of conservation easements (**Figure 19).** Conservation easements are held on 235 acres by the Virginia Outdoors Foundation, 72 acres by Friends of Dragon Run, and 32 acres by the Chesapeake Bay Foundation.

Structures

Interpretation of digital orthophoto quadrangles from 1994 revealed that there were 1,311 structures or clusters of structures (e.g. barns and accessory buildings) in the Dragon Run watershed (**Figure 20**) (MPPDC, 2002). As expected, the majority of the structures are located along the primary highways and, to a lesser degree, along the secondary road network. It is likely that population growth and accompanying residential structures will continue to follow this pattern.

Sustainable Economic Development

Landowners find it increasingly difficult to sustain farm and forest operations. Virginia's River County, the Middle Peninsula's business development partnership, finds that sustainable economic development in the region is limited and the farming and forestry industries are suffering losses (VRC, 2002). Virginia's River Country indicates in its strategic plan that one of its priorities is to promote sustainable growth in resource-based industries (e.g. forestry, farming, nature-based tourism) to preserve natural resources from the pressures of development. In other words, the region has opportunities to develop the capacity to produce sustainable and value-added forest and agricultural products.

Buildout analysis

A buildout analysis offers an assessment of the potential number of lots allowed by land use regulations. Assessments may be based upon the number of lots allowed by right or upon the number of lots allowed by exception or by rezoning.

Based on a supplement to the *Dragon Run Land Use Policy Audit* (MPPDC, 2003), it is estimated that there is a potential for 3,916 parcels allowed by right (i.e. without the need for an exception or rezoning). This estimate is founded upon the number of lots and the minimum lot size permitted by right for minor subdivisions. The result represents a 27% increase in the potential number of parcels. An example of potential development under current land use policies in the watershed is featured in **Figure 21**.

As part of the *Dragon Run Management Framework* (MPPDC, 2002), a buildout analysis was completed based on both the potential number of lots allowed by right, by exception, or by rezoning. The analysis evaluated buildout based on both "build-compatible" values (i.e. wetlands) and "environmental" values (i.e. wetlands, topography [slope], floodplains, land cover, conservation easements, threatened and endangered species locations, and conservation species sites). An index was created based on these values and those that ranked low for development unsuitability were assessed for their development potential under current zoning designations. Based on zoning and subdivision rules, "theoretical lots" were then calculated within

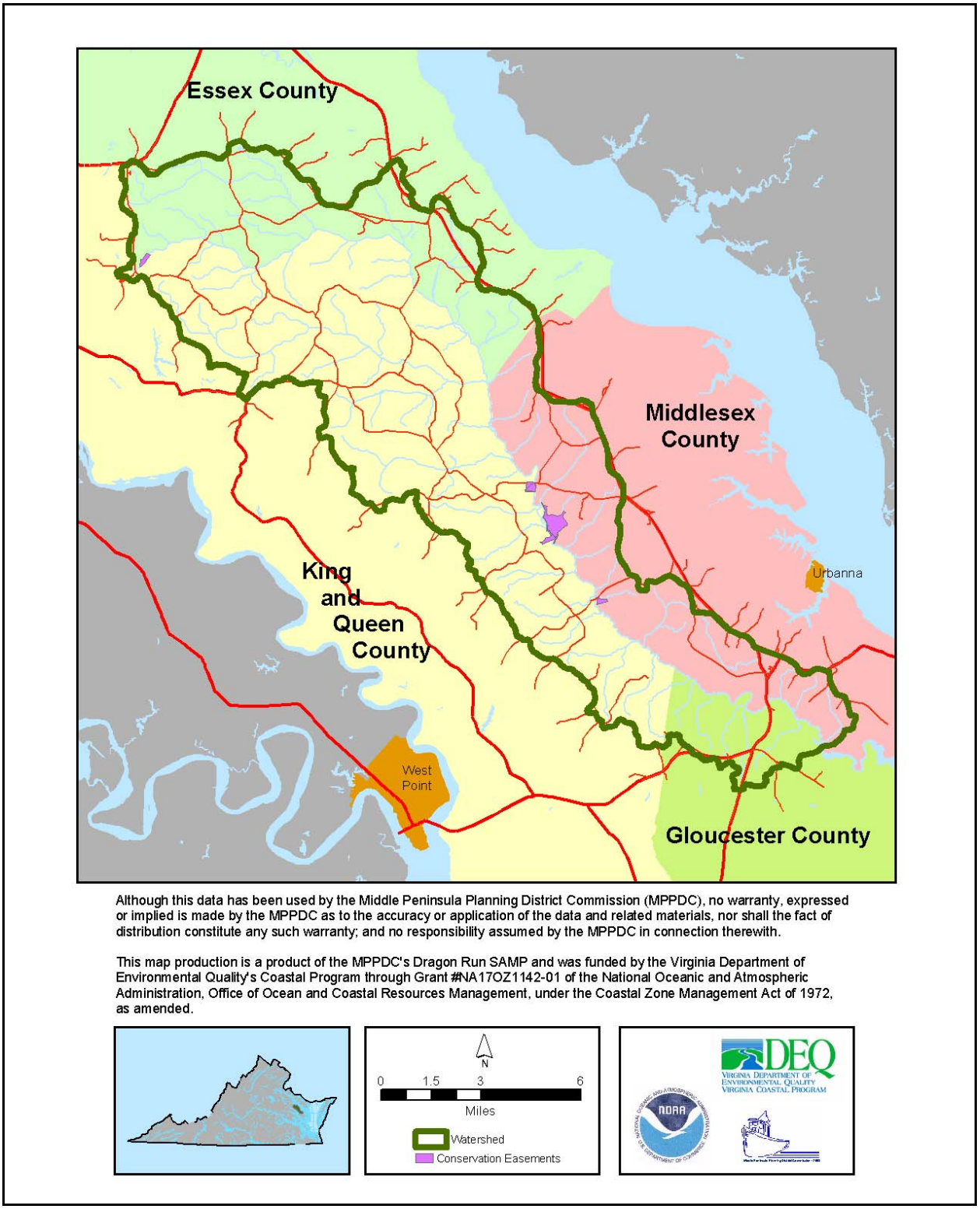


Figure 19. Conservation easements in the Dragon Run watershed.

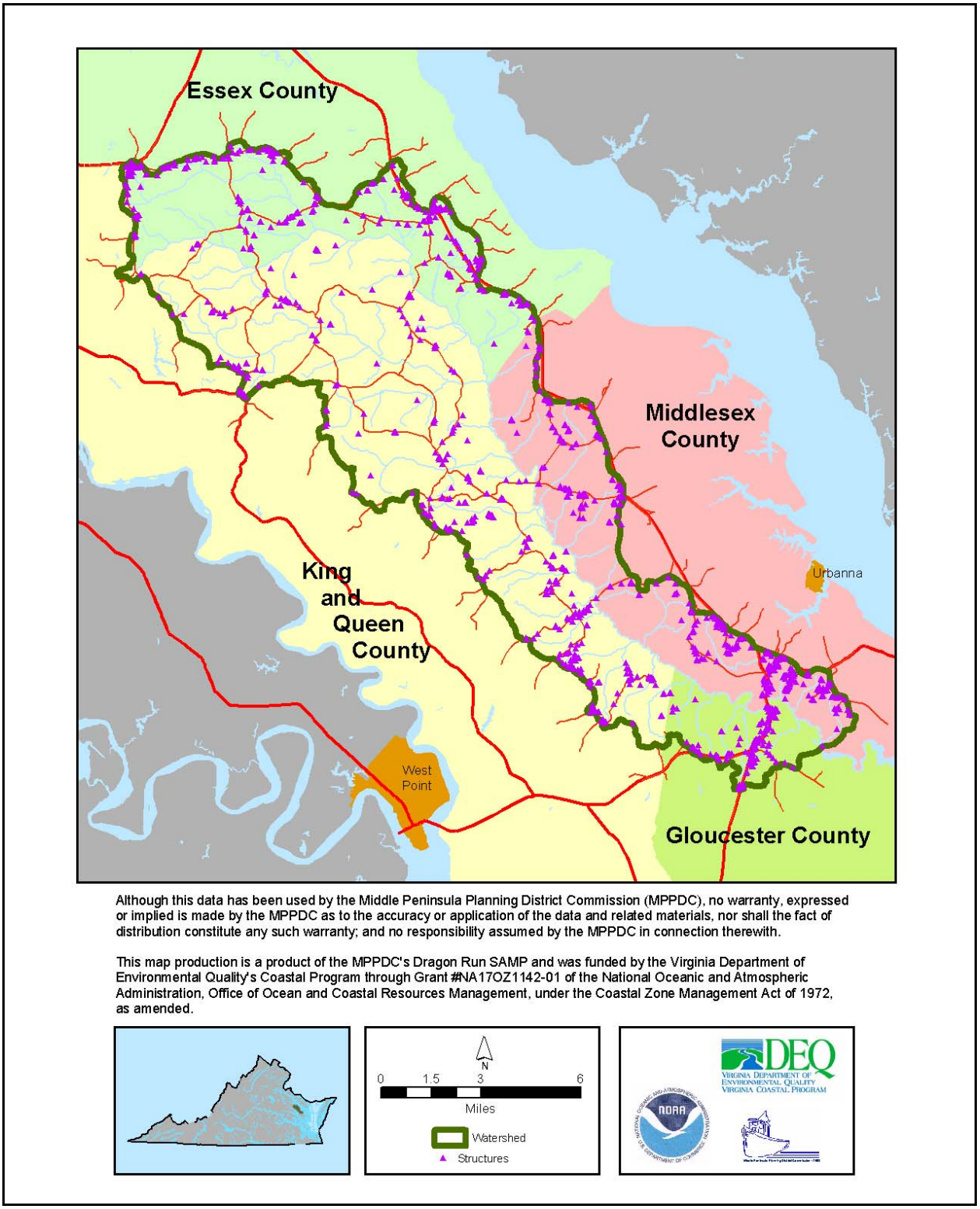


Figure 20. Structures in the Dragon Run watershed.

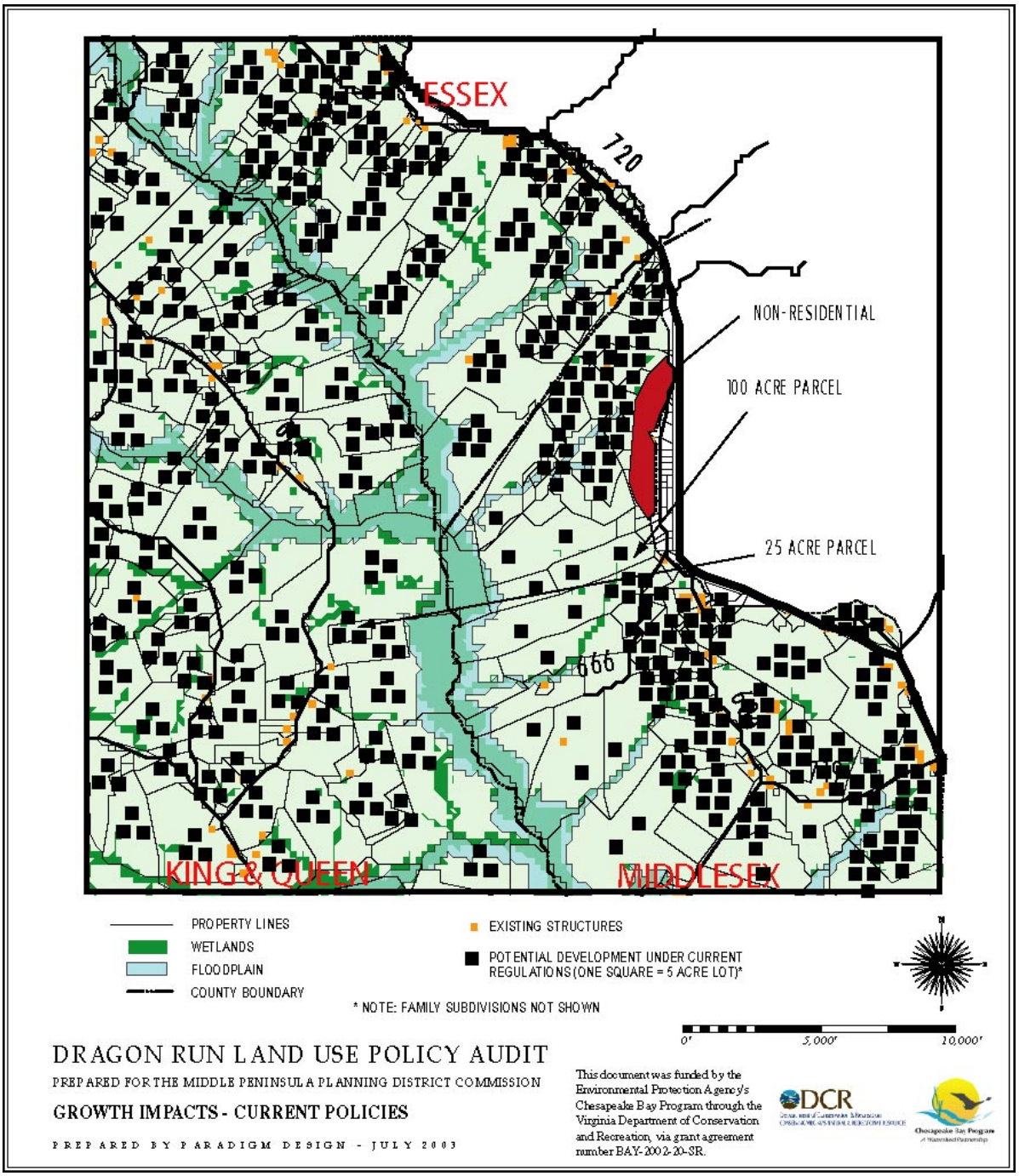


Figure 21. Potential development under current land use policies in the Dragon Run watershed (from MPPDC, 2003).

those areas that were ranked as suitable for development under both scenarios. The "build-compatible" analysis yielded a total of 40,851 theoretical lots that could be developed under current zoning, while the "environmental" analysis yielded 38,208 theoretical lots. The results of the analysis represent a 1,143% increase in the potential number of parcels based on "environmental" values and a 1,229% increase in the potential number of parcels based on "build-compatible" values.

Identified Data Gaps

Several gaps in the available data were identified. Two of these data gaps, fish communities and benthic macroinvertebrates including freshwater mussels, are being addressed by a research project being undertaken by Virginia Commonwealth University's Center for Environmental Studies (VCU). This project is anticipated to be completed during the fall of 2003. Its final report will also summarize previous data collection efforts by VCU and the Virginia Department of Game and Inland Fisheries.

Natural heritage information is available for the main channel of the Dragon Run and its adjacent swamps, but not for headwater streams and adjacent uplands. This data gap is being addressed by a natural heritage inventory of 14 sites in the upper reaches of the watershed being undertaken by the Department of Conservation and Recreation's Division of Natural Heritage. A technical report titled "A Natural Heritage Inventory of Fourteen Headwater Sites in the Dragon Run Watershed" will be completed by December 2003.

The status of invasive species in the Dragon Run is partially known. Efforts to gather more detailed information about invasive species, primarily common reed and blue catfish, are underway.

Other data gaps are not being addressed at this time. For example, there is scant information about migratory birds, other than highly specific research (e.g. bald eagle nesting assessment, colonial bird nesting assessment) and amateur observational records. The scope of a research project to comprehensively assess migratory bird activity in the watershed is tremendous and would require funding that is not available at this time.

Another data gap that is not currently being addressed is the source of water quality impairments (e.g. pH, fecal coliform, mercury, lead) for stream segments on the Virginia 303(d) list (DEQ, 2002). It is assumed that pH impairment is from natural sources (i.e. swamps are naturally acidic). Development of Total Maximum Daily Loads (TMDL) for impairments in Dragon Run stream segments are planned by the Virginia Department of Environmental Quality (DEQ) in 2010.

Finally, the effect of tax policies on the viability of farming and forestry operations is not fully understood in the watershed. The impact of tax incentive programs (e.g. land use taxation) and tax policies (e.g. taxation based on full development potential) on the sustainability of agriculture and silviculture has not been assessed.

SECTION 7: Resource Needs

Section 7 itemizes the resources needed to implement the actions in the watershed management plan. This section also identifies responsible parties and possible funding sources.

Table 3 lists Actions (**Section 4)** with responsibilities, estimates of funding needs, and possible funding sources.

ACTION	RESPONSIBILITY	FUNDING	FUNDING SOURCE
1. Land Use and Resource Preservation			
A. Designate a Unified "Dragon Run Planning Area"	MPPDC; Dragon Run Steering Committee; local governments	Minimal to moderate	MPPDC (VA Coastal Program); local governments
B. Implement Tools to Preserve Forest, Farm, and Natural Resources	Local, state, federal government; non-profits; landowners	Varies from minimal (local "right-to-farm") to considerable (PDR program)	Local, state governments; non-profits; EPA; Forest Legacy Program
C. Address Public and Landowner Access Issues	Dragon Run Steering Committee; local, regional, state gov'ts	Varies from low (signs) to considerable (land acquisition, site development)	VA Coastal Program; Public Access Authority
D. Control Invasive Species	Dragon Run Steering Committee; Invasive Species Initiative	Moderate	VA Coastal Program; DGIF; VMRC; DCR; U.S. Fish and Wildlife Service
2. Education and Landowner Stewardship	Dragon Run Steering Committee; local, state, federal gov'ts; citizens	~$20K/year; programmatic	VA Coastal Program; Dept. of Forestry; USDA/NRCS; DCR; EPA; US FWS
3.Encourage and Support Sustainable Economic Development	Dragon Run Steering Committee; local gov'ts; business	$18,000 in 2003-2004	VA Coastal Program
4. Monitor Plan Implementation	Dragon Run Steering Committee; local gov'ts	Minimal to moderate	MPPDC (VA Coastal Program); local gov'ts

Table 3. Resource needs for Dragon Run Watershed Management Plan.

SECTION 8: Progress Benchmarks

Section 8 serves as a monitoring framework for assessing the implementation of the watershed management plan.

Table 4 lists Actions from **Section 4** and their corresponding progress benchmarks, including responsible parties and anticipated completion time. This table serves as a monitoring plan framework.

ACTION	RESPONSIBILITY	BENCHMARK	COMPLETION
1. Land Use and Resource Preservation			
A. Designate a Unified "Dragon Run Planning Area"	MPPDC; Dragon Run Steering Committee; local governments	Adoption of phases of strategy in all four counties	Level 1 - September 2004; Levels 2 & 3 – 2005-2006?
B. Implement Tools to Preserve Forest, Farm, and Natural Resources	Local, state, federal government; non-profits; landowners	Use 1 or more tools to preserve 50 acres/year	Ongoing
C. Address Public and Landowner Access Issues	Dragon Run Steering Committee; local, regional, state gov'ts	Acquisition of 1 land-based site; erect trespassing signs at access points	December 2004
D. Control Invasive Species	Dragon Run Steering Committee; Invasive Species Initiative	Representation on Council; establish education materials	September 2004; ongoing
2. Education and Landowner Stewardship	Dragon Run Steering Committee; local, state, federal gov'ts; citizens	Establish festival and awards; perform 6 trips/year; post signs along major roadways; develop forest stewardship plans (5/year); enrollment in farm programs (100 acres/year); complete one action-based project/year	December 2004; ongoing
3. Encourage and Support Sustainable Economic Development	Dragon Run Steering Committee; local gov'ts; business	Complete sustainable economic development report; promote Coastal Birding Trail	September 2004; ongoing
4. Monitor Plan Implementation	Dragon Run Steering Committee; local gov'ts	Complete Table 4	As designated

Table 4. Benchmarks for monitoring the Dragon Run Watershed Management Plan.

SECTION 9: Conclusions

Section 9 reminds readers of the watershed management plan's purpose. This section recalls the plan's citizen-initiated beginnings and that it serves as a vision for the future of the Dragon Run watershed.

This watershed management plan for the Dragon Run watershed represents a body of work by citizens, stakeholders, and decision-makers to achieve a common vision for the future – the preservation of the traditional uses and unique resources in the pristine Dragon Run. It is a symbol of regional cooperation and coordination that crosses jurisdictional boundaries. It is the next logical step on the path towards protecting the Dragon Run watershed and preserving its cultural, historic, and natural heritage for future generations.

The plan's goals and objectives (**Section 3**) speak to the major issues at play in the watershed. Its actions (**Section 4**) attempt to address those issues. Together, they are a road map for the watershed.

The plan also captures the current status and state of knowledge of the watershed (**Section 6**). It highlights what we know and what we do not know. It also offers a mechanism for monitoring plan implementation by comparing the baseline watershed information to future results. Progress benchmarks are the basis for this monitoring (**Section 8**). The plan designates responsibility for plan implementation (**Sections 7 & 8**) and estimates costs and funding sources (**Section 7**).

The watershed management plan is not a static document. It is not an end in and of itself. It is a citizen-initiated vision for the future of the watershed that may be modified as situations change or as new information becomes available. It is a vision that harnesses the passion and energy for the Dragon Run (**Figure 22**) of those who live, work and play in its watershed.

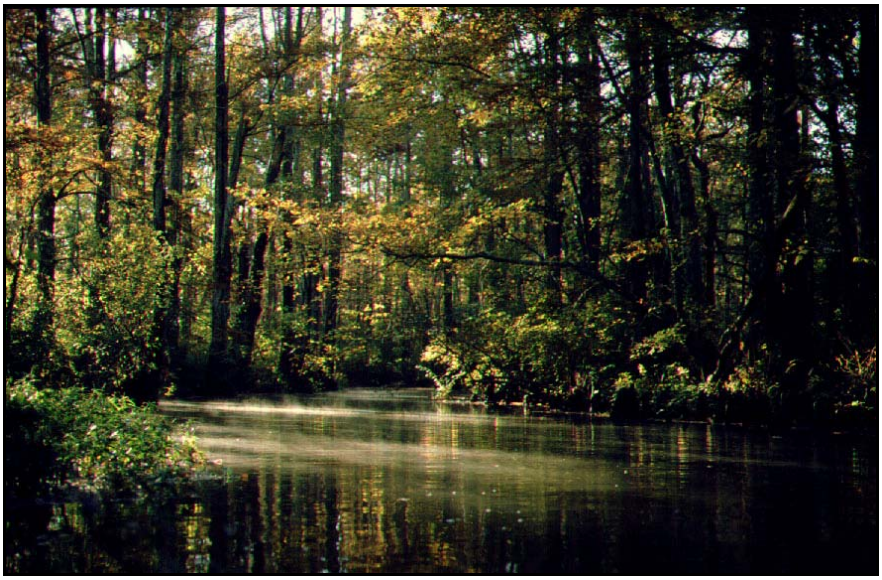


Figure 22. A misty morning on the Dragon Run (Credit: Teta Kain)

SECTION 10: Literature Cited

Belden, A. Jr., A.C. Chazal, G.P. Fleming, C.S. Hobson, and K.M. McCoy. 2001. A Natural Heritage Inventory of the Dragon Run Watershed. Second edition. Natural Heritage Technical Report 01-03. Virginia Department of Conservation and Recreation, Division of Natural Heritage, Richmond, VA. 64 pp. plus appendix.

Belden, A. Jr., A.C. Chazal, and C.S. Hobson. 2003. A Natural Heritage Inventory of Fourteen Headwater Sites in the Dragon Run Watershed. Natural Heritage Technical Report 03-16. Virginia Department of Conservation and Recreation, Division of Natural Heritage, Richmond, VA.

Center for Watershed Protection. 2002. Watershed Vulnerability Analysis. Center for Watershed Protection, Ellicott City, MD. http://www.cwp.org.

DeHardit, E., D. Miller, and J. Uzel. 1996. Dragon Run Watershed Management Plan. Middle Peninsula Planning District Commission, Saluda, Virginia.

Department of Agriculture and Consumer Services. October 23, 2003. Virginia Agriculture: Facts and Figures web page. Virginia Department of Agriculture and Consumer Services, Richmond, VA. http://www.vdacs.state.va.us/agfacts/index.html.

Department of Conservation and Recreation. 2002. The Biennial Nonpoint Source Pollution Water Quality Assessment Report. Virginia Department of Conservation and Recreation, Division of Soil and Water Conservation, Richmond, VA.

Department of Conservation and Recreation. 2003a. Natural Heritage Resources Maps. Virginia Department of Conservation and Recreation, Division of Natural Heritage, Richmond, VA.

Department of Conservation and Recreation. 2003b. Virginia 2002 Nonpoint Source (NPS) Assessment Landuse/Area web site. Virginia Department of Conservation and Recreation, Division of Soil and Water Conservation, Richmond, VA. http://192.206.31.52/cfprog/dswc/lutype.cfm.

Department of Environmental Quality. 2002. 2002 303(d) Report on Impaired Waters. Virginia Department of Environmental Quality, Richmond, VA. http://www.deq.state.va.us/water/303d.html.

Department of Forestry. 2002. Virginia's Forestry Best Management Practices for Water Quality, Fourth Edition. Virginia Department of Forestry, Charlottesville, VA, July 2002.

Department of Forestry. October 23, 2003. Economic Impact of the Forest Industry in Virginia web page. Virginia Department of Forestry, Charlottesville, VA. http://www.dof.state.va.us/resinfo/economic-impact.shtml.

Department of Game and Inland Fisheries. 2002a. Virginia Birding and Wildlife Trail: Coastal Area. Virginia Department of Game and Inland Fisheries, Richmond, VA. http://www.dgif.state.va.us/wildlife/vbwt/trail.asp.

Department of Game and Inland Fisheries. 2002b. Watchable Wildlife…What's in Your Field of Vision?: An Introduction to Wildlife Viewing and the Virginia Birding and Wildlife Trail. Presentation to Northampton County, October 2002. Virginia Department of Game and Inland Fisheries, Richmond, VA.

Fleming, G.P., P.P. Coulling, D.P. Walton, K.M. McCoy, and M.R. Parrish. 2001. The natural communities of Virginia: classification of ecological community groups. First approximation. Natural Heritage Technical Report 01-1. Virginia Department of Conservation and Recreation, Division of Natural Heritage, Richmond, VA. Unpublished report. January 2001. 76 pp.

Garman, G.C. 2003. Aquatic Living Resources Inventories in the Dragon System: Virginia Commonwealth University On-going Activities. Dragon Run Natural Resources Symposium, February 11, 2003, Virginia Institute of Marine Science, Gloucester Point, VA.

Hoppe, D.A.S. 1989. Soil Survey of Essex County, Virginia. U.S. Dept. of Agriculture, Soil Conservation Service in cooperation with Virginia Polytechnic Institute and State University, Blacksburg, VA.

Jenkins, D.W. 1974. Natural Areas of the Chesapeake Bay Region: Ecological Priorities. Center for Natural Areas, Ecology Program, Smithsonian Institution, Washington, D.C.

James City County. October 23, 2003. Protecting Resources in Delicate Environments: PRIDE web page. James City County Department of Development Management, Williamsburg, VA. http://www.protectedwithpride.org/.

McIninch, S.P., G.C. Garman, L. Smock, and W. Shuart. 2003. Preliminary Aquatic Living Resources Inventory. Virginia Commonwealth University, Center for Environmental Studies, Richmond, VA. Prepared for Middle Peninsula Planning District Commission.

Middle Peninsula Planning District Commission. 1972. Charter Agreement of the Middle Peninsula Planning District Commission. Middle Peninsula Planning District Commission, Saluda, VA, April 1, 1972.

Middle Peninsula Planning District Commission. 1994. Dragon Run Access Plan. Middle Peninsula Planning District Commission, Saluda, Virginia.

Middle Peninsula Planning District Commission. 2001. Dragon Run Watershed Land-Water Quality Preservation Project. Middle Peninsula Planning District Commission, Saluda, Virginia.

Middle Peninsula Planning District Commission. 2002. Dragon Run Management Framework. Middle Peninsula Planning District Commission, Saluda, Virginia. Prepared by Anderson and Associates, Richmond, Virginia.

Middle Peninsula Planning District Commission. 2003. Dragon Run Land Use Policy Audit. Middle Peninsula Planning District Commission, Saluda, Virginia. Prepared by Paradigm Design, Reston, Virginia.

Natural Resources Conservation Service. October 23, 2003a. U.S. Department of Agriculture, Natural Resources Conservation Service, Washington, D.C. October 23, 2003. http://www.nrcs.usda.gov/.

Natural Resources Conservation Service. October 23, 2003b. Electronic Field Office Technical Guides web site. U.S. Department of Agriculture, Natural Resources Conservation Service, Washington, D.C. http://www.nrcs.usda.gov/technical/efotg/.

Newhouse, M.E., P.R. Cobb, L.F. Baldwin, and D.V. McCloy. 1985. Soil Survey of Middlesex County, Virginia. U.S. Dept. of Agriculture, Soil Conservation Service in cooperation with Virginia Polytechnic Institute and State University, Blacksburg, VA.

Newhouse, M.E., P.R. Cobb, W.S. Barnes, and D.V. McCloy. 1980. Soil Survey of Gloucester County, Virginia. U.S. Dept. of Agriculture, Soil Conservation Service in cooperation with Virginia Polytechnic Institute and State University, Blacksburg, VA.

Smither, J.M., R.M. Thomas, D.B. Geeson, and R.S. Morris. 2003. Shoreline Sanitary Survey: Piankatank River, Upper; Gloucester, Mathews, and Middlesex Counties. Virginia Department of Health, Division of Shellfish Sanitation, White Stone, VA.

Vanlandingham, M.L. 2003. SEAS Report #T03063. Virginia Department of Conservation and Recreation, York/Rappahannock Watershed Office, Tappahannock, VA, April 18, 2003.

Virginia Farm Bureau. October 23, 2003. Virginia Farm Bureau, Richmond, VA. http://www.vafb.com.

APPENDIX A: Rare Species and Natural Communities

Table 4 indicates the rare species and natural communities that have been found in the Dragon Run watershed, according to the Virginia Division of Natural Heritage (Belden, Jr. et al., 2001; Belden, Jr. et al., 2003).

SCIENTIFIC NAME	COMMON NAME	STATUS
Animals		
Atlides halesus	Great purple hairstreak	S2, S3
Enallagma weewa	Blackwater bluet	S1
Epitheca spinosa	Robust baskettail	S2
Haliaeetus leucocephalus	Bald eagle	S2
Helocordulia selysii	Selys' sunfly	S2
Isoparce cupressi	Cypress sphinx	S1, S3
Somatochlora filosa	Fine-lined emerald	S2
Wyeomyia haynei	Southern pitcher-plant mosquito	S1
Plants		
Bolboschoenus fluviatillis	River bulrush	S2
Cardamine pratensis	Cuckooflower	S1
Carex decomposita	Cypress-knee sedge	S2
Chelone oblique	Red turtlehead	S1
Desmodium strictum	Pineland tick-trefoil	S2
Eriocaulon parkei	Parker's pipewort	S2
Sarracenia purpurea var. purpurea	Northern purple pitcher-plant	S2
**Hottonia inflata	Featherfoil	S3
**Ranunculus flabellaris	Yellow water crowfoot	S3
Natural Communities		
Baldcypress-Tupelo Swamp		
Fluvial Terrace Woodland		
Tidal Baldcypress-Tupelo Swamp		
Tidal Baldcypress Woodland/Savanna		
Tidal Freshwater Marsh		

S1 = Extremely rare; usually 5 or fewer occurrences in the state; or may have a few remaining individuals; often especially vulnerable to extirpation.

S2 = Very rare; usually between 5 and 20 occurrences; or few occurrences with many individuals; often susceptible to becoming endangered.

S3 = Rare to uncommon; usually between 20 to 100 occurrences; may have fewer occurrences, but with a large number of individuals in some populations; may be susceptible to large-scale disturbances

** = No longer tracked by the Division of Natural Heritage; placed on watchlist due to an increased number of documented occurrences within the state since 2001

Table 4. Rare species and natural communities in the Dragon Run watershed.

The following descriptions of natural communities are taken from *The Natural Communities of Virginia* (Fleming et al., 2001).

Bald Cypress-Tupelo Swamps

Seasonally to semipermanently flooded forests of backswamps, sloughs, and low terraces of Coastal Plain rivers and large streams. These swamp forests are distributed throughout southeastern Virginia, north to Dragon Swamp (Gloucester, King and Queen, and Middlesex Counties). Habitats are deeply flooded (up to 1m) for part of the year; most retain at least some standing water throughout the growing season. Microtopography is often pronounced with small channels, swales, tree-base hummocks, and numerous bald cypress "knees." Tree canopies vary from mixed stands of bald cypress (Taxodium distichum), water tupelo (Nyssa aquatica), and swamp tupelo (N. biflora) to nearly pure stands of one species or another. The three dominants have complex competitive and successional relationships. As a rule, the two tupelos are less shade-tolerant than bald cypress and regenerate more readily by sprouting in cut-over stands. Thus, tupelos tend to become dominant when bald cypress stands are heavily logged. Green ash (Fraxinus pennsylvanica) and red maple (Acer rubrum) are occasional canopy associates and frequent understory trees. Carolina ash (F. caroliniana) is often dominant in the small tree and shrub layers, while vines of climbing hydrangea (Decumaria Barbara) are often abundant. Herb layers vary from sparse to rather lush. Most herbaceous plants of bald cypress-tupelo swamps are tolerant of muck soils and fluctuating water levels, or are capable of becoming established on tree hummocks, stumps, and logs. A few of the typical herbs are lizard's tail (Saururus cernuus), false nettle (Boehmeria cylindrical), Walter's St. John's-wort (Triadenum walteri), swamp beggar-ticks (Bidens discoidea), weak stellate sedge (Carex seorsa), giant sedge (Carex gigantean), taperleaf bugleweed (Lycopus rubellus), and pale mannagrass (Torreyochloa pallida). Although community types in this group are relatively common, high-quality specimens of the dominant trees are known to provide nesting habitats for the globally uncommon, state-rare eastern big-eared bat (Corynorhinus rafinesquii macrotis) and southern myotis (Myotis austroparius). Old-growth stands of bald cypress-tupelo swamp with trees up to 800 years old occur along the Blackwater River in Surry and Isle of Wight Counties. References: Fleming and Moorhead (1998), Parker and Wyatt (1975), Plunkett and Hall (1995).

Tidal Bald Cypress Forests and Woodlands

Coniferous or mixed swamp forests and woodlands occurring along the upper tidal reaches of rivers in southeastern Virginia. Examples are documented from the Dragon Swamp/Piankatank River (Gloucester, King and Queen, and Middlesex Counties), the Chickahominy River (Charles City, James City, and New Kent Counties), the James River (Isle of Wight and Surry Counties), and the wind-tidal Northwest River (City of Chesapeake). At some sites, these communities occur in ecotones between tidal marshes and non-tidal backswamps or uplands. Bald cypress (Taxodium distichum) dominates the open to very open canopy, with or without hardwood associates such as swamp tupelo (Nyssa biflora), water tupelo (Nyssa aquatica), and green ash (Fraxinus pennsylvanica). Stand structure and canopy cover range from closed forest to very open woodland. Shrub and herb layers are variable but generally contain a mixture of species characteristic of both marshes and swamps. Some well-developed tidal bald cypress forests appear floristically similar to palustrine bald cypress-tupelo swamps. Other stands have a nearly monospecific herb dominance by shoreline sedge (Carex hyalinolepis). In a unique, possibly fire-influenced, savanna-like stand on the Northwest River, the herbaceous dominants, in rough seasonal order, are silvery sedge (Carex canescens spp. Disjuncta), spikerushes (Eleocharis fallax and E. rostellata), marsh rattlesnake-master (Eryngium aquaticum var. aquaticum), and wild rice (Zizania aquatica var. aquatica). The environmental dynamics, compositional variation,

and state-wide distribution of this group are poorly known and need intensive study. Reference: Fleming and Moorhead (1998).

Fluvial Terrace Woodlands

A somewhat enigmatic group of communities occurring on flat, sandy terraces and islands along Coastal Plain rivers in eastern Virginia. These habitats are elevated well above the level of adjacent swamps and are characterized by xeric, sandy soils and open forest or woodland vegetation. Single occurrences have been documented along the Nottoway River (Sussex County), Chickahominy River (New Kent County), Dragon Swamp (Middlesex County), and Mattaponi River (Caroline County). At all four sites, hickories (Carya pallida and C. alba) are dominant trees, with drought-tolerant oaks (Quercus falcate, Q. nigra, Q. marilandica, Q. alba) present in smaller numbers. Shrubs occurring at all or most sites include sand post oak (Q. margarettiae), horse-sugar (Symplocos tinctoria), American holly (Ilex opaca var. opaca), and eastern red cedar (Juniperus virginiana var. virginiana). Typical herbs include sedges (Carex albicans var. australis, C. pensylvanica, and C. tonsa), Canada frostweed (Helianthemum canadense), butterfly-pea (Clitoria mariana), late goldenrod (Solidago tarda), and prickly-pear (Opuntia humifusa). The Dragon Run site is anomalous in the presence (despite low soil pH and base status) of several calciphiles such as eastern redbud (Cercis canadensis var. canadensis), wild columbine (Aquilegia canadensis), smooth rock-cress (Arabis laevigata var. laevigata), robin's-plantain (Erigeron pulchellus var. pulchellus), and elm-leaved goldenrod (Solidago ulmifolia var. ulmifolia). A full understanding of the status and compositional relationships of this group will require additional inventory and assessment.

Tidal Freshwater Marshes

A diverse group of herbaceous wetlands subject to regular diurnal flooding along upper tidal reaches of inner Coastal Plain river and tributaries. Freshwater marshes occur in the uppermost portion of the estuarine zone, where the inflow of saltwater from tidal influence is diluted by a much larger volume of freshwater from upstream. Strictly speaking, freshwater conditions have salt concerntrations <0.5 ppt, but pulses of higher salinity may occur during spring tides or periods of unusually low river discharge. The most common species are arrow-arum (Peltandra virginica), dotted smartweed (Polygonum punctatum), wild rice (Zizania aquatic var. aquatica), pickerelweed (Pontederia cordata), rice cutgrass (Leersia oryzoides), tearthumbs (Polygonum arifolium and P. sagittatum), and beggar-ticks (Bidens spp.). Locally, sweetflag (Acorus calamus) and southern wild rice (Zizaniopsis miliacea) may form large dominance patches. Species diversity and vegetation stature vary with salinity, duration of inundation, and disturbance; the most diverse marshes occupy more elevated surfaces in strictly freshwater regimes. Mud flats that are fully exposed only at low tide support nearly monospecific stands of spatterdock (Nuphar advena), although cryptic submerged aquatic species may also be present. Tidal freshwater marshes are best developed on sediments deposited by large meanders of the Pamunkey and Mattaponi Rivers, although outstanding examples also occur along the Potomac, Rappahannock, Chickahominy, and James Rivers. These communities provide the principal habitat for the globally rare plant sensitive joint-vetch (Aeschynomene virginica). Chronic sea-level rise is advancing the salinity gradient upstream in rivers on the Atlantic Coast, leading to shifts in vegetation composition and the conversion of some tidal freshwater marshes into oligohaline marshes. Tidal Freshwater Marshes are also threatened by the invasive exotic marsh dewflower (Murdannia keisak). Several communities in this group are chiefly restricted to the Chesapeake Bay drainage basin and are considered globally rare or uncommon. References: Parker and Wyatt (1975), Perry and Atkinson (1997), Perry and Hershner (1999), McCoy and Fleming (2000).

APPENDIX B: Memorandum of Agreement

Memorandum of Agreement

Between

Middle Peninsula
Planning District Commission

County of Essex, Virginia

County of Gloucester, Virginia

County of King and Queen, Virginia

County of Middlesex, Virginia

To Participate in the

Dragon Run Watershed
Special Area Management Plan

Memorandum of Agreement
Between

Middle Peninsula Planning District Commission
County of Essex, Virginia
County of Gloucester, Virginia
County of King and Queen, Virginia
County of Middlesex, Virginia

To Participate in the
Dragon Run Watershed Special Area Management Plan

1. PARTIES TO THE AGREEMENT

This Memorandum of Agreement (MOA) is between the following entities:

- Middle Peninsula Planning District Commission
- County of Essex, Virginia
- County of Gloucester, Virginia
- County of King and Queen, Virginia
- County of Middlesex, Virginia

2. ENABLING AUTHORITY

Counties of Essex, Gloucester, King and Queen, and Middlesex

Section 15.2-1300 of the Code of Virginia enables local governments to enter into cooperative agreements to exercise those powers that each may be enabled to exercise.

Middle Peninsula Planning District Commission

Section 15.2-4205 of the Code of Virginia enables the Middle Peninsula Planning District Commission to enter into cooperative agreements with local governments to exercise those powers that each may be enabled to exercise.

3. CONTEXT

The Dragon Run is a brackish water stream that flows forty miles through the Virginia Middle Peninsula counties of Essex, King and Queen, Middlesex, and Gloucester and eventually empties into the Piankatank River. The Dragon Run Watershed has been defined for the purposes of this Agreement as the Commonwealth Hydrologic Unit ID ‘CO2’ described by the Virginia Department of Conservation and Recreation from the streams’ headwaters down to and including Meggs Bay (see Appendix).

The Dragon Run's pristine nature can, in large part, be attributed to exemplary landowner stewardship and difficult access and is a central part of the region's culture and identity. Ecologically unique, the Dragon Run was ranked second of 232 ecologically significant areas throughout the Chesapeake Bay region by the Smithsonian Institution and is characterized by extensive tidal and nontidal cypress swamp, which is otherwise rare this far north. Furthermore, the Virginia Division of Natural Heritage recognizes the importance of the Dragon Run due to occurrences of one endangered animal species, five rare animal species, eight rare plant species, and five rare natural communities. Moreover, the Dragon Run Watershed supports a high quality of life for its residents. For example, recreational activities, such as hunting, fishing, and paddling, are popular in the Dragon Run.

The Middle Peninsula Planning District Commission, advised by the Dragon Run Steering Committee, obtained a Virginia Coastal Resources Management Program grant for the development of the Dragon Run Watershed Special Area Management Plan (SAMP). Each county in the watershed makes three appointments – one elected official and two landowners along the Dragon Run – to the Dragon Run Steering Committee. The SAMP Advisory Group, which reports to the Steering Committee, represents a cross-section of the community, including: Steering Committee members; local government elected officials and planning staff; landowners; state agencies; farming; forestry; education; non-profit organizations; and ecotourism.

4. PURPOSE AND TERMS OF THE AGREEMENT

The project's mission, as recommended by the SAMP Advisory Group to the Dragon Run Steering Committee, is to support and promote community-based efforts to preserve the cultural, historic, and natural character of the Dragon Run, while preserving property rights and the traditional uses within the watershed.

Each of the signatory entities in this Memorandum of Agreement agrees to participate in the Special Area Management Plan to promote the distinctive treatment deserving of the Dragon Run Watershed through the support and efforts of local government, the fostering of educational partnerships and grassroots support and the involvement of landowners whose stewardship has served to preserve the wonder of the Dragon. The signatories will consider the recommendations of the Dragon Run Steering Committee's SAMP Advisory Group to achieve the following goals and objectives that it developed by consensus:

GOAL I
Establish a high level of cooperation and communication between the four counties within the Dragon Run Watershed to achieve consistency across county boundaries.

OBJECTIVE A
Develop a plan to address the inevitable future development pressure to change the traditional use of land in the Dragon Run Watershed.

OBJECTIVE B
Achieve consistency across county boundaries among land use plans and regulations in order to maintain farming and forestry and to preserve natural heritage areas by protecting plants, animals, natural communities, and aquatic systems.

OBJECTIVE C
Provide ongoing monitoring of existing plans and planning tools in order to assess traditional land uses and watershed health and take action necessary to preserve the watershed.

OBJECTIVE D
Comprehensively implement Best Management Practices (BMPs) for water quality, wildlife habitat, and soil conservation.

GOAL II
Foster educational partnerships and opportunities to establish the community's connection to and respect for the land and water of the Dragon Run.

OBJECTIVE A
Encourage experience-based education consistent with the Stewardship and Community Engagement goals of the Chesapeake 2000 Agreement.

OBJECTIVE B
Promote the community and economic benefits of the Dragon Run derived from its natural characteristics and traditional uses such as farming, forestry, hunting and fishing.

GOAL III
Promote the concept of landowner stewardship that has served to preserve the Dragon Run Watershed as a regional treasure.

OBJECTIVE A
Address the potential dilemma of preserving the watershed's sense of peace and serenity by protecting open space and reducing fragmentation of farms, forests, and wildlife habitat versus the landowners rights in determining or influencing future land use.

OBJECTIVE B
Educate landowners about the regional importance of the Dragon Run.

The Advisory Group's recommendations to achieve the goals and objectives will be delivered by the Dragon Run Steering Committee to the signatory entities for their consideration.

5. MODIFICATIONS

Modifications to this Memorandum of Agreement must be submitted in writing and approved by all parties to the Memorandum of Agreement.

6. EFFECTIVE DATE

The effective date of the Memorandum of Agreement shall be the date of the signing of the Memorandum of Agreement by the Counties of Essex, Gloucester, King and Queen, and Middlesex and the Middle Peninsula Planning District Commission.

7. DURATION AND TERMINATION OF THE AGREEMENT

The duration of this Memorandum of Agreement will be until such time as it is terminated upon agreement of all parties; however, any party to the Memorandum of Agreement may terminate its participation by written notice to all other parties.

8. MANNER OF FINANCING

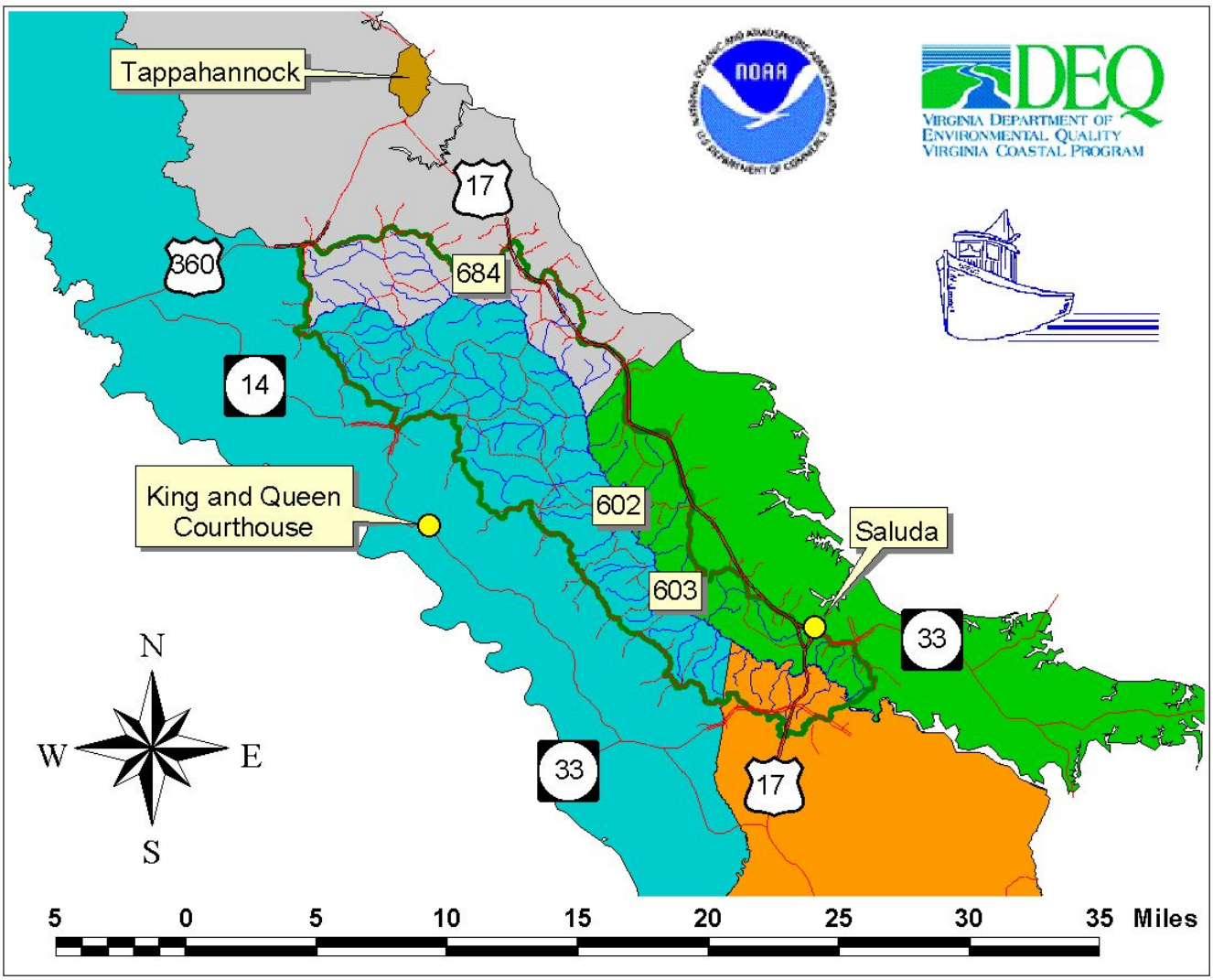
This Memorandum of Agreement will not require financing or budgeting from or by the signatory agencies; however, this clause will not preclude, under a separate document or agreement, grant funding or other financial assistance from one signatory to another for the purpose of carrying out the purposes of the Memorandum of Agreement.

9. OWNERSHIP OF PROPERTY

It is not the intent of the signatory parties that this Memorandum of Agreement will result in the purchase, ownership, holding or conveying of any real or personal property.

10. APPENDIX

Map of the Dragon Run Watershed - defined as Commonwealth Hydrologic Unit ID 'CO2' described by the Virginia Department of Conservation and Recreation from the streams' headwaters down to and including Meggs Bay.



LIST OF SIGNATORIES

Middle Peninsula Planning District Commission

County of Essex, Virginia

County of Gloucester, Virginia

County of King and Queen, Virginia

County of Middlesex, Virginia

SIGNATURE PAGE FOR THE MIDDLE PENINSULA PLANNING DISTRICT COMMISSION

IN WITNESS WHEREOF, the following individuals execute this agreement

Chairman, Middle Peninsula Planning District Commission

County Administrator, County of Essex, Virginia

County Administrator, County of Gloucester, Virginia

County Administrator, County of King and Queen, Virginia

County Administrator, County of Middlesex, Virginia

MIDDLE PENINULA PLANNING DISTRICT COMMISSION

By: Charles E. Ingram

Date: 8-1-2002

Attest: [illegible]

Date: 8/1/02

SIGNATURE PAGE FOR THE COUNTY OF ESSEX, VIRGINIA

IN WITNESS WHEREOF, the following individuals execute this agreement

Chairman, Middle Peninsula Planning District Commission

County Administrator, County of Essex, Virginia

County Administrator, County of Gloucester, Virginia

County Administrator, County of King and Queen, Virginia

County Administrator, County of Middlesex, Virginia

COUNTY OF ESSEX, VIRGINIA

By: Margaret Dimmio

Date: AUGUST 20, 2002

Attest: Linda E. Pumpelin

Date: AUGUST 20, 2002

SIGNATURE PAGE FOR THE COUNTY OF GLOUCESTER, VIRGINIA

IN WITNESS WHEREOF, the following individuals execute this agreement

Chairman, Middle Peninsula Planning District Commission

County Administrator, County of Essex, Virginia

County Administrator, County of Gloucester, Virginia

County Administrator, County of King and Queen, Virginia

County Administrator, County of Middlesex, Virginia

COUNTY OF GLOUCESTER, VIRGINIA

By: _____

Date: 10-3-02

Attest: _____

Date: _____

SIGNATURE PAGE FOR THE COUNTY OF KING AND QUEEN, VIRGINIA

IN WITNESS WHEREOF, the following individuals execute this agreement

Chairman, Middle Peninsula Planning District Commission

County Administrator, County of Essex, Virginia

County Administrator, County of Gloucester, Virginia

County Administrator, County of King and Queen, Virginia

County Administrator, County of Middlesex, Virginia

COUNTY OF KING AND QUEEN, VIRGINIA

By: _____

Date: 9/9/02

Attest: K. Deane Gabe

Date: 9-9-02

SIGNATURE PAGE FOR THE COUNTY OF MIDDLESEX, VIRGINIA

IN WITNESS WHEREOF, the following individuals execute this agreement

Chairman, Middle Peninsula Planning District Commission

County Administrator, County of Essex, Virginia

County Administrator, County of Gloucester, Virginia

County Administrator, County of King and Queen, Virginia

County Administrator, County of Middlesex, Virginia

COUNTY OF MIDDLESEX, VIRGINIA

By: _____

Date: 10-2-02

Attest: Betty S. Collins

Date: 10-2-02

APPENDIX C: Description of Natural Resource Preservation Tools

Conservation Easements: According to the Virginia Conservation Easement Act (§10.1-1009 et seq.), a conservation easement "means a nonpossessory interest of a holder in real property, whether easement appurtenant or in gross, acquired through gift, purchase, devise, or bequest imposing limitations or affirmative obligations, the purposes of which include retaining or protecting natural or open-space values of real property, assuring its availability for agricultural, forestal, recreational, or open-space use, protecting natural resources, maintaining or enhancing air or water quality, or preserving the historical, architectural or archaeological aspects of real property." There are significant tax benefits associated with the donation of conservation easements. The terms of the easement are highly flexible and dictate the permissible uses of the land. The easement is attached to the deed for the property.

Purchase of Development Rights (PDR) or Purchase of Agricultural Conservation Easements (PACE): A voluntary land conservation program that pays landowners to protect the cultural and natural resource assets of their property. The purpose is to protect open-space, agricultural, historic, scenic, and natural resources. In particular cases, the purpose is to maintain the economic viability of farm and forest operations. The program allows landowners to enter into agreements to sell the development potential of qualifying property to the County while maintaining the right to continue to use, own, sell, mortgage, and bequeath the property. PDR programs accommodate a variety of conservation categories and generally protect land in perpetuity, while PACE programs are specifically geared to agricultural operations and sometimes offer a buyback option at the current fair market value after a specified period of time.

Chesapeake Bay Preservation Act: The Chesapeake Bay Preservation Act (§10.1-2100 et seq.) requires that "(i) the counties, cities, and towns of Tidewater Virginia incorporate general water quality protection measures into their comprehensive plans, zoning ordinances, and subdivision ordinances; (ii) the counties, cities, and towns of Tidewater Virginia establish programs, in accordance with criteria established by the Commonwealth, that define and protect certain lands, hereinafter called Chesapeake Bay Preservation Areas, which if improperly developed may result in substantial damage to the water quality of the Chesapeake Bay and its tributaries." Furthermore, the Act states that "Local governments have the initiative for planning and for implementing the provisions of this chapter, and the Commonwealth shall act primarily in a supportive role by providing oversight for local governmental programs, by establishing criteria as required by this chapter, and by providing those resources necessary to carry out and enforce the provisions of this chapter."

Agricultural and Forestal Districts: The Local Agricultural and Forestal Districts Act (§15.2-4400 et seq.) indicates that "It is state policy to encourage localities of the Commonwealth to conserve and protect and to encourage the development and improvement of their agricultural and forestal lands for the production of food and other agricultural and forestal products. It is also state policy to encourage localities of the Commonwealth to conserve and protect agricultural and forestal lands as valued natural and ecological resources which provide essential open spaces for clean air sheds, watershed protection, wildlife habitat, aesthetic quality and other environmental

purposes. It is the purpose of this chapter to provide a means by which localities may protect and enhance agricultural and forestal lands of local significance as a viable segment of the local economy and as an important economic and environmental resource." Agricultural/forestal districts qualify for reduction in property tax rate under land use assessment.

Land Use Assessment: Authorized by the Code of Virginia (§58.1-3229 et seq.), a land use assessment program provides for the deferral of real estate taxes on real estate that qualifies for agricultural, horticultural, forestry and/or open space uses. Assessed values under the program are generally less than those estimated at fair market value. The purpose of such a program is generally to encourage the preservation of land, the protection of natural resources, the supply of safe water, and the promotion of orderly land use planning and development.

Sliding Scale Property Tax Rate: Used in conjunction with a land use assessment program, local governments may reduce the tax rate on properties that agree to remain in their current use for up to 20 years. The sliding scale of tax rates is based upon the length of the agreement.

Sliding Scale Zoning: This zoning method targets land in agricultural zoning districts and is designed to preserve agricultural land and open space. Sliding scale zoning allows a range of density depending on the size of the original lot. As parcel size increases, the density of allowable dwelling units decreases, enabling the preservation of large contiguous tracts of land that can still be farmed or simply preserved as open space. Lots that have been created from a parent parcel cannot be subdivided.

Local "Right-to-Farm": Virginia's Right-to-Farm laws (§3.1-22.28 et seq.) make any agricultural or silvicultural operation a "by right" use in agriculturally zoned areas. Special use permits cannot be required for operations in these areas and these operations cannot be found guilty of nuisance. The local variation of Right-to-Farm triggers notification to new or potential purchasers of land in agricultural zones of daily farming activities and possible "inconveniences" (e.g. dust, odors, noise).

State Forest: The Virginia Dept. of Forestry (DOF) manages state forests by balancing a self-supporting operation with multiple benefits, such as timber management, recreation, aesthetics, wildlife, water quality, and stability of the local economy. Operations are funded by the sale of forest products, with twenty-five percent of this revenue returned to the county in which the state forest is located. Special demonstration, research, and recreation areas are sometimes featured in state forests.

Virginia Natural Area Preserves System: Administered by the Department of Conservation and Recreation's Division of Natural Heritage, the Virginia Natural Area Preserves System protects examples of some of the rarest natural communities and rare species habitats in the Commonwealth. Natural Area Preserves are managed for their rare plants, animals and natural communities. Natural Area Preserve dedication places legally binding restrictions on future activities on a property. Preserve ownership

includes the Department of Conservation and Recreation, local governments, universities, private citizens, and non-profit conservation organizations. Access ranges from low-intensity public access to owner permission.

Virginia Estuarine and Coastal Research Reserve System: The Virginia Estuarine and Coastal Research Reserve System (VECRRS), created in the Code of Virginia (28.2-1103 et seq.), protects estuarine and coastal lands for research and long-term monitoring that supports the Commonwealth's coastal resource management efforts. The Virginia Institute of Marine Science administers the Reserve System, which is coordinated with the Chesapeake Bay National Estuarine Research Reserve in Virginia. A 121-acre research reserve site is located in the Dragon Run watershed.

APPENDIX D: Description of Farm Programs

The **Conservation Reserve Program** (NRCS, 2003a) reduces soil erosion, protects the Nation's ability to produce food and fiber, reduces sedimentation in streams and lakes, improves water quality, establishes wildlife habitat, and enhances forest and wetland resources. It encourages farmers to convert highly erodible cropland or other environmentally sensitive acreage to vegetative cover, such as tame or native grasses, wildlife plantings, trees, filterstrips, or riparian buffers. Farmers receive an annual rental payment for the term of the multi-year contract. Cost sharing is provided to establish the vegetative cover practices.

The **Conservation Reserve Enhancement Program (CREP)** (NRCS, 2003a) aims to improve Virginia's water quality and wildlife habitat by offering rental payments to farmers who voluntarily restore riparian buffers, filter strips and wetlands through the installation of approved conservation practices. CREP is an enhancement to the federal *Conservation Reserve Program*.

The Virginia CREP has two programs. The *Chesapeake Bay CREP* targets Virginia's entire bay watershed and calls for the planting of 22,000 acres of riparian buffer and filter strips as well as 3,000 acres of wetland restoration. The *Southern Rivers CREP* targets watersheds outside the bay drainage basin and will establish 8,500 acres of riparian buffer and filter strip plantings and 1,500 acres of wetland restoration.

The **Environmental Quality Incentives Program (EQIP)** (NRCS, 2003a) was reauthorized in the Farm Security and Rural Investment Act of 2002 (Farm Bill) to provide a voluntary conservation program for farmers and ranchers that promotes agricultural production and environmental quality as compatible national goals. EQIP offers financial and technical help to assist eligible participants install or implement structural and management practices on eligible agricultural land.

EQIP offers contracts with a minimum term that ends one year after the implementation of the last scheduled practices and a maximum term of ten years. These contracts provide incentive payments and cost-shares to implement conservation practices. Those engaged in livestock or agricultural production on eligible land may participate. EQIP activities are carried out according to an environmental quality incentives program plan of operations developed in conjunction with the producer that identifies the appropriate conservation practice or practices to address the resource concerns. The practices are subject to NRCS technical standards adapted for local conditions. The local conservation district approves the plan.

EQIP may cost-share up to 75 percent of the costs of certain conservation practices. Incentive payments may be provided for up to three years to encourage producers to carry out management practices they may not otherwise use without the incentive. However, limited resource producers and beginning farmers and ranchers may be eligible for cost-shares up to 90 percent. Farmers and ranchers may elect to use a certified third-party provider for technical assistance. An individual or entity may not receive, directly or indirectly, cost-share or incentive payments that, in the aggregate, exceed $450,000 for all EQIP contracts entered during the term of the Farm Bill.

The program targets watersheds, regions, and areas of special environmental sensitivity or other areas facing significant soil, water or related natural resources concerns. By encouraging voluntary landowner participation in these areas, EQIP supports the development and implementation of conservation plans in critical areas. Developed in cooperation with professional resource managers, the plans encompass both scientific management principles, and landowner objectives.

The **Farm and Ranch Lands Protection Program** (NRCS, 2003a) provides matching funds to help purchase development rights to keep productive farm and ranchland in agricultural uses. Working through existing programs, the U.S. Department of Agriculture (USDA) partners with State, tribal, or local governments and non-governmental organizations to acquire conservation easements or other interests in land from landowners. USDA provides up to 50 percent of the fair market easement value.

To qualify, farmland must: be part of a pending offer from a State, tribe, or local farmland protection program; be privately owned; have a conservation plan for highly erodible land; be large enough to sustain agricultural production; be accessible to markets for what the land produces; have adequate infrastructure and agricultural support services; and have surrounding parcels of land that can support long-term agricultural production.

The **FarmLink Program** (Virginia Farm Bureau, 2003) connects farmers who are looking to sell, but wish to see their farms remain active, with people who would like to farm. Currently, the "highest and best use" of most farmland is considered to be in housing lots and shopping malls. As farmers retire or move on, they are often forced to divide up their farmland to pay off debt. In other cases, the land is worth so much more as a "development" site that the farmer finds it impossible to turn this option down. The goal of the FarmLink Program is to curb this trend and maintain the state's agricultural heritage for generations to come.

Prospective farmers and farmers searching for options for their farms each fill out an application form. This information is entered into a database so that farms may be sorted by location, size, type and other features that a potential buyer might be seeking. When it appears that a match is possible, the buyer and seller are both contacted by the FarmLink coordinator. If the farm owner agrees to meet the potential buyer, they are connected. Because many people who are looking to farm cannot afford to buy a farm outright, sellers are asked to consider long-term leases and work-in options in addition to immediate sale.

The **Forest Land Enhancement Program** (FLEP) (NRCS, 2003a) was part of Title VIII of the 2002 Farm Bill. FLEP embodies a commitment to sustainable forest management to enhance the productivity of timber, fish and wildlife habitat, soil and water quality, wetlands, recreational resources, and aesthetic values of forest land. It also establishes a coordinated and cooperative Federal, State, and local sustainable forestry program for

the establishment, management, maintenance, enhancement, and restoration of forests on nonindustrial private forest land.

FLEP is a voluntary program designed to provide technical, educational, and cost-share assistance to promote sustainability of non-industrial private forest. State forestry agencies develop State Priority Plans that provide details for how the FLEP funds will be utilized, including minimum acres, maximum acres, aggregate payment, use for technical, educational and cost-share assistance, and all other factors for the program. Landowners are required to have a forest management plan to be eligible for cost-share. The practices to be cost-shared and the cost-share rate are described in the State Priority Plan.

The cost-share practices are limited to the treatment of 1,000 acres per year on non-industrial private forest (NIPF) with an aggregate payment not to exceed $100,000 for the life of this Farm Bill. A waiver for the treatment of up to 5,000 acres is available if significant public benefit is shown. There is no limit to the amount of forest land owned by an individual as long as the person qualifies as an NIPF owner.

The **Wetlands Reserve Program** (NRCS, 2003a) is a voluntary program offering landowners the opportunity to protect, restore, and enhance wetlands on their property. The USDA Natural Resources Conservation Service (NRCS) provides technical and financial support to help landowners with their wetland restoration efforts. The NRCS goal is to achieve the greatest wetland functions and values, along with optimum wildlife habitat, on every acre enrolled in the program. This program offers landowners an opportunity to establish long-term conservation and wildlife practices and protection.

The **Wildlife Habitat Incentives Program (WHIP)** (NRCS, 2003a) is a voluntary program for people who want to develop and improve wildlife habitat primarily on private land. NRCS provides both technical assistance and up to 75 percent cost-share assistance to establish and improve fish and wildlife habitat. WHIP agreements between NRCS and the participant generally last from 5 to 10 years from the date the agreement is signed.

Ecology and Management of Sericea Lespedeza

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http://osufacts.okstate.edu

Sericea lespedeza (*Lespedeza cuneata*) (Figure 1) is an introduced perennial legume, relatively free of insect and disease problems. It is very competitive and highly tolerant of a variety of conditions, which are among the reasons it has become an invasive and noxious weed in Oklahoma. Sericea was planted in the past to control soil erosion and provide forage for livestock and wildlife. From these plantings, it has been spread by animals and movement of hay contaminated with sericea seed to native prairies, shrublands, forests and introduced pastures. Normal management practices such as grazing, burning and applying 2,4-D herbicide do not control sericea lespedeza. Sericea lespedeza should be officially classified as a noxious weed in Oklahoma.

Sericea has been found growing in all parts of Oklahoma, except the Panhandle, and has been designated a noxious weed in southeastern Kansas because of its ability to invade and decrease grass production on rangelands and introduced pastures. It has had a negative impact on forage production for livestock, food and cover for wildlife and biological diversity.

Mature sericea plants are 18 to 40 inches tall with coarse stems and leaves composed of three spatula-shaped leaflets with squared-off ends (Figure 2). Sericea often is confused with desirable native legumes, especially slender lespedeza, which looks very similar to sericea lespedeza. Note the tips of slender lespedeza (*Lespedeza virginica*) leaflets are more rounded and do not have a conspicuous point at the end of the leaf (Figure 3). Pure stands of sericea may produce 430 to 850 pounds of seed per acre per year with about 350,000 seeds in each pound. Seedlings are not very competitive, but, once established, are long-lived.

Sericea will tolerate soils ranging from very acidic to slightly alkaline, but prefers a pH of 6.0 to 6.5. It does best on clayey and loamy soils that are deep, fertile, and well-drained, but will also grow on poor sites. Sericea uses water less efficiently than many other warm-season plants and does best when annual precipitation is 30 inches or more, which explains why it is a greater problem in eastern Oklahoma. However, sericea occurrence has been reported on Conservation Reserve Program (CRP) lands and rangelands in western Oklahoma.

Figure 1. Sericea lespedeza.

History in the United States

Sericea lespedeza was first brought to the United States from Japan in the 1890s. Agronomists soon learned it was tolerant of drought, acidity and shallow soils of low fertility. Because of this, sericea first was used as a protective cover for poor sites. Two varieties of sericea were developed for improved quality and to resist nematodes. These varieties were used on strip mines, highway right-of-ways, dams and waterways. Sericea also was promoted for use in wildlife food plots during the 1950s.

Forage Quality

Sericea lespedeza has high levels of crude protein, negated by high concentrations of a class of chemical compounds called tannins. Tannins bind proteins, leaving them unavailable for digestion. They also reduce the palatability and digestibility of forages. The level of tannins in sericea increases with maturity of the plant, high air temperatures, and low rainfall. New varieties of sericea have been developed with lower tannin concentrations, but tannin levels are still high and forage production is 15 percent lower than that of high tannin varieties.

Animal performance of goats and sheep grazing sericea is variable, but grazing trials with steers and heifers in Alabama suggest higher daily gains can be achieved on native grasses in Oklahoma with much less intensive management.

Competitive Effects

Once established, sericea lespedeza will reduce or eliminate competing vegetation. Sericea restricts the amount of light other plants can use because it is tall and produces multiple branches with dense foliage. More water also is used to produce each pound of sericea forage because it is less efficient in water use than most warm-season plants. In addition to competing for light, water, and nutrients, sericea produces allelopathic chemicals (toxins) that inhibit seed germination and growth of other plants. Some of these toxins are produced by the roots, while others come from plant residues, mainly leaves. Root extracts from sericea have been shown to reduce germination of bermudagrass by 9 percent and forage production of bahiagrass, bermudagrass, rye, ryegrass, and tall fescue by as much as 15, 24, seven, 11 and 15 percent, respectively. Reports of influences of sericea root exudates are variable for germination and production of forage species.

Sericea is a legume, but furnishes very little nitrogen to surrounding plants, and is negated by the effects of the toxins it produces. Rather than providing nitrogen for other plants, sericea actually makes it necessary to add nitrogen fertilizer to maintain production of introduced forages. The shoots of grass exposed to the toxins of sericea residue have lower nitrogen content and overcoming the loss of production caused by the toxins requires nitrogen fertilization.

Much of the research on the competitiveness of sericea lespedeza has been conducted with introduced forages in greenhouses. Because studies involving introduced forages often occur in controlled environments and focus on individual factors of competition, the combined negative effects on native plants in the uncontrolled environment of native prairies and forests are probably much greater. For example, in one study, sericea seeded with switchgrass quickly dominated the area and switchgrass was eliminated by the third year.

Wildlife and Plant Community Diversity

Sericea lespedeza has been promoted for use in wildlife food plots and revegetation of roadsides and bare ground, but its value for these purposes is not supported by research or practical experience. Deer will not utilize sericea unless it is kept short by mowing or grazing. Quail occasionally consume the seeds and some wildlife species will use sericea for thermal cover during the summer. Cover, however, is lacking when sericea is dormant because it reduces many desirable native plants. The exclusion of other plant species by sericea also reduces the diversity of plant foods needed to support wildlife. Wildlife are adapted to the native plants of an area and are much better served by them for food and cover.

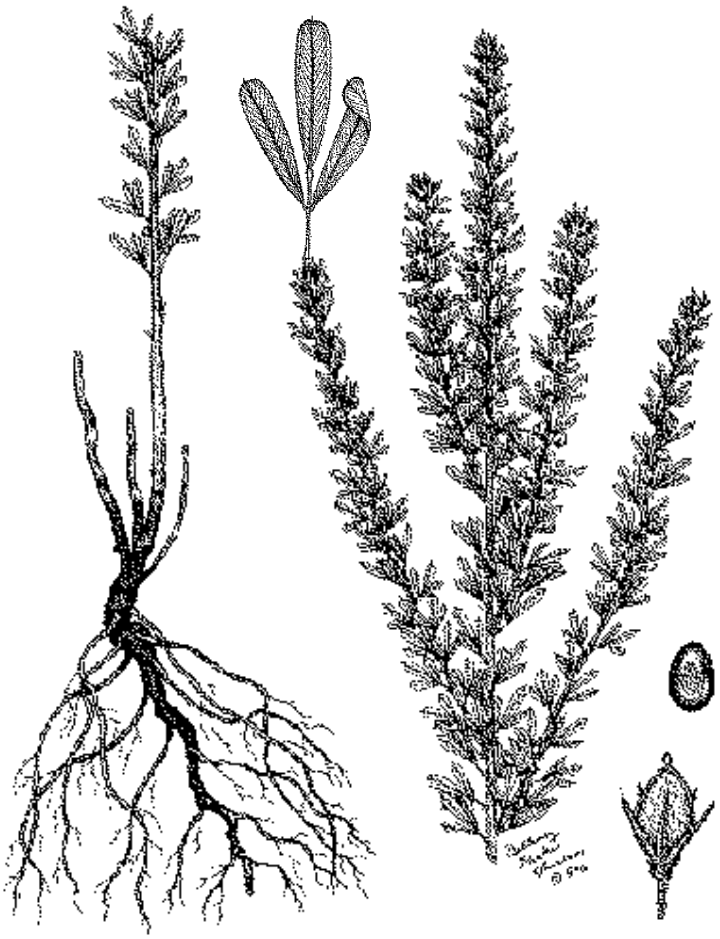

Figure 2. Sericea lespedeza.

Control

The best control approach is early detection, isolation of infested areas and control of individual plants with herbicides like Remedy and Ally. Once established, an integrated approach to control will be necessary to minimize the damage. Conventional management practices of prescribed grazing and prescribed fire have not been effective in preventing the spread of sericea in rangelands, introduced pastures and forests.

It is difficult to give grasses a competitive edge with season-long and rotational grazing because cattle will select grasses and leave the sericea plants because of low palatability. If grasses are over-utilized, the invasion of sericea will be hastened. Some suppression of sericea has been observed after mowing or burning followed by intensive early stocking (IES) with stocker cattle. Livestock will consume the seeds and deposit them elsewhere in manure, so it is advisable to temporarily fence these infested areas to exclude livestock until the sericea has been controlled. This is particularly important during late summer and fall when the plants are flowering and producing seed. Goats may provide control, since they have been known to eat sericea.

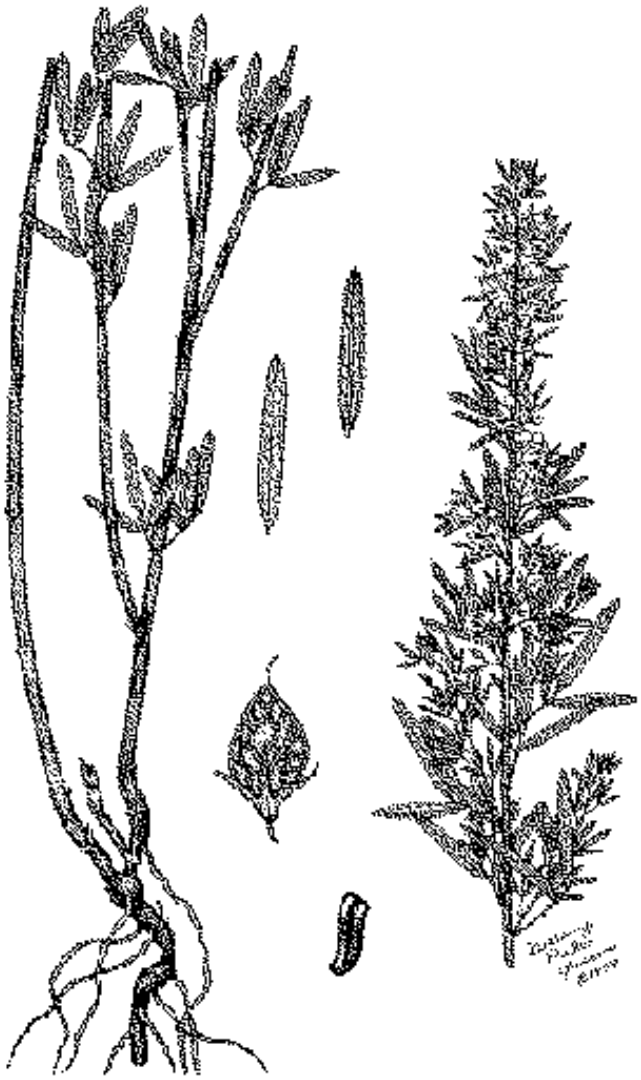

Figure 3. Slender lespedeza.

Spring burning removes the old dead growth of sericea, but has no negative effect on established plants. In fact, fire probably increases seed germination by scarifiying the seed and thus promote the establishment of new plants. Seeds of sericea germinate in early April through June. Seedlings establish when moisture conditions are favorable; thus, burning most likely will result in a denser stand of sericea if control measures are not implemented. However, the increased seed germination following fire should improve the effectiveness of a control program that involves spraying in July with Remedy or spraying in September with Ally.

Mowing will reduce the vigor of sericea plants if they are cut closely multiple times each year. Plants should be mowed each time they reach a height of 12-18 inches. The most damaging time to cut sericea is late in the growing season when the plants are trying to build root reserves for the next year's growth. However, mowing will not kill sericea and may damage desirable grasses, depending on the timing and frequency of cutting. In addition, a large sericea seed bank will remain in the soil, ready to germinate when conditions are suitable.

None of the commonly used herbicides for broad-leaved weed control have provided good control of sericea lespedeza. Amber, 2,4-D, Grazon P+D, and Weedmaster have been ineffective on established stands of sericea. In studies conducted at three locations in 1988 and 1989, sericea was not controlled by 2,4-D at rates up to 2 lb/acre and minimal kill was achieved with 1 quart/acre of Grazon P+D or Weedmaster. Sericea was, however, adequately controlled with 1 pt/ac of Remedy (better than 93 percent in five of the studies and 79 percent in the sixth study). In additional studies in 1995, excellent control of sericea was obtained with 1 pt/ac of Remedy applied in June and July and Ally applied in September (Table 1). Currently, the maximum labeled rate for Ally is 0.3 oz/acre. Broad-leaved plants like western ragweed also are controlled with a June application of Remedy. It is critical the sericea plants be actively growing at the time of herbicide application or the treatment will not be effective.

Table 1. Chemical costs and average control (stem reduction) of sericea lespedeza using two herbicides applied at different times and rates at four sites in 1995.

Herbicide	Rate/Acre	Cost $/Acre[1]	Month of Application		
			June	July	Sept.
			Reduction (%)		
Remedy	1.0 pt.	10.50	100	100	88
Remedy	1.5 pt.	15.75	100	100	92
Ally	0.3 oz.	6.15	68	92	94
Ally	0.5 oz.[2]	10.25	85	97	99

1 Chemical costs as of March 1997. Cost of application or surfactants not included.
2 Currently, the maximum labeled rate of Ally is 0.3 oz/acre.

Since areas infested with sericea often have an enormous supply of seed in the soil, follow-up treatments will be required. Seedlings emerge after the mature plants are killed and by the third or fourth year, sericea will dominate the area again.

Preliminary results indicate mowing before application of Ally or Remedy can increase the level of control. Combining a single mowing in June or July with a herbicide treatment in July or September provided 100 percent control of sericea seedlings. Using fire to encourage seed germination before spraying may be helpful in diminishing the seed supply in the soil, reducing the amount of follow-up treatment needed.

A combination of grazing management, fire, mowing and herbicide offers the most effective control of sericea lespedeza. An example of how these techniques may be used together is as follows:

1) Use light or moderate stocking, allowing fuel to accumulate for a prescribed burn.
2) Burn in spring to encourage germination of sericea seed and remove old growth.
3) After fire, intensively early stock (IES) areas until mid-June.
4) Apply Remedy at 1 pt/acre in mid-July.
5) Apply Ally in September to areas missed by Remedy.
6) During September and October, exclude livestock from areas with sericea stands.
7) Thereafter, spot treat sericea with Remedy or Ally as needed.

Summary

While sericea lespedeza unfortunately has been promoted as an “improved” forage and a protective cover, it is currently a major weed problem in Oklahoma’s rangelands, forests, and introduced pastures. It is a noxious weed and requires aggressive control. Its adaptability, high seed yield, production of toxic chemicals and general competitiveness combine to make sericea lespedeza a serious threat to native plant communities, introduced forages, wildlife habitat and livestock production. An integrated approach to control, using grazing management, prescribed fire, mowing and herbicide, may offer the greatest success. Control of sericea can be expensive, so treatment costs and production losses are minimized by early detection and control.

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Appendix H. Deer Hunting Samples

Special Managed Waterfowl Hunt: KEY IDEAS

WHY CONDUCT A WATERFOWL HUNT ON A NATURAL AREA?

- Historical use: prior to acquisition and/or management by the state as a natural area; private interests hunted ducks and geese here regularly.

- VIMS is now responsible for regulating and managing the use of portions of the property by the public. These uses must be compatible with the objectives for which the property was acquired by the state in the first place.

- Virginia law provides that anyone can hunt waterfowl in public waters during established seasons and using legal methods so long as they are not within 500 yards of an existing licensed waterfowl blind. Therefore, if VIMS does not license, establish, and use (for the purpose of hunting) waterfowl blinds along the shoreline at Goodwin Islands Reserve, then any member of the public has the opportunity to obtain a license and build a stationary hunting blind in the public waters surrounding the Reserve. Where stationary blinds are not built, anyone could legally hunt from licensed floating blinds (boats) in the waters adjacent to the Reserve.

- The result of VIMS not establishing and managing the use of shore blinds at portions of Goodwin Islands Reserve is expected to be the rapid licensing and construction of blinds, and the frequent use of these blinds in the public waters surrounding the Reserve, making it a *de facto* waterfowl hunting area from November through January of every year. This unregulated use would not be in the interest of VIMS and visitor/researcher safety would be of high concern.

The Department of Conservation and Recreation, Division of Natural Heritage allows managed waterfowl and deer hunting at selected Natural Area Preserves. The information that follows are examples of information that DCR-DNH distributes to potential and/or registered hunters participating in these hunts.

---------- Natural Area Preserve
Managed Deer Hunt Rules and Regulations

1. All hunters must sign in at the check-in kiosk when arriving at the Preserve and sign out when leaving.

2. All hunters in the party must possess a valid DCR hunting permit. Each permit will bear the name of the Chief-of-Party, who will be responsible for providing the name and Virginia Hunting License number of each party member on their hunting permit.

3. Each hunter must have on his/her person proof of successfully completing a Hunter Education Course (certificate or copy of certificate).

4. Hunters hunting alone must be 16 years of age by the date of the hunt. Youth hunters aged 12-15 must be accompanied by an adult at all times. Both the youth and the adult must possess a DCR hunting permit and proof of completing a Hunter Education Course.

5. Hunters must have all necessary state licenses and abide by all state and DCR regulations.

6. Allowable weapons are shotguns with rifled slugs or buckshot.

7. All deer targeted must be within the Preserve boundaries, which are marked by conspicuous white signs and yellow boundary paint.

8. A limit of two (2) deer per hunter, per day, one of which must be antlerless, may be harvested. **The objective of the hunt is to reduce the size of the deer herd. Therefore, the harvesting of antlerless deer is strongly encouraged.**

9. All deer harvested should be tagged immediately at the point of kill.

10. Hunters are asked to voluntarily provide the following data for harvested deer:
    - sex
    - weight (dressed)
    - number of points (bucks), lactation status, pregnancy & number of young (does)
    - general health and condition

Additional notes:

Data sheets will be available at the check-in kiosk. Scales for weighing deer will not be provided. It is requested that hunters bring their own scales to provide this key harvest statistic. If necessary and only if scales are unavailable, hunters should estimate the field dressed weights of harvested deer in order to complete the data sheet.

Hunter Information Summary Sheet
2004 Lottery Deer Hunt
---------- Natural Area Preserve

Dates: December 6-11, 2004 (Monday - Saturday)
December 13-18, 2004 (Monday - Saturday)

Type of Hunt:
●This is a **lottery** hunt.
●A non-refundable $5.00 State Park Reservation fee will be required at the time of application in order to enter the lottery. Applications and payment must be received by **5:00 PM on Friday, October 8, 2004**. Make checks payable to *Treasurer of Virginia*. Telephone applications and payment by credit card is also acceptable.
●Each selected applicant will be assigned one (1) hunt day during the 2-week hunting period. Selected applicants will be notified within two (2) weeks of the random drawing.
●Each selected applicant may request up to five (5) permits for their assigned hunt day, for a party of up to five hunters. For each member of the hunting party, a $10.00 Natural Area Preserve hunting permit fee must be remitted.
●Hunting permit fee payments must be received by Friday, November 5, 2004. Hunting permit fees must be made by personal check, payable to *Natural Area Preservation Fund*, and mailed to the Department of Conservation and Recreation, 217 Governor Street, Richmond, VA, 23219 – Attention: ---------- Deer Hunt

Participation Requirements:
All members of the hunting party:
1. Must possess all necessary state licenses.
2. Must possess issued hunt permit from DCR.
3. **Must show proof of having completed a Hunter Education Course**.
4. Must be 16 years of age or older to hunt alone. Hunters 12-15 years of age may hunt as a member of the party, but must be under the direct supervision of a hunting adult.
5. Must abide by and meet all rules and regulations, including but not limited to, weapons and ammunition restrictions/specifications and blaze orange requirements (vest and hat).

How to Participate:
●By filling out a lottery application and returning it to the State Parks Reservation Center – along with a non-refundable $5.00 application fee. Applications may also be made by telephone with application fees paid by credit card (call 1-800-933-PARK).
Applications must be received by 5:00 PM on October 8, 2004.
●Selected hunters will be notified by October 22, 2004. Each hunter must render payment of the Natural Area Preserve fee ($10.00 per hunter) to: DCR-Division of Natural Heritage, 217 Governor Street, Richmond, Virginia 23219. Payment must be received by November 5, 2004 or the hunt date will be forfeited and offered to hunters on a stand-by list. Payment should be by personal check made out to *Natural Area Preservation Fund*. Please specify -------- Deer Hunt on the memo line.
●The selected applicant will be considered the Chief-of-Party and will be responsible for all payment to DCR and distributing permits to hunt party members.

●Once payment is made, the Chief-of-Party will be sent an information packet, including maps and hunting permits.

Allowable Weapons:
Allowable weapons are shotguns with rifled slugs or buckshot.
Hunters may ground hunt or use portable tree stands with approved safety belts.

Hunt Zones:
Hunters may hunt anywhere within the preserve boundaries (299 acres). All deer targeted must be within the preserve boundaries. There will only be 1 hunting party on any given day (the hunting party consisting of the successful applicant and up to four other hunters if the applicant chooses).

Allowable Harvest:
A limit of two (2) deer per hunter, one of which must be antlerless, may be harvested. The objective of the hunt is to reduce the size of the herd. Therefore, the harvesting of does is strongly encouraged.

Additional Harvest Information:
All deer harvested must be tagged immediately. Field dressing of deer should occur at the point of kill.

Hunter's will be required to provide the following information for harvested deer:
●sex
●weight **(either live or dressed; hunter's must provide scale)**
●number of antler points, lactation status, pregnancy (as applicable)
●general health and condition.
Data sheets will be available at the Hunter Check-in Kiosk.

Disabled Hunters:
Hunting at ------- NAP requires traversing rough terrain (thick underbrush, sand dunes, drainage ditches, wetlands).

Scouting and Additional Information:
To arrange a scouting date or for additional information, call: -----

What can the public do on rivers that are navigable for title purposes?
The three activities that the courts have traditionally mentioned are navigation, fishing, and commerce. The public can fish, from the river or from the shore below the "ordinary low water line." (Note that the fish and wildlife are owned by the state in any case.) But the courts have ruled that any and all non-destructive activities in these areas are legally protected.

What about getting to and from the river?
Normally there is no right to cross private land to get to or from a river. For example, there is no right to walk across a farmer's field to get from a public highway to a river.

However, the state has a duty to maintain public access routes to rivers under certain conditions, as part of its public trust duties. Courts have found it unlawful for a state to close off an existing public access route when there are no other public access routes nearby.

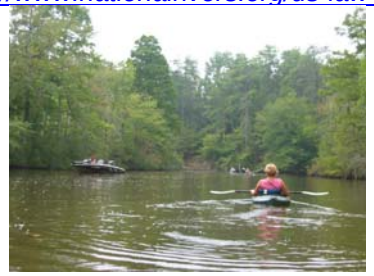
What about river pollution and leaving trash?
Local, state and federal regulations limit or prohibit water pollution. Hefty fines can apply.

Balancing private property and public rights through a Code of Conduct in the Dragon Run
The sense of being invaded by trespassers strikes a deep emotional chord in many a landowner who has a river flowing through his property. Some Dragon Run landowners tend to lump all river users together - those who canoe quietly down the middle of the river, those who stand quietly below the ordinary low water line to fish, those who stay on or near the river but litter and make noise, and those who proceed well away from the river onto private land. However, the right of the public for the use of title navigable waterways soundly exists in the Public Trust Doctrine. This right may be compared to the right to use a public roadway. Individuals have the right to use the roadway in its defined boundaries, but not drive through adjacent private yards or throw litter out of the window as they are passing through.

Additionally, while public roadways are generally well defined, the line between navigable and non-navigable waterways becomes increasingly vague as one travels further from the natural and ordinary Dragon Run mainstem, thereby increasing the potential for conflict between landowners and users.

Ultimately, the practice of responsible recreation coupled with an awareness of the public and private rights, including its vagueness in some locations, is the key to reducing conflict.

Acknowledgement: Adapted from *Who Owns the River?* From the National Rivers Website:
http://www.nationalrivers.org/us-law-who-



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Public Use Guide

Mission: To support and promote community-based efforts to preserve the cultural, historic, and natural character of the Dragon Run, while preserving property rights and the traditional uses within the watershed.

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www.mppdc.com/dragon.shtml

DRAGON RUN SPECIAL AREA MANAGEMENT PROGRAM

DRAGON RUN SPECIAL AREA MANAGEMENT PROGRAM

What is the Dragon Run Special Area Management Program (SAMP)?
This partnership between the Virginia Coastal Zone Management Program and the Dragon Run Steering Committee of the Middle Peninsula Planning District Commission is designed to address both the differing viewpoints and common ground that exist concerning the future of the watershed.

What is the Dragon Run Steering Committee?
Formed in 1985, the Dragon Run Steering Committee consists of landowners and local elected officials and is the key vehicle for cooperation and coordination among the four counties concerning watershed issues.

What counties are in the watershed?
The counties of Essex, Gloucester, King and Queen, and Middlesex contain the watershed.

STEERING COMMITTEE

Essex County – Prue Davis (Chair)(S), Fred Hudson (P), Dorothy Miller (L), M. Scott Owen (L)
Gloucester County – Charles "Rick" Allen (S), Dr. Eric Weisel (P), Terry DuRose (L), Dr. Willy Reay (L)
King and Queen County – Keith Haden (S), Kempton Shields (P), Robert Gibson (L), William "Frank" Herrin (L)
Middlesex – John D. "Jack" Miller (S), John England (P), R. D. Johnson (L), William Bagby (L)

(S) denotes Supervisor
(P) denotes Planning Commissioner
(L) denotes Land Interest

Staff – Sara Stamp

PUBLIC RIGHTS FOR USE OF THE DRAGON RUN

Which rivers are owned by the public?
The U.S. Supreme Court has held that the bed and banks under all rivers, lakes, and streams that are navigable, for title purposes, are owned by the states, held in trust for the public through the Public Trust Doctrine. Title in this context means ownership. In Virginia, this public-trust ownership extends up to the ordinary low water line, (or ordinary low water mark,) encompassing what is commonly referred to as the submerged and submersible land, as opposed to the upland.

What does navigability, for title purposes, mean?
Through various court cases, federal courts have articulated the following test, which is known as the federal test of navigability for title purposes:

* Navigability is determined as of the date of statehood
* Waters must be navigable in their natural and ordinary condition;
* The waterway must be usable for transportation conducted in customary modes of trade and travel on water; and
* The waterway must be capable of or susceptible to use as a highway for the transportation of people or goods.

The courts have determined that the use or potential for use by almost any type of watercraft is sufficient to determine this type of navigability.

Do shallows, rapids, and other obstacles make a river non-navigable for title purposes?
No. The courts make no requirements that a river be uniformly deep, or flat, or that navigation be practical going upstream as well as downstream. The presence of rapids, even numerous rapids and waterfalls, or blockages does not disqualify a river.

What if the river is only physically navigable during the wet season of the year?
It still qualifies as navigable for title purposes. But a normally dry creek bed or "wash" that is only temporarily navigable during extreme weather does not qualify. (If it's normally dry because of upstream dams, then it does qualify. The legal test is based on the river's natural condition.)

What if the current property owner's deed reads to the middle of a river, or seems to surround and include the river?

If the physical characteristics of the river are such that it meets the federal test of title navigability, it is public land up to the ordinary low water line. Since a deed can only convey interests actually owned by the seller, and since the bed and banks of all navigable rivers passed to the states at the time of statehood, it is likely that the state is the true owner. The state's ownership is a "prior existing right" and is frequently mentioned as such on deeds. Somewhere along the chain of property transactions, a deed may have been changed to include the riverbed. If this happened it was likely done incorrectly.

Appendix J. Federal and State Natural Resource Laws

Federal and State Natural Resource Laws

LEGISLATION	CITATION	RESPONSIBLE AGENCY
Presidential Order on Introduction of Exotic Species	Executive Order # 11987	Office of the President
U.S. Noxious Weed Law	7 USC 2802-2814	U.S. Department of Agriculture (USDA)
U.S. Clean Water Act	33 USC 1344	U.S. Army Corps of Engineers (ACOE), U.S. Environmental Protection Agency (EPA)
U.S. Anadromous Fish Conservation Act	16 USC 757a-757g	National Marine Fisheries Service (NMFS)
U.S. Clean Air Act	42 USC 7401-7671q	EPA
National Environmental Policy Act	42 USC 4321-4307d	all Federal agencies
Lacey Act (exotics)	18 USC 42	U.S. Department of Interior (DOI)
U.S. Endangered Species Act	16 USC 1531-1544	U.S. Fish & Wildlife Service (FWS), NMFS
U.S. Fish & Wildlife Coordination Act	16 USC 661-668s	many
U.S. Migratory Bird Treaty Act	16 USC 701-712	FWS
U.S. Aquatic Nuisance Prevention & Control Act	16 USC 4701-4751	FWS, NMFS
VA Commercial Fishing Law / Recreational Fishing Law	VA Code 28.2-100 – 1001	VA Marine Resources Comm. (VMRC)
VA Wetlands Act	VA Code 28.2-1300 – 1320	VMRC
VA Historic Resources Law	VA Code 10.1-2200 – 2216	VA Department of Historic Resources (VDHR)
VA Antiquities Act	VA C ode 10.1-2300 – 2306	VDHR
VA Endangered Species Act	VA Code 29.1-563 – 570	VA Department of Game & Inland Fisheries (VDGIF)
VA Fish & Wildlife Law	VA Code 29.1-100 et seq.	VDGIF
VA Endangered Plant & Insect Species Act	VA Code 3.1-1020 – 1030	VA Department of Agriculture and Consumer Services (VDACS)
VA Noxious Weed Law	VA Code 3.1-296.11 - 296.21	VDACS

Federal and State Natural Resource Laws (continued)

LEGISLATION	CITATION	RESPONSIBLE AGENCY
VA Chesapeake Bay Preservation Act	VA Code 10.1-2100 - 2115	Chesapeake Bay Local Assistance Dept. (CBLAD)
VA Water Quality Improvement Act of 1997	VA Code 10.1-2118 – 2128.B.	VDCR
VA Water Control Law	VA Code 62.1-44.2 - 44.34	VA Department of Environmental Quality (VDEQ)
VA Ground-water Management Act	VA Code 62.1-44.84 - 44.104	VDEQ
VA Environmental Quality Act	VA Code 10.1-1200 - 1221	VDEQ
VA Waste Management Act	VA Code 10.1-1400 - 1457	VDEQ
VA Open Space Land Act	VA Code 10.1-1700 - 1705	VA Outdoors Foundation (VOF)
VA Erosion & Sediment Act	VA Code 10.1-560 - 571	VDCR
VA Natural Area Preserves Act	VA Code 10.1-202 - 217	VDCR
VA Conservation Easement Act	VA Code 10.1-1009 - 1016	VDCR

Appendix K. Glossary Of Technical Terms And Abbreviations

GLOSSARY OF TECHNICAL TERMS AND ABBREVIATIONS

ac – acre(s).
acidic – having a pH value < 7.0, often indicating moderate or low fertility.
alluvial – of or pertaining to deposition of sediment by a stream.
alluvium – unconsolidated sand, silt, clay, or gravel deposited by running water.
asl – above sea level
aspect – the direction a slope faces (e.g., a north aspect).
basal area – the cross-sectional area of a tree at breast height; extrapolated to a larger area, basal area is an estimated measure of how much of a site is occupied by trees.
basic – as applied to soils, having high levels of base cation (e.g., calcium and magnesium) saturation, typically indicating high fertility; as applied to rocks, having high concentrations of iron, magnesium, and calcium.
biological resource management – those components of natural areas stewardship pertaining to or impinging on vegetation, natural communities, or habitat for rare species. Examples of biological resource management include invasive species control, habitat restoration, and monitoring of species population status.
biomass – the total weight of all living organisms in a biological community; in vegetation science, usually the total weight of all above-ground plant parts.
bryophyte – a non-vascular green plant; includes mosses, hornworts, and liverworts
colluvial – of or pertaining to colluvium.
colluvium – unconsolidated earth materials deposited on steep slopes by direct gravitational action and local unconcentrated run-off.
community – as applied to plants, any unit of vegetation regardless of rank or development; an aggregation of plants on the landscape; in broader terms, any assemblage of organisms that co-occur and interact.
cover – the percentage of the ground covered by the vertical projection of above-ground plant parts.
DCR – Virginia Department of Conservation and Recreation.
dbh – diameter at breast height (4.6 ft above the ground); the standard position at which woody stems are measured in forestry procedures.
dedication – dedication of a natural area is the strongest form of protection that can be afforded a natural area in Virginia and involves recording a legally binding Deed of Dedication with the property deed. The Deed of Dedication states the preservation purpose of the property, designates the property as Open-Space Land, restricts land uses which are incompatible, and formally places the site in Virginia's Natural Area Preserve System. Dedication is perpetual, and although ownership of the property can be transferred, the dedication will remain in effect.
density – the number of plants per unit area; used more specifically in this study as a measure of the number of woody stems ≥ 1in in diameter at breast height per hectare.
DGIF – Virginia Department of Game & Inland Fisheries.
dip slope – a side slope determined by and approximately aligned with the angle of the underlying bedrock plane.
DNH –Virginia Department of Conservation & Recreation, Division of Natural Heritage.
DOF – Virginia Department of Forestry.

dominant – of or pertaining to an organism or taxon that by its size, abundance, or coverage exerts considerable influence on a community's biotic and abiotic conditions.
dry-mesic – intermediate between dry and moist but well drained; submesic to subxeric.
duff – the matted, partly decomposed organic surface layer of forest soils.
EO – element occurrence. A site that supports a population of a rare plant or animal or an exemplary stand of an ecological community. EOs are sites tracked in the natural heritage database by the Division of Natural Heritage.
EO rank – the viability of a particular EO, graded from A to D.
ecological community - an assemblage of co-existing, interacting species, considered together with the physical environment and associated ecological processes, that usually recurs on the landscape.
ecological community group – a level in the hierarchical ecological community classification used by DNH (Fleming et al. 2001). An ecological community group consists of ecological communities with similar topographic, edaphic, physiognomic, and gross floristic traits. This level is comparable to the level at which many natural community classifications define their basic units, *e.g*., Basic Oak-Hickory Forests. Ecological community groups are not defined at a single, standard scale. Because community groups differ in their extent on the landscape, some are very broadly defined and have large geographic coverage (*e.g*., Chestnut Oak Forests), while others are very narrow in concept and distribution (*e.g*., Granitic Flatrocks). Ecological community types are nested within an ecological community group.
ecological community type – an abstract unit of vegetation representing concrete plant communities sharing a similar structure and floristic composition, and occurring under similar environmental conditions; more or less equivalent to the "association" used in traditional vegetation studies and the U.S. National Vegetation Classification. Ecological community types are the next finest level in the community classification hierarchy after ecological community groups.
ecotone – a transitional area where characteristics of adjacent communities or environments intermingle or intergrade.
ecosystem – a complete interacting system of organisms and their environment, applicable at any spatial scale.
edaphic – of or pertaining to the influence of soils on living organisms, particularly plants.
endemic – geographically restricted; a species or taxonomic group restricted to a particular geographic region.
environmental gradient - a spatially varying aspect of the environment (*e.g*., elevation, slope position, soil pH) that is expected to be related to species composition.
ericaceous – of the Heath Family (*Ericaceae*).
ericad – a plant of the Heath Family (*Ericaceae*); for example, blueberries (*Vaccinium* spp.), rhododendrons (*Rhododendron* spp.), and mountain-laurel (*Kalmia latifolia*).
exotic – an introduced, non-native species.
fire management – all activities associated with the management of fire-prone land, including the use of fire to meet land management goals and objectives - a unique and distinct component of natural areas stewardship combining elements of both biological and operations management. Fire management activities include both prescribed fire implementation and wildfire management.

fire management plan – statement, for a specific area, of fire policy, objectives, and prescribed action.
flora – all the vascular plants that make up the vegetation of a specified area.
floristic – of or pertaining to the flora of an area and the geographic patterns of distribution represented by its taxa.
floristics – the study of a flora and the geographic distributions of its taxa.
floodplain – a nearly level alluvial plain that borders a stream and is subject to inundation (non-tidal) under flood-stage conditions.
foliose lichen - a lichen typically lying flush to its substrate, but removable such that the lower surface is visible; foliose lichens are often attached to rocks and other substrates by numerous fine structures called rhizines.
forb – a broad-leaved herbaceous plant.
forest – an ecosystem dominated by trees (≥ 20ft tall) producing a more or less closed canopy, typically with 60-100% cover; some forests may temporarily have < 60% canopy cover following disturbances such as windthrow, disease, etc.
fruticose lichen – a lichen that grows erect or pendent, with thalli that have no clearly distinguishable upper and lower surfaces; includes species that are branched and shrubby, as well as those that form unbranched stalks.
ft – foot (feet).
geomorphic – of or pertaining to processes that change the form of the earth (e.g., volcanic activity, running waters, glaciers).
graminoid – grasses and grass-like plants (e.g., sedges and rushes).
groundwater – water occurring below the earth's surface in bedrock and soil.
heath - a plant of the Heath Family (*Ericaceae*); an Ericad; for example, blueberries (*Vaccinium* spp.), rhododendrons (*Rhododendron* spp.), and mountain-laurel (*Kalmia latifolia*).
herb – a vascular plant lacking woody tissue at or above ground level.
herbivory – the consumption of plants by animals.
hibernacula – over-wintering den sites used by animals such as bats, snakes, and insects.
humus – decomposed organic matter that has lost all trace of the structure and composition of the vegetable or animal matter from which it was derived.
hydric –wet and poorly drained.
hydrology – the science that deals with the circulation, distribution, movement, and chemistry of the waters of the earth.
in – inch(es).
invasive species – any species of plant, animal, or other organism (e.g. microbes) that is both non-native (exotic) to the ecosystem under consideration and whose introduction causes or is likely to cause economic or environmental harm or harm to human health.
integrated pest management – is the maintenance of destructive agents, including insects, at tolerable levels by the planned use of a variety of preventative, suppressive, or regulatory tactics and strategies that are ecologically and economically efficient and socially acceptable. The methods used in pest management must be ecologically based, involve a combination of tactics from insecticides to “doing nothing” appropriate to the situation and the biota and be a part of an overall management plan for the ecosystem being considered.
interstice – an intervening space or crevice.

interstitial – of or pertaining to interstices.
Jurassic – the second period of the Mesozoic era (following the Triassic), from approximately 190 to 135 million years ago.
liana – a woody vine.
lichen – a symbiotic association between a fungus and one or more species of algae and/or blue-green algae; although not based on genetic relationships, lichen species, for the aid of identification, are divided into foliose, fruticose, crustose, and umbilicate groups based on their growth strategies.
lithologic – of or pertaining to the physical characteristics of a rock.
lithology – the description of rocks on the basis of physical characteristics such as color, mineralogical composition, and grain size.
liverwort - a nonvascular, chlorophyll-containing plant closely related to mosses and hornworts, but differing in reproductive structures; liverworts have two dominant growth forms, one which resembles moss with overlapping leaves, the other forming prostrate leafless bodies.
m – meter(s).
macroinvertebrate – an animal lacking a backbone (invertebrate) and visible without the aid of magnification.
mafic – geologically, containing large amounts of dark-colored silicate minerals rich in magnesium and iron, e.g., pyroxene, amphibole, and biotite mica; examples include igneous and metamorphic rocks such as amphibolite, basalt, diabase, gabbro, and greenstone; also applied to soils with high levels of magnesium and iron that are derived from these formations.
mesic – of intermediate moisture conditions (i.e., moist and well-drained).
mesophyte – a plant characteristic of mesic environments.
mesophytic – of or pertaining to plants or vegetation adapted to environments of moist, well-drained sites.
Mesozoic – an Era of geologic time, from the end of the Paleozoic to the beginning of the Cenozoic, or about 225 to 65 million years ago; includes the Triassic, Jurassic, and Cretaceous periods.
metabasalt – metamorphosed basalt, a fine-grained igneous rock composed largely of plagioclase feldspar, pyroxene, and volcanic glass.
metamorphic – altered in mineral composition, chemical composition, and structure by heat, pressure, and hot fluids at some depth below the earth's surface; applied to rocks of igneous and sedimentary origin.
metasedimentary – consisting of sedimentary rock that shows evidence of having been subject to metamorphism; examples include quartzite (= metasandstone) and metasiltstone.
mi – mile(s).
microclimate – the local climate of a small site; this may vary from the climate of the larger, surrounding area due to aspect, tree cover, elevation, wind exposure, and other local factors.
microhabitat – within a habitat, a subdivision or precise location that has distinctive environmental characteristics; e.g., a tree-base hummock in a flooded swamp.
microtopography – the fine-scale variation in topography within a habitat; e.g., the pattern of vertical rock faces, shelves, and crevices on a cliff.

monospecific – consisting wholly or largely of a single species.
moss - a nonvascular chlorophyll-containing plant closely related to liverworts and hornworts, but differing in reproductive structures.
muscovite – a mineral of the mica group that is common in gneisses and schists; also known as "white mica."
natural community - those ecological communities which have experienced only minimal human alteration or have recovered from anthropogenic disturbance under mostly natural regimes of species interaction and disturbance. No portion of Virginia's landscape, however, has altogether escaped modern human impacts – direct or indirect – and only a few small, isolated habitats support communities essentially unchanged from their condition before European settlement.
natural heritage resources – as defined in the Virginia Natural Area Preserves Act these are "…the habitat of rare, threatened, or endangered plant and animal species, rare or state significant natural communities or geologic sites, and similar features of scientific interest." (Code of Virginia, section 10.1-209, et seq.).
non-vascular – lacking a structural system of tissue (xylem and phloem) that conducts water and soluble nutrients; non-vascular plants include mosses, lichens, and liverworts.
oligotrophic – infertile; nutrient-poor.
operations management – those components of natural areas stewardship pertaining to or impinging on non-biological features of natural area preserves. Examples of operations management activities include public access facilities development and maintenance, boundary line marking, sign installation, law and regulation enforcement, and ensuring visitor safety.
overstory – the uppermost layer of trees forming the canopy of a forest or woodland.
Paleozoic – the era of geologic time from 600 to 230 million years ago.
patch-dominant – a species that exerts dominance by forming dense but spatially discrete colonies; such a species typically varies from abundant to completely absent within a given habitat.
pathogen – an organism that causes disease in another organism.
pH – a value on the scale 0 to 14 that gives a measure of the acidity or alkalinity of a medium.
physiognomic – of or pertaining to vegetative form and structure.
physiognomy – the form and structure of vegetation.
phytogeography – the study of the geographic distribution of plants and vegetation , with an emphasis on environmental determinants of distribution.
Pleistocene – the first Epoch of the Quaternary Period of geologic time, from approximately two million to ten thousand years ago.
prescribed burn plan – a written statement defining the objectives to be attained as well as the conditions of temperature, humidity, wind direction and speed, fuel moisture, and soil moisture, under which a fire will be allowed to burn. A prescription is generally expressed as acceptable ranges of the prescription elements, and the limit of the geographic area to be covered.
prescribed fire – a management ignited wildland fire that burns under specified conditions where the fire is confined to a predetermined area and produces the fire behavior and fire characteristics required to attain planned fire treatment and resource management objectives.

pyrophytic – of or pertaining to plants or vegetation adapted to environments in which fire is an important ecological process.
quartzite –metamorphosed sandstone.
rare species – species believed to be sufficiently rare or threatened in Virginia to merit an inventory of their status and locations by DNH.
recruitment – generally, the trees involved in natural supplementation of a forest stand; more specifically, trees that have entered a particular category (age or size class) during a given period.
refugia – sites where plants or vegetation that formerly had much wider distributions have survived locally through periods of unfavorable conditions in a region.
regolith – all unconsolidated earth materials above solid bedrock.
rhizomatous – having a horizontal, creeping, perennial rootstock that produces smaller roots and vegetative shoots.
riparian – of the area beside a stream, especially a river.
rill – a small streamlet or rivulet.
ruderal vegetation – vegetation resulting from succession following anthropogenic disturbance of an area; generally characterized by unnatural combinations of species (primarily native though including small to substantial numbers of exotics) and relatively short persistence in the absence of additional disturbance.
sandstone – a medium-grained sedimentary rock composed of rounded sand grains cemented together by silica, iron oxide, or calcium carbonate.
saturated – wet for extended periods during the growing season, but never or rarely flooded by surface water; usually applied to wetlands maintained by seepage inputs or perched water tables.
schist – a metamorphic rock containing abundant, visible platy minerals (*e.g.*, mica), giving it a pronounced foliation and cleavage.
sedimentary – formed from the deposition and compression of mineral and rock particles, and sometimes material of organic origin; examples of sedimentary rocks include sandstone, shale, and limestone.
seep – a small area of groundwater discharge, either non-forested or shaded by trees rooted in adjacent, upland habitats; seeps generally support characteristic herbaceous wetland species but are too small or narrow to support hydrophytic woody vegetation.
seepage swamp – a large area of groundwater discharge supporting wetland forest or shrubland vegetation.
seral – of or pertaining to an intermediate or transitional stage in plant succession.
serotinous cone – the cone of a pine that remains closed for a period of time, sometimes years, following maturation; the opening of such cones are often triggered by the heat of fires; a reproductive adaptation that ensures seed dispersal under optimal conditions.
site operations – in the context of natural areas management, those activities that deal with boundaries, facilities, access, signage, public safety, and other human use issues.
smoke management – application of fire intensities and meteorological processes to minimize degradation of air quality during prescribed fires.
snag – a standing dead tree.
sp. – a species.
spp. - species (plural).

spring ephemeral – a plant that completes its reproductive cycle early in the growing season, typically before or during the period in which trees leaf out; such species usually die back and become dormant during unfavorable summer months when habitats are characterized by high temperatures and deep shade.
ssp. – subspecies, a taxonomic rank below species.
stewardship – in the context of natural areas management, the combination of three primary components – biological resource management, site operations, and fire management – with the objective of perpetuating occurrences of natural heritage resources and preserving inherent biological diversity.
stratigraphy – the arrangement of bedrock strata, particularly their geographic position and chronological order of sequence.
stratum – a distinct vertical layer of vegetation defined by relative height (e.g., overstory, understory) and/or by a specific range of heights.
sub-canopy – the understory tree layer immediately below the overstory.
submesic – somewhat moist but well drained, or intermediate between dry and moist; dry-mesic.
subxeric – somewhat dry and drought-prone; intermediate between submesic and xeric.
succession – natural change in the composition and structure of a plant community over time in the absence of disturbance.
successional – of or pertaining to the process of succession.
surface substrate – a collective term for the abiotic materials (e.g., leaf litter, rocks, dead wood) that constitute the ground cover of a site.
terrestrial – of or pertaining to upland (non-wetland) environments.
Triassic – the earliest period of the Mesozoic Era, from approximately 225 million to 190 million years ago.
umbilicate lichen - a leaf-like lichen attached to rocks by a single cord; umbilicate lichens, especially those of the genus *Umbilicaria*, are often referred to as "rock tripes."
understory – collective term for the small trees and shrubs growing beneath the canopy in a forest or woodland.
var. – variety, a taxonomic rank below species.
vascular – having a structural system of tissue (xylem and phloem) that conducts water and soluble nutrients; vascular plants include ferns and flowering plants.
vegetation – the plant life of an area, including its floristic composition, structure, biomass, and phenology.
watch-list species – species of uncommon or uncertain status in Virginia. More information is needed on these species, which may or may not be of high conservation concern at this time; these species are monitored for general population trends.
woodland – vegetation dominated by trees (≥ 20 ft tall) producing an open canopy, typically with 5-60% cover; such vegetation with canopy cover from 5 to 25% is referred to as a sparse woodland; some woodlands may have > 60% canopy cover following elimination or reduction of natural disturbances (e.g., fire).

Management Plan for Dragon Flats: The Nature Conservancy

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Middle Peninsula Planning District Commission
Dragon Run Special Area Management Plan

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Management Plan for Dragon Flats The Nature Conservancy

2007

Dragon Run Special Area Management Plan Technical Report 07-02

Middle Peninsula Planning District Commission
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This Management Plan for the Dragon Flats was compiled, developed, and completed with the combined expertise of individuals from Department of Game and Inland Fisheries, The Nature Conservancy and the Middle Peninsula Planning District Commission.

SECTION 1: Management Framework

MANAGING ENTITY

Dragon Flats is owned (fee simple) by The Nature Conservancy (TNC). The primary point of contact for this site is Andy Lacatell, Director, Chesapeake Rivers Program, (804) 644-6800, extension 18, Alacatell@tnc.org, 530 East Main St, Suite 800, Richmond, VA 23219.

MANAGEMENT STRATEGY FOR DRAGON FLATS

Program Overview

The Chesapeake Rivers project area, identified in the Chesapeake Rivers Plan (Appendix A), totaling roughly 1,800 square miles, encompasses the tidal freshwater portions of the Mattaponi, Pamunkey, and lower Rappahannock river systems as well as the non-tidal blackwater river, Dragon Run . The project area, settled by Europeans 400 years ago, is predominately rural and agricultural, dissected by extensive, unaltered rivers and tributaries that flow into the Chesapeake Bay. These rivers systems are home to some of the most pristine and extensive tidal freshwater marsh and swamp communities remaining in the coastal plain of the Chesapeake Bay, providing unique habitat for the federally listed, globally rare *Aeschynomene virginica* (sensitive joint vetch). The marshes also provide critical nursery habitat for native anadromous fishes like shad and herring and nesting grounds for bald eagles, black ducks, king rails and other resident and migratory waterfowl.

The Chesapeake Rivers area has been a focal area for The Nature Conservancy of Virginia (TNC-VA) since 1986. Past efforts have been focused on land protection for rare species such as the sensitive joint vetch. While the landscape of the Chesapeake Rivers appears to maintain its rural and natural character, its future is precarious as the human populations in Newport News/Hampton Roads, Richmond and Fredricksburg continue to grow and sprawl into the project area, with a high demand for open space and freshwater resources. To fulfill TNC's mission to conserve all biodiversity in this area given the impending threats, broader, more holistic strategies are necessary to address freshwater conservation, restoration of degraded ecological systems, and land protection *at the landscape scale*.

As an example of a site best capturing the biodiversity and ecological processes in the Chesapeake Rivers project area, Dragon Flats represents the high quality bald cypress forests found exclusively on the Dragon Run.

Site Purpose

The primary purpose of Dragon Flats is conservation. Natural resources on this site that make it representative of the ecosystems of the coastal plain include its uniquely pristine swamp habitat and its upland component with significant ecological value. In this context, Dragon Flats is part of one of Virginia's most extensive and relatively unimpacted swamp forest communities, was selected as a site representing one of the Chesapeake Bay's most pristine waterways (Figure 1).

The site priorities at Dragon Flats include: 1) the protection of water quality and the baldcypress community; 2) development and protection of a quality forest block habitat value; 3) grooming the site for future showcase potential; and 4) serving as a demonstration site for forest management.

Policy and Management Approach

The purpose of this management plan is to guide an adaptive resource management process that protects key natural resources on Dragon Flats, utilizes forestry management for habitat development, yet allows for use by traditional groups, such as private hunt clubs.

SECTION 2: Site Background and Resources

INTRODUCTION

Description and Location

Dragon Flats is located east of the New Dragon Bridge on Route 603(Figure 2). The site is an estimated 495 acres and includes primarily mixed hardwoods, quality riparian buffer forest and pristine swamp habitat.

The Dragon Run, headwaters to the Piankatank River, is one of the Chesapeake Bay's most pristine waterways. The Dragon Run watershed remains largely undeveloped and represents one of Virginia's most extensive and relatively unimpacted swamp forest communities. The Dragon Run contains the northernmost example of Baldcypress-Tupelo Swamp community in Virginia and four other natural communities (e.g. Fluvial terrace woodland, Tidal Baldcypress-Tupelo Swamp, Tidal Baldcypress-Woodland/Savanna, and Tidal freshwater marsh) and up to fourteen state rare species (Belden, Jr. et al., 2001; Belden, Jr. et al., 2003).

Climate

While detailed climatic data are not specifically available for Dragon Flats, data for nearby Urbanna, VA describe an average annual minimum temperature of (48.7° F) and an average annual maximum temperature of (68.5° F) from 1971 – 2000. Average monthly maximum temps for the same time period are in July (87.8° F) and the average minimum monthly temps are in January (29.8°F). Precipitation is generally well distributed throughout the year with slightly more than average rainfall in the summer and slightly less in the autumn.
Average total precipitation for the same period is (42.22 inches(Southeast Regional Climate Center, 2007). Soils tend to be wettest in winter and early spring due to reduced evaporation and evapotranspiration. Snow can be expected any time from November to April. The average growing season length is approximately 197 days, and although variable, first fall frosts usually occur in late October and the last spring frosts are often in early to mid-April.

As with most parts of Virginia's coastal plain, the Dragon Flats is vulnerable to hurricanes, tropical storms, ice storms and northeasters that affect the Chesapeake Bay and surrounding shores. Northeasters tend to occur in the autumn, winter, and spring. Hurricanes and tropical storms are less frequent, generally more severe, and usually occur in late summer through autumn. Some northeasters may reach the strength of a tropical storm. These storm events can cause drastic changes to the physiography of the site and surrounding area. Most recently, many coastal forests lost a considerable number of trees, many of which remain where they fell, during Hurricane Isabel in September 2003.

Geology, Landforms, Soils

As one of the Chesapeake Bay watershed's most pristine waterways, the Dragon Run "encompasses some of the most extensive and unspoiled swamp forest and woodland communities in Virginia" (Belden, Jr. et al, 2001). Effectively bisecting Virginia's Middle Peninsula located between the York and Rappahannock Rivers, this fresh and brackish water stream meanders forty miles along and through nontidal and tidal cypress swamp.

During the site survey, it was noted that much of the upland area consisted of primarily sandy soils. Richer soils were found in the riparian buffer area and the lands adjacent to the Run itself.

Geological features are described by the following excerpt from *A Natural Heritage Inventory of the Dragon Run Watershed* (Belden, Jr. et al., 2001):
Surficial deposits of riverine terraces bordering Dragon Run from the vicinity of the Essex-Middlesex county line to Meggs Bay belong to the Shirley Formation and the Sedgefield Member of the Tabb formation. The middle Pleistocene Shirley Formation consists of light- to dark-gray, bluish-gray and brown sand, gravel, silt, clay, and peat; the Sedgefield Member is of upper Pleistocene age and consists of pebbly to bouldery, clayey sand and fine to medium, shelly sand grading upward to sandy and clayey silt. Somewhat higher topography away from the waterway is underlain by the Chesapeake Group. This consists of fine to coarse quartzose sand, silt, and clay (variably shelly and diatomaceous) deposited in shallow waters of the upper Pliocene and lower Miocene periods. At still higher elevations, the Windsor Formation is found, consisting of gray and yellowish to reddish-brown sand, gravel, silt, and clay of lower Pleistocene or upper Pliocene age. At higher elevations southwest of Dragon Run, two other formations are prevalent, both of upper Pliocene age. The Bacons Castle Formation is characterized by gray, yellowish-orange, and reddish-brown sand, gravel, silt, and clay and the Moorings Unit by white, light gray, and grayish-yellow quartzose sand and clay to grayish-brown clayey silt and silty clay.

Watershed elevation ranges from 180 feet to near sea-level. Detailed soils information can be found in the Soil Survey for each county. Many of the soils in the watershed are considered prime farmland and are suitable for silviculture.

Hydrologic Conditions, Water Quality and Water Quality Monitoring Hydrologic Conditions. The Dragon Run watershed, state hydrologic unit CO2, is a fourth-order stream system that is nontidal freshwater above the U.S. Route 17 bridge and tidal freshwater from the U.S. 17 bridge to its mouth at Meggs Bay. There it forms the Piankatank River, where it becomes estuarine, and eventually drains into the Chesapeake Bay. Underground springs, feeder swamps, and surface waters support streamflow in the Dragon Run. Significant tributaries include Dragon Swamp, Yonkers Swamp, Exol Swamp, Timber Branch Swamp, Briery Swamp, Holmes Swamp, White Marsh, Zion Branch, Carvers Creek, Mill Stream, and Meggs Bay (MPPDC, 2001).

According to the National Wetland Inventory, wetlands along the Dragon Run are Palustrine, mostly Forested Wetlands except for Emergent Wetlands in Meggs Bay. U.S. Route 17 is the approximate demarcation between tidal wetlands and nontidal wetlands. The hydrologic regime of most Dragon Run wetlands is Seasonally Flooded, Seasonally Flooded-Saturated, or Temporarily Flooded (Belden, Jr. et al., 2001).

The U.S. Geological Survey (USGS) maintained a streamflow gaging station at Church View (Route 602) from 1943 to 1981 that received drainage from 60% of the watershed (84 square miles) and has maintained a streamflow gaging station at Mascot (Route 603) since 1981 that receives drainage from 75% of the watershed (105 square miles). Median daily streamflow at Mascot from 1981 to 1999 was 79 ft3/sec and varied between 0.01-6050 ft3/sec. Median daily streamflow at Church View from 1943 to 1981 was 57 ft3/sec and varied from 0-3790 ft3/sec.

Compared to other coastal plain stream systems such as the Chickahominy River (New Kent County), the Mattaponi River (King William County), and Cat Point Creek (Richmond County), the Dragon Run exhibits lower median daily streamflow per square mile of drainage area. Base flow, fed primarily by groundwater discharge, accounts for two-thirds of the Dragon Run's total streamflow, with the remaining third attributable to surface water runoff. Of the annual precipitation, only one-third becomes streamflow, with two-thirds lost to evapotranspiration. Seasonally, streamflow is highest in the spring and lowest in the fall (MPPDC, 2001).

Water Quality. The primary water contaminant sources in the Dragon Run are point source discharges and nonpoint source pollution from precipitation (atmospheric deposition), residential land use, agricultural land use, and forested lands (MPPDC, 2002). According to the Virginia Department of Environmental Quality (DEQ), the Dragon Run generally exhibits medium nutrient levels and is listed as "impaired" for pH, fecal coliform bacteria, mercury, and lead (DEQ, 2002). Based on agricultural, urban, and forested pollution loadings potential determined by DCR, however, the overall nonpoint source pollution potential rating is low for the Dragon Run (DCR, 2002).

Point source discharges, which are permitted and monitored by the Virginia Department of Environmental Quality, are relatively easy to quantify and, in turn, control or track. Point source discharges to the Dragon Run include: stormwater runoff from a wood treatment facility (arsenic, chromium, copper) at Pitts Lumber Company, Inc. to an intermittent stream adjacent to U.S. Route 17 in Middlesex County (Permit #VA0083011); discharge from a sewage treatment plant (biological oxygen demand, total suspended solids, ammonia nitrogen, total residual chlorine, pH, fecal coliform) at Rappahannock Community College to an intermittent stream near Glenns in Gloucester County (Permit #VA0028461); and discharge from a wellwater treatment plant (pH, total suspended solids) at the Miller's Square Subdivision to an intermittent stream near Miller's Tavern in Essex County (Permit #VA0075302). According to the Shoreline Sanitary Survey (Smither et al., 2003), there are 9 other indirect sources of pollution, including five animal pollution sources (Middlesex County near Saluda and Stormont and Gloucester County near Glenns); a solid waste dumpsite in Middlesex County near Stormont; and a potential pollution source in Middlesex County in Saluda. Furthermore, a network of water quality monitoring wells is maintained at the Browning-Ferris Industries landfill in King and Queen County.

Throughout the Chesapeake Bay, atmospheric deposition (e.g. precipitation) contributes a significant amount of the total nutrient loadings in coastal waters (MPPDC, 2001). Air quality is not currently monitored in the watershed.

More than 90% of residents in Gloucester, King and Queen, and Middlesex Counties use on-site wastewater treatment systems, commonly known as septic systems (MPPDC, 2001). When operated properly, conventional septic systems remove nutrients and fecal coliform. Conventional septic systems can pose potential environmental and health risks due to inappropriate design, poor maintenance, poor soils, or inefficient nitrogen removal. Driven by changes to Department of Health regulations for on-site wastewater treatment systems (12 VAC 5-610-10 et seq. effective July 2000), the popularity of non-conventional on-site wastewater treatment systems is increasing. These alternative systems, when properly maintained, can be

effective at removing nutrients and fecal coliform in areas where conventional septic systems are ineffective. Regardless of the type, however, improperly maintained or failing septic systems pose significant environmental and health risks by contributing nutrients, pathogenic bacteria, and viruses to groundwater.

Forested lands, representing a significant land area, yield low nutrient input to streams relative to other land uses in the watershed. Best Management Practices (BMPs) are designed to minimize these inputs. For example, forested riparian buffers provide effective protection for water quality. The watershed currently exhibits intact riparian buffers. By contrast, agricultural land use in rural and semirural areas in Virginia can be the source of significant sediments, fecal coliform bacteria, and nutrients such as nitrogen and phosphorus. Nitrogen is transported through the groundwater, whereas phosphorus is generally transported on soil particles in surface water. BMPs such as fencing cattle out of streams, conservation tillage, and expanded riparian buffers are designed to minimize these inputs.

Residential and commercial land uses typically contribute less nutrients and sediments than agriculture, but more than forestry. These residential and commercial contributions are mainly attributable to reduced or no riparian buffers, chemical application for landscaping, and stormwater runoff.

Water Quality Monitoring. Water quality data sets in the watershed are sparse in quantity, duration, and parameters measured. Existing data sets include: STORET, a database managed by the Virginia Department of Environmental Quality (DEQ); data collections during fish surveys by the Virginia Department of Game and Inland Fisheries (DGIF) and Virginia Commonwealth University (VCU); data collections by the Chesapeake Bay National Estuarine Research Reserve in Virginia at the Virginia Institute of Marine Science (VIMS); and a now-defunct volunteer water quality monitoring program in the watershed (MPPDC, 2001).

Two stations are currently sampled regularly by the DEQ. Station DRN003.40 is located at the U.S. Route 17 bridge and Station DRN010.48 is located at the Route 603 bridge near Mascot. Data are available from DRN003.40 for the period 1968-1974 and 1992- present and from DRN010.48 for the period 1992-present. Samples are evaluated bimonthly for nutrients, fecal coliform, suspended solids, dissolved oxygen, pH, salinity, and temperature and are occasionally evaluated for pesticides, toxic metals, and other harmful compounds (MPPDC, 2001). The data sets collected at these sampling stations were used by the DEQ to list the Dragon Run as “impaired” for pH and fecal coliform bacteria. Fish tissue samples were used by the DEQ to list the Dragon Run as “impaired” for mercury and lead. The Virginia Department of Health issued a health advisory for the Dragon Run for mercury contamination in largemouth bass (DOH, 2003). The DEQ attributes the pH impairment to natural causes, citing the acidic nature of water in swamps. The DEQ lists the cause of the fecal coliform and mercury and lead impairments as unknown. Potential sources of fecal coliform bacteria include: wildlife; failing septic systems; and livestock. Potential sources of metals include: atmospheric deposition; automobile and roadway deposits; and industrial operations.

Data collected by the DGIF in 1995-1996 and 1998 includes temperature, Secchi depth, pH, dissolved oxygen, conductivity, salinity, alkalinity, hardness, and total dissolved solids. Nutrient

data are very limited and were frequently below detection limits. Dissolved oxygen at sampling stations with no or low flow frequently violated daily minimum standards to support aquatic life (MPPDC, 2001).

VIMS data from 2000-2001 measured temperature, salinity, total dissolved solids, pH, dissolved inorganic nitrogen, and fecal coliform bacteria. Of specific note, samples from Briery Swamp exhibited high nitrate and fecal coliform levels, indicating the presence of subsurface agricultural or wastewater drainage (MPPDC, 2001).

A weekly volunteer water quality monitoring program collected data throughout the watershed during the period 1994-1997, although monitoring was not continuous at all eight sites. Measurements included dissolved oxygen, Secchi depth, water and air temperature, pH, and water color. The findings indicated: low dissolved oxygen during warm temperatures and high dissolved oxygen during cold temperatures; low Secchi depth values during the summer associated with algal blooms and storm events; and acidic pH values in the upper Dragon Run with slightly more basic pH values in the tidal waters (MPPDC, 2001).

Site History

The Dragon Run plays a central role in the Middle Peninsula's culture and identity. Its intriguing name is frequently borrowed by local enterprises and establishments and is often overheard in community conversations. Since European settlement in the early 1600's and Native American inhabitation up to 10,000 years before that, natural resources have been the bedrock of the watershed's economy. For older generations, forestry, farming, hunting, trapping and fishing were the primary ventures. Today, forestry and farming continue to generate wealth and drive the watershed's economy. Upholding an ancient tradition, hunters range over prime hunting grounds stalking prized game. These land uses, together with extensive swamps, are the main reasons that the Dragon Run remains wild and secluded.

While no archeological artifacts have been found for the site according to the Virginia Department of Historic Resources, the New Dragon Bridge is considered to be a point of navigational significance. In the late mid 1800s, the Dragon Swamp Navigation Company attempted to construct a navigational channel to allow for transportation (primarily of timber) from the Dragon Run to the Piankatank and on to the Chesapeake Bay. This channel was not utilized and considered to be a failure. The channel has since returned to its natural state and is virtually undistinguishable from the surrounding landscape.

Surrounding Land Use

The watershed is mainly undeveloped, almost entirely privately-owned, and encompasses approximately 140 square miles (90,000 acres) of rural landscape – mostly forests, farms, and wetlands. The spring-fed Dragon Run flows through portions of Essex, King and Queen, Middlesex, and Gloucester Counties, emptying into the estuarine Piankatank River and ultimately the Chesapeake Bay.

Land cover data (Figure 5) indicate that the watershed is 80.3-83.9% forested and wetlands, 15.1-18.4% agricultural, and 1.0-1.3 % commercial and residential (MPPDC, 2002; DCR, 2003). The Dragon Run watershed lies within the transitional Oak-Pine vegetation region where

dominant oaks share the forest with Virginia pine, shortleaf pine, and loblolly pine. Although loblolly pine originally appeared in the forest as scattered associates of oaks and other hardwoods, loblolly pine plantations are increasingly common.

In recent years, several public and non-governmental organizations have been actively acquiring land in the Dragon Run watershed for conservation or conservation-compatible purposes. These entities include the Middle Peninsula Chesapeake Bay Public Access Authority, the Friends of Dragon Run, the Nature Conservancy and VIMS. Other conservation holdings in the vicinity of the Dragon Bridge Tract can be seen on Figure 6.

Associated Natural Resources

The watershed's wilderness is both expansive and unique. The Dragon Run contains the northernmost example of the Baldcypress-Tupelo Swamp natural community in Virginia and the best example north of the James River (Belden, Jr. et al., 2001). Natural Heritage Areas are numerous throughout the Dragon Run. Moreover, 14 rare species and 5 rare natural communities are found here (Appendix C). Based on his investigations of the watershed's aquatic communities, one researcher observes that the Dragon Run is a "100 year old time capsule," resembling coastal plain streams in the Chesapeake Bay region at the turn of the 20th century (Garman, 2003).

NATURAL HERITAGE RESOURCES

Overview

Natural heritage resources are defined in the Virginia Natural Area Preserves Act (Section 10.1-209 through 217, Code of Virginia), as "the habitat of rare, threatened, or endangered plant and animal species, rare or state significant natural communities or geologic sites, and similar features of scientific interest benefiting the welfare of the citizens of the Commonwealth." Natural heritage resources are the most likely natural resources to be lost without conservation action in the near future. DCR-DNH inventories and compiles lists of the natural heritage resources of the state.

Since the watershed is relatively intact, it contains many unique resources. Natural heritage resources are abundant in the Dragon Run. Several rare natural communities occur in the Dragon Run, including Baldcypress-Tupelo Swamp, Tidal Baldcypress-Tupelo Swamp, Tidal Baldcypress Woodland/Savanna, Fluvial Terrace Woodland, and Tidal Freshwater Marsh.

Biodiversity Significance

A variety of rarity patterns exist based on the geographic range, habitat specificity and local abundance of species (Rabinowitz, 1981). Standard Natural Heritage methodology ranks plants, animals, and natural communities on two scales of rarity. The global rank (G-rank) and state rank (S-rank) are based on the number of occurrences of a species at a global scale and state scale, respectively (see Appendix C). G- and S-ranks help direct conservation actions to the rarest species and communities since these are usually the most vulnerable to extinction.

Natural Communities

The inventory and classification of natural communities constitute an important "coarsefilter" approach to biological conservation that ensures the protection of diverse organisms. The

identification and protection of excellent examples of all natural community types facilitates the protection of the majority of component native plant and animal species, including a host of taxa too cryptic, poorly known, or numerous to receive individual management strategies.

At present DCR-DNH classifies communities principally at the level of *ecological community group*, which represents a broadly defined unit based on combinations of topographic, edaphic, physiognomic, and gross floristic similarities (Fleming et al., 2004).

Given below are brief descriptions of the primary ecological community groups and their respective ecological community type(s) occurring in the Dragon Run.

Baldcypress-Tupelo Swamp. Forests in this group occupy seasonally to semipermanently flooded backswamps, sloughs, and first bottoms of Coastal Plain rivers and streams. These swamp forests occur throughout the Coastal Plain from Delaware south to Florida and west to eastern Texas, and in the Mississippi River alluvial basin north to Kentucky. They are distributed throughout southeastern Virginia, north to Dragon Swamp (Gloucester, King and Queen, and Middlesex Counties). Habitats are deeply flooded (up to 1.3 m) for part of the year; many retain at least some standing water throughout the growing season. Microtopography is often pronounced with small channels, swales, tree-base hummocks, and numerous bald cypress "knees." Overstory composition varies from mixed stands of bald cypress (*Taxodium distichum*), water tupelo (*Nyssa aquatica*), and/or swamp tupelo (*Nyssa biflora*) to nearly pure stands of one species or another. The three dominants have complex competitive and successional relationships. As a rule, the two tupelos are less shade-tolerant than bald cypress and regenerate more readily by sprouting in cut-over stands. Thus, tupelos tend to become dominant when bald cypress stands are heavily logged. In addition, swamp tupelo appears to be most abundant in organic swamp soils, while water tupelo appears to prefer mineral soils with high silt content.

Green ash (*Fraxinus pennsylvanica*), overcup oak (*Quercus lyrata*), American elm (*Ulmus americana*), and red maple (*Acer rubrum*) are occasional overstory associates and frequent understory trees; swamp cottonwood (*Populus heterophylla*) is also an occasional overstory associate and often abundant in disturbed or cut-over stands. Carolina ash (*Fraxinus caroliniana*) is often dominant in the small tree and shrub layers, while vines of climbing hydrangea (*Decumaria barbara*) and red-berried greenbrier (*Smilax walteri*) are often abundant.

Herb layers vary from sparse to seasonally lush. Most herbaceous plants of bald cypress-tupelo swamps are tolerant of muck soils and fluctuating water levels, or are capable of becoming established on tree hummocks, stumps, and logs. A few of the typical herbs are lizard's-tail (*Saururus cernuus*), false nettle (*Boehmeria cylindrica*), Walter's St. John's-wort (*Triadenum walteri*), swamp beggar-ticks (*Bidens discoidea*), weak stellate sedge (*Carex seorsa*), giant sedge (*Carex gigantea*), taperleaf bugleweed (*Lycopus rubellus*), catchfly cutgrass (*Leersia lenticularis*), and pale mannagrass (*Torreyochloa pallida*). Draw-down zones may support large populations of false pimpernel (*Lindernia dubia* var. *dubia*), marsh fleabane (*Pluchea camphorata*), horse-tail paspalum (*Paspalum fluitans*), Carolina boltonia (*Boltonia caroliniana*), and other fast-growing herbs. This group differs from Coastal Plain / Piedmont Swamp Forests in the clear dominance or co-dominance of bald cypress and tupelos (vs. dominance of mixed hardwoods) and apparently by longer hydroperiods and more deeply flooded habitats. It is

distinguished from Non-Riverine Swamp Forests, which are also dominated by bald cypress and tupelos, by habitat (floodplains vs. non-riverine peatlands) and lower-strata floristics.

Although community types in this group are relatively common, high-quality examples are scarce and all stands provide valuable wildlife habitat and resources. Mature, hollow specimens of the dominant trees are known to provide nesting habitats for the globally uncommon, state-rare eastern big-eared bat (*Corynorhinus rafinesquii macrotis*) and southeastern myotis (*Myotis austroriparius*). Old-growth stands of bald cypress-dominated swamp with trees up to 800 years old occur along the Blackwater River in Surry and Isle of Wight Counties. However, the largest individuals of both bald cypress and water tupelo occur in swamps along the Nottoway River in Southampton County.

References: Fleming and Moorhead (1998), Parker and Wyatt (1975), Plunkett and Hall (1995).

Tidal Baldcypress Woodland. Coniferous or mixed swamp forests and woodlands dominated by bald cypress (*Taxodium distichum*) are known only from the upper tidal reaches of rivers in Maryland, southeastern Virginia and North Carolina. Examples are documented in Virginia from the lunar-tidal Dragon Swamp / Piankatank River (Gloucester, King and Queen, and Middlesex Counties), Chickahominy River (Charles City, James City, and New Kent Counties), and James River (Isle of Wight and Surry Counties); and the wind-tidal Northwest and North Landing Rivers (City of Chesapeake and Virginia Beach). At some sites, these communities occur in ecotones between tidal marshes and non-tidal backswamps or uplands.

In lunar-tidal stands, Bald cypress (*Taxodium distichum*) dominates an open to very open overstory, with or without hardwood associates such as swamp tupelo (*Nyssa biflora*), water tupelo (*Nyssa aquatica*), and green ash (*Fraxinus pennsylvanica*). Stand structure and canopy cover range from closed forest to very open woodland. Shrub and herb layers are variable but generally contain a mixture of species characteristic of both marshes and swamps. Some well-developed tidal bald cypress forests appear floristically similar to palustrine Bald Cypress-Tupelo Swamps. Other stands have a nearly monospecific herb dominance by shoreline sedge (*Carex hyalinolepis*). In a unique, possibly fire-influenced, savanna-like stand on the Northwest River, the herbaceous dominants, in rough seasonal order, are silvery sedge (*Carex canescens* ssp. *disjuncta*), spikerushes (*Eleocharis fallax and Eleocharis rostellata*), marsh rattlesnake-master (*Eryngium aquaticum* var. *aquaticum*), and wild rice (*Zizania aquatica* var. *aquatica*).

A distinctive, mixed tidal swamp forest in extreme southeastern Virginia is subject to irregular wind-tidal flooding. As currently defined, this community type appears to be a globally rare endemic of the Embayed Region of southeastern Virginia and northeastern North Carolina; similar communities, however, may also occur in Maryland and Delaware. In Virginia, stands are confined to the North Landing and Northwest Rivers (Cities of Virginia Beach and Chesapeake), estuarine tributaries of Currituck Sound. Although these systems are no longer influenced by lunar tides because of inlet closures, they are subject to wind-driven currents that produce as much as 1 m (3 ft) of variation in water levels and contribute to a salinity regime that fluctuates between completely fresh and about 5 ppt. This forest borders the wind-tidal marshes along the lower portions of the two rivers, extending well upstream of the limit of marshes in

narrowing channel-side belts. It appears to represent a long-term seral stage in succession from marsh to swamp forest. Habitats have a pronounced hummock-and-hollow microtopography, with an average flooding depth 40 cm (16 in) above the hollow bottoms. Soils are coarse, fibric peats that appear indistinguishable from adjacent marsh peats. Bald cypress (*Taxodium distichum*), swamp tupelo (*Nyssa biflora*), and loblolly pine (*Pinus taeda*) are the dominant overstory trees in variable combinations. Spanish moss (*Tillandsia usneoides*) is locally abundant, festooning the trees in some stands. Sweetbay (*Magnolia virginiana*) and red bay (*Persea palustris*) are scattered understory trees, while southern bayberry (*Myrica cerifera* var. *cerifera*) dominates the shrub layer. The herb layer is diverse, containing species characteristic of both marshes and swamps, but royal fern (*Osmunda regalis* var. *spectabilis*) often dominates. This type differs from vegetation of the Maritime Wet Pine Forests group, which also contains loblolly pine, southern bayberry, and royal fern, in its tidally flooded hydrologic regime (vs. non-tidal saturated hydrology, the co-dominance of bald cypress,) and the prevalence of numerous, flood-tolerant swamp species.

The environmental dynamics, compositional variation, and state-wide distribution of Tidal Bald Cypress Forests and Woodlands are not well known and need intensive study.

Reference: Fleming and Moorhead (1998).

Fluvial Terrace Woodland. This is a somewhat enigmatic group of communities occurring on flat, sandy terraces and islands along Coastal Plain rivers in eastern Virginia. These habitats are elevated well above the level of adjacent swamps and are characterized by xeric, sandy soils and open forest or woodland vegetation. Single occurrences have been documented along the Nottoway River (Sussex County), Chickahominy River (New Kent County), Dragon Swamp (Middlesex County), and Mattaponi River (Caroline County). At all four sites, hickories (*Carya pallida* and *Carya alba*) are the dominant trees, with drought-tolerant oaks (*Quercus falcata*, *Quercus nigra*, *Quercus marilandica*, *Quercus alba*) and pines (*Pinus taeda*, *Pinus virginiana*) present in smaller numbers. Shrubs occurring at all or most sites include sand post oak (*Quercus margarettiae*), sweetleaf (*Symplocos tinctoria*), American holly (*Ilex opaca* var. *opaca*), and eastern red cedar (*Juniperus virginiana* var. *virginiana*). Typical herbs include sedges (*Carex albicans* var. *australis* , *Carex pensylvanica* , and *Carex tonsa*), Canada frostweed (*Helianthemum canadense*), butterfly-pea (*Clitoria mariana*), late goldenrod (*Solidago tarda*), and prickly-pear (*Opuntia humifusa* var. *humifusa*). The Dragon Run site is anomalous in the presence (despite low soil pH and base status) of several calciphiles such as eastern redbud (*Cercis canadensis* var. *canadensis*), wild columbine (*Aquilegia canadensis*), smooth rock-cress (*Arabis laevigata* var. *laevigata*), robin's-plantain (*Erigeron pulchellus* var. *pulchellus*), and elm-leaved goldenrod (*Solidago ulmifolia* var. *ulmifolia*). A full understanding of the status and compositional relationships of this group will require additional inventory and assessment.

Tidal Freshwater Marsh. This is a diverse group of herbaceous wetlands subject to regular diurnal flooding along the upper tidal reaches of inner Coastal Plain rivers and tributaries. Ranging from New York to North Carolina, freshwater marshes occur in the uppermost portion of the estuarine zone, where the inflow of saltwater from tidal influence is diluted by a much larger volume of freshwater from upstream. In Virginia, tidal freshwater marshes are best developed on sediments deposited by large meanders of the Pamunkey and Mattaponi Rivers,

although outstanding examples also occur along the Potomac, Rappahannock, Chickahominy, and James Rivers. Strictly speaking, freshwater conditions have salt concentrations < 0.5 ppt, but pulses of higher salinity may occur during spring tides or periods of unusually low river discharge.

The most common species are arrow-arum (*Peltandra virginica*) dotted smartweed (*Polygonum punctatum* var. *punctatum*), wild rice (*Zizania aquatica* var. *aquatica*), pickerelweed (*Pontederia cordata*), rice cutgrass (*Leersia oryzoides*), tearthumbs (*Polygonum arifolium* and *Polygonum sagittatum*), and beggar-ticks (especially *Bidens laevis* and *Bidens coronata*). Locally, sweetflag (*Acorus calamus*), waterhemp pigweed (*Amaranthus cannabinus*), marsh senna (*Chamaecrista fasciculata* var. *macrosperma*), and southern wild rice (*Zizaniopsis miliacea*) may form dominance patches. Species diversity and vegetation stature vary with salinity, duration of inundation, and disturbance; the most diverse marshes occupy more elevated surfaces in strictly freshwater regimes. Mud flats that are fully exposed only at low tide support nearly monospecific stands of spatterdock (*Nuphar advena*), although cryptic submerged aquatic species may also be present.

Tidal freshwater marshes provide the principal habitat for the globally rare plant sensitive joint-vetch (*Aeschynomene virginica*) and are important breeding habitats for a number of birds, *e.g.*, the least bittern (*Ixobrychus exilis*) . Chronic sea-level rise is advancing the salinity gradient upstream in rivers on the Atlantic Coast, leading to shifts in vegetation composition and the conversion of some tidal freshwater marshes into oligohaline marshes. Tidal Freshwater Marshes are also threatened by the introduced invasive plant marsh dewflower (*Murdannia keisak*). Several communities in this group are chiefly restricted to the Chesapeake Bay drainage basin and are likely globally rare or uncommon.

References: Ahnert (1960), Coulling (2002), McCoy and Fleming (2000), Megonigal and Darke (2001), Parker and Wyatt (1975), Perry and Atkinson (1997), Perry and Hershner (1999).

Rare Plant and Animal Species. The Baldcypress-Tupelo Swamp community also harbors a number of rare plant and animal species. Rare animals include bald eagle, great purple hairstreak, blackwater bluet, robust baskettail, cypress sphinx, Selys' sunfly, fine-lined emerald and Southern pitcher-plant mosquito. Rare plants include cuckooflower, red turtlehead, Parker's pipewort, pineland tick-trefoil, river bulrush, Northern purple pitcher-plant, and cypress-knee sedge (Belden, Jr. et al., 2001; Belden, Jr. et al., 2003). The Dragon Run also harbors a number of rookeries for colonial water birds, such as egrets and herons. Other natural communities that occur in the Dragon Run include: Coastal Plain/Piedmont Bottomland Forest; Coastal Plain/Piedmont Acidic Seepage Swamp; and Coastal Plain Semipermanent Impoundment (Belden, Jr. et al., 2003).

In addition to natural heritage resources, the Dragon Run supports a diversity of freshwater and estuarine fishes, aquatic macroinvertebrates, freshwater bivalves (primarily unionid mussels), and herptefauna (amphibians and reptiles) (McIninch et al., 2003). At least forty-five fish species from nineteen families have been collected in the Dragon Run, representing a mixed assemblage of mostly lowland freshwater forms that is highly dynamic spatially and temporally. At least

sixty-five macroinvertebrate species from fourteen orders and forty-seven families have been recorded from the Dragon Run.

SECTION 3: Management Guidance

RESOURCE STEWARDSHIP

Goals and Objectives

The primary goal of management at Dragon Flats is to maintain a pristine ecosystem with a matrix of communities native to the site that will provide for high biodiversity, water quality and habitat protection, and a high quality forest block. The philosophy and policy direction for management of Dragon Flats is supported those found in the Chesapeake Rivers Site Conservation Plan in Appendix A. Reserve-level management and monitoring actions, as well as cooperative management initiatives and protection strategies, are planned based on the best current information and available resources.

Management objectives for Dragon Flats include:

- Maintain and protect key pristine swamp habitat, primarily the baldcypress communities.
- Protect water quality by maintaining quality functioning riparian buffers.
- Manage site to provide for a high quality forest block.
- Groom the site for future conservation management showcase potential.
- Manage habitat and uses to ensure long-term quality of environment.
- Prevent invasive species from taking hold.
- Manage habitat to benefit the array of natural resources, scenic resources, and historic resources.
- Monitor and evaluate effects of management on plants, animals, and natural communities.
- Maintain populations of rare or uncommon plants and animals.
- Foster consistency with surrounding parcel land uses.
- Ensure site-security and visitor safety.

SITE MANAGEMENT GUIDE

Aquatic and Wildlife Habitat Management Issues

Biological resource management actions shall be taken to preserve and maintain the pristine nature of the swamp community and to utilize the upland area of the site as quality riparian buffer habitat. Due to the current pristine state of the ecosystem of the swamp community on the site, preventing ecosystem degradation is more applicable than ecosystem restoration. Regarding the upland portion of the site, the primary goal is to manage the area to remain a high quality habitat that provides superior buffer qualities to protect the swamp portion of the site. Figure 3 displays the current composition of Dragon Flats.

Major threats to biodiversity generally include: habitat degradation/loss, invasive non-native species, pollution, overexploitation, disease, land conversion to development, water development (e.g., dams, drainage projects), some agricultural practices, livestock grazing, some outdoor recreation (e.g. off-road vehicles), pollutants, infrastructure development (e.g. roads), disruption of fire regimes, logging, and mining activities (Wilcove et al., 1998). After habitat loss, invasive non-native species are the greatest threat to terrestrial species. For aquatic species, water

pollution is the most significant threat after habitat loss (Richter et al., 1997). Because of these threats to biodiversity, active management is often needed to restore and maintain natural resources (Wilcove and Chen, 1998).

Biological issues of greatest concern and most likely to cause negative impacts to natural resources at Dragon Flats are potential invasive species introduction/expansion, use and development pressures outside the reserve, and native animal populations lacking natural abundance controls. Due to the permission-only use management schema of the site, habitat degradation by users should be relatively limited.

Upland/riparian buffer management. The establishment and maintenance of riparian buffers is recognized as a significant protection mechanism of both water quality and key swamp ecosystems. One of the principle components of the management goals includes the establishment of a riparian buffer along Dragon Run and associated riparian zones. The most obvious buffer line is the road on western edge of the property that parallels the creek. The Virginia Department of Game and Inland Fisheries (DGIF) site surveyor's recommendation to achieve this goal is to leave the mixed hardwood forest in the bottomland to serve as riparian buffer. This leaves the upland planted pines as the area for management activities. As the exact direction of management activities had not been several options are listed with an attempt at discussing the pros and cons of each.

The planted pines (Figure 7) appear to be in excellent condition and will need to be thinned at the appropriate time (approx. 5-10 yrs), allowing a lot of understory growth that is excellent for early successional species. As the trees continue to mature, TNC will have a couple of options. Trees should reach a harvestable size (consultation with a certified forester is recommended) in the next 10-15 years. At that point, a decision to harvest the timber or allow the pine trees to continue growing past their prime and eventually die must be made. As the pines die off, the forest will change into a mixed pine hardwood forest (most likely with more of a pine component since oak, beech or hickory species in the understory were not found in high quantities; there were a few yellow poplar saplings in certain areas). If the goal is to eventually have an old growth forest, then the only option is to allow the forest to change over time.

The DGIF site surveyor recommendation is to manage the existing pine forest in similar fashion to neighboring pine forests on different properties. It appears that most of them are naturally regenerated pine forests that are harvested at different periods. If this option is chosen, then maintaining the log decks and planted food plots in an early successional state would fit with management goals. They can be planted in clover or a similar perennial species or allow them to revegetate naturally and mechanically set it back every three years or so. This method would also allow the harvest of different stands of timber for a monetary income that can be reinvested into conserving wetland habitat of performing management activities.

Prescribed fire. Burning can be an important tool for promoting early successional growth in a pine ecosystem, especially once the pines grow large enough to shade out the understory. The existing road network can serve as fire breaks for future management activities and can be planted for wildlife food sources with just a few minor changes. In order to make effective fire breaks, the roads need to be widened slightly by clearing 10 ft from the center to each side of the

road. The roads will also have to be extended to completely surround the upland forested acres. As they exist now, they will not work as fire breaks. Road sides can then be planted in a perennial clover to serve as erosion control and a wildlife food source. As part of a timber harvest plan, the loggers may be able to create roads for TNC while removing certain areas of timber as required. Once created, roads can be maintained as fire breaks very easily.

Key habitat and Natural Heritage Resource protection zones. Areas identified as key habitat, such as the swamp habitat and its riparian buffer should be prevented from being impacted by site activities. Most, if not all, of the Natural Heritage Communities may be found in these zones. Therefore, protection of these zones (Figure 4) is equivalent to protection of the Natural Heritage Communities. Any activities that may damage these habitats should be prohibited and this guidance establishing this prohibition should be enforced.

Threat mitigation.
Invasive, non-native species. The watershed contains only limited examples of invasive, or non-native, species, again emphasizing a relatively intact natural system. Currently, blue catfish, common reed, Asiatic dayflower, Chinese Lespedeza and Japanese stiltgrass occur in the Dragon Run in limited quantities. Nationwide, however, invasive species have been identified as the second highest threat to biological diversity, second only to loss of species and habitat from development and urban sprawl (Stein et al., 2000). Control of invasive non-native plants is expensive, resources are limited, and management efforts must be prioritized (Hiebert and Stubbendieck, 1993). The goal of management at Dragon Flats is to prevent the worst invasive species from becoming established in its high-quality natural communities. While no invasive species were found during the site survey, the managing entity should continue to monitor for these species and prevent their occurrence.

At nearby Dragon Bridge Tract, owned by the Virginia Institute of Marine Science, the following invasive species was noted: Chinese Lespedeza (*Lespedeza cuneata* (sericea lespedeza)).

Chinese Lespedeza (*Lespedeza cuneata* (sericea lespedeza)). Chinese lespedeza, sometimes called sericea lespedeza, is primarily a threat to open areas such as meadows, prairies, open woodlands, wetland borders and fields. Once it gains a foothold, it can crowd out native plants and develop an extensive seed bank in the soil, ensuring its long residence at a site. Established dense stands of lespedeza suppress native flora and its high tannin content makes it unpalatable to native wildlife as well as livestock.

Native animal problem species. Due to overabundance, certain native species of animals have become problematic – from both ecological and economic perspectives. While these species are native to Virginia, recent population increases have resulted in negative effects on habitat. Overabundance of some species is often incompatible with a broad array of resource management objectives. For ecological and/or economic reasons, natural resource managers must sometimes control burgeoning populations of native animals. The primary native species of impact at the Dragon Flats is the white-tailed deer.

White-tailed deer (*Odocoileus virginianus*). A large body of research (Russell et al., 2001) presents evidence that dense populations of deer in many eastern U.S. ecosystems can negatively

impact tree and herb regeneration, recruitment and composition (Alverson and Waller, 1997, Horsley et al., 2003), alter natural community composition (Rooney and Dress, 1997), eliminate certain plant species from areas (Augustine and Frelich, 1998), and disrupt bird populations (deCalesta, 1994; McShea and Rappole, 1997). Deer also avoid browsing on the invasive non-native plants, such as Japanese stilt grass (Tu, 2000) further exacerbating the nefarious effects of these weeds on native flora. Of particular concern for natural areas management are negative effects of high deer densities on herbaceous plants (Balgooyen and Waller, 1995; Augustine and Frelich, 1998) and rare plants (Miller et al., 1992). At the end of the 19th century, deer were over-hunted to the point of near extirpation from Virginia. Since then, implementation of strict game laws, elimination of natural predators, and the changing landscape (with more edge habitat) has given rise to a burgeoning deer population that today, in most areas of the state, exceeds estimated presettlement deer densities (Knox, 1997).

Monitoring programs can be designed to estimate and track deer population densities and deer impacts in order to guide management actions. Additional information on white-tailed deer monitoring and control can be found in Appendix E.

Urban interface factors. Increasing development in the Dragon Run watershed, and specifically along the mainstem itself, has immediate and long-term impacts on natural resource quality and thereby natural resource-based industries. In particular, both large scale development and the placement of sporadic single family homes negatively impact these watershed values.

The network of roads that accompanies larger scale new development creates negative ecological impacts beyond just the effect of construction of new buildings. Increased impervious surfaces alter surface water flow and aquifer recharge, in addition to increased soil loss and sedimentation, which contribute to water quality degradation. Even more distantly located emissions from motor vehicles, power plants, industry, and other fossil-fuel producers have negative air and water quality impacts in the Dragon Run.

While the development of single family homes along the Dragon Run may leave a smaller footprint with regard to impervious surfaces and infrastructure requirements, it contributes significantly to the fragmentation of key habitat. Most of the traditional uses, ie farming and forestry, which have been practiced in the Dragon Run require large tracts of land to operate. These large holdings have been the key to keeping the watershed primarily intact. The patchy placement of new single family homes, especially close to the mainstem itself, reduces the cohesiveness of the ecosystem, as well as the capacity of the traditional industries to operate effectively in the future.

To help mitigate and plan for the impacts of the urban interface factors, TNC should continue to support the Dragon Run Steering Committee and the Dragon Run Special Area Management Plan in its efforts to work with the watershed counties to develop land-use planning recommendations that balance growth demands and the protection of traditional uses of the Dragon Run.

Fire management. Fire management is frequently an important facet of natural areas management in Virginia. Fire management activities include both prescribed fire implementation

and wildfire management. While some wildfires are potentially destructive and should be suppressed, some situations – such as in the case of Dragon Flats - should be explored as an opportunity to realize the benefits of fire in a natural setting.

To prepare for and provide guidance in the event of a wildfire in the future, a wildfire contingency plan should be developed for Dragon Flats. Such a plan should explore the past role of fire on the site, clearly state the potential benefits and disadvantages of wildfire under current landowner and management contexts, outline management objectives, and provide a viable set of management options should a wildfire occur. Development of a wildfire contingency plan would best be accomplished by TNC staff working closely with agencies and organizations that frequently deal with fire management issues, including DCR, and Department of Forestry (DOF), DGIF.

Cultural/Historic Site Protection
A Virginia Department of Historic Resources review was conducted and there do not appear to be any applicable archeological or architectural artifacts located on the Dragon Flats site.

Use, Public Access, and Enforcement Plan
Operations management is a crucial aspect of natural area management, especially on lands where recreational uses by members of the public may conflict with the primary management objectives of water, habitat and biodiversity protection. Managers must design and maintain infrastructure such as signs to best protect resources from adverse human effects. Routine operations management activities include boundary line maintenance, permitted/prohibited activity posting, and law enforcement. Since TNC lacks its own law enforcement staff, it will be necessary to partner with other natural resource agencies such as VDGIF when law enforcement issues affecting natural resource protection arise.

Specific permited uses discussed for Dragon Flats included leasing to hunt clubs, forestry/timbering and case-by-case passive recreation. Other activities may be permitted by TNC on a case-be-case basis, subject to approval by TNC managing staff.

Visitor management. All requests for access to and use of Dragon Flats must be submitted to the TNC for review, processing and permission. Any permitted access or usage must be consistent and compatible with the management strategies and goals outlined in this management plan. Failure to comply with approved visitation permission stipulations shall result in the cessation of all activities by that entity. Trespass or failure to request permission for an activity shall result in cessation of use by that entity until such time as the activity is approved by TNC

Code of conduct. Site users should receive a copy of the Public Use Guide (Appendix F), which provides information regarding the public and private rights associated with waterways in Virginia. This brochure provides an overview of the Public Trust Doctrine and how it is applied. This use of this document may help to reduce conflicts between individuals exercising their public trust rights and landowners, and vice versa.

Hunting. Virginia law provides that any appropriately licensed person can hunt waterfowl in public waters during established seasons and using legal methods so long as they are not within

457 meters (500 yards) of an existing licensed stationary waterfowl blind. Therefore, if TNC does not license, establish, and use (for the purpose of hunting) stationary waterfowl blinds on Dragon Flats, then members of the public may obtain a license and build a stationary hunting blind in public waters surrounding and adjacent to the site. Where stationary blinds are not established, hunters could also legally hunt from licensed floating blinds in the waters adjacent to the site.

Any hunt clubs leasing the site should be registered in the D-Map system. Deer hunting guidance can be found in Appendix E.

Plan for Consistency with Surrounding Properties and Participation with Regional Conservation Area Coordination Efforts

There are several sites in the vicinity of Dragon Flats that also are conservation acquisitions held by public and non-governmental organizations, yet have varying goals and management schema than Dragon Flats. It is recommended that the site managers communicate as needed to maximize opportunities that become available and to ensure consistency and compatibility across the watershed.

Establishment of Conservation Easements

It is recommended that a conservation easement be placed on the property, primarily the swamp habitat and its riparian buffer to permanently protect the key natural habitats of this property.

Plan for Management Sustainability and Funding

TNC aims to utilize on-site earning, such as those from timber harvests and hunt club leases to fund future conservation management needs. As time and capacity are a limiting factor for site management, TNC also aims to use these leases and agreements to conduct much of the site maintenance, such as road maintenance, culvert installation and trail clearing.

IN SUMMARY

Summarized below are Action Items identified by this management plan to fulfill the Management Objectives listed in Section 3:

Action Items

- Adopt “do-not-disturb” approach to management of riparian buffers/swamp/Natural Heritage Communities
- Install culvert to keep roadway accessible
- Select forest management approach from discussed options and consult with Virginia Department of Forestry to implement
- Take prescribed measures to prevent invasive species, such as Chinese Lespedeza; monitor for other invasive species that may move into the area
- Require D-Map registration for all hunt clubs leasing the property
- Continue with Dragon Run Steering Committee participation and input, especially regarding land-use planning in King and Queen and the surrounding counties
- Adopt Public Use Guide
- Erect signage internal to the site with management contact information, use restrictions and guidance and other information, such as the Public Use Guide.

- Post boundary markers to differentiate the site from surrounding lands
- Continue with permission-based management approach for site use
- Coordinate with surrounding public and non-governmental entities regarding conservation site management goals and opportunities

CONCLUSION

Contrary to the management of many conservation sites in more populated areas, the isolation and currently pristine key habitats of Dragon Flats require minimal active management. Because the swamp and primary riparian buffer of the site currently reflects the "natural" landscape of pre-industrial/pre-urban expansion America 500 years ago, a "do-not-disturb" management strategy will go a long way to conserve natural resources. By addressing several key management issues upfront, including road corridor maintenance, prevention/removal of invasive species, management of the upland forest, and by controlling activities and enforcing the prohibition of incompatible uses, it is likely that successful stewardship of natural resources will be attained with more passive management requirements in the future.

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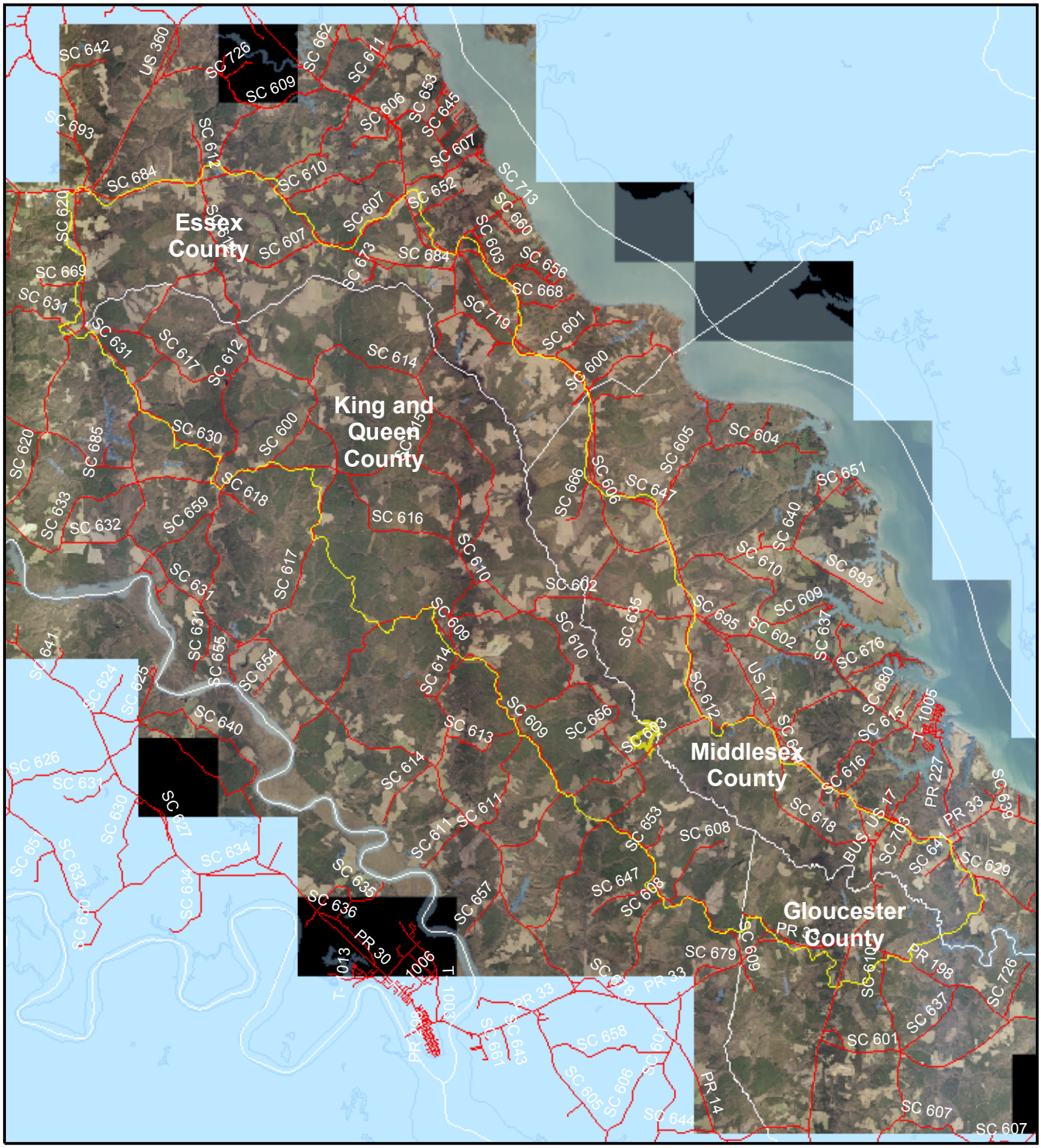
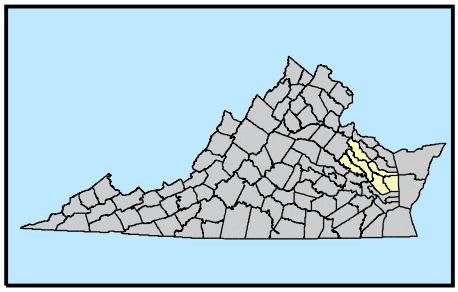
Figure 1: Dragon Run Watershed

Figure 1: Dragon Run Watershed





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Virginia Coastal Zone
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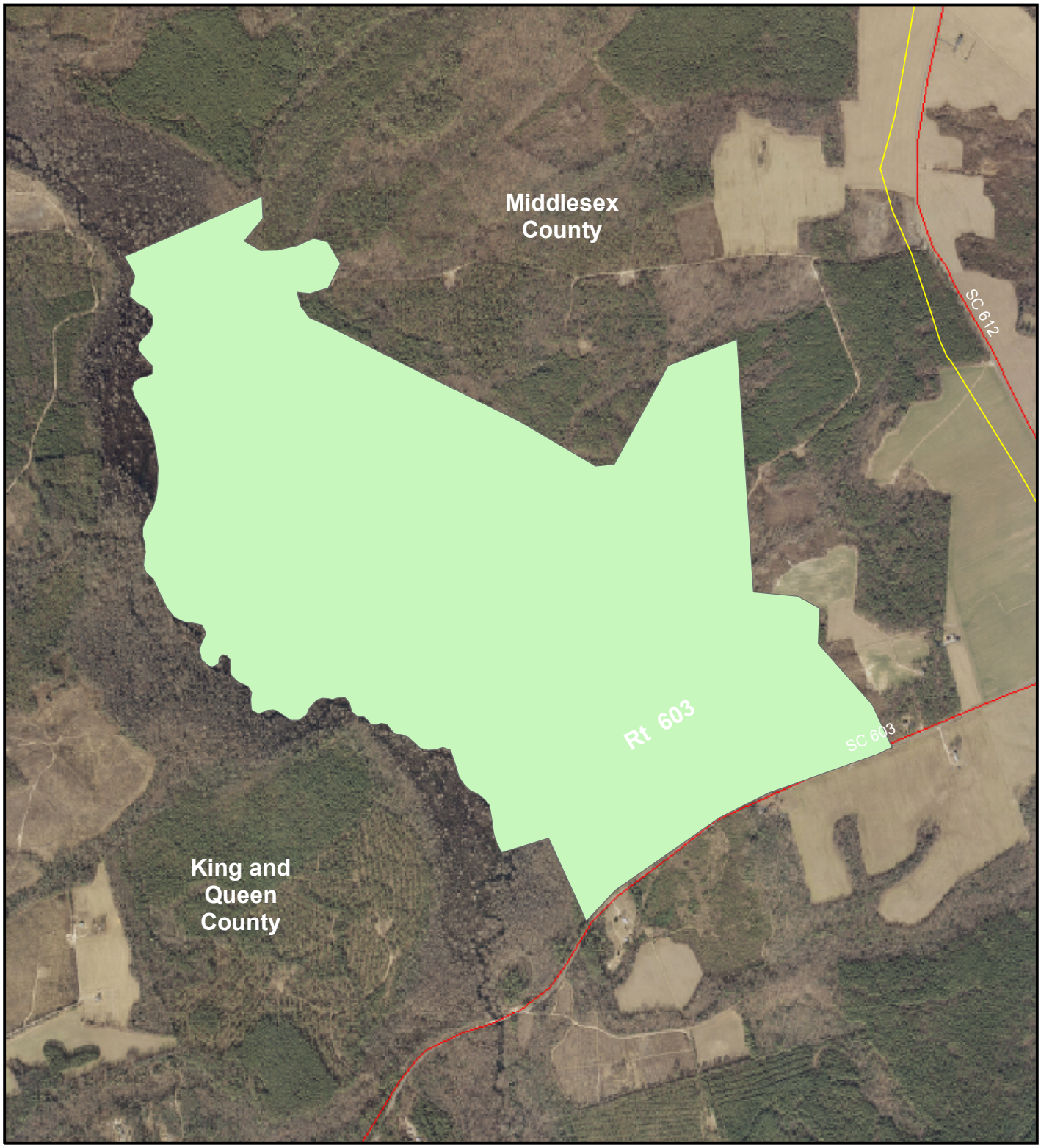
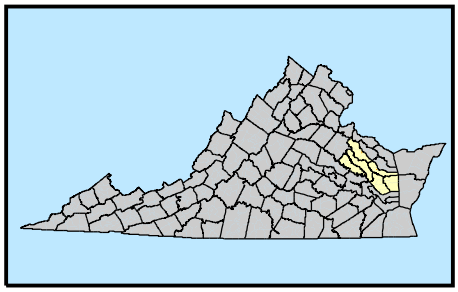
Dragon Run WATERSHED

Middle Peninsula Planning District Commission - 2004

Figure 2. Dragon Flats – The Nature Conservancy: Site Boundary

Figure 2: Dragon Flats - TNC





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Virginia Coastal Zone
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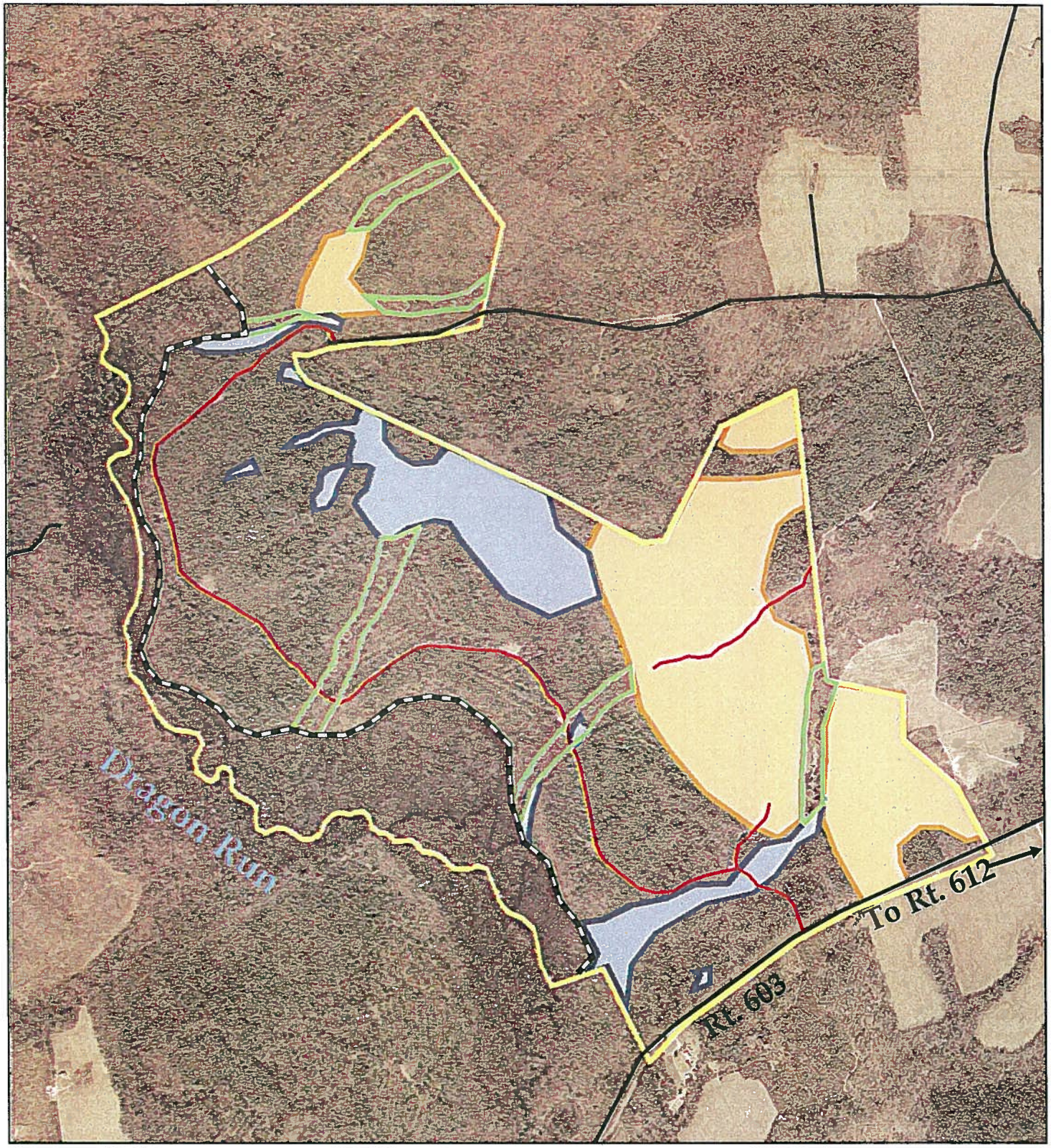
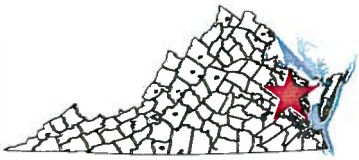
Dragon Run WATERSHED

Middle Peninsula Planning District Commission - 2004

Figure 3. Site Survey Findings of Dragon Flats



The Nature Conservancy



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Dragon Run Block Combination Management

- Dragon Run High Water Line
- Wetlands
- Hardwood Stands
- Travel Corridor

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Figure 4.Dragon Flats: High Priority Protection Areas

Dragon Flats (TNC)

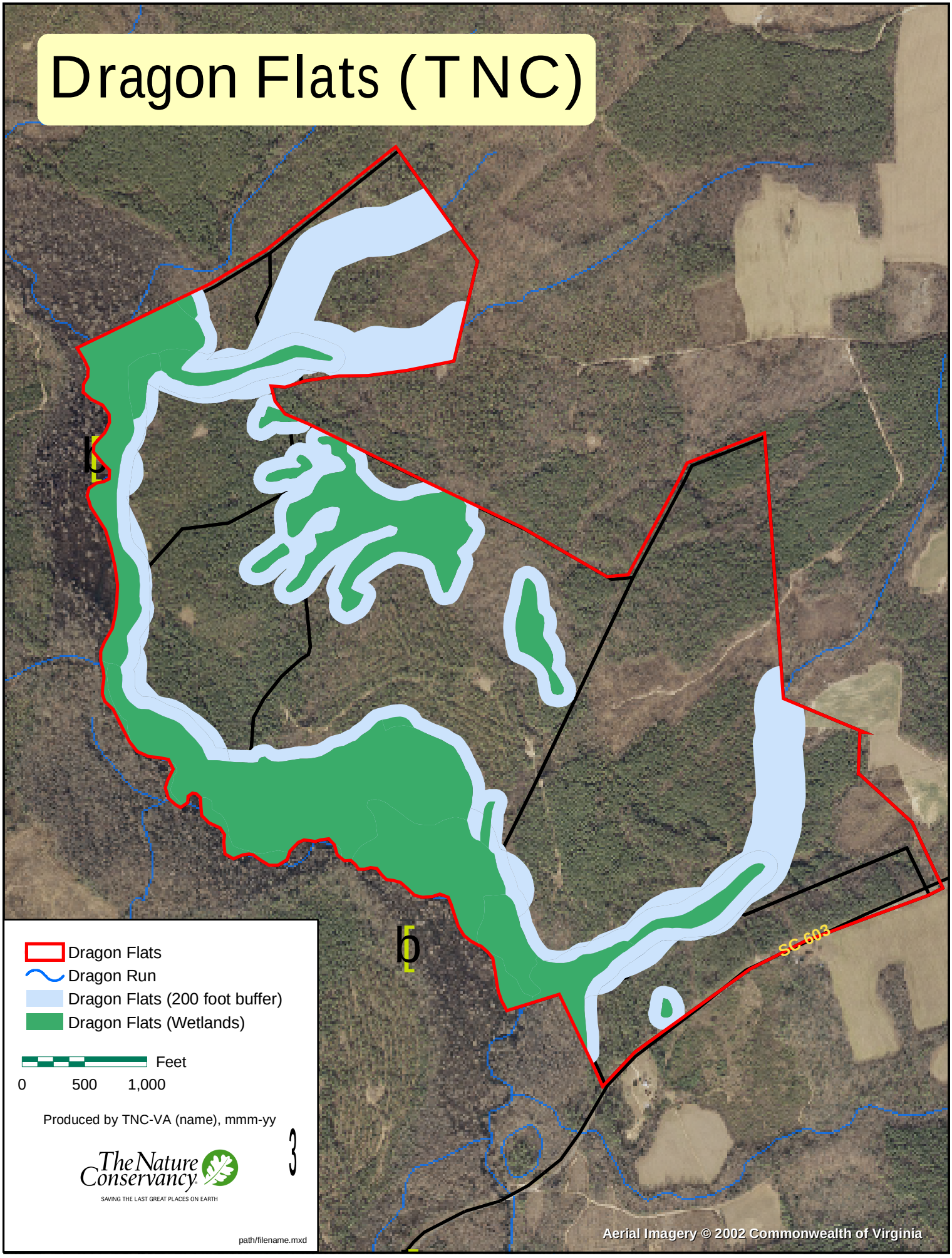
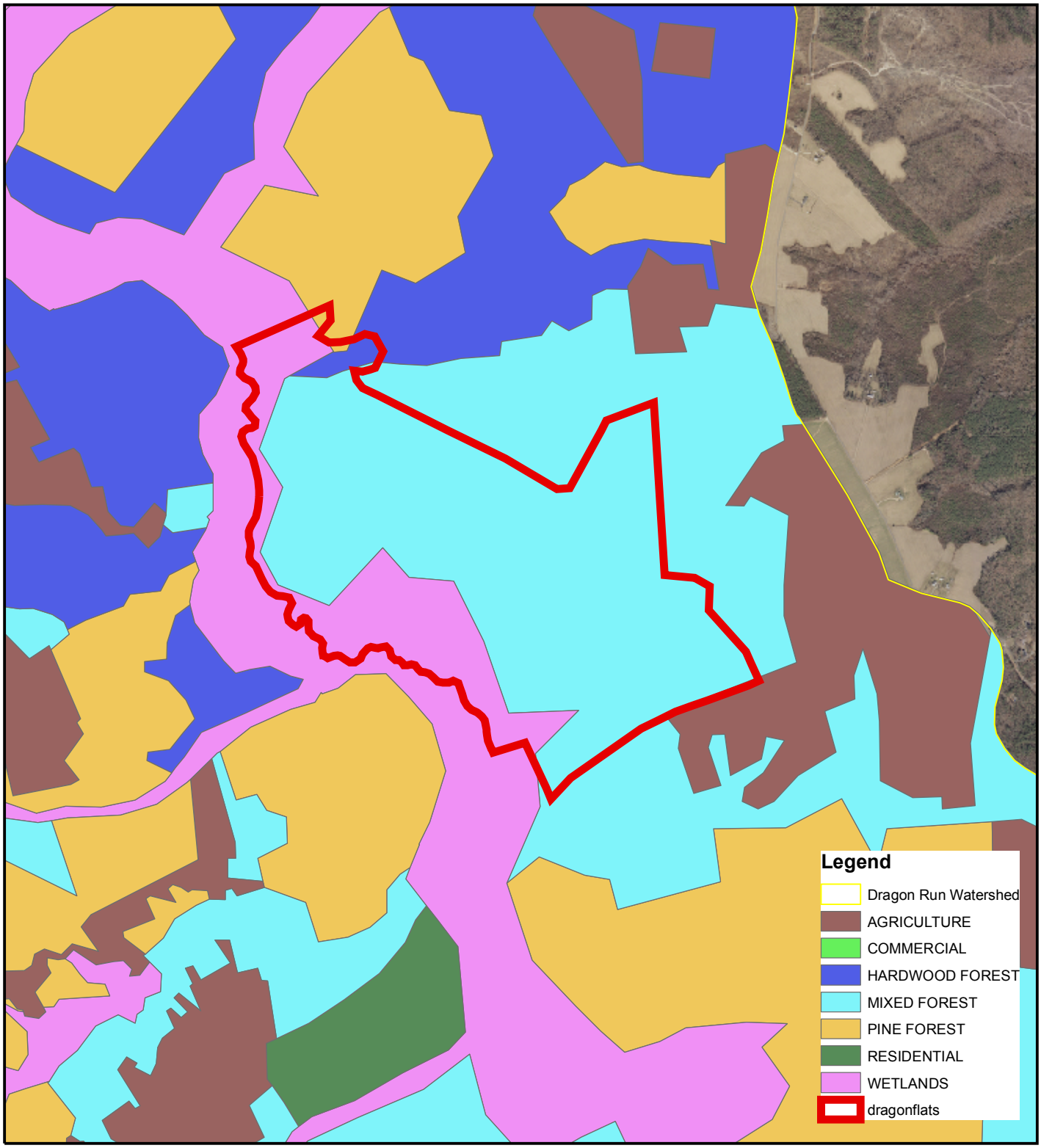


Figure 5. Surrounding Landcover

Figure 5: Dragon Bridge Tract - Surrounding Landcover



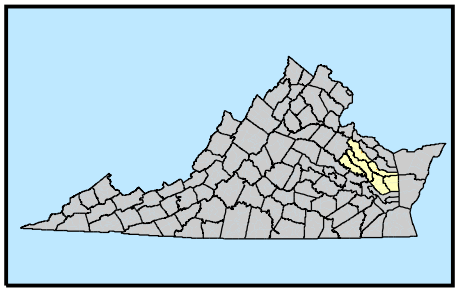


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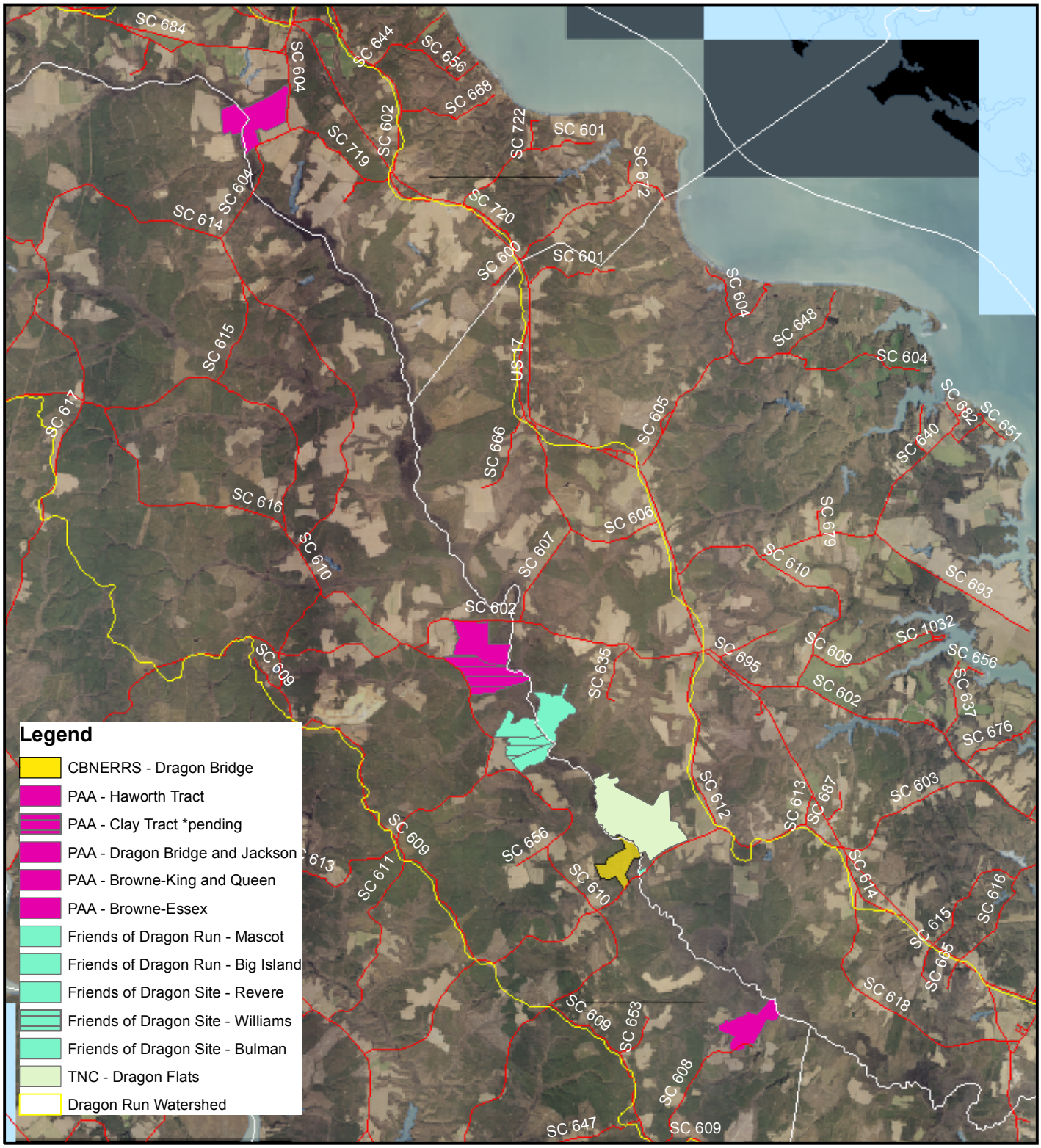
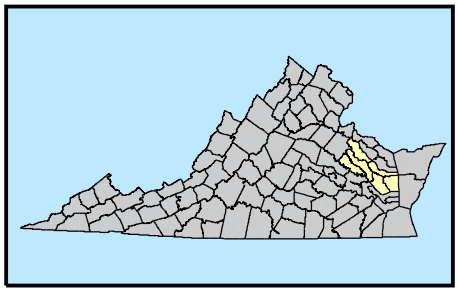
Figure 6. Surrounding Conservation Holdings

Figure 6: Dragon Flats - Surrounding Conservation Holdings





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REFERENCES

Alverson, W. S. and D. M. Waller. 1997. Deer populations and the widespread failure of hemlock regeneration in northern forests. Pp. 280-297. In: W. J. McShea, H. B. Underwood, and J. H. Rappole (eds.). The science of overabundance: deer ecology and population management. Smithsonian Institution Press, Washington, D.C.

Augustine, D. J. and L. E. Frelich. 1998. Effects of white-tailed deer on populations of an understory forb in fragmented deciduous forests. Conservation Biology 12:995-1004.

Augustine, D. J., L. E. Frelich and P. A. Jordan. 1998. Evidence for two alternate stable states in an ungulate grazing system. Ecological Applications 8:1260-1269.

Balgooyen, C. P. and D. M. Waller. 1995. The use of Clintonia borealis and other indicators to gauge impacts of white-tailed deer on plant communities in northern Wisconsin. Natural Areas Journal 15:308-318.

Belden, A. Jr., A.C. Chazal, G.P. Fleming, C.S. Hobson, and K.M. McCoy. 2001. A Natural Heritage Inventory of the Dragon Run Watershed. Second edition. Natural Heritage Technical Report 01-03. Virginia Department of Conservation and Recreation, Division of Natural Heritage, Richmond, VA. 64 pp. plus appendix.

Belden, A. Jr., A.C. Chazal, and C.S. Hobson. 2003. A Natural Heritage Inventory of Fourteen Headwater Sites in the Dragon Run Watershed. Natural Heritage Technical Report 03-16. Virginia Department of Conservation and Recreation, Division of Natural Heritage, Richmond, VA.

DeCalesta, D. S. 1994. Impact of white-tailed deer on songbirds within managed forests in Pennsylvania. Journal of Wildlife Management 58:711-718.

Department of Conservation and Recreation. 2002. The Biennial Nonpoint Source Pollution Water Quality Assessment Report. Virginia Department of Conservation and Recreation, Division of Soil and Water Conservation, Richmond, VA.

Department of Conservation and Recreation. 2003a. Natural Heritage Resources Maps. Virginia Department of Conservation and Recreation, Division of Natural Heritage, Richmond, VA.

Department of Conservation and Recreation. 2003b. Virginia 2002 Nonpoint Source (NPS) Assessment Landuse/Area web site. Virginia Department of Conservation and Recreation, Division of Soil and Water Conservation, Richmond, VA. http://192.206.31.52/cfprog/dswc/lutype.cfm.

Department of Environmental Quality. 2002. 2002 303(d) Report on Impaired Waters. Virginia Department of Environmental Quality, Richmond, VA. http://www.deq.state.va.us/water/303d.html.

Elzinga, C. L., D. W. Salzer, and J.W. Willoughby. 1998. Measuring and monitoring plant populations. Bureau of Land Management, Denver, Colorado

Fleming, G.P., P.P. Coulling, D.P. Walton, K.M. McCoy, and M.R. Parrish. 2001. The natural communities of Virginia: classification of ecological community groups. First approximation. Natural Heritage Technical Report 01-1. Virginia Department of Conservation and Recreation, Division of Natural Heritage, Richmond, VA. Unpublished report. January 2001. 76 pp.

Garman, G.C. 2003. Aquatic Living Resources Inventories in the Dragon System: Virginia Commonwealth University On-going Activities. Dragon Run Natural Resources Symposium, February 11, 2003, Virginia Institute of Marine Science, Gloucester Point, VA.

Hiebert, R. and J. Stubbendieck. 1993. Handbook for ranking exotic plants for management control. USDI National Park Service, Midwest Regional Office, Omaha

Horsley, S. B., S. L. Stout and D. S. DeCalesta. 2003. White-tailed deer impact on the vegetation dynamics of a northern hardwood forest. Ecological Applications 13:98-118.

Knox, W. M. 1997. Historical changes in the abundance and distribution of deer in Virginia. Pp. 27-36 *in* W.J. McShea, H.B. Underwood and J.H. Rappole (eds.). The science of overabundance: Deer ecology and population management. Smithsonian Institution Press, Washington, D.C.

McShea, W. J. and J. H. Rappole. 1997. Herbivores and the ecology of understory birds. Pp. 298-309. In: W. J. McShea, H. B. Underwood and J. H. Rappole (eds.). The science of overabundance: deer ecology and population management. Smithsonian Institution Press, Washington, D.C.

McIninch, S.P., G.C. Garman, L. Smock, and W. Shuart. 2003. Preliminary Aquatic Living Resources Inventory. Virginia Commonwealth University, Center for Environmental Studies, Richmond, VA. Prepared for Middle Peninsula Planning District Commission.

Middle Peninsula Planning District Commission. 2001. Dragon Run Watershed Land-Water Quality Preservation Project. Middle Peninsula Planning District Commission, Saluda, Virginia.

Middle Peninsula Planning District Commission. 2002. Dragon Run Management Framework. Middle Peninsula Planning District Commission, Saluda, Virginia. Prepared by Anderson and Associates, Richmond, Virginia.

Miller, S. G., S. P. Bratton, and J. Hadidian. 1992. Impacts of white-tailed deer on endangered and threatened vascular plants. Natural Areas Journal 12:67-74.

Rabinowitz, D. 1981. Seven forms of rarity. Pp. 205-218 *in* H. Synge (ed.). The biological aspects of rare plant conservation. Wiley and Sons, New York.

Richter, B. D., D. P. Braun, M.A. Mendelson, and L. L. Master. 1997. Threats to imperiled freshwater fauna. Conservation Biology 11:1081-1093.

Rooney, T. P. and W. J. Dress. 1997. Species loss over sixty-six years in the ground-layer vegetation of Heart's Content, an old-growth forest in Pennsylvania, USA. Natural Areas Journal 17:297-305.

Russell, F. L., D. B. Zippin, and N. L. Fowler. 2001. Effects of white-tailed deer (Odocoileus virginianus) on plants, plant populations and communities: a review. American Midland Naturalist 146:1-26.

Smither, J.M., R.M. Thomas, D.B. Geeson, and R.S. Morris. 2003. Shoreline Sanitary Survey: Piankatank River, Upper; Gloucester, Mathews, and Middlesex Counties. Virginia Department of Health, Division of Shellfish Sanitation, White Stone, VA

Southeast Regional Climate Center. 2007. Climatic summaries for Virginia stations. Available at Website: http://www.dnr.state.sc.us/climate/sercc/services.html.

Stein, B. A., L. S. Kruner, and J. S. Adams. 2000. Precious Heritage: The Status of Biodiversity in the United States. Oxford University Press, Oxford, New York. 399 pp.

Tu, M. 2000. Element Stewardship Abstract for *Microstegium vimineum*, stilt grass. The Nature Conservancy's Wildland Invasive Species Program.

Wilcove, D.S. and L.Y. Chen. 1998. Management costs for endangered species. Conservation Biology 12:1405-1407.

Wilcove, D.S., D Rothstein, J. Dubow, A. Phillips, and E. Losos. 1998. Quantifying threats to imperiled species in the United States. BioScience 48:607-615.

APPENDICES

A. Chesapeake Rivers Plan
B. Rare Species and Community List
C. Natural Heritage Rarity Ranks and Status Explanation
D. Dragon Run Watershed Management Plan
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APPENDIX A: Chesapeake Rivers Plan

The Chesapeake Rivers Site Conservation Plan

August 2001

The Nature Conservancy of Virginia

Executive Summary

The Chesapeake Rivers project area, totaling roughly 1,800 square miles, encompasses the tidal freshwater portions of the Mattaponi, Pamunkey, and lower Rappahannock river systems as well as the non-tidal blackwater river, Dragon Run . The project area, settled by Europeans 400 years ago, is predominately rural and agricultural, dissected by extensive, unaltered rivers and tributaries that flow into the Chesapeake Bay. These rivers systems are home to some of the most pristine and extensive tidal freshwater marsh and swamp communities remaining in the coastal plain of the Chesapeake Bay, providing unique habitat for the federally listed, globally rare *Aeschynomene virginica* (sensitive joint vetch). The marshes also provide critical nursery habitat for native anadromous fishes like shad and herring and nesting grounds for bald eagles, black ducks, king rails and other resident and migratory waterfowl.

The Chesapeake Rivers site has been a focal area for The Nature Conservancy of Virginia (TNC-VA) since 1986. Past efforts have been focused on land protection for rare species such as the sensitive joint vetch. While the landscape of the Chesapeake Rivers appears to maintain its rural and natural character, its future is precarious as the human populations in Newport News/Hampton Roads, Richmond and Fredricksburg continue to grow and sprawl into the project area, with a high demand for open space and freshwater resources. To fulfill TNC's mission to conserve all biodiversity in this area given the impending threats, broader, more holistic strategies are necessary to address freshwater conservation, restoration of degraded ecological systems, and land protection *at the landscape scale*. Therefore, TNC-VA has developed a strategic conservation plan, which re-defines and focuses the goals and plan of action over the next 5-10 years for the Chesapeake Rivers project area, as summarized below.

Seven focal conservation targets were selected to best capture the biodiversity and ecological processes in the Chesapeake Rivers project area (Table i.). The tidal freshwater system and upland terrestrial system capture the gamut of critical ecological functions and the characteristic native biota within the project area at multiple scales, for rivers and uplands. Other targets represent significant biological elements not captured explicitly by the tidal freshwater or upland terrestrial systems. These include high quality bald cypress forests found exclusively on the Dragon Run, the cryptic fluvial terrace woodland communities occurring in only 2 sites on elevated islands in river floodplains, calcareous forests found in coves and ravines on unique marine shell deposits, and seepage wetlands which occur in highly dissected headwater areas of the inner coastal plain within the project area. Anadromous shad and herring fish species were also singled out as conservation targets due to the unique co-occurrence of these species in the Chesapeake Rivers and potential for viability not possible elsewhere given the unaltered river runs necessary to their reproduction.

The overall biodiversity health or viability is ranked as "fair" for the project area (Table iii). This reflects the severe and widespread degradation, fragmentation and destruction of the upland forest communities. However, the tidal freshwater system is considered to be functional and viable given the lack of alteration to the naturally variable flow regimes of

the respective river systems. Significantly, the overall landscape context of the project area considered good due to its rural and agricultural setting, improving the likelihood of conservation success.

The top 5 threats to conservation targets identified in the Chesapeake Rivers project area are development, incompatible forestry practices (i.e. clearcutting, high grading, conversion to pine plantations), invasive and non-native plant and fish species, sea level rise and water management (i.e. water withdrawals, dam/reservoir construction, etc.) (Table iii). ***Residential development*** is a threat to almost all of the targets throughout the project area. Historically, the ***conversion of upland forest to agriculture*** in addition to the current ***silivicultural practices*** such as conversion to pine plantations, clear cutting and high-grading has had a severe and widespread effect on the functioning of these forest communities***. Introduced, invasive non-native freshwater fish species*** such as blue catfish predate on native anadromous fishes, posing a serious threat to their population viability***. Invasive plant species*** permeate tidal freshwater marshes, upland and calcareous forests, out-competing the native flora and altering the structure and composition of these communities. ***Sea level rise*** threatens to completely alter all vegetation in the freshwater rivers by increasing the amplitude of tides and moving the salt gradient further upstream, favoring halophytic species and communities. Finally, ***water management*** issues such as surface and ground water withdrawals, dam and reservoir construction are becoming more imminent as threats to the natural flow regimes of the Chesapeake Rivers which support a range ecological processes, species and communities. Demand for freshwater is ever-pressing with the growing populations surrounding the project area.

TNC-VA will implement several conservation strategies in the Chesapeake Rivers to abate the most severe threats to conservation targets and to improve their viability through out the project area (Table iv), grouped into the following five categories:

- **Land Use and Land Protection.** These strategies consist of working with partners (e.g. DCR, USFWS, river organizations) to protect viable occurrences of conservation targets through acquisition or conservation easements as well as working with priority localities to promote land use policies or incentive based land protection programs.
- **Upland Forest Restoration**. The conservation goal for the upland terrestrial forest system is to restore 3 contiguous mixed hardwood-pine forest patches of 10,000 acres or more (one between the Dragon Run and the Mattaponi, one along the mid Rapphannock, and one at Fort A.P. Hill). Strategies to accomplish this include working to promote sustainable and profitable forestry to private landowners through model forest sites which demonstrate the economic value of longer rotations, uneven age class structure, and hardwood regeneration for sawtimber procurement, quail hunting, etc.
- **Water Management**. To address water management issues, TNC-VA will work to develop and implement a regional and state water use policy that preserves the naturally variable flow regimes of the project area rivers. This may be one of the most bold and challenging conservation strategies ever undertaken by the TNC-VA, yet is the most promising means of ensuring conservation of freshwater targets.

- **Invasive Species.** TNC-VA will work with partners to promote policies to eliminate invasive species introductions and trades, for both fish and plants, while seeking to develop control methods for species which are currently established or anticipated in the project area.

The new TNC Chesapeake Rivers Program Director, Andy Lacatell, has recently been hired to work with the local community groups, landowners, and government agencies to implement conservation strategies set forth in the conservation plan. Doors to TNC's new Chesapeake Rivers office in Tappahannock opened the first of January 2001. With a comprehensive strategic plan and increased on-site capacity and leadership, the VAFO hopes to successfully work with partners toward the conservation and restoration of the unique and vast landscape of the Chesapeake Rivers.

Table i. Descriptions of Chesapeake Rivers conservation targets.

Conservation Target	**Description**
Tidal Freshwater System	Mosaic of inter-grading tidal freshwater emergent herbaceous marshes, mudflats, semi-open multi-strata hardwood swamp forest, and submerged aquatic vegetation, including sensitive joint vetch, (*Aeschynomene virginica* (G2)). Marshes at site are likely the most exemplary and extensive on the Atlantic coast.
Upland Terrestrial Forest System	Well-drained upland forests consisting of beech, oaks, hickories and other common hardwood species. Represents remnant occurrences of a formerly characteristic upland matrix forest of the coastal plain and will require significant restoration.
Bald Cypress Forests	Tidal and non-tidal/seasonally to semi-permenantly flooded bald cypress forests found exclusively along Dragon Run in project area. Non-tidal swamp on Dragon represents best and northernmost example of its kind in the eastern U.S.
Fluvial Terrace Woodlands	Small patch, open woodland communities composed of xeric hickories and oak species anomalous due to elevated topographic position and sandy substrate in floodplain--likely relicts of sandhill communities.
Calcareous Forest	Small patch, rich northeast-facing, mature oak-hickory-beech-poplar forests with paw-paw dominant in the shrub layer and a diverse herbaceous layer. Found in unique calcareous ravines.
Seepage Wetlands	A mosaic of intergrading fire-maintained shrub/ graminoid-dominated seepage bogs and forested seepage swamps that occur in areas of dissected topography and sandy/peaty soils, supporting rare plant species such as swamp pink and New Jersey Rush (*Helonias bullata* (G3, LT) and *Juncus caesariensis (G2))* as well as critical breeding habitat for odonates and amphibian species.
Anadromous Fishes	Reproductive habitat of blueback herring, alewife, hickory shad and American shad. Historically, these four species' distribution overlapped in the mainstem tributaries of the Chesapeake Bay; however, the Rappahannock, Mattaponi and Pamunkey watersheds (to Fall Line) maybe last places where all 4 species can still migrate/reproduce successfully without significant habitat impediments or alterations.

Table ii. Viability ranks for Chesapeake Rivers conservation targets.

Target	**Size**	**Condition**	**Context**		**Viability Rank**
Tidal Freshwater System	**Very Good**	**Good**	**Good**		**Good**
Upland Terrestrial Forest System	**Poor**	**Poor**	**Fair**		**Poor**
Bald Cypress Forests	**Very Good**	**Good**	**Good**		**Good**
Fluvial Terrace Woodland	**Very Good**	**Good**	**Good**		**Good**
Calcareous Forest	**Good**	**Very Good**	**Good**		**Good**
Seepage Wetlands	**Good**	**Fair**	**Fair**		**Fair**
Anadromous Fishes	**Fair**	**Fair**	**Good**		**Fair**
Site Biodiversity Health Rank					**Fair**

Table iii. Threat ranks for the Chesapeake Rivers conservation targets.

Active Threats across Conservation Targets	Tidal Fresh-water System	Bald Cypress Forests	Fluvial Terrace Woodland	Upland Terrestrial Forest System	Calcar-eous Forest	Seepage Wetlands	Anadro-mous Fishes	**Overall threat rank**
Development (residential homes, roads, other infrastructures)	Medium	-	Medium	Very High	Medium	High	Medium	**HIGH**
Incompatible forestry practices (silviculture)	-	Medium	-	Very High	Medium	-	-	**HIGH**
Invasive and/or non-native fish species	-	-	-	-	-	-	Very High	**HIGH**
Invasive and/or non-native plant species	High	-	-	Medium	High	-	-	**HIGH**
Sea level rise	High	Medium	-	-	-	-	Medium	**MEDIUM**
Water Management	High	-	-	-	-	-	Medium	**MEDIUM**
Lack of fire	-	-	-	High	-	Medium	-	**MEDIUM**
Fishing (includes boating)	Low	-	-	-	-	-	High	**MEDIUM**
Dam construction by beavers	-	-	-	-	-	High	-	**MEDIUM**
Incompatible crop and forestry practices (inadequate BMPs)	Medium	-	-	-	-	-	Low	**LOW**
Structural impediments to fish passage (dams, clogged culverts, etc.)	-	-	-	-	-	-	Medium	**LOW**
Conversion to agriculture (Active)	-	-	-	Medium	-	-	-	**LOW**
Threat Status for Targets and Site	High	Medium	Low	Very High	Medium	High	High	**HIGH**

Table iv. Profile of each conservation strategy, the targets benefited threats abated and conservation goals met by the strategy.

Strategy	**Targets benefited by strategy**	**Threats abated by strategy**	**Threat abatement goals to be met by strategy**
1. Identify tracts of land with the most viable occurrences of conservation targets and protect through acquisition or conservation easements.	➢ Tidal Freshwater System ➢ Upland Terrestrial Forest System ➢ Calcareous Forests ➢ Seepage Wetlands ➢ Bald Cypress Forests ➢ Fluvial Terrace Woodland	➢ Development (residential homes, roads, other infrastructures) ➢ Incompatible forestry practices (silviculture) ➢ Lack of fire ➢ Conversion to agriculture (Active)	➢ Protect key tracts with exemplary occurrences of conservation targets. ➢ Reduce the impacts of development on conservation targets. ➢ Restore at least one functional upland terrestrial forest (>10,000 acres) in each matrix block. ➢ Restore viable seepage wetlands
2. Develop/promote land use policies and compatible economic development initiatives that conserve land in matrix blocks and protect water quality/flow regimes**.**	➢ Tidal Freshwater System ➢ Upland Terrestrial Forest System ➢ Calcareous Forests ➢ Seepage Wetlands ➢ Anadromous Fishes	➢ Development (residential homes, roads, other infrastructures) ➢ Incompatible forestry practices (silviculture) ➢ Lack of fire ➢ Conversion to agriculture (Active)	➢ Protect key tracts with exemplary occurrences of conservation targets. ➢ Reduce the impacts of development on conservation targets. ➢ Restore at least one functional upland terrestrial forest (>10,000 acres) in each matrix block.
3. Develop region water use policy to determine the source of current and future water need and to affect the best method to meet the need.	➢ Tidal Freshwater System ➢ Anadromous Fishes	➢ Development (residential homes, roads, other infrastructures) ➢ Water Management ➢ Structural impediments to fish passage (dams, clogged culverts)	➢ Preserve natural range of variability of flow regimes of tidal freshwater system.
4. Restore connectivity of matrix forest through a shift in current pine management to longer-rotation mixed hardwood/pine forest.	➢ Upland Terrestrial Forest System	➢ Incompatible forestry practices (silviculture) ➢ Conversion to agriculture (Active)	➢ Restore at least one functional upland terrestrial forest (>10,000 acres) in each matrix block.
5. Restore connectivity of matrix forest through conversion of key agricultural lands to mixed hardwood/pine forest.	➢ Upland Terrestrial Forest System	➢ Conversion to agriculture (Historical)	➢ Restore at least one functional upland terrestrial forest (>10,000 acres) in each matrix block.
6. Determine invasive/ non-native fish species that contribute the greatest threats to conservation target.	➢ Anadromous Fishes	➢ Invasive and/or non-native fish species	➢ Reduce the threat of non-native, invasive predatory fishes on anadromous fish populations.
7. Develop policy to eliminate introduction and stocking of non-native fish species in the Coastal Plain and Piedmont.	➢ Anadromous Fishes	➢ Invasive and/or non-native fish species	➢ Reduce the threat of non-native, invasive predatory fishes on anadromous fish populations.

Strategy	**Targets benefited by strategy**	**Threats abated by strategy**	**Threat abatement goals to be met by strategy**
8. Work with local, state and federal agencies to develop policy to reduce and control non-native/invasive fish populations and to enforce existing laws.	➢ Anadromous Fishes	➢ Invasive and/or non-native fish species	Reduce the threat of non-native, invasive predatory fishes on anadromous fish populations.
9. Determine invasive/ non-native plant species that contribute the greatest threats to conservation targets.	➢ Tidal Freshwater System ➢ Upland Terrestrial Forest System ➢ Calcareous Forests	➢ Invasive and/or non-native plant species	Reduce the threat of non-native, invasive plant species in tidal freshwater and upland terrestrial systems.
10. Develop control strategies for priority invasive plant species in key conservation areas.	➢ Tidal Freshwater System ➢ Upland Terrestrial Forest System ➢ Calcareous Forests	➢ Invasive and/or non-native plant species ➢	Reduce the threat of non-native, invasive plant species in tidal freshwater and upland terrestrial systems.
11. Work with state/federal agencies and other conservation partners to prevent the introduction of new invasive plant species.	➢ Tidal Freshwater System ➢ Upland Terrestrial Forest System ➢ Calcareous Forests	➢ Invasive and/or non-native plant species	Reduce the threat of non-native, invasive plant species in tidal freshwater and upland terrestrial systems.
12. Evaluate current and future effects of sea level rise on species and communities in Coastal Plain to determine compensatory conservation actions to protect conservation targets.	➢ Tidal freshwater system ➢ Bald Cypress Forests	➢ Sea level rise	Assess long-term effects of sea level rise on project area and conservation targets.
13. Promote sound fisheries management policy to increase anadromous fish abundance.	➢ Tidal Freshwater System ➢ Anadromous Fishes	➢ Fishing (includes boating) ➢ Structural impediments to fish passage (dams, clogged culverts)	Reduce the threat of fishing to anadromous fish populations.
14. Support Fort A.P. Hill's Natural Resources Division to restore seepage wetlands.	➢ Seepage Wetlands	➢ Lack of fire ➢ Dam construction by beavers	Restore viable seepage wetlands

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Preface

As stated in *Conservation by Design*, The Nature Conservancy's conservation goal is "the long term survival of all viable native species and community types" within portfolios of sites by ecoregion. In order to accomplish the ambitious goal of conserving all native biodiversity, the Conservancy has developed many tools for conservation planning at the ecoregional and site-based scale. The Chesapeake Rivers project area has long been a priority for The Nature Conservancy based on its freshwater resources, rare species and critical ecological linkage to the incomparable Chesapeake Bay. The rivers and much of the terrestrial landscape found within the project have been identified as significant sites through the Chesapeake Bay Lowlands ecoregional planning process (to be completed by Fall 2001).

To address conservation strategies at the site scale for the Chesapeake Rivers, the TNC-VA Protection and Stewardship staff were invited in January 2001 to participate in a series of three Efroymson Workshops, led by Greg Low, Vice President and Managing Partner of U.S. Conservation Programs, and members of the Conservation Science Division. The goal of these workshops was to apply The Nature Conservancy's site conservation "5-S Framework" to the Chesapeake Rivers project area, thereby developing a conservation blueprint for action and a baseline from which to measure its success over time. The 5-S's are defined below:

- **Systems**: the conservation targets occurring at a site, and the natural processes that maintain them, that will be the focus of site-based planning.

- **Stresses**: the types of degradation and impairment afflicting the system(s) at a site.

- **Sources**: the agents generating the stresses.

- **Strategies**: the types of conservation activities deployed to abate sources of stress (threat abatement) and persistent stresses (restoration).

- **Success**: measures of biodiversity health and threat abatement at a site.

Through the guidance of the Efroymson workshops and supplemental staff meetings, the TNC-VA conservation planning team selected conservation targets (systems), analyzed and ranked stresses and sources of stress for each target, and identified conservation strategies to abate threats. A comprehensive conservation plan and strategy for implementation has been developed that will focus and direct the TNC-VA's new Chesapeake Rivers Program for the next 5 to 10 years. This report documents the results of these workshops and meetings.

Introduction

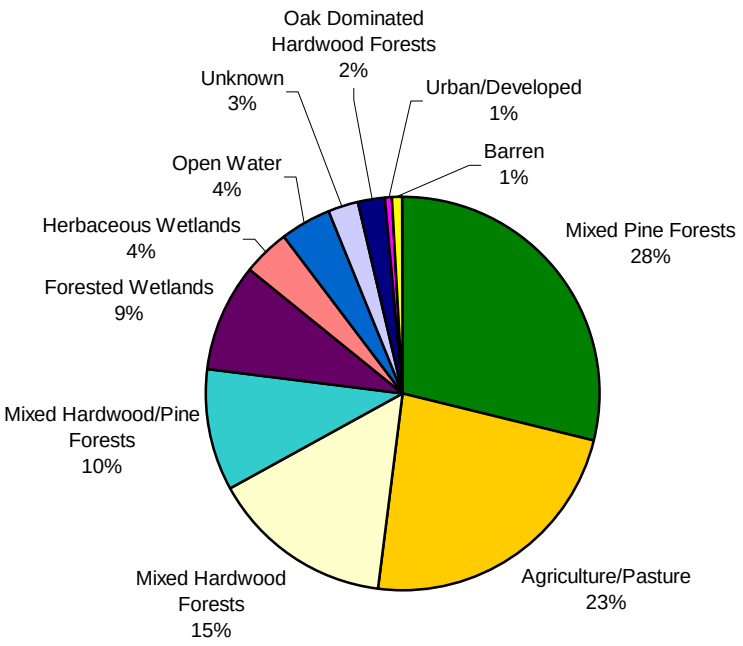
♦ ***Site description***

The Chesapeake Rivers site, part of the Chesapeake Bay Lowlands Ecoregion (CBY), is located in "tidewater" Virginia, roughly bounded by the Chesapeake Bay to the east, the Fall Line to the west, the James River to the south and the Potomac River to the north (Map 1). The site, totaling roughly 1,800 square miles, primarily encompasses the tidal freshwater portions of the Mattaponi, Pamunkey, lower Rappahannock rivers and watersheds as well as the non-tidal blackwater river, Dragon Run and its watershed (Map 2). The mighty Rappahannock is the largest and longest of the four, its headwaters found in at the foot of the Blue Ridge Mountains and draining into the Chesapeake Bay 184 miles later. The Mattaponi and Pamunkey are both part of the York River drainage, the Mattaponi forming in the coastal plain and the Pamunkey in the Piedmont. Dragon Run forms the headwaters of the Piankatank River and is the smallest and shortest of the rivers (<20 miles in length). For planning purposes, the site is defined as a "project area" containing multiple functional landscapes (i.e. the lower Rappahannock watershed, the Dragon watershed and the Mattaponi and Pamunkey watersheds).

Overall, the project area is characterized by flat to gently undulating alluvial and upland coastal plain topography dissected by slow-flowing meandering rivers and tributaries. Expansive tidal freshwater marshes and swamp forests populate the wide, sinuous flood plains and are surrounded by upland areas of wheat fields, pine plantations and residential areas interspersed with patches of native forests and wetlands. The area has experienced a long history of human settlement, starting with the presence of Native American inhabitants after the last ice age. Native Americans hunted the last of the large predatory mammals, causing mass extinctions and forever changing the ecology of the region. In addition, Native Americans used wildfire as a management tool to keep woodlands open for hunting while also inadvertently sustaining a biologically diverse landscape. European colonists arrived in Jamestown four hundred years ago and have been intensively cultivating the uplands since through agriculture, forestry and development ever since.

Today, 23% of the landscape is in agricultural production (including pastures and row crops), 30% is pine plantations, while 13% is wetlands and 27% remains as natural forest cover (VA GAP 2000). Less than 1% of the landscape is developed (urban or residential) (Figure 1). While the ecological integrity of upland areas has been greatly disturbed by this long history of human settlement, the predominantly rural, agricultural character of the site has helped to maintain its natural character, making effective conservation actions such as restoration possible. One of the unique features of this project area is that the rivers themselves have remained relatively pristine compared with other tidal rivers of the eastern seaboard. With the exception of Embrey Dam on the Rappahannock in Fredricksburg these rivers remain un-dammed with natural flow regimes intact and relatively high water quality. Moreover, Embrey Dam is scheduled to be removed by the Army Corps of Engineers in 2002.

Figure 1. Land use/land cover classification of the Cheasapeake Rivers project area (VA GAP 2000).



♦ ***Conservation value***

The Mattaponi, Pamunkey and Rappahannock river systems are home to some of the most pristine and extensive examples (some greater than 1000 acres) of functional tidal freshwater marsh communities remaining in the CBY ecoregion and the eastern seaboard of the United States. In addition, high quality, globally rare tidal hardwood forests communities of gum and ash are found along these rivers intermittent with the marshes. An outstanding occurrence of non-tidal cypress-gum swamp forest along the Dragon Run River represents the best and northernmost occurrence of this southern community type in the eastern U.S. Moreover, these largely unaltered marsh and swamp communities support occurrences of rare and endangered plant species, in particular the federally-listed sensitive joint vetch (*Aeschynomene virginica)* (G2), Parker's pipewort (*Eriocaulon parkeri)* (G3), and wild marsh senna (*Chamaechrista fasciculata var. macrosperma*) (G5T2). The marshes also provide critical nursery habitat for anadromous fishes like shad and herring and nesting grounds for bald eagles, black ducks, king rails and other resident and migratory waterfowl.

The upland portions of the project area were once characterized by matrix forming mesic to dry oak-hickory-beech and mixed pine-oak-ericad forest communities. Most of these forests have been cleared and cultivated over the course of four centuries for agricultural and silvicultural purposes, yet extant, secondary growth patches occur throughout the

area. Other more rare, small patch upland communities include mature mesophytic calcareous ravine forests found on slopes of exposed marine shell deposits. Fire-dependent seepage bogs and swamps are found in areas of dissected topography where plant rarities such as New Jersey rush (*Juncus caesariensis*) (G2) and federally-listed swamp bog rose (*Helonias bullata*) (G3) occur in addition to a host of breeding amphibians and odonates.

♦ ***Socio-Economic Characterization***

The economy of the area is dependent on agricultural production of wheat, corn and soybeans as well as pulp and timber production from both pine plantations and forestry. Aside from agriculture and silviculture, there is very little commercial or industrial use of the land within the project area. Yet conversion of upland forests to agriculture or pine plantations continues to be a local economic pressure. Moreover, increasing demand from outside markets for hardwood timber is placing new pressures on the remaining upland hardwood forest communities of the Chesapeake Rivers, one of the few reservoirs of mature salable hardwood timber in the southeast.

Overall, the human population has grown substantially in the corners of the project area as residential sprawl has spread from Richmond, Fredricksburg and the Hampton Roads area (e.g. Hanover, Spotsylvania and York Counties) (Table 1, Map 3). Growing human populations in surrounding urban areas are creating an increase in demand for residential housing and accompanying infrastructures as well as for the freshwater resources of these rivers (i.e. drinking water supply). The threat of population growth to freshwater resources is epitomized by the controversial and still unresolved application by the city of Newport News to the U.S. Army Corps of Engineers to provide water for its citizens by pumping it from the Mattaponi River and storing it in a reservoir to be constructed on a tributary of the Pamunkey in King William County.

Table 1. Population estimates for counties falling within (or partially within) the Chesapeake Rivers project area from the 1990 and 2000 census counts, with absolute and percent change over the decade (US Census Bureau 2001).

	Census Population		**Change, 1990 to 2000**	
County Name	**April 1, 1990**	**April 1, 2000**	**Number**	**Percent**
Caroline County	19,217	22,121	2,904	15.1
Essex County	8,689	9,989	1,300	15.0
Gloucester County	30,131	34,780	4,649	15.4
Hanover County	63,306	86,320	23,014	36.4
Henrico County	217,881	262,300	44,419	20.4
King and Queen County	6,289	6,630	341	5.4
King George County	13,527	16,803	3,276	24.2
King William County	10,913	13,146	2,233	20.5
Lancaster County	10,896	11,567	671	6.2
Mathews County	8,348	9,207	859	10.3
New Kent County	10,445	13,462	3,017	28.9
Northumberland County	10,524	12,259	1,735	16.5
Richmond County	7,273	8,809	1,536	21.1

	Census Population		Change, 1990 to 2000	
County Name	**April 1, 1990**	**April 1, 2000**	**Number**	**Percent**
Spotsylvania County	57,403	90,395	32,992	57.5
Westmoreland County	15,480	16,718	1,238	8.0
York County	42,422	56,297	13,875	32.7
Fredericksburg city	19,027	19,279	252	1.3
Richmond city	203,056	197,790	-5,266	-2.6
Newport News city	170,045	180,150	10,105	5.9

♦ ***Conservation Lands***

Only 1.5% of the Chesapeake Rivers project area can be considered under conservation management (Table 2, Map 4). 7% is publicly owned in the project area, most of which is comprised of the federal military base Fort A.P. Hill, totally approximately 75,000 acres in Caroline County. Second to Fort A.P., the Rappahannock Valley National Wildlife Refuge, established by the U.S. Fish and Wildlife Service in 1995, owns over 3,500 acres of wetland habitat along the Rappahannock River. The Nature Conservancy and other conservation groups such as the Trust for Public Land and The Conservation Fund work together as the Rappahannock Working Group to continue to acquire and transfer land to the refuge. A private corporate timber management group is the largest private land owner in the Chesapeake Rivers, owning almost 75,000 acres of land throughout the project area (equal to Fort A.P. Hill), most of which is managed as pine plantations for pulp wood.

Table 2. Ownership of conservation lands in the Chesapeake Rivers project area.

Owner/ Management Agency	**Acres**	**% of total project area**
Department of Defense (Fort A.P. Hill)	74,645.90	6.45%
The Nature Conservancy	4,935.11	0.43%
US Fish and Wildlife Service (Rappahannock Valley National Wildlife Refuge)	3,849.32	0.33%
Mattaponi and Pamunkey Tribal Governments	1,653.71	0.14%
National Park Service	1,624.15	0.14%
VA Dept. of Game & Inland Fisheries	1,384.85	0.12%
VA Dept. of Conservation and Recreation	1,337.07	0.12%
VA Dept. of Forestry	376.51	0.03%
Total	*89806.602*	7.76%

The Chesapeake Rivers site has been a focal area for The Nature Conservancy of Virginia (TNC-VA) since 1986. In the past, the TNC-VA has primarily focused on the protection of tidal freshwater marsh habitat and associated rare species, particularly sensitive joint vetch. TNC-VA has protected close to 5,800 acres of land in the area, including 4 preserves, 5 conservation easements and one transfer to the USFWS Rappahannock River Valley National Wildlife Refuge (NWR). Most notable among these are the 1,100 acre Cumberland Marsh Preserve along the Pamunkey River which conserves examples of high quality tidal freshwater marsh and swamp habitat and one of the best global

populations of the sensitive joint vetch, and Sandy Point, a 2,200 acre tract of similar habitat on the Mattaponi, also protecting the sensitive joint vetch. The Voorhees Nature Preserve protects 729 acres of tidal freshwater marsh and mesic mixed hardwood forest on the Rappahannock River. In addition to acquisition and easements, over 150 landowners have volunteered for a natural area registry and with this group, TNC-VA helped to form a new organization in 1988 called the Mattaponi and Pamunkey River Association.

♦ ***A Strategic Vision and Key Partners***

Overall, the Chesapeake Rivers is a very large and complex landscape and there is much that we still do not know or understand about its species, natural communities and ecological processes. To meet TNC's mission in the Chesapeake Rivers, we need a strategic vision and plan for conservation action at the landscape scale that includes protection, restoration and policies regarding freshwater use. Partnerships will be the key to success in such a large area. Partners include USFWS, DOD, VA-DGIF, VA-DOF, Chesapeake Bay Foundation (CBF), Rappahannock Working Group, planning district commissions and localities, and local groups (Friends of Dragon Run, Mattaponi and Paumunkey Rivers Association, Middle Pennisula Land Trust, etc.). The new TNC Chesapeake Rivers Program Director, Andy Lacatell, has recently been hired to work with the local community groups, landowners, and government agencies to implement conservation strategies set forth in the conservation plan from TNC's new Chesapeake Rivers office in Tappahannock as of the first of January 2001. With a comprehensive strategic plan and increased on-site capacity and leadership, the VAFO hopes to successfully work with the above-mentioned partners toward the conservation and restoration of the unique and irreplaceable landscape of the Chesapeake Rivers.

Conservation Targets

♦ ***Overview of Methods***

Clearly defining conservation targets is the first and most critical step in the site conservation planning process. Conservation targets are the basis for all subsequent steps in the planning process and ultimately determine what conservation actions will be taken. The goal of selecting targets is to represent the biodiversity of the site and capture its "functionality"—or the ecological processes that sustain diversity. Therefore, conservation targets should occur at multiple scales across all ecological systems such that the long term functionality or collective viability of the site is ensured if they are conserved (Richter and Poiani 2000). The list of "focal" targets is limited to eight in order to encourage a systematic approach towards developing a succinct list that is "indicative of threats and viability of the biodiversity of interest" at the site (TNC 2000).

The viability of each conservation target is then ascertained based on and evaluation of the ecological processes and attributes necessary for the target's long term persistence. This information is crucial to establish a viability baseline for each target by which to analyze stresses to the targets, set conservation goals, determine conservation strategies, and ultimately, to measure success of conservation actions over time. To accomplish this, specific viability attributes have been developed for each conservation target. Size, condition and landscape context are the factors used to indicate the viability of a target system, community, or species. They are defined as follows (TNC 2000):

- **Size**: A measure of the area or abundance of the conservation target's occurrence.
- **Condition**: An integrated measure of the composition, structure and biotic interactions that characterize an occurrence
- **Landscape context**: An integrated measure of two factors: the dominant environmental regimes and processes that establish and maintain the target occurrence and connectivity

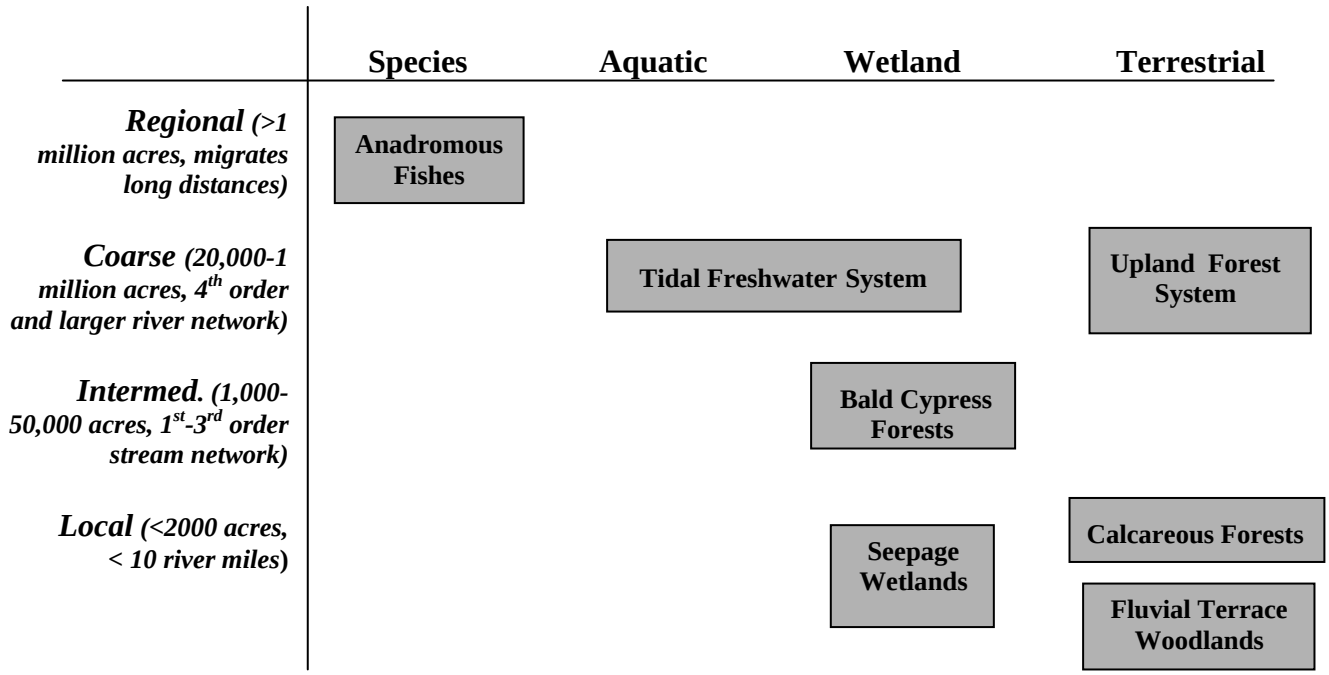
Size, condition and landscape context are indicators of viability but do not necessarily equal viability. They are a more accurate measurement of current status from which we project or infer the target's ability to persist and be resilient over the long term.

For each of the Chesapeake Rivers focal conservation targets, qualitative criteria have been developed to rank the target's size, condition and context, and in turn the target's overall viability. The ranking system consists of four general categories: "Very Good", "Good", "Fair" and "Poor". Therefore, each of the three variables (size, condition and context) is attributed with specifications that define the 4 quality ranks. The target viability attributes are found in Appendix B. Ranks based on these attributes are found in Table 3. An overall viability rank per target is derived from averaging the size, condition and context ranks for all occurrences throughout the site. Individual viability "scores" for the targets are then aggregated to develop a biodiversity health rank for the site as a whole, establishing a baseline from which to measure future success towards conserving the site (TNC 2000).

♦ ***Conservation Targets and Viability Assessments***

Seven conservation targets were selected to best capture the biodiversity and ecological processes in the Chesapeake Rivers project area (Figure 2, Map 5). The tidal freshwater system and upland terrestrial system capture the gamut of critical ecological functions and the characteristic native biota within the project area at multiple scales, for rivers and uplands. Other targets represent significant biological elements not captured explicitly by the tidal freshwater or upland terrestrial systems. These include high quality bald cypress forests found exclusively on the Dragon, the cryptic fluvial terrace woodland communities occurring in only 2 sites on elevated islands in river floodplains, calcareous forests found in coves and ravines on unique shell deposits, and seepage wetlands which occur in highly dissected headwater areas of the inner coastal plain within the project area. Anadromous shad and herring fish species were also singled out as conservation targets due to the unique co-occurrence of these species in the Chesapeake Rivers and potential for viability not possible elsewhere given the unaltered river runs necessary to their reproduction. Conservation target profiles and viability assessments are presented below for each target (Table 3). Information on conservation targets, except for anadromous fishes, is based on the descriptions found in the Virginia Division of Natural Heritage's First Approximation classification of ecological community groups of Viriginia (Fleming et al. 2001) and extensive personal communications with Natural Heritage ecologists Gary Fleming, Phil Coulling and Dean Walton. Information on anadromous fishes is based on extensive communications with Dr. Greg Garman and Dr. Steve McIninch of Virginia Commonwealth University and the work of McIninch and Garman (1999).

Figure 2. Chesapeake Rivers conservation targets represented across different levels of biological organization at multiple scales.



1. Tidal Freshwater System

Definition:

Mosaic of inter-grading tidal freshwater emergent herbaceous marshes, mudflats, semi-open multi-strata hardwood swamp forest, and submerged aquatic vegetation found in the uppermost portions of the estuarine zone along inner coastal plain rivers; marshes are likely the most exemplary and extensive on the Atlantic coast. Rare species include sensitive joint vetch (*Aeschynomene virginica* (G2)), wild marsh senna (*Chaemacrista fasiculata var macrosperma* (G5T2)), Parker's pipewort (*Eriocaulon parkerii* (G3)), and *Cardamine longii* (G3Q).

Key Ecological Processes/Conditions:

- Flooding from diurnal lunar tides up to 1.5 m.
- Maintenance of freshwater regime (<.5ppt).
- Natural variability of sedimentation/erosion cycle.
- Adequate light penetration in water column (for SAV).

Viability Ranking:

Size: VERY GOOD
Comments: Multiple 1000+ acre occurrences of marshes and swamps.
Condition: GOOD
Comments: Marshes are in excellent condition in terms of species composition and structure; however, *Murdannia* is rampant thoughout and its impacts are unknown. Swamp forests are in fair condition exhibiting increased crown stress, mortality, shrub and marsh species invasion w/ canopy cover < 25% in some cases. Mudflats are in good condition based on the persistence of historic rarities. SAV condition unknown.
Context: GOOD
Comments: Terrestrial context is agriculture, silviculture and natural forest—all relatively stable systems. Little hydrologic alteration to the rivers (except for the Rappahannock), allowing for natural flow regimes and sediment/erosion cycles to occur. Potential increase in salinity and changes in water levels from rising sea level.

Overall Rank: GOOD

2. Upland Terrestrial Forest System

Description:

Well-drained upland forests consisting of beech, oaks, hickories and other common hardwood species; drier, acidic variants consist of strong ericad shrub component, little herbaceous cover and overall low species diversity; richer, mesic variants have higher (almost double) species diversity with paw-paw, holly, spicebush, dogwood with ferns and other herbaceous species in understory, including *Isotria medeoloides* (G2G3). Represents remnant occurrences of a formerly characteristic upland matrix forest of the coastal plain that will require significant restoration.

Key Ecological Processes:

- Gap regeneration and seedling recruitment of characteristic species resulting in uneven, mature age structure.
- Occasional fire to regenerate oaks and heaths (every 30-50 years)—but not in mesic forest types.

Viability Ranking

Size: POOR
Comment: Most occurrences are small (~10 acres); occurrences of 200+ acres are rare.
Condition: POOR
Comments: Overall, stands are immature and weedy. In more mature stands, beech, tulip poplar and red maple are often dominant due to the selective harvest of oaks and hickories and fire suppression.
Context: FAIR
Comments: Forests are highly fragmented often found in isolated patches surrounded by agricultural, silvicultural or residential land uses. Fire frequency and extent have been reduced throughout landscape.

Overall Rank: POOR

3. Bald Cypress Forests

Definition:

Progression from tidal bald cypress forest/woodlands to non-tidal, seasonally to semi-permanently flooded cypress-gum found primarily along Dragon Run. Non-tidal swamp on Dragon represents the most significant northernmost example of its kind on the coastal plain. The tidal forest is of outstanding quality.

Key Ecological Processes:

- Seasonal and semi-permanent flooding and innundation during growing season.
- Periodic drawdowns for regeneration and seedling recruitment.

Viability Ranking:

Size: VERY GOOD
Comment: Combined occurrence of tidal cypress forest and non-tidal cypress-gum forest is over 2,000 acres on Dragon.
Condition: GOOD
Comments: Tidal and portions of non-tidal forests are outstanding occurrences of very mature forests (100+ years old), exemplary in structure and composition. Non-tidal forest show evidence of logging, with ash and red maple dominated patches in the midst of mature stands of cypress.
Context: GOOD
Comments: Surrounded primarily by upland pine plantations; subject to episodic siltation and pesticide run-off; beavers active.
Overall Rank: GOOD

4. Fluvial Terrace Woodlands

Description:

Small patch, open woodland communities composed of xeric hickory and oak species. Anomalous due to elevated topographic position and sandy substrate in floodplain--likely relicts of sandhill communities. Enigmatic distribution with only 2 known occurrences in study area (on Dragon Run and on Mattaponi), but likely that other occurrences exist between James and Potomac. Occurrence along Dragon Run is especially unusual due presence of calciphiles such as redbud and columbine intermixed with typical sandhill species that favor acidic, lower nutrient conditions.

Key Ecological Processes/Conditions:

- Edaphically limited; fire may play a role in oak regeneration.

Viability Ranking:

Size: VERY GOOD
Comment: Reedy Mill occurrence is roughly 25 acres, Dragon occurrence is 10 acres.
Condition: GOOD
Comments: Dragon occurrence excellent with anomalous assemblage of sandhill species and herbaceous calciphiles, trees mature (~100 year old) w/ no evidence of logging, no exotics. Reedy Mill EO shows more signs of disturbance due to selective cutting.
Context: GOOD
Comments: Dragon occurrence is an elevated island buffered by high quality tidal cypress forest with no access. Reedy Mill surrounded by agricultural fields, road and boat launch.
Overall Rank: GOOD

5. Calcareous Forest

Description:

Small patch, rich northeast-facing, mature oak-hickory-beech-poplar forests with paw-paw dominant in the shrub layer and a diverse herb layer consisting of rock ferns, columbine, and other mountain disjuncts. Found in unique calcareous ravines where erosion has cut through surficial non-calcareous soils into marine shell deposits from Pliocene epoch. Distinctive and unusual communities in the coastal plain because of geology, species composition and maturity relative to other upland hardwood communities. Note: A very rare calcareous forest type (G1) is found on dry south-facing convex slopes and is dominated by *Quercus muehlenbergii* and diverse, dry-site herbs; not known in site but is likely be present (occurrences documented in Stafford and Surry Counties).

Key Ecological Processes:

- Gap regeneration and seedling recruitment of characteristic species resulting in uneven, mature age structure.

Viability Ranking:

Size: GOOD
Comment: Gasch property and Fort A.P. occurrences < 50 acres each.
Condition: VERY GOOD
Comment: Mature to very mature (150+ years old) with evidence of selective oak removal 80 to 100 years ago.
Context: GOOD
Comment: Found in forested landscape surrounded by bottomland hardwoods in floodplain and mixed oak-heath forest or pine plantations on ridge tops, grading into mixed mesic hardwoods on slopes.
Overall Rank: GOOD

6. Seepage Wetlands

Description:

A mosaic of inter-grading fire-maintained shrub/graminoid-dominated seepage bogs and forested seepage swamps that occur in small patches in areas of dissected topography and sandy/peaty soils in braided seepage streams of small headwaters and toe slopes fed by groundwater. Support rare plant species (*Helonias bullata* (G3, LT) and *Juncus caesariensis (G2))* and critical breeding habitat for odonates and amphibian species. Groundwater supports globally rare interstitial gastropods and isopods. Seepage wetlands (particularly the fire-dependent open bogs) are mostly extirpated throughout site due to fire-suppression and hydrological degradation and are in need of significant restoration. Scattered throughout inner coastal plain and Piedmont (G3/G4?).

Key Ecological Processes/Conditions:

- Groundwater flow and recharge.
- Frequent fire return interval (bogs only).

Viability Ranking:

Size: GOOD
Comment: Most swamps < 10 acres and bogs are ~1-2 acres.
Condition: FAIR to GOOD
Comments: Swamps are in very good condition with mature canopy structure. Bogs mostly degraded by the succession of non-fire tolerant woody species throughout range except where artificially maintained in powerline right-of-ways.
Context: FAIR
Comments: Swamps generally secure, buffered by other forests. Fire suppression suppression/lack of ignition throughout landscape. Hydrologic alteration due to road building and beaver dams.
Overall Rank: FAIR

7. Anadromous Fishes

Description

Unique assemblage of herrings--includes *Alosa aestivalis* (blueback herring), *Alosa pseudoharengus* (alewife), *Alosa mediocris* (hickory shad), and *Alosa sapidissima* (American shad). Target is the reproductive habitat of these fishes in the site. Historically, these four species' distribution overlapped in the mainstem tributaries of the Chesapeake Bay; however, the Rappahannock, Mattaponi and Pamunkey watersheds (to Fall Line) maybe last places where all 4 species can still migrate/reproduce successfully . without significant habitat impediments or alterations. In these 3 river systems, the ranges of the target species are found from Chesapeake Bay to upper portions of Chesapeake River watersheds in Piedmont and Blue Ridge. Adult fishes found throughout the rivers of the Atlantic seaboard from Newfoundland to Florida.

Key Ecological Processes/Conditions:

- Long, largely unaltered natural passages for migration and spawning.
- Appropriate substrate for spawning; emergent vegetation for nurseries.
- Lack of predation.

Viability Ranking:

Size: FAIR
Comment: Blueback and alewife are doing OK; hickory is rebounding; American shad has very low populations.
Condition: FAIR
Comments: Condition unknown but experts suggest that the combination of naturally variable population fluctuations with impacts of predation by non-native invasive predatory fishes, over fishing and degraded reproductive habitat may adversely affect age class structure, reducing the number of juveniles and spawning adults.
Context: GOOD
Comment: Rivers and tributaries are largely unaltered and provide strong spawning runs (exception is Embrey Dam); marshes provide high quality nursery habitat. Sedimentation from upland run-off a threat to viability of eggs.

Overall Rank: FAIR

♦ ***Site Biodiversity Health Score***

The overall biodivesity health rank is ranked as "fair" (Table 3). This primarily is a reflection the severe degradation and loss of functionality of the upland matrix forest system. However, the tidal freshwater system is considered to be functional and viable given its lack of alteration and natural state. The non-system scale targets are all considered viable. Significantly, the overall landscape context of the project area is good due to its rural and agricultural setting, improving the likelihood of conservation success.

Table 3. Viability ranks for Chesapeake Rivers conservation targets. (Please refer to Appendix B. for definitions of ranks).

Target	**Size**	**Condition**	**Context**		**Viability Rank**
Tidal Freshwater System	**Very Good**	**Good**	**Good**		**Good**
Upland Terrestrial Forest System	**Poor**	**Poor**	**Fair**		**Poor**
Bald Cypress Forests	**Very Good**	**Good**	**Good**		**Good**
Fluvial Terrace Woodland	**Very Good**	**Good**	**Good**		**Good**
Calcareous Forest	**Good**	**Very Good**	**Good**		**Good**
Seepage Wetlands	**Good**	**Fair**	**Fair**		**Fair**
Anadromous Fishes	**Fair**	**Fair**	**Good**		**Fair**
Site Biodiversity Health Rank					**Fair**

Stresses and Sources of Stress

♦ ***Overview of Methods***

A threat is defined as a combination of the stress on the target and the source(s) of stress. A stress is defined as an "impairment or degradation of the size, condition, and landscape context of a conservation target, and results in reduced viability of the target" (TNC 2000). Stresses are identified and ranked for each conservation target based on the severity of damage to the target and the scope or scale of damage over the next 10 years. Consideration of a given target's viability attributes and ranks informs the process of identifying and ranking stresses. For instance, a target with "fair viability" indicates that there are severe and widespread stresses to the target having deleterious effects on its size, condition and context.

Each stress is attributed to one or more source for a given target (Table 4). A source of stress is defined as "an extraneous factor, either human or biological, that infringes upon a conservation target in a way that results in stress" (TNC 2000). Sources may be cited as historical or active. A historical source is currently inactive, but its past impacts remain persistent today (e.g. historical clearing of upland terrestrial forest for conversion to agriculture). An active source contributes to the stresses on a target presently and into the future (e.g. development). Sources are ranked based on both their degree of contribution to the stresses and the irreversibility of impacts over the next 10 years.

Stresses and sources of stress are ranked as "very high", "high", "medium" or "low". The active and historical threats are ranked for all targets both individually (Appendix C) and collectively across the site (Table 6).

♦ ***Definition of Stresses***

The following stresses have been identified for the Chesapeake Rivers conservation targets:

- **Habitat destruction:** The elimination of physical habitat suitable for a given target.
- **Target destruction:** The physical elimination of the conservation target itself. The habitat or substrate of the target may still remain though the target is destroyed.
- **Altered composition and structure:** Changes the characteristic species diversity, structure and abundance of a given vegetation community due to disturbances such as logging, invasive and/or non-native species, and fire suppression.
- **Habitat fragmentation**
  1. Loss of connectivity, size and functionality of a given target's distribution due to a conversion or destruction event.
  2. Increased edge-to-area ratio that creates edge effects, disrupting the interior forest conditions. Edge effects change the light, temperature and moisture regimes of forest interiors in addition to increasing competition and predation by early successional and/or invasive species.
- **Extraordinary competition for resources**: The process by which invasive species out-compete native species and communities for resources such as light, nutrients, and water, thereby succeeding and displacing the native vegetation.

- **Alteration of natural fire regime.** Disruption of natural, historical fire return intervals, fire intensity, severity and extent in vegetation communities that changes the composition, structure and abundance of characteristic, fire-influenced species and communities.
- **Changes in water levels/alteration of natural flow regime:**
  1. A significant change to a river's flow regime that reduces the natural seasonal variability in baseflow (i.e. higher average minimum baseflows or lower average peak baseflows), affecting the persistence of wetland vegetation. Alterations of this sort are due to hydrologic alterations such as dams and reservoirs, water withdrawals or sea level rise.
  2. A change to groundwater or surface water flow, volume and period of inundation that affects the persistence of palustrine wetlands. Sources of this stress are disruption of water flow by development/ construction activities and beaver dams.
- **Alteration of sediment regime.** Changes to the naturally variable cycles of sediment accretion and erosion that create and maintain tidal wetland communities.
- **Sedimentation**: The addition of soil, sand, silt and other substrate to water bodies via overland flow during rain or flood events due to erosion/disturbance of upland habitat.
- **Salinity alteration:** Increased salinity levels in the tidal and non-tidal freshwater communities that favor brackish and salt marsh tolerant vegetation, thereby displacing and eliminating obligate freshwater species. Increases in salinity can be due to sea level rise, freshwater withdrawals (both surface and ground water) and periods of drought.
- **Erosion of substrate.** The loss of substrate due to disturbance or destruction of its rooting vegetation by logging or development activities. This stress is particular to calcareous forests that are distributed on ravines and steep northeasterly facing slopes on top of rich calcareous deposits of marine shells.
- **Nutrient loading**: Addition of excessive nutrients such as nitrogen and phosphorus to water bodies via overland flow during rain or flood events. Excess nutrients cause eutrophication of river and stream channels, leading to algae blooms that block available sunlight for photosynthesis of SAV.
- **Extraordinary predation.** The excessive mortality of an organism (in this case, the anadromous fishes) caused by an invasive predatory species or anthropogenic hunting/fishing activities.
- **Loss of access to reproductive habitat.** Inaccessibility of spawning and nursery habitat for anadromous fishes due to structural impediments and fishing practices that block fish passage.

Table 4. Stresses and sources of stress to conservation targets in the Chesapeake Rivers. The matrix below illustrates the various sources for a given stress to a conservation target in the project area.

	STRESSES												
SOURCES of Stress	***Habitat or target destruction***	***Altered composition and structure***	***Habitat fragmentation***	***Extraordinary competition for resources***	***Alteration of natural fire regime***	***Changes in water levels/alteration of natural flow regime***	***Alteration of sediment regime***	***Sedimentation***	***Alteration of salinity regime***	***Erosion of substrate***	***Nutrient loading***	***Extraordinary predation***	***Loss of access to reproductive habitat***
Invasive and/or non-native species		**X**		**X**								**X**	
Development (residential homes, roads, other infrastructures)	**X**		**X**			**X**	**X**	**X**		**X**	**X**		**X**
Incompatible forestry practices (silviculture)	**X**	**X**	**X**							**X**			
Lack of fire		**X**			**X**								
Fishing (includes boating)	**X**											**X**	**X**
Dam construction by beavers						**X**							
Conversion to agriculture	**X**		**X**										
Sea level rise						**X**	**X**		**X**				
Construction of dams and reservoirs						**X**	**X**	**X**	**X**				**X**
Ground water withdrawals						**X**			**X**				
Structural impediments to fish passage (dams, clogged culverts, etc.)						**X**		**X**				**X**	**X**
Surface water withdrawals (Agriculture)						**X**			**X**				
Incompatible crop and forestry practices (inadequate BMPs)							**X**	**X**			**X**		

♦ ***Sources of Stress***

A list of the conservation targets affected and descriptive information on each source of stress is presented below in order of its overall threat rank, from highest to lowest.

1. Development (residential homes, roads, other infrastructures)

- *Overall threat rank*: **High**
- *Total targets affected*: 6 (tidal freshwater system, fluvial terrace woodlands, upland terrestrial forest system, calcareous forests, seepage wetlands and anadromous fishes).

Comments: The Chesapeake Rivers project area is primarily threatened by residential home development and other infrastructures such as roads and powerlines. Residential sprawl is prevalent in the outskirts of northeastern Richmond on the south side of the upper Pamunkey River and in southeastern Fredricksburg on the upper Rappahannock. Warsaw and Tappahannock, flanking either side of the lower Rapphannock, are both predicted to experience accelerated residential sprawl over the next 10 years. Currently, 6% of the Rappahannock watershed that falls in the project area is residential. Development is ranked highly due to the permanent and irreversible damage to conservation targets.

2. Incompatible forestry practices (silviculture)

- *Overall threat rank*: **High**
- *Total targets affected*: 3 (bald cypress forests, upland terrestrial forest system and calcareous forests)

Comments: Native upland hardwood and mixed pine-hardwood forests have been extensively cleared and replaced with plantations of loblolly pine throughout the project area, most notably in King and Queen County. Estimates using classified landcover data show that roughly 334,000 acres, or 29%, of the Chesapeake Rivers project area are mixed pine forest, the majority of which is pine plantation (VA GAP 2000). Hardwood sawtimber is one of the most commercially valuable natural resources of the project area. Mature, prime sawtimber species such as oaks are found in rich, mesic calcareous ravine forests and mesic mixed hardwood forests of the dissected topography along tributaries of rivers. Due to the moratorium on logging in select areas of the national forests lands of Virginia, private logging companies have begun to expand their areas of sawtimber procurement to include the coastal plain. Moreover, in the next 10 years, it is expected that large operation logging companies from the western U.S. will begin to move into areas such as the Chesapeake Rivers to procure hardwood sawtimber as well. This is especially alarming as these larger companies will employ newer logging technology such as cable logging which will enable them to remove timber from areas previously considered inaccessible using conventional logging methods. Currently, there are 7 paper, 25 lumber and 11 forestry companies located within the project area (Map 6).

3. Invasive fish species

- *Overall threat rank*: **High**
- *Total targets affected*: 1 (anadromous fishes)

Comments: There are 18 confirmed introduced, invasive and mostly predatory fishes the Rappahannock and York drainages, representing roughly 30% of the fish species in these rivers (Table 5) (G. Garman and D. Fowler, *personal communication*). The life history

strategy of native anadromous clupeid fishes is to migrate upstream as a means of escaping predation in the Bay and ocean, ensuring the success of their offspring. Therefore, the introduction of invasive predatory fish into the spawning and nursery waters of these anadromous fishes poses a severe threat to the viability of their populations to which they have no natural defenses. Many of the fish species were introduced in the later 19th century by the U.S. Fish Commission and then between 1953 and 1972 by the Virginia Department of Game and Inland Fisheries (VDGIF) (Jenkins and Burkhead 1994). Limited stocking by VDGIF of a few species continues today (Table 5) (D. Fowler, *personal communication*). The blue catfish (stocked in the mid-1970's) is of particular concern as it is a newer introduction that has successfully thrived and naturalized in the rivers and is a voracious predator of native anadromous fishes such as alewife and blue back herrings (G. Garman, *personal communication*). The blue is on average 15-20 pounds and can grow as big as 100 pounds in comparison to the average 2-4 pound weight of an alewife or blueback herring.

Table 5. List of invasive non-native fishes of the Chesapeake Rivers project area. Information on the fishes status as a predator of native anadromous, clupeid fishes and on its stocking history is included. (Information compiled from personal communication with G. Garman, D. Fowler and Jenkins and Burkhead 1994.)

Invasive Fishes in Project Area	**Predator? (at all life stages unless otherwise indicated)**	**Currently Stocked?**
grass carp	Yes (on eggs only)	Unknown; since 1983, VDGIF has issued permits for importation of sterile triploids; stocked lakes in Orange Co. in mid-1980's
red shiner	No	No; never stocked but is sold commonly as a tropical fish for aquariums and often used as bait
flat-head catfish	Yes	No
thread-fin shad	Yes (on eggs and larvae only)	No
common carp	Yes (eggs during only demersal phase)	No; introduced in 1880 via commercial hatcheries
channel catfish	Yes	Yes (in impoundments by VDGIF and private landowners)
Largemouth bass	Yes	Yes (in new or renovated public impoundments by VDGIF)
Smallmouth bass	Yes	No; stocked by the VA Fisheries Commission in Rappahannock around 1880
spotted bass	Yes	No; stocked by VDGIF in Lake Anna in 1979
blue catfish	Yes	Unknown; stocked in Rappahannock in early 1970's
green sunfish	Yes (on eggs, larvae, and juveniles only)	No; introduced in Rapphannock in 1941 by aquarium trade.
bluegill	No	Yes (in new or renovated public impoundments by VDGIF)
redear sunfish	No	Yes (in new or renovated public impoundments by VDGIF)
black crappie	Yes	No; first records in York 1949, Rappahannock 1959, probably stocked by private sector
white crappie	Yes	No

Invasive Fishes in Project Area	Predator? (at all life stages unless otherwise indicated)	Currently Stocked?
warmouth	Yes (on eggs, larvae, and juveniles only)	No; first stocked in York in 1934 and in Rappahannock in 1968
northern pike	Yes (found almost exclusively in impoundments)	No (but stocked by DGIF in other drainages)
Muskellunge	Yes (found almost exclusively in impoundments)	No (but stocked by DGIF in other drainages)

4. Invasive and/or non-native plant species

- *Overall threat rank*: **High**
- *Total targets affected*: 3 (tidal freshwater system, upland terrestrial forest system, calcareous forests)

*Comments***:** Invasive, non-native plant species pose a serious threat to the viability of natural communities by competitively displacing native species. In the tidal freshwater system, some of the most alarming invaders include *Murdannia keisak* (marsh dewflower)**,** *Phragmites australis,* and *Hydrilla verticillata* (hydrilla). Invasive plants of the upland terrestrial system (including calcareous forests) include *Lonicera japonica* (Japanese honeysuckle)**,** *Microstegium vimineum* (Japanese grass) and *Alliaria petiolata* (garlic mustard). Each of these plant species are well-established and naturalized in the eastern U.S. due to historical introductions for horticulture, erosion control or mishap. While each of these species is present within in the project area, the distribution, abundance and impact is unknown at this point in time.

5. Conversion to agriculture --(historical and active)

- *Overall historical threat rank:* **High**
- *active threat rank*: **Medium**
- *Total targets affected*: 1 (upland terrestrial forest system)

Comments: The majority of the upland areas of the Chesapeake Rivers project area has undergone repeated land clearings and cultivation over the last 400 years since Europeans first arrived. Currently, roughly 23% of the landscape is classified as agricultural (VA GAP 2000, Map 1). The land is farmed primarily for commercial crops such as wheat, corn, and soy in addition to limited row cropping. Very little livestock farming takes place in this part of Virginia. Today, clearing of upland secondary forests for agricultural uses continues though not as extensively as in the past.

6. Sea level rise

- *Overall threat rank*: **Medium**
- *Total targets affected*: 3 (tidal freshwater system, bald cypress forests and anadromous fishes)

Comments: Current thinking suggests that sea levels will rise at a rate of 5 cm per decade or 50 cm over the next century (Map 7). Over the next 10 years, there will be negligible effects on the project area in terms of increased water levels or salinity to the tidal freshwater and non-tidal systems of the rivers. However, over the next 50-100 years, it is

assumed that a gradual migration of vegetation inland will occur as the tidal zone and salinity gradients move upstream. Much is unknown regarding the future character and condition of marsh and swamp communities with accelerated rates of sea level rise. The persistence of tidal freshwater vegetation is in large part due to the fluvial geomorphologic processes of coastal plain rivers. How will fluvial geomorphology change in the Chesapeake rivers with rising sea level and how this will affect the dynamics, composition and structure of marsh and swamp communities as we know them today? Moreover, little information exists on the impacts of sea level rise on freshwater aquatic fauna. For example, how will rising sea levels affect the reproductive habitat of anadromous fishes, if at all? Given these many contingencies and uncertainies, sea level rise is ranked as a medium for the next 10 years.

7. Water Management

- *Overall threat rank*: **Medium**
- *Total targets affected*: 2 (tidal freshwater system, anadromous fishes)

Comments. Water management is a complicated threat consisting of several different sources, including surficial water withdrawal projects (reservoirs, dams), groundwater withdrawals (primarily for industrial uses), and headwater withdrawals for agricultural.

Overall, rivers in the project area are relatively free of hydrologic alterations such as dams and reservoirs. However, growing human populations in surrounding urban areas are creating an increasing demand for freshwater resources, particularly for drinking water supply. This threat is epitomized by the controversial and still unresolved application by the city of Newport News to the U.S. Army Corps of Engineers to provide water for its citizens by pumping it from the Mattaponi River and storing it in a reservoir to be constructed on Cohoke Creek, a tributary of the Pamunkey in King William County. It is anticipated that more applications such as this one will be submitted over the next 10 years, though it is improbable that more than 1 reservoir—if that--would be built during this time given the surrounding controversies and beauracratic maneuverings involved in such projects.

The contribution of groundwater to base freshwater flow needs to be understood to fully evaluate the impact groundwater withdrawal has on freshwater flow regimes of the rivers. Comprehensive information on groundwater withdrawals by paper, chemical or nuclear plants is not available, though it is available for local areas designated as groundwater management zones. A paper mill along the lower Pamunkey near West Point has been withdrawing significant amounts of groundwater from an underground aquifer which has in turn caused subsidence of the marshes, precluding the future full capacity recharge of the aquifer. Though this is a localized event, the same type of groundwater withdrawals could be occurring in multiple locations throughout the project area.

In addition, surface water withdrawals for agricultural purposes do commonly occur, especially in times of drought, and have the potential to contribute to an overall reduction in freshwater flow to these smaller streams. Farmers can withdraw unregulated volumes of water from headwater streams and other tributaries without permits. This makes it impossible to account for the total amount or rate at which these withdrawals take place

throughout the project area. At this time, this does not seem to be causing significant stress to the targets.

8. Lack of fire

- *Overall threat rank:* **Medium**
- *Total targets affected*: 2 (upland terrestrial forest system, seepage wetlands)

Comments: The lack of fire in the landscape is due to fire suppression, a lack of natural ignition sources and human infrastructures (roads, farmlands) that prevent its spread. Upland terrestrial and palustrine vegetation in the coastal plain have adapted to fire due to its consistent use by indigenous peoples since the retreat of the last ice age. European settlers used fire in a similar fashion as the native peoples to clear land for hunting, agriculture, and so forth. However, for most of the 20th century and continuing into the 21st, cultural attitudes towards fire have radically changed to exclude and actively suppress its use as a land management tool. The Virginia Department of Forestry has banned prescribed burning on privately owned lands in the spring (February 15th to May 1st until 4pm) to reduce risks and costs of fire problems.

9. Fishing (includes boating)

- *Overall threat rank*: **Medium**
- *Total targets affected*: 2 (tidal freshwater system, anadromous fishes)

Comments: Large scale commercial fishery operations in the Chesapeake Bay employ "intercept" methods such as pound and gill netting. While this type of fishing for American shad has been banned in the Virginia jurisdiction of the Bay, it still occurs in the Bay at large—though the Atlantic Fisheries Commission plans to impose regulations to protect shad throughout the Bay in the next 5 years. However, no regulations exist in the Bay to protect the blueback herring, alewife and hickory shad from intercept fishing practices, resulting in excessive mortality of these fishes as incidental by-catch.

Within the project area (i.e. along the rivers), most fishing is recreational and does not have a significant impact on fish populations. However, the boating activities associated with fishing have numerous impacts the vegetation of the tidal freshwater marshes. The propellers on motorized boats that are used to fish in the rivers and tributaries damage and disturb submerged and low tide emergent vegetation. Motorized boats also promote the spread hydrilla by carrying pieces of the plant in the propellers far distances, allowing the plant to disperse and colonize new habitat. There are a total of 6 designated recreational boating access points along the Mattaponi and Pamunkey Rivers and 11 along the Rappahannock River.

10. Dam construction by beavers

- *Overall threat rank*: **Medium**
- *Total targets affected*: 1 (seepage wetlands)

Comments: Since the re-introduction of beavers to the mid-Atlantic states in the first half 20th century, beaver populations have exploded in Virginia. In the project area, beavers are particularly attracted to slow moving seepage streams, the same habitat of seepage swamp forests and bogs. They down trees and build dams, flooding the habitat for emergent and forested wetland vegetation of the seepage communities. Beavers were

most likely a keystone species historically that shaped the wetland landscape. However, due to the degradation, destruction and fragmentation of the natural landscape in conjunction with the lack of natural predators, the overpopulation of beavers poses a serious threat to the sensitive hydrology of rare small patch vegetation communities such as seepage wetlands. While beavers are a very high contributor to the immediate destruction of these seeps, the damage can be remedied in a straightforward manner[1]. Therefore the overall threat rank is a medium.

11. Structural impediments to fish passage (dams, clogged culverts, etc.)

- *Overall threat rank*: **Low**
- *Total targets affected*: 1 (anadromous fishes)

*Comments***.** The rivers and tributaries of the project area are without significant structural impediments to the migration of spawning anadromous fishes; hence the low ranking of this threat. Embrey Dam is the only mainstem dam in the project area, located on the upper Rappahannock at the Fall Line in Fredricksburg. This dam blocks the passage of migrating American and hickory shad and to a lesser extent the blueback herring and alewife. However, this dam is scheduled to be removed in 2002 by the Corps. Lake Anna, located on the border between Louisa and Spotsylvania counties in the Piedmont, is a reservoir on a main tributary (the North Anna River) of the Pamunkey; however, its role in blocking fish passage is insignificant as little evidence exists to suggests herrings and shads currently migrate above the Fall Line in the York drainage. Numerous smaller structural impediments exist on tributaries such as low head dams and culverts that clog easily with debris, preventing fish passage.

12. Incompatible crop and forestry practices (BMPs)

- *Overall threat rank*: **Low**
- *Total targets affected*: 2 (tidal freshwater system, anadromous fishes)

*Comments***.** Incompatible crop and forestry practices primarily refer to increases in sedimentation and nutrient loading to the tidal freshwater system due to a lack of implementation of best management practices. The Chesapeake Bay Preservation Act stipulates the designation of resource management zones for implementation of BMPs to protect the bay only if ratified by the county. While all counties east of I-95 have ratified the act, compliance is still largely voluntary and unenforceable. The more recent Chesapeake 2000 Agreement developed by the Chesapeake Bay Commission (a coalition of state and federal agencies) stipulates that 20% of the Virginia portion of the Chesapeake Bay watershed must be protected by the year 2010. This is a low ranking threat because non-compliance with BMPs on the flat to gently rolling terrain of the coastal plain does not cause as severe sedimentation or nutrient loading in the Piedmont or mountains.

- ***Overall Site Threat Rank***

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[1] Though a beaver dam can be unplugged easily, wetlands created by beavers have the same status as non-beaver created wetlands under the Clean Water Act. However, one does not neeed a license to trap and kill beavers in the state of Virginia.

Overall, the active threat rank for the Chesapeake Rivers landscape is "high" (Table 6). The high ranking reflects an increasingly populated area that is developing at a moderate pace and increasing the demand for land and freshwater resources, with a lucrative forestry and timber industry, while the remaining natural systems are plagued by numerous intractable and spreading invasive/non-native species.

Table 6. Threat ranks for the Chesapeake Rivers conservation targets.

Active Threats across Conservation Targets	Tidal Fresh-water System	Bald Cypress Forests	Fluvial Terrace Woodland	Upland Terrestrial Forest System	Calcar-eous Forest	Seepage Wetlands	Anadro-mous Fishes	**Overall threat rank**
Development (residential homes, roads, other infrastructures)	Medium	-	Medium	Very High	Medium	High	Medium	**HIGH**
Incompatible forestry practices (silviculture)	-	Medium	-	Very High	Medium	-	-	**HIGH**
Invasive and/or non-native fish species	-	-	-	-	-	-	Very High	**HIGH**
Invasive and/or non-native plant species	High	-	-	Medium	High	-	-	**HIGH**
Sea level rise	High	Medium	-	-	-	-	Medium	**MEDIUM**
Water Management	High	-	-	-	-	-	Medium	**MEDIUM**
Lack of fire	-	-	-	High	-	Medium	-	**MEDIUM**
Fishing (includes boating)	Low	-	-	-	-	-	High	**MEDIUM**
Dam construction by beavers	-	-	-	-	-	High	-	**MEDIUM**
Incompatible crop and forestry practices (inadequate BMPs)	Medium	-	-	-	-	-	Low	**LOW**
Structural impediments to fish passage (dams, clogged culverts, etc.)	-	-	-	-	-	-	Medium	**LOW**
Conversion to agriculture (Active)	-	-	-	Medium	-	-	-	**LOW**
Threat Status for Targets and Site	High	Medium	Low	Very High	Medium	High	High	**HIGH**

Conservation Strategies

♦ ***Overview of Methods***

The next step in the site conservation planning process is to decide how best to protect and conserve the conservation targets, given the analyses of their viability and threats. The general goals of the site conservation plan are to improve the viability and abate the threats to the conservation targets. Conservation strategies are means by which we meet these goals.

As a prelude to determining the most effective conservation strategies for the Chesapeake Rivers, the team set both conservation goals and threat abatement goals. A ***conservation goal*** is defined as the desired viability of a given conservation target. General conservation goals (Table 7) specify the aspect (i.e. size, condition or context) of viability to be maintained or improved and the intended degree (i.e. "fair" to good) of improvement. These goals are based on a consideration of the key attributes that are most vulnerable to threats in combination with the feasibility of taking effective conservation action (i.e. it may be possible to improve the condition of a given target but not the size or context). More specific and quantitative management goals will be determined as part of a monitoring program for the conservation targets to be completed in the next year. A ***threat abatement goal*** articulates the desired future reduction of a given threat or the restoration of a target that will in turn improve its viability. Threat abatement goals are based on the threats with medium to very high ranks only in order to concentrate energies on areas of immediate need.

Based on these conservation and threat abatement goals, the planning team developed 14 conservation strategies to fulfill conservation and threat abatement goals for the Chesapeake Rivers (Table 8). Conservation strategies are grouped by the following categories:

- Land Use/Land Protection
- Water Management
- Forest Restoration
- Invasive Fishes
- Invasive Plants
- Sea Level Rise
- Seep Restoration

For a each conservation strategy, a list of implementation or action steps are presented that will be incorporated in the TNC-VA annual strategic plan and staff goals and objectives. Lead staff members and time lines for implementation are noted for each step.

Strategies were also evaluated for their effectiveness in abating sources of stress to targets, improving viability, costs of implementation, and feasibility (Table 9). While the results of this evaluation are not used to assign priority to the conservation strategies, they are helpful in deciphering and taking into full consideration the realistic constraints involved with implementation.

Table 7. Conservation goals and threat abatement goals for Chesapeake Rivers conservation targets.

Conservation Targets	**Viability Rank**	**Conservation Goal**	**Threat Rank**	**Threat Abatement Goals**
Tidal Freshwater System	Good	To maintain "good" condition.	High	➢ Protect key tracts with exemplary occurrences of conservation target. ➢ Reduce the threat of non-native, invasive plant species. ➢ Assess long-term effects of sea level rise on project area and conservation target. ➢ Preserve natural range of variability of flow regimes of tidal freshwater system.
Bald Cypress Forests	Good	To maintain "very good" size and “good” condition. Target local occurrences for improvement from “fair” to “good” condition.	Medium	➢ Protect key tracts with exemplary occurrences of conservation target. ➢ Assess long-term effects of sea level rise on project area and conservation target.
Fluvial Terrace Woodland	Good	To maintain "very good" size and “good” condition.	Low	➢ Protect key tracts with exemplary occurrences of conservation target.
Upland Terrestrial Forest	Poor	To improve size and condition from "poor" to "good".	Very High	➢ Protect key tracts with exemplary occurrences of conservation targets. ➢ Reduce the impacts of development on conservation target. ➢ Restore at least one functional upland terrestrial forest (>10,000 acres) in each matrix block. ➢ Reduce the threat of non-native, invasive plant species
Calcareous Forest	Good	To maintain "good" size and condition.	Medium	➢ Protect key tracts with exemplary occurrences of conservation targets. ➢ Reduce the impacts of development on conservation target. ➢ Reduce the threat of non-native, invasive plant species
Seepage Wetlands	Fair	To improve condition from "fair" to "good".	High	➢ Protect key tracts with exemplary occurrences of conservation target. ➢ Restore viable seepage wetlands.
Anadromous Fishes	Fair	To increase "fair" population sizes to "good", improve populations' condition from "fair" to “good” and maintain “good” context.	High	➢ Protect key tracts with exemplary occurrences of conservation target. ➢ Reduce the threat of non-native, invasive predatory fishes ➢ Assess long-term effects of sea level rise on project area and conservation target. ➢ Preserve natural range of variability of flow regimes of tidal freshwater system. ➢ Reduce the threat of fishing.

♦ ***Conservation Strategies and Implementation Steps***

Each strategy category lists the appropriate conservation strategies followed by the initials of staff members responsible for implementation of the strategy. For each strategy, implementation or action steps are listed followed by a list of key partners critical to implementation success. All strategies are of equal priority.

I. Land Use/ Land Protection

➢ **Strategy 1.** *Identify tracts of land with the most viable occurrences of conservation targets and protect through acquisition or conservation easements* (**ADL, LLC***).*

Action Steps:

1. Continue to work with the Rappahannock Working Group to add key tracts to the Rappahannock Valley NWR using funds from the LWCF.
2. Establish a cooperative agreement with Fort A.P. Hill to manage and protect exemplary occurrences of seepage wetlands on the military base.
3. Apply for NAWCA grants and other sources to support land acquisition.
4. Develop a protection priority map and promote at state and county levels to direct the fulfillment of Chesapeake Bay Agreement for Virginia within the project area.
5. Protect key tracts on the Dragon Run, Rappahannock, Pamunkey and Mattaponi through TNC and partner acquisition of legal interest and management.
6. Secure easements on high quality upland forest through Forest Legacy Program.
7. Identify potential reservoir sites and work to acquire or place restrictive covenants on them.
8. Enroll Wetland Restoration Trust Fund sites as appropriate for acquisition and restoration.

Key Partners:

DCR, RWG, USFS, USFWS, DOD, VAULT, Resource Management, ACE, VA-DOF

➢ **Strategy 2.** ***Develop/promote land use policies and compatible economic development initiatives with partners that conserve land in matrix blocks and protect water quality/flow regimes*** (**ADL**, NR).

Action Steps:

1. Identify the important conservation areas most vulnerable to residential sprawl and calculate the true benefit/cost of development; use information to assist county comprehensive planning processes to promote more compatible economic development.
2. Work with local citizens in designated areas to determine which types of economic development are consistent with the conservation goals and work to promote this type of development to key areas.
3. Become involved with county comprehensive planning process where necessary and work with localities to integrate TNC conservation goals into upcoming county comprehensive plans.
4. Develop a protection priority map and promote at state and county levels to direct the fulfillment of Chesapeake 2000 Agreement for Virginia within the project area.

5. Co-ordinate coalition of local environmental groups (include American Farmland Trust) to develop strategy for PDR open space programs in counties where appropriate (i.e. has sufficient tax base and where a PDR program would be most useful towards meeting conservation goals).
6. Work with the Farm Bureau, local organizations, land owners and localitites to create forestry and/or agricultural districts in matrix sites or enact land use taxation to maintain current land use over the short term.

Key Partners:
County governments, planning district commissions, local organizations (Friends of the Dragon Run, Friends of the Rappahannock, Mattaponi and Pamunkey Rivers Association, Middle Peninsula Land Trust, etc.),

II. Water Management

- **Strategy.** ***Develop regional water use policy[2] to determine the source of current and future water need and to effect the best method to meet the need.*** (**NMR**, MLL, JKD)

  Action Steps:
  1. Research past efforts to establish a water use policy in the east in addition to existing laws and regulations concerning water use in Virginia.
  2. Hold TNC meeting on water policy, inviting TNC-HO experts, to determine policy content and best course of action for its implementation.
  3. Start small coalition with CBF in support of proposed water use policy.
  4. Solicit endorsement of policy by broader audience of partners.
  5. Support partner agencies to seek sponsor for policy who will introduce to General Assembly for enactment.

  Key Partners:
  CBF, SELC, local organizations, county governments, PDCs

III. Forest Restoration (See Map 8 for locations of matrix sites chosen for forest restoration.)

- **Strategy 1.** ***Restore connectivity of matrix forest through a shift in current pine management to longer-rotation mixed hardwood/pine forest*** (**ADL**, LLC, JKD).

  Action Steps:
  1. Work with private forestry consulting agencies and public agencies (DOF) to encourage them to promote longer rotations and hardwood regeneration when working with private landowners. As part of this:
     - Work with consultants to conduct economic analysis to compare returns on clearcutting young pine plantations and selective harvest of hardwood over time and use results to educate landowners about different options for forest management and procurement.

[2] However, upon further investigation, if a regional water use policy strategy proves ineffective due to inter-basin transfers of water supplies, the next step will be to develop a state-wide water use policy to comprehensively abate the threat of water withdrawals.

- Establish a network of demonstration forest with help from private consultants and DOF that promotes sustainable forestry, longer rotations, hardwood regeneration and saw timber procurement.

2. Establish hunting preserves for quail and turkey to promote sustainable forestry.
3. Secure conservation easements for patches of core forest area or significant linkages between large patches through partners such as the Forest Legacy program or VOF.
4. Work with DOD's Natural Resources staff at Fort A.P. Hill to manage forest for mature, un-even aged mixed pine/hardwood community types.

Key Partners: DOF, DCR, USFWS, DOD, private consultants, private landowners, and local organizations

- **Strategy 2.** ***Restore connectivity of matrix forest through conversion of key agricultural lands to mixed hardwood/pine forest*** (**ADL**, LLC, JKD).

Action Steps:

1. Identify key agricultural lands necessary for forest restoration in matrix sites and work to acquire legal interests.
2. Continue to work with the Rappahannock Working Group to add key tracts to the Rappahannock Valley NWR using funds from the LWCF and to reforest these tracts where appropriate.

Key Partners:
USFWS, NRCS, local organizations, private landowners

IV. Invasive Fishes

- **Strategy 1.** ***Determine invasive/ non-native fish species that contribute the greatest threats to conservation target*** (**ADL**, Aquatic Ecologist).

Action Steps:

1. Conduct a cost-benefit analysis to determine the feasibility for DGIF to promote recreational fishing of native fish species over non-native species in terms of revenue generated from recreational fishing licenses.
2. Meet with DGIF to promote inventory and monitoring of native and invasive fishes on the Mattaponi, Pamunkey and Dragon Run.
3. Research possible funding sources (i.e. EPA, USFWS, NOAA, TNC Invasives Program) and submit proposals to fund DGIF to inventory and monitor native and non-native invasive fishes on Mattaponi, Pamunkey and Dragon Run.
4. Sponsor conferences for the Chesapeake Bay region on the potential impacts of all invasive species to native aquatic and terrestrial biodiversity to communicate the current state of knowledge, research and strategies for effective control measures.
5. Model the distribution and abundance of anadromous fish nursery habitat and invasive predatory fish abundance.
   - Apply for FWI project grant support with match by the ACE to contract a university (i.e. VCU) to conduct work on the Rappahannock.
   - Using grant money, establish baseline data on fish (anadromous natives and invasives), impediments and physical/chemical attributes of water.

- Build GIS model that predicts the distribution and of andromous fish reproductive habitat and invasive predatory fish habitat (or density?).
- Work to gather data and model habitat for fishes on the Mattaponi, Pamunkey and Dragon Run as well.

Key Partners:
ACE, VCU, CBF, DGIF, local organizations

- **Strategy 2.** ***Develop policy to eliminate introduction and stocking of non-native fish species in the Coastal Plain and Piedmont*** (**ADL**, NMR, Aquatic Ecologist).
  Action Steps:
  1. Work to develop list of alternative native species for stocking as well as aquarium and bait trade.
  2. Build Chesapeake Rivers coalition with Bay organizations (CBF) and local grass roots river organizations, including sports fisherman groups, dedicated to public education, advocacy of regulatory policies and protection of native, anadromous fishes.
  3. With coalition, approach Gary Martel and Bill Woodfin of VDGIF with proposed alternatives to current stocking and aquarium/bait trade policies and regulations.
  4. Work with NRCS and the Cooperative Extension to promote alternatives to current recommended species for stocking ponds and reservoirs on private land.
  5. Research Maine's laws banning the importation of non-native fish species.

  Key Partners: CBF, VDGIF, NRCS, local organizations, Coastal Conservation Association (CCA), and American Sport Fishermen's Association (ASFA).

- **Strategy 3.** ***Work with local, state and federal agencies to develop policy to reduce and control non-native/invasive fish populations and to enforce existing laws*** (**ADL**, NMR, Aquatic Ecologist).
  Action Steps:
  1. Consult with commercial fishery operations in areas where invasive fishes are native to research the types of markets for these fishes.
  2. Working with partners and university community, explore measures for controlling fish populations at large through methods such as low frequency electrofishing, bio-controls and weirs that restrict upstream passage of larger invasive species.

  Key Partners:
  CBF, VCU, local organizations, CCA, and ASFA

- **Strategy 4.** ***Promote sound fisheries management to increase anadromous fish abundance*** (**ADL**, NMR, Aquatic Ecologist).
  Action Steps:
  1. [***Repeat***] Build Chesapeake Rivers coalition with Bay organizations (CBF) and local grass roots river organizations, including sports fisherman groups, dedicated to public education, advocacy of regulatory policies and protection of native, anadromous fishes.

2. Approach VMRC to initiate dialogue regarding regulations and policies that will protect all anadromous clupeid fish targets similar to those that already exist for the American shad.
3. [***Repeat***] Model the distribution and abundance of anadromous fish nursery habitat and invasive predatory fish abundance.
   - Apply for FWI project grant support with match by the ACE to contract a university (i.e. VCU) to conduct work on the Rappahannock.
   - Using grant money, establish baseline data on fish (anadromous natives and invasives), impediments and physical/chemical attributes of water.
   - Build GIS model that predicts the distribution and of andromous fish reproductive habitat and invasive predatory fish habitat (or density?).
   - Work to gather data and model habitat for fishes on the Mattaponi, Pamunkey and Dragon Run as well.
4. Work with DOT and VDGIF to install fish passage-friendly culverts.
5. Work with local organizations and volunteers to remove obstructed culverts in critical areas for spring migration of anadromous fishes in small headwater streams.

Key Partners:
CBF, VMRC, AMFC, local organizations, CCA, and ASFA

V. Invasive Plants

- **Strategy 1.** ***Determine invasive/ non-native plant species that contribute the greatest threats to conservation targets*** (**SGL**, JKD, JA).

  Action Steps:
  1. Create list of actual and potential invasive plant species by literature review, consultation with partners and observation.
  2. Assess risk of invasion posed by each species based on the following:
     - Life history characteristics.
     - Observed invasion of habitats similar to targets elsewhere in the target's range.
     - Proximity of species to key conservation area.
     - Vector of invasion.
  3. Determine degree of impact of high risk invasive plants on conservation targets by performing literature review and expert interview and by working with academic partners to perform applied research.
  4. ***[Repeat]*** Sponsor conferences for the Chesapeake Bay region on the potential impacts of all invasive species to native aquatic and terrestrial biodiversity to communicate the current state of knowledge, research and strategies for effective control measures.

  Key Partners:
  DCR, USFWS, CBF, VNPS, local river groups, universities

- **Strategy 2.** ***Develop control strategies for priority invasive plant species in key conservation areas*** (**SGL**, JKD, JA).

  Action Steps:

1. Map weed control zones based on degree of threat and feasibility of control for high risk invasive plant species.
2. Acquire management agreements or form collaborative partnerships to control invasive species in weed control zones not in TNC ownership.
3. Recruit volunteer weed watchers to survey and weed control zones for imminent invasions by high risk species on TNC preserves.
4. Assess the availability and risks of bio-control methods for invasive species targeted for control.
5. Work with partners to have priority invasive species listed as noxious weeds by VDACS to limit trade.
6. Continue community-based control of *Phragmites* on the Rappahannock, and expand to the Mattaponi and Pamunkey, lower Dragon/Piankatank.
7. Work with state and federal regulators to implement monitoring and control of *Phragmites* as part all permits granted for wetland-related activities (mitigation, construction of docks, peers, etc.).

Key Partners:
DCR, USFWS, CBF, VNPS, RPAC, local river groups, universities

- **Strategy 3.** ***Work with state/federal agencies and other conservation partners to prevent the introduction of new invasive plant species*** (**SGL**, NMR, JKD)**.**

Action Steps:
1. Improve enforcement of noxious weed law.
2. Work with Mid-Atlantic Pest Council and VA-DCR to gather information on new, anticipated invasive species and control strategies for these species.

Key Partners:
DCR, USFWS, CBF, VNPS, local river groups, universities

VI. Sea Level Rise

- **Strategy.** ***Evaluate current and future effects of sea level rise on species and communities in Coastal Plain to determine compensatory conservation actions to protect conservation targets*** (**JKD**).

Action Steps:
1. Gather current research, literature and predictive models on sea level rise due to global climate change and its potential effects on mid-Atlantic coastal plain terrestrial and aquatic communities.

Key Partners:
Universities, research centers, EPA, NOAA

VII. Seep Restoration/Management

- ***Support Fort A.P. Hill's Natural Resources Division to restore seepage wetlands*** (**JKD**, ADL, SGL).

Action Steps:

2. Target examples of potentially viable seepage bogs at Fort A.P. Hill for restoration and implement fire management plan for bogs in collaboration with DOD Natural Resources staff and DCR.
3. Work with DOD Natural Resources staff to remove beavers and beaver dams from seepage swamps with critical *Helonias bullata* habitat.

Key Partners:
DOD and DCR

Table 8. Profile of each Chesapeake Rivers conservation strategy, the targets benefited, threats abated and goals met.

Strategy	**Targets benefited by strategy**	**Threats abated by strategy**	**Threat abatement goals to be met by strategy**
1. Identify tracts of land with the most viable occurrences of conservation targets and protect through acquisition or conservation easements.	➢ Tidal Freshwater System ➢ Upland Terrestrial Forest System ➢ Calcareous Forests ➢ Seepage Wetlands ➢ Bald Cypress Forests ➢ Fluvial Terrace Woodland	➢ Development (residential homes, roads, other infrastructures) ➢ Incompatible forestry practices (silviculture) ➢ Lack of fire ➢ Conversion to agriculture (Active)	➢ Protect key tracts with exemplary occurrences of conservation targets. ➢ Reduce the impacts of development on conservation targets. ➢ Restore at least one functional upland terrestrial forest (>10,000 acres) in each matrix block. ➢ Restore viable seepage wetlands
2. Develop/promote land use policies and compatible economic development initiatives that conserve land in matrix blocks and protect water quality/flow regimes.	➢ Tidal Freshwater System ➢ Upland Terrestrial Forest System ➢ Calcareous Forests ➢ Seepage Wetlands ➢ Anadromous Fishes	➢ Development (residential homes, roads, other infrastructures) ➢ Incompatible forestry practices (silviculture) ➢ Lack of fire ➢ Conversion to agriculture (Active)	➢ Protect key tracts with exemplary occurrences of conservation targets. ➢ Reduce the impacts of development on conservation targets. ➢ Restore at least one functional upland terrestrial forest (>10,000 acres) in each matrix block.
3. Develop regional water use policy to determine the source of current and future water need and to affect the best method to meet the need.	➢ Tidal Freshwater System ➢ Anadromous Fishes	➢ Development (residential homes, roads, other infrastructures) ➢ Water Management ➢ Structural impediments to fish passage (dams, clogged culverts)	➢ Preserve natural range of variability of flow regimes of tidal freshwater system.
4. Restore connectivity of matrix forest through a shift in current pine management to longer-rotation mixed hardwood/pine forest.	➢ Upland Terrestrial Forest System	➢ Incompatible forestry practices (silviculture) ➢ Conversion to agriculture (Active)	➢ Restore at least one functional upland terrestrial forest (>10,000 acres) in each matrix block.
5. Restore connectivity of matrix forest through conversion of key agricultural lands to mixed hardwood/pine forest.	➢ Upland Terrestrial Forest System	➢ Conversion to agriculture (Historical)	➢ Restore at least one functional upland terrestrial forest (>10,000 acres) in each matrix block.
6. Determine invasive/ non-native fish species that contribute the greatest threats to conservation target.	➢ Anadromous Fishes	➢ Invasive and/or non-native fish species	➢ Reduce the threat of non-native, invasive predatory fishes on anadromous fish populations.
7. Develop policy to eliminate introduction and stocking of non-native fish species in the Coastal Plain and Piedmont.	➢ Anadromous Fishes	➢ Invasive and/or non-native fish species	➢ Reduce the threat of non-native, invasive predatory fishes on anadromous fish populations.
8. Work with local, state and federal agencies to develop policy to reduce and control non-native/invasive fish	➢ Anadromous Fishes	➢ Invasive and/or non-native fish species	➢ Reduce the threat of non-native, invasive predatory fishes on anadromous fish populations.

Strategy	**Targets benefited by strategy**	**Threats abated by strategy**	**Threat abatement goals to be met by strategy**
populations and to enforce existing laws.			
9. Determine invasive/ non-native plant species that contribute the greatest threats to conservation targets.	➢ Tidal Freshwater System ➢ Upland Terrestrial Forest System ➢ Calcareous Forests	➢ Invasive and/or non-native plant species	➢ Reduce the threat of non-native, invasive plant species in tidal freshwater and upland terrestrial systems.
10. Develop control strategies for priority invasive plant species in key conservation areas.	➢ Tidal Freshwater System ➢ Upland Terrestrial Forest System ➢ Calcareous Forests	➢ Invasive and/or non-native plant species ➢	➢ Reduce the threat of non-native, invasive plant species in tidal freshwater and upland terrestrial systems.
11. Work with state/federal agencies and other conservation partners to prevent the introduction of new invasive plant species.	➢ Tidal Freshwater System ➢ Upland Terrestrial Forest System ➢ Calcareous Forests	➢ Invasive and/or non-native plant species	➢ Reduce the threat of non-native, invasive plant species in tidal freshwater and upland terrestrial systems.
12. Evaluate current and future effects of sea level rise on species and communities in Coastal Plain to determine compensatory conservation actions to protect conservation targets.	➢ Tidal freshwater system ➢ Bald Cypress Forests	➢ Sea level rise	➢ Assess long-term effects of sea level rise on project area and conservation targets.
13. Promote sound fisheries management policy to increase anadromous fish abundance.	➢ Tidal Freshwater System ➢ Anadromous Fishes	➢ Fishing (includes boating) ➢ Structural impediments to fish passage (dams, clogged culverts)	➢ Reduce the threat of fishing to anadromous fish populations.
14. Support Fort A.P. Hill's Natural Resources Division to restore seepage wetlands.	➢ Seepage Wetlands	➢ Lack of fire ➢ Dam construction by beavers	➢ Restore viable seepage wetlands

Table 9. Evaluation of Chesapeake Rivers conservation strategies in terms of benefits to conservation targets, feasibility and cost of implementation.

	Benefits					**Feasibility**			**Cost**
Conservation Strategies	Threat Abatement Benefit	Restoration Benefit	Leverage	Overall Benefits	Overall Benefits User Override	Lead Institution/ Individual	Ease of Implementation	Overall Feasibility	
Determine invasive/ non-native fish species that contribute the greatest threats to conservation target.	High	-	High	High		Medium	Medium	Medium	Medium
Determine invasive/ non-native plant species that contribute the greatest threats to conservation targets.	High	-	High	High		High	Medium	Medium	Medium
Develop control strategies for priority invasive plant species in key conservation areas.	High	-	High	High		Medium	Medium	Medium	High
Develop policy to eliminate introduction and stocking of non-native fish species in the Coastal Plain and Piedmont.	High	-	Medium	High		High	Medium	Medium	Medium
Develop state water use policy to determine the source of current and future water need and to affect the best method to meet the need.	Medium	-	High	Medium		Medium	Low	Low	High
Develop/promote land use policies with partners (CBF, localities), focusing on counties within Upper Rappahannock and Dragon/Mattaponi matrix blocks.	High	-	High	High		Low	Medium	Low	High
Evaluate current and future effects of sea level rise on species and communities in Coastal Plain to determine compensatory conservation actions that buffer sea level rise impacts on conservation targets.	Medium	-	High	Medium		Low	Low	Low	Medium
Identify tracts of land with the most viable occurrences of conservation targets and protect through acquisition or conservation easements.	High	-	High	High		Very High	Very High	Very High	High
Promote sound fisheries management policy to increase anadromous fish abundance.	Medium	-	Very High	High		High	Medium	Medium	Medium

	Benefits					**Feasibility**			**Cost**
Conservation Strategies	Threat Abatement Benefit	Restoration Benefit	Leverage	Overall Benefits	Overall Benefits User Override	Lead Institution/ Individual	Ease of Implementation	Overall Feasibility	
Restore connectivity of matrix forest through a shift in current pine management to longer-rotation mixed hardwood/pine forest.	High	-	Medium	High		Low	Low	Low	High
Restore connectivity of matrix forest through conversion of key agricultural lands to mixed hardwood/pine forest.	High	-	Medium	High		Low	Low	Low	High
Support Fort A.P. Hill's Natural Resources Division to manage and restore seepage wetlands.	Medium	-	High	Medium		High	High	High	Low
Work with federal/state agencies and other conservation groups to prevent the introduction of new invasive plant species.	High	-	Medium	High		High	Medium	Medium	Medium
Work with local, state and federal agencies to develop strategy and policy for eradication of non-native/invasive fish species and to enforce existing laws regarding non-native/invasive species.	High	-	High	High		High	Medium	Medium	Medium

Conclusion

The Chesapeake Rivers project area while currently a relatively stable area in terms of land use, human population growth and economy, faces several signficant threats over the next 10-20 years, including residential sprawl and development from surrounding urban areas, widespread industrialized forestry and removal of hardwood resources, invasive plants and animals, and water withdrawals—in addition to the uncertain changes wrought by global warming and sea level rise. To abate these threats to the area's native biodiversity, The Nature Conservancy of Virginia is embarking upon many new, challenging and complex conservation strategies to achieve mission success in the Chesapeake Rivers. Among the most formidable frontiers are large-scale forest restoration, water use policy, invasive species policies and management, and land use policy. Working with partners such as USFWS, DOD, VA-DGIF, VA-DOF, Chesapeake Bay Foundation (CBF), Rappahannock Working Group, planning district commissions and localities, and local groups is critical to implementing conservation strategies at the scale of the landscapes that fall within in this project area. Moreover, TNC-VA has committed significant resources towards building the necessary capacity to implement strategies as well through the establishment of the Chesapeake Rivers Program in Tappahannock. The pristine nature of the rivers combined with the predominately rural landscape offer promising opportunities for TNC-VA, our partners, and the Chesapeake Rivers community at large to effectively conserve and restore the biological diversity and ecological processes that characterize this irreplaceable coastal plain landscape.

Literature Cited

Coulling, Phil. 2001. Personal communication. Virginia Department of Conservation and Recreation, Division of Natural Heritage, Richmond, Virginia.

Fleming, G.P., P.P Coulling, D.P. Walton, K.M. McCoy, and M.R. Parrish. 2001. The natural communities of Virginia: classification of ecological community groups. First approximation. Natural Heritage Technical Report 01-1. Virginia Department of Conservation and Recreation, Division of natural Heritage, Richmond, VA. Unpublished report. January 2001. 76 pp.

Fleming, Gary. 2001. Personal communication. Virginia Department of Conservation and Recreation, Division of Natural Heritage, Richmond, Virginia.

Fowler, Dean. 2001. Personal communication. Virginia Department of Game and Inland Fisheries, Williamsburg, Virginia.

Garman, Greg. 2001. Personal communication. Virginia Commonwealth University, Richmond, Virginia.

Jenkins, R.E. and N.M. Burkhead. 1993. The Freshwater fishes of Virginia. American Fisheries Society, Bethesda, Maryland.

McIninch, Steve. 2001. Personal communication. Virginia Commonwealth University, Richmond, Virginia.

McIninch, S.P. and G.C. Garman. 1999. The anadromous clupeid fishes of the Chesapeake Bay. An evaluation of essential habitat and barriers to migration in the Rappahannock River basin. FInal Project Report to VA Department of Game and Inland Fisheries, Richmond, VA.

Poiani, K.A. and B.D. Richter. 1999. Functional landscapes and the conservation of biodiversity. Working Papers in Conservation Science, No. 1. The Nature Conservancy: Arlington, Virginia.

The Nature Conservancy. 2000. The Five-S Framework for Site Conservation. The Nature Conservancy. Arlington, Virginia.

Virginia GAP Analysis Project. 2000. Land use/land cover data. Fish and Wildlife Information Exchange. Virginia Tech, Blacksburg, Virginia.

Walton, Dean. 2001. Personal communication. Virginia Department of Conservation and Recreation, Division of Natural Heritage, Richmond, Virginia.

APPENDIX A. CHESAPEAKE RIVERS CONSERVATION TARGET DESCRIPTION MATRIX

Appendix A. Chesapeake Rivers conservation target description matrix.

Target	Description	Distribution	Nested Targets	Key Processes
Tidal Freshwater System	Mosaic of inter-grading tidal freshwater emergent herbaceous marshes, mudflats, semi-open multi-strata hardwood swamp forest, and submerged aquatic vegetation found in the uppermost portions of the estuarine zone along inner coastal plain rivers; provides habitat numerous globally rare plant species as well as for migratory waterfowl; marshes at site are likely the most exemplary and extensive on the Atlantic coast.	***Biophysical:*** Marshes and swamp forests found in low, flat tidally flooded areas along rivers and tributaries, mudflats and SAV found in open channels. ***Site:*** On Pamunkey, located between Sweet Hall marsh to just past Liberty Hall; on the Mattaponi, between Gleason marsh and Aylett; on Rappahannock from Peedee Creek to Fredericksburg. ***Global:*** Marshes occur along tidal portions of rivers throughout the Atlantic coastal plain; tidal forest restricted to coastal plain rivers north of James.	***Ecological groups[3]:*** 1. **Tidal Freshwater Marshes**. Consist of several community associations dominated by *Peltandra virginica, Leersia oryzoides, Zizania aquatica, Bidens laevis, Polygonum punctatum, P. arifolium, P. sagittatum, Zizaniopsis miliacea, and Acorus calamus*. ➢ Associated Rare Species: *Aeschynomene virginica* (G2), *Chaemacrista fasiculata var macrosperma* (G5T2) ➢ Migratory waterfowl habitat 2. **Tidal Freshwater Forests**. Semi-permenantly saturated forest with canopy dominants *Nyssa biflora, Fraxinus profunda*, and *F. pennsylvanica*. Shrub layer consists of *Clethra alnifolia, Alnus serrulata, Myrica cerifera, Viburnum nudum* and *V. dentatum*. 3. **Sand/Gravel/Mud Bars and Shores**. Semi-permenantly flooded *Nuphar lutea* spp. *advena* dominated mudflats w/several other fine-scaled sub-types including populations of *Elatine minima, Ludwigia palustris, Justicia americana, Isoetes* spp., *Lilaeopsis chinensis*, and other rare plants. ➢ Associated Rare Species: *Eriocaulon parkerii* (G3), *Cardamine longii* (G3Q), and *Bacopa innominada* 4. **Tidal Freshwater Aquatic Beds**. Consists of permanently flooded *Ceratophyllum demersum* with associated occurrences of *Utricularia* spp., *Elodea nuttallii, Spirodela polyrrhiza* and *Wolffiella gladiata.*	Flooding from diurnal lunar tides up to 1.5 m; maintenance of freshwater regime (<.5ppt); natural variability of sedimentation/erosion cycle; adequate light (for SAV)

[3] All ecological groups are based on the VA Division of Natural Heritage's publication *The Natural Communities of Virginia: Classification of Ecological Community Groups* (First Approximation) (Fleming et al. 2001), except where noted.

Target	Description	Distribution	Nested Targets	Key Processes
Bald Cypress Forests	Progression of tidal bald cypress forest and woodlands to non-tidal, seasonally to semi-permanently flooded cypress-gum primarily along Dragon Run. Non-tidal swamp on Dragon represents the most significant northernmost example of its kind on the coastal plain. The tidal forest is of outstanding quality in terms of size and condition.	***Biophysical*:** Found in upper tidal reaches of rivers and in backswamps, sloughs, and low terraces adjacent to coastal plain rivers. ***Site:*** Occurs extensively along the Dragon Run ***Global*:** Tidal swamp may be restricted to CBY ecoregion but southern distribution in MACP is unknown; non-tidal swamp found in coastal plain from Virginia to Texas.	***Ecological Groups:*** ➢ **Bald Cypress-Tupelo Swamps**. Seasonally to semi-permanently flooded forest with *Taxodium distichum* and *Nyssa biflora dominant* and *Acer rubrum, Fraxinus pennsylvanica* are canopy associates and understory species and variable herb layer (includes *Saururus cernuus, Boehmeria cylindrica* and *Tiadenum walteri*). ➢ **Tidal Bald Cypress Forest and Woodlands**. *T. distichum* dominated canopy with or without co-dominants *N. biflora* or *F. pennsylvanica*, shrub and herb layers a mixture of marshes and swamp vegetation. ➢ **Associated Rare Species**: populations of *Ranunculus flabellaris* (G5/S1), *Chelone obliqua* (G4/S1); possibly Mabee's (G4/S1) and tiger salamander (G5/S1) and other breeding amphibians; *Epitheca spinosa* (robust baskettail) (G3G4/S2)	Seasonal and semi-permanent flooding and innundation during growing season; periodic drawdowns for regeneration and seedling recruitment (non-tidal)
Fluvial Terrace Woodlands	Small patch, open woodland communities composed of xeric hickories and oak species anomalous due to elevated topographic position and sandy substrate in floodplain--likely relicts of sandhill communities. Occurrence along Dragon Run is especially unusual due presence of calciphiles such as *Cercis canadensis*, *Aquilegia canadnsis*, and *Arabis laevigata* var. *laevigata*, etc. intermixed with typical sandhill species favoring acidic, lower nutrient conditions.	***Biophysical***: Found on elevated, flat, xeric sandy islands and terraces adjacent to forest swamps. ***Site***: Only 2 known occurrences in study area (on Dragon Run and on Mattaponi). ***Global***: Occurs sporadically along coastal plain rivers in eastern VA (G?).	***Ecological group:*** ➢ **Fluvial Terrace Woodlands**. Overstory consists of *Carya pallida, C. alba*, and to a lesser extent *Quercus falcata, Q. nigra, Q. marilandica, Q. alba*. Shrubs include *Q. margarettiae, Symplocos tinctoria, Ilex opaca* and *Juniperus virginiana*. Herb layer consists of *Carex* spp., *Helianthemum canadense, Clitoria mariana, Solidago tarda* and *Opuntia humifusa.*	Edaphically limited; perhaps fire is important (long return interval of >40 years?) for oak regeneration and open stand structure

Target	Description	Distribution	Nested Targets	Key Processes
Upland Terrestrial Forest System	Well-drained upland forests consisting of beech, oaks, hickories and other common hardwood species; drier, acidic variants consist of strong ericad shrub component, little herbaceous cover and overall low species diversity; richer, mesic variants have higher (almost double) species diversity with paw-paw, holly, spicebush, dogwood with ferns and other herbaceous species in understory. Represents remnant occurrences of a formerly characteristic upland matrix forest of the coastal plain and will require significant restoration.	***Biophysical***. Found on mesic to xeric acidic, nutrient-poor soils of uplands and flats. ***Site*:** Fragmented patches scattered throughout uplands; some good patches documented at Rappahannock tributaries in Fort A.P. Hill and others have been observed on the Gasch, Massie and Hanover School for Boys properties in the Pamunkey watershed. ***Global*:** Characteristic upland hardwood forests types of the Atlantic coastal plain ecoregions (G5).	***Ecological Groups:*** ➢ **Mesic Mixed Hardwood Forests**. Dominated by *Fagus grandifolia*, *Quercus alba*, *Liriodendron tulipifera* and *Carya spp*. with *Ilex opaca*, *Cornus florida* and *Carpinus caroliniana* in the understory. ➢ **Mixed Oak/Heath Forests**. Canopy dominants include various combinations of *Quercus spp*. (*Q. alba*, *Q. montana*, *Q. falcata*) and associates *Acer rubrum*, *Nyssa sylvatica* and/or *Oxydendrum arboreum*. Shrub layer consists of ericads such as *Kalmia latifolia* and *Gaylussacia* spp. ➢ **Acidic Oak-Hickory Forests**. *Quercus* spp. canopy dominants, hickories are canopy associates and understory trees; *Vaccinium pallidum* and *V. stamineum* shrub layer; rich herbaceous layer. ➢ **Chestnut Oak Forests**. Canopy dominated by *Quercus montana* with associates *Fagus grandifolia* and *Ilex opaca*. Shrub layer consists of a variety of ericads such as *Kalmia latifolia*. ➢ **Piedmont/Coastal Plain Oak-Beech/Heath Forest**. Like Mesic Mixed Forests but with greater abundance of heaths and fewer mesophytic plants. ➢ **Associated Rare Species:** *Isotria medeoloides* (G2G3)	Gap regeneration and seedling recruitment of characteristic species resulting in uneven, mature age structure; occasional fire to regenerate oaks and heaths (every 30-50 years)—but not in mesic forest types.
Calcareous Forest	Small patch, rich northeast-facing, mature oak-hickory-beech-poplar forests with paw-paw dominant in the shrub layer and a diverse herb layer consisting of rock ferns, columbine, and other mountain disjuncts found in unique calcareous ravines. Distinctive and unusual communities in the coastal plain because of geology, species composition and maturity relative to other	***Biophysical***: Found where erosion has cut through surficial non-calcareous soils into marine shell deposits from Pliocene epoch. ***Site***: Notable occurrences documented at Fort A.P. Hill and Gasch property. ***Global***: Probably G4/G5 community, found scattered throughout the Piedmont and coastal plain, but more unusual in coastal plain.	***Community type (Fleming 2000):*** ➢ *Fagus grandifolia-Liriodendron tulipifera-Carya cordiformis/ Asimina triloba/ Lindera benzoin/ Podophyllum peltatum* Forest ➢ **Note**: A very rare calcareous forest type (G1) is found on dry south-facing convex slopes and is dominated by *Quercus muehlenbergii* and diverse, dry-site herbs; not known in site but is likely be present (occurrences documented in Stafford and Surry Counties).	Gap regeneration and seedling recruitment of characteristic species resulting in uneven, mature age structure.

Target	Description	Distribution	Nested Targets	Key Processes
	upland hardwood communities.			
Seepage Wetlands	A mosaic of intergrading fire-maintained shrub/ graminoid-dominated seepage bogs and forested seepage swamps; support rare plant species and critical breeding habitat for odonates and amphibian species; the groundwater supports globally rare interstitial gastropods and isopods. Seepage wetlands (particularly the fire-dependent open bogs) are mostly extirpated throughout site due to fire-suppression and hydrological degradation and are in need of significant restoration.	***Biophysical:*** Occur in small patches in areas of dissected topography and sandy/peaty soils in braided seepage streams of small headwaters and toe slopes fed by groundwater. ***Local:*** Caroline Co. (Fort A.P. Hill) is has highest density of seepage wetlands in the site, while occurrences elsewhere are scattered and isolated. ***Global:*** Scattered throughout inner coastal plain and Piedmont (G3/G4?).	***Ecological Groups:*** *1.* **Coastal Plain/ Piedmont Acidic Seepage Swamp**. Saturated forests characterized by *Acer rubrum-Nyssa sylvatica-Liriodendron tulipifera/ Magnolia virginica-Clethra alnifolia-Vaccinium* spp./ *Symplocarpus foetidus-Parnassia asarifolia*/ various sedges/ *Sphagnum*. ➢ Associated Rare Species: *Helonias bullata* (G3, LT) 2. **Coastal Plain/ Piedmont Seepage Bog**. Woody species include *Magnolia virginica, Toxicodendron vernix, Vaccinium spp., Viburnum nudum* var. *nudum, Alnus serrulata*. Typical herbaceous spp. Include *Eleocharis tortilis, Rhynchospora spp., Dichanthelium* spp., *Fuirena squarrosa, Rhexia* spp., etc. ➢ Associated Rare Species: *Juncus caesariensis (G2)* ➢ **Note**: Breeding amphibians such as salamanders (e.g. Mabee's and tiger salamanders) are of special management concern in these communities.	Groundwater flow and recharge; frequent fire return interval
Anadro-mous Fishes	Unique assemblage of herrings--includes *Alosa aestivalis* (blueback herring), *Alosa pseudoharengus* (alewife), *Alosa mediocris* (hickory shad), *Alosa sapidissima* (American shad). Rappahannock, Mattaponi and Pamunkey watersheds (to Fall Line) maybe the only place where all 4 fish species are still able to migrate/reproduce successfully. Target is the reproductive habitat of these fishes in the site.	***Biophysical:*** Shads restricted to mainstem and large tributaries for spawning and herring and alewife utilize smaller tributaries. ***Local:*** Historically found from Chesapeake Bay to upper portions of Chesapeake River watersheds in Piedmont and Blue Ridge. ***Global***: Fishes found throughout the rivers of the Atlantic seaboard from Newfoundland to Florida.	NA	Long, largely unaltered natural passages for migration and spawning; appropriate substrate for spawning; emergent vegetation for nurseries

APPENDIX B. CHESAPEAKE RIVERS CONSERVATION TARGET VIABILTY ATTRIBUTES

Appendix B. Viability Attributes for Occurrences of Conservation Targets in the Chesapeake Rivers Project area. Generic community viability specifications ("EO Specs") developed for use in ecoregional planning were used as a general guideline for defining size, condition and context for each target. Attributes are based on extensive personal communication with ecologists Gary Fleming, Dean Walton and Phil Coulling (VA-DCR Division of Natural Heritage). These attributes were used to determine the viability ranks for the conservation targets, found in the text under the "Conservation Targets" chapter**. PLEASE NOTE** that anadromous fishes do not have viability attributes at this time due to lack of sufficient information. As this information is obtained through research and monitoring, it will be included in the plan.

Table B.1. Viability attributes for Tidal Freshwater System

Rank	Size (acres)	Condition	Landscape Context
Very Good	>1000 acres	Intergrading mosaic of native emergent marsh vegetation dominated by *Peltandra virginica, Leersia oryzoides, and Zizania aquatica* and tidal forest dominated by canopy of *Nyssa biflora, Fraxinus profunda*, and *F. pennsylvanica*. Small intermittent patches of SAV and mudflat vegetation in open channels and on marsh edges. Species diversity between 9 and 34, depending on community type. Minor presence of invasive species like *Murdannia keisak, Phragmites australis* and *Hydrilla verticillata*. Historic rare plant populations persistent in marshes/ mudflats such as *Aeschynomene virginica, Chaemacrista fasiculata var macrosperma, Eriocaulon parkerii, Cardamine longii*, and *Bacopa innominata.*	Well connected to landscape of 80% natural vegetation-agricultural-silvicultural lands. Well drained forests in uplands, oligohaline marshes downstream, non-tidal alluvial forests and wetlands upstream. Natural range of variable flow patterns in riverine system occur that maintain the sedimentation regime. Freshwater conditions prevail (<.5 ppt salinity).
Good	>500	Increase in shrub density within swamp forest. Trees show some evidence of crown stress and mortality. Invasives species present. Slight decrease in abundance and distribution of rare plant species.	Moderately connected to landscape of 80% natural vegetation-agricultural-silvicultural lands. Moderate modification to natural range of variable flow patterns affecting sediment budget (either increasing/decreasing accretion or erosion).
Fair	>200	Lower plant species diversity among and within marsh types. Trees show increasing crown stress and mortality with canopy cover less than 10-15% in some places, leading to an increase in competitive displacement of forest by marsh and shrub species and communities. Increased competitive displacement by invasive species and perhaps by brackish species. Competitive displacement by hydrilla in SAV communities. Occurrences of historically rare plant populations are marginally viable.	Somewhat isolated, surrounded predominately by human altered landscapes (roads, industrial/commercial, development) and 20-50% natural vegetation/silviculture/agriculture. Alteration of natural flow regime due to dams, water withdrawals, sea level rise significantly adversely impacting the sediment regime to extremes which in turn threaten the persistence of marsh vegetation. Increasingly oligohaline conditions moving upstream as sea level rises.

Rank	Size (acres)	Condition	Landscape Context
Poor	<200	Mortality of swamp forest, succeeded by tidal marsh and shrub vegetation. Competitive exclusion of tidal freshwater marsh vegetation by dominant brackish or invasive species types. Disappearance of mudflat communities. Extirpation of all native SAV. Possible shift to aquatic system with sea level rise	Highly isolated, almost entirely surrounded by urban land use with 0-20% vegetation/silviculture/agriculture. Persistent oligohaline conditions. Higher tidal amplitude and flooding. Simplification of natural flow regime.

Table B.2. Viability attributes for Upland Terrestrial Forest System

Rank	Size (acres)	Condition	Landscape Context
Very Good	>10,000	Canopy dominants found in varying compositions including *Quercus* spp., *Carya* spp., *Fagus grandifolia*, *Pinus* spp., *Liriodendron tulipifera*, etc. Variable herbaceous and shrub diversity (shrubs are predominately in the ericad family), composition and abundance depending on substrate. Uneven age structure w/mature dominants 100+ years old. No invasive species present.	Well connected to predominant natural landscape mosaic of 80% natural vegetation/silviculture.
Good	>5,000	Younger forest w/characteristic canopy dominants and associates. Increase in even aged stands of individual weedy species (e.g. pines, red maple, sweet gum, tulip poplar). Evidence of logging in last ~40 to 80 years. Invasives present (i.e. *Allaria petiolata*, *Lonicera japonica*, *Microstegium vimineum*, *Ligustrum sinese*)	Moderately connected to landscape with 50-80% natural vegetation/silviculture.
Fair	>2,000	Young even aged stands of forest prevalent, composed of weedy single species canopy dominants, especially pines (*Pinus taeda*, *P. virginiana*). Little oak or ericad regeneration occurring. Evidence of clearcutting in last ~30-40 years Invasive species competitively displacing native understory species (both herbs and shrubs), resulting in lower diversity and abundance native species. Episodic gypsy moth infestations resulting in mortality of oaks.	Somewhat isolated, surrounded predominately by human altered landscapes (agriculture, roads, development) and 20-50% natural vegetation/silviculture.
Poor	<2,000	Conversion to pine plantation or agriculture OR current clearcutting is occurring. Immature and even aged stands of weedy species, pines dominant. No oak regeneration. Invasive species well established and competitively displacing all native herbaceous and shrub diversity.	Highly isolated, almost entirely surrounded by agricultural or urban land use with 0-20% natural vegetation.

Table B.3. Viability attributes for Bald Cypress Forests

Rank	Size (acres)	Condition	Landscape Context
Very Good	>1000 acres	Dominants in canopy are *Taxodium distichum* and *Nyssa biflora/ Nyssa aquatica*; canopy associates are *Fraxinus pennsylvanica* and *Acer rubrum*; shrub and herbaceous layers variable in terms of composition and density from site to site with constants such as Carolina ash (*Fraxinus caroliniana*), climbing hydrangea (*Decumaria barbara*), lizards's tail (*Saururus cernuus*), false nettle (*Boehmeria cylindrica*), Walter's St. John's-wort (*Triadenum walteri*) and swamp beggar-ticks (*Bidens discoidea*). Mature dominants (100+ years). Uneven aged forest structure. No evidence of recent logging activity (in last 100 years).	Well connected to predominant natural landscape mosaic of >80% natural vegetation/silvicultural lands. Tidal forests area interspersed with tidal freshwater marsh communities and grade into non-tidal forests upstream. Non-tidal forests are connected with well-drained mixed pine-oak communities in uplands. Non-tidal forests are seasonally to semi-permanently flooded for part of year with some standing water during growing season. Tidal forests experience freshwater (<.5 ppt salinity) lunar tidal regimes.
Good	>500	Mostly connected progression of community types from headwaters to estuary; less cypress dominance and regeneration, increased dominance of *Nyssa* spp., *F. pennsylvanica* and *A. rubrum*. Intermittent patches of younger, even aged stands of *Nyssa* spp. or *F. pennsylvanica*. Evidence of logging within last 40-100 years.	Moderately connected to 50-80% natural vegetation (including a mix of pine plantations). Moderate alteration of periods of inundation in terms of both duration and volume.
Fair	>200	Cypress minor component of canopy with little regeneration, *Nyssa* spp., *F. pennsylvanica* and *A. rubrum*. dominant in canopy. Mix of even aged stands of immature trees with other uneven aged stands Evidence of clearcutting in last 30-40 years Increased presence of shrubs and emergent vegetation.	Somewhat isolated, surrounded predominately by human altered landscapes (agriculture, roads, development) and 20-50% natural vegetation/silviculture. Significant alteration of periods of inundation in terms of both duration and volume. Persistent oligohaline conditions in tidal zone, moving upstream.
Poor	<200	Highly fragmented and isolated patches. Dominance of pure even aged stands of *Nyssa* spp., *F. pennsylvanica* and *A. rubrum*. Very recent clearcutting. Forest die-off and possible succession to brackish emergent vegetation.	Highly isolated, almost entirely surrounded by agricultural or urban land use with 0-20% natural vegetation/silviculture. Severe alteration of hydrology Mesohaline conditions in tidal zone, moving upstream.

Table B.4. Viability attributes for Fluvial Terrace Woodland

Rank	Size (acres)	Condition	Landscape Context
Very Good	>50	Canopy dominants consist of hickories (*Carya pallida, C. alba*) and to a lesser extent oaks (*Quercus falcata, Q. nigra, Q. marilandica, Q. alba*). Shrubs include *Q. margarettiae, Symplocos tinctoria, Ilex opaca* and *Juniperus virginiana*. Herb layer consists of *Carex* spp., *Helianthemum canadense, Clitoria mariana, Solidago tarda* and *Opuntia humifusa.* Uneven age woodlands with canopy dominants 100+ years old. Open, woodland structure. No evidence of logging activity.	Well connected to landscape of 80% natural vegetation-agricultural-silvicultural lands. Surrounded by either bald cypress swamp forests or alluvial floodplain forests. Possible long interval fire regime (every 50+ years)
Good	> 20	*Pinus virginica* is a minor canopy component and is present in moderate abundance as saplings. Small patches of more even aged, younger (30+ yrs.) dominant trees. Canopy cover shows slight increase, shading out some of the herbaceous species. Evidence of logging over last 40-80 years. Presence of invasive species such as *Lonicera japonica*.	Moderately connected to landscape with 50-80% natural vegetation- agricultural-silvicultural lands.
Fair	> 10	*P. virginica* becomes more significant component in canopy as saplings mature, little oak and hickory regeneration. Trees are predominately young, even aged and densely distributed, competitively displacing characteristic shrub and herbaceous species. Litte oak regeneration. More closed, short stature canopy. Invasive species competitively displace characteristic herbaceous species. Logging activities in past 30-40 years.	Somewhat isolated, surrounded predominately by human altered landscapes (roads, industrial/commercial, development) and 20-50% natural vegetation/silviculture/agriculture.
Poor	< 10	No oak or hickory regeneration; mostly immature, even aged pine, creating excessive shade. Invasive species prevalent. Clearcutting or destruction of habitat in last 30 years.	Highly isolated, almost entirely surrounded by urban land use with 0-20% vegetation/silviculture/agriculture.

Table B.5. Viability attributes for Calcareous Forests

Rank	Size (acres)	Condition	Landscape Context
Very Good	>50	*Fagus grandifolia-Liriodendron tulipifera-Carya cordiformis/ Asimina triloba/ Lindera benzoin/ Podophyllum peltatum* Forest w/a diverse herb layer consisting of rock ferns, columbine, and other mountain disjuncts. Uneven age w/ relatively mature dominants (+150 years) No evidence of logging activity over last 150 yrs. High herbaceous diversity.	Well connected to predominant natural landscape mosaic of 80% natural vegetation/silviculture. Found interspersed in forested landscape surrounded by bottomland hardwoods in floodplain and mixed oak-heath forest on ridge tops, grading into mixed mesic hardwoods on slopes. Substrate intact.
Good	>20	Younger forest w/characteristic canopy dominants and associates. Increase in even aged stands of individual weedy species (e.g. *Liriodendron tulipifera* and *Acer rubrum*). Evidence of logging in last ~40 to 80 years Invasive species present (i.e. *Allaria petiolata*, *Lonicera japonica*, *Microstegium vimineum*, *Ligustrum sinese*) in herbaceous layer.	Moderately connected to landscape with 50-80% natural vegetation/silviculture. Moderate erosion of calcareous substrate.
Fair	>10	Young, even aged stands of *L. tulipifera* and *A. rubrum* as canopy dominants more prevalent. Evidence of logging activity in last ~30-40 years Invasive species competitively displacing native herbaceous species—lower diversity and abundance of native species.	Somewhat isolated, surrounded predominately by human altered landscapes (agriculture, roads, development) and 20-50% natural vegetation/silviculture. Significant erosion of calcareous substrate.
Poor	<10	Clearcutting and/or destruction of habitat Immature, weedy saplings of *L. tulipifera* and *A. rubrum* dominate. Invasive species rampant. Little to no herbaceous diversity remains.	Highly isolated, almost entirely surrounded by agricultural or urban land use with 0-20% natural vegetation Severe erosion of calcareous substrate.

Table B.6. Viability attributes for Seepage Wetlands

Rank	Size (acres)	Condition	Context
Very Good	Size irrelevant (all example are small between 1 and 2 acres)	Mosaic of intergrading fire-maintained shrub/ graminoid-dominated seepage bogs and forested seepage swamps. Swamps characterized by mature, uneven aged canopy dominants *Acer rubrum, Nyssa sylvatica* and *Liriodendron tulipifera* with a shrub layer consisting of *Magnolia virginica, Clethra alnifolia, Vaccinium* spp., and common herbs such as *Symplocarpus foetidus, Parnassia asarifolia*, various sedges and *Sphagnum*. Open bogs are a mosaic of graminoids such as *Eleocharis tortilis, Rhynchospora spp., Dichanthelium* spp., and woody species including *Magnolia virginica, Toxicodendron vernix, Vaccinium spp., Viburnum nudum* var. *nudum*, and *Alnus serrulata*. Support viable populations of rare plant species *Juncus caesariensis* and *Hellonias bullata* as well as critical breeding habitat for odonates and amphibian species.	Well connected to landscape of 80% natural vegetation-agricultural-silvicultural lands. Connected to upland and palustrine Coastal Plain vegetation such as mesic mixed forests, non-riverine hardwood forests and open graminoid dominated habitats. Fire occurs frequently in landscape (possibly every 1-10 years?) Unimpeded flow into seep from ground water creating saturated conditions.
Good	Size irrelevant (all example are small between 1 and 2 acres)	Seepage wetland mosaic fragmented increasingly into disconnected, discrete occurrences of bog vs. swamps. Species diversity, structure and abundance is slightly modified. In the swamp this is due to intermittent occurrences of younger (30+ years) canopy dominants (e.g *Acer rubrum*) and a decrease in overall canopy cover, leading to the invasion of more partially shade tolerant species in the herbaceous layer. In the bogs, this is due to competition by increasing density of young woody and shrubby species.	Moderately connected to landscape with 50-80% natural vegetation-agricultural-silvicultural lands. Fire occurs less frequently in landscape (possibly every 10-20 years?) Moderate disturbance to groundwater flow regime manifest by less saturated conditions in seep.
Fair	Size irrelevant (all example are small between 1 and 2 acres)	Swamps and bogs are mostly isolated, discrete occurrences. Species diversity, structure and abundance is significantly modified. In the swamps, this is due to the succession of a young <30 yrs.), even aged weedy canopy trees in the wake of a disturbance, leading to the competitive displacement of the characteristic herbaceous layer, including *H. bullata*. In bogs, this is due to the encroachment and succession of woody and shrubby species that displace characteristic graminoids and herbs, including *J. caesariensis*. For both, may see succession by facultative upland/wetland	Somewhat isolated, surrounded predominately by human altered landscapes (roads, industrial/commercial, development) and 20-50% natural vegetation/silviculture/agriculture. Bogs may be maintained artificially by mowing in power cuts. Fire excluded (lack of ignition sources and actively suppression) for long periods of time (20 to 30 years?). Significant disturbance to groundwater flow regime manifest by less saturated conditions in seep OR intermittent flooding by beaver dams/other impediments to flow.

Rank	Size (acres)	Condition	Context
		herbaceous and woody species due to falling water levels OR increased die off of all vegetation due to rising water levels. Decreasing diversity and abundance of odonates and amphibians species.	
Poor	Size irrelevant (all example are small between 1 and 2 acres)	Extirpation of bogs due to progressive succession by weedy tree species which create a shaded environment. Swamp structure and composition is dominated by immature, weedy even aged tree species w/poor herbaceous diversity in understory. **OR** both swamp and bog vegetation succeeded entirely by non-wetland vegetation **OR** drown by flooding. Rare plants extirpated. No evidence of successful breeding by odonate and amphibian species.	Highly isolated, almost entirely surrounded by urban land use with 0-20% vegetation/silviculture/agriculture. Hydrology severely altered either by reduction in flow to seep or flooding of seep. No fire over long term (30+ years?)

APPENDIX C. CHESAPEAKE RIVERS 5-S WORKBOOK

APPENDIX D. CHESAPEAKE RIVERS SPECIES DATA

Appendix D. I. Natural species elements that are inventoried and tracked by the Department of Conservation and Recreation's Division of Natural Heritage (DCR-NHP), including global rank, state rank, federal and state protection status. In addition, tracked elements selected conservation targets in the Chesapeake Bay Lowlands (CBY) Ecoregional Plan are indicated in the column "CBY Target?"

Major Taxonomic Group	*Scientific Name*	**Common Name**	**Global Rank**	**State Rank**	**Federal Status**	**State Status**	**CBY Target?**
Amphibians	*Siren intermedia*	Lesser siren	G5	S2			
	Siren lacertina	Greater siren	G5	S2			
Birds	*Aimophila aestivalis*	Bachman's sparrow	G3	S1		LT	
	Asio flammeus	Short-eared owl	G5	S1			
	Haliaeetus leucocephalus	Bald eagle	G4	S2	LT	LT	Yes
	Rallus elegans	King rail	G4G5	S2			
Crustaceans	*Stygobromus araeus*	Tidewater interstitial amphipod	G2G3	S2		SC	Yes
	Stygobromus indentatus	Tidewater amphipod	G2G3	S2		SC	Yes
Insects	*Anax longipes*	Comet darner	G5	S2			
	Atlides halesus	Great purple hairstreak	G5	S2S3			
	Boloria selene	Silver-bordered fritillary	G5	S2			
	Callophrys irus	Frosted elfin	G3	S2			Yes
	Enallagma dubium	Burgundy bluet	G5	S2			
	Epitheca spinosa	Robust baskettail	G4	S2			Yes
	Helocordulia selysii	Selys' sundragon	G4	S2			
	Isoparce cupressi	Cypress sphynx	G4				
	Libellula exusta	White corporal skimmer	G4	S1			
	Nannothemis bella	Elfin skimmer	G4	S1			
	Nehalennia gracilis	Sphagnum sprite	G5	S2			
	Nehalennia integricollis	Southern sprite	G5	S2			
	Sigara depressa	Virginia piedmont water boatman	G1G3	S1S3			
	Somatochlora filosa	Fine-lined emerald	G5	S2			
	Somatochlora provocans	Treetop emerald	G4	S2			Yes
	Stenogomphurus rogersi	Sable clubtail	G4	S2			
Mussels	*Alasmidonta heterodon*	Dwarf wedgemussel	G1G2	S1	LE	LE	Yes
	Elliptio lanceolata	Yellow lance	G2G3	S2S3		SC	
	Lampsilis cariosa	Yellow lampmussel	G3G4	S2		SC	Yes
	Lampsilis radiata	Eastern lampmussel	G5	S2		SC	
	Lasmigona subviridis	Green floater	G3	S2		SC	Yes
Bryophytes	*Sphagnum carolinianum*	Carolina peatmoss	G3	S2			
	Sphagnum strictum	Straight peatmoss	G5	S2			
Vascular Plants	*Aeschynomene virginica*	Sensitive joint-vetch	G2	S2	LT		Yes
	Bacopa innominata	Tropical water-hyssop	G3G5	S2		LE	
	Chelone obliqua	Red turtlehead	G4	S1			
	Cuscuta cephalanthi	Button-bush dodder	G5	S1?			
	Cuscuta polygonorum	Smartweed dodder	G5	S2?			
	Desmodium ochroleucum	Creamflower tick-trefoil	G2G3	S1			Yes
	Desmodium strictum	Pineland tick-trefoil	G4	S2			
	Elatine minima	Small water-wort	G5	S1			

Major Taxonomic Group	*Scientific Name*	**Common Name**	**Global Rank**	**State Rank**	**Federal Status**	**State Status**	**CBY Target?**
	Hottonia inflata	Featherfoil	G4	S2S3			
	Kalmia angustifolia	Sheep-laurel	G5	S2			
	Mimosa quadrivalvis var angustata	Little-leaf sensitive-briars	G5T5	S2			
	Quercus prinoides	Dwarf chinquapin oak	G5	S2			
	Ranunculus flabellaris	Yellow water-crowfoot	G5	S2			
	Ranunculus trichophyllus var trichophyllus	White water crowfoot	G5T5	S1			
	Rorippa sessiliflora	Stalkless yellowcress	G5	S1			
	Sabatia kennedyana	Plymouth gentian	G3	S1			Yes
	Sarracenia flava	Yellow pitcher-plant	G5?	S1			
	Sarracenia purpurea ssp purpurea	Northern purple pitcher-plant	G5T5	S2?			
	Solidago uliginosa var uliginosa	Bog goldenrod	G4G5T?	S2			
	Tetragonotheca helianthoides	Pineland squarehead	G5	S1			
	Utricularia purpurea	Purple bladderwort	G5	S2			
	Juniperus communis var depressa	Ground juniper	G5T5	S1			
	Bolboschoenus fluviatilis	River bulrush	G5	S1			
	Carex lacustris	Lake-bank sedge	G5	S1			
	Carex vestita	A sedge	G5	S2			
	Digitaria cognata	Mountain hairgrass	G5	S2			
	Eleocharis robbinsii	Robbins spikerush	G4G5	S1			
	Eriocaulon parkeri	Parker's pipewort	G3	S2			Yes
	Helonias bullata	Swamp-pink	G3	S2S3	LT	LE	Yes
	Isotria medeoloides	Small whorled pogonia	G2G3	S2	LT	LE	Yes
	Juncus caesariensis	New jersey rush	G2	S2			Yes
	Lachnocaulon anceps	Bog-buttons	G5	S2			
	Leersia hexandra	Club-head cutgrass	G5	SH			
	Paspalum dissectum	Walter paspalum	G4?	S2			
	Platanthera blephariglottis var conspicua	Large white fringed orchid	G4G5T3T4	S1			
	Potamogeton oakesianus	Oakes pondweed	G4	S2			
	Potamogeton spirillus	Spiral pondweed	G5	S1			
	Rhynchospora alba	White beakrush	G5	S2			
	Schoenoplectus subterminalis	Water bulrush	G4G5	S1S2			
	Wolffia columbiana	Columbia water-meal	G5	S1			
	Thelypteris simulata	Bog fern	G4G5	S1S2			

Apendix A.II. List of known fish, mussel, crayfish and odonate species found in the Chesapeake Rivers Drainage compiled from VA Department of Inland Game and Fisheries' collections database and VA Natural Heritage Program's biological database system.

1. Mattaponi Drainage

Tax Group	Scientific name	Common name	Grank	Federal status	Data source
Mussel	*Alasmidonta heterodon*	Mussel, dwarf wedge		LE	VDGIF
Mussel	*Alasmidonta heterodon*	Dwarf wedgemussel	G1G2	LE	VAHP
Mussel	*Alasmidonta undulata*	Mussel, triangle floater			VDGIF
Mussel	*Elliptio complanata*	Mussel, eastern elliptio			VDGIF
Mussel	*Elliptio lanceolata*	Mussel, yellow lance			VDGIF
Mussel	*Elliptio lanceolata*	Yellow lance	G2G3		VAHP
Mussel	*Lampsilis cariosa*	Yellow lampmussel	G3G4		VAHP
Mussel	*Lampsilis radiata*	Eastern lampmussel	G5		VAHP
Mussel	*Pyganodon (anodonta) cataracta catar*	Mussel, eastern floater			VDGIF
Mussel	*Pyganodon grandis*	Mussel, giant floater			VDGIF
Mussel	*Strophitus undulatus*	Mussel, creeper			VDGIF
Fish	*Acantharchus pomotis*	Sunfish, mud			VDGIF
Fish	*Alosa aestivalis*	Herring, blueback			VDGIF
Fish	*Alosa mediocris*	Shad, hickory			VDGIF
Fish	*Alosa pseudoharengus*	Alewife			VDGIF
Fish	*Alosa sapidissima*	Shad, american			VDGIF
Fish	*Ambloplites rupestris*	Bass, rock			VDGIF
Fish	*Ameiurus catus*	Catfish, white			VDGIF
Fish	*Ameiurus natalis*	Bullhead, yellow			VDGIF
Fish	*Ameiurus nebulosus*	Bullhead, brown			VDGIF
Fish	*Amia calva*	Bowfin			VDGIF
Fish	*Anguilla rostrata*	Eel, american			VDGIF
Fish	*Aphredoderus sayanus sayanus*	Perch, pirate			VDGIF
Fish	*Brevoortia tyrannus*	Menhaden, atlantic			VDGIF
Fish	*Catostomus commersoni*	Sucker, white			VDGIF
Fish	*Centrarchus macropterus*	Flier			VDGIF
Fish	*Clinostomus funduloides*	Dace, rosyside			VDGIF
Fish	*Cyprinella analostamas*	Shiner, satinfin			VDGIF
Fish	*Cyprinus carpio*	Carp, common			VDGIF
Fish	*Dorosoma cepedianum*	Shad, gizzard			VDGIF
Fish	*Enneacanthus gloriosus*	Sunfish, bluespotted			VDGIF
Fish	*Enneacanthus obesus*	Sunfish, banded			VDGIF
Fish	*Erimyzon oblongus*	Chubsucker, creek			VDGIF
Fish	*Esox americanus americanus*	Pickerel, redfin			VDGIF
Fish	*Esox niger*	Pickerel, chain			VDGIF
Fish	*Etheostoma fusiforme*	Darter, swamp			VDGIF
Fish	*Etheostoma olmstedi*	Darter, tessellated			VDGIF
Fish	*Etheostoma vitreum*	Darter, glassy			VDGIF
Fish	*Exoglossum maxillingua*	Minnow, cutlips			VDGIF
Fish	*Fundulus diaphanus*	Killifish, banded			VDGIF
Fish	*Gambusia holbrooki*	Mosquitofish, eastern			VDGIF

Tax Group	Scientific name	Common name	Grank	Federal status	Data source
Fish	*Hybognathus regius*	Minnow, eastern silvery			VDGIF
Fish	*Hypentelium nigricans*	Sucker, northern hog			VDGIF
Fish	*Ictalurus punctatus*	Catfish, channel			VDGIF
Fish	*Lampetra aepyptera*	Lamprey, least brook			VDGIF
Fish	*Lampetra appendix*	Lamprey, american brook			VDGIF
Fish	*Lepisosteus osseus*	Gar, longnose			VDGIF
Fish	*Lepomis auritus*	Sunfish, redbreast			VDGIF
Fish	*Lepomis cyanellus*	Sunfish, green			VDGIF
Fish	*Lepomis gibbosus*	Pumpkinseed			VDGIF
Fish	*Lepomis gulosus*	Warmouth			VDGIF
Fish	*Lepomis macrochirus*	Bluegill			VDGIF
Fish	*Lepomis microlophus*	Sunfish, redear			VDGIF
Fish	*Luxilus cornutus*	Shiner, common			VDGIF
Fish	*Micropogonias undulatus*	Croaker, atlantic			VDGIF
Fish	*Micropterus dolomieu*	Bass, smallmouth			VDGIF
Fish	*Micropterus salmoides*	Bass, largemouth			VDGIF
Fish	*Morone americana*	Perch, white			VDGIF
Fish	*Morone saxatilis*	Bass, striped			VDGIF
Fish	*Moxostoma macrolepidotum*	Redhorse, shorthead			VDGIF
Fish	*Nocomis leptocephalus*	Chub, bluehead			VDGIF
Fish	*Nocomis micropogon*	Chub, river			VDGIF
Fish	*Notemigonus crysoleucas*	Shiner, golden			VDGIF
Fish	*Notropis amoenus*	Shiner, comely			VDGIF
Fish	*Notropis bifrenatus*	Shiner, bridle			VDGIF
Fish	*Notropis hudsonius*	Shiner, spottail			VDGIF
Fish	*Notropis procne*	Shiner, swallowtail			VDGIF
Fish	*Noturus gyrinus*	Madtom, tadpole			VDGIF
Fish	*Noturus insignis*	Madtom, margined			VDGIF
Fish	*Perca flavescens*	Perch, yellow			VDGIF
Fish	*Percina notogramma*	Darter, stripeback			VDGIF
Fish	*Percina peltata*	Darter, shield			VDGIF
Fish	*Petromyzon marinus*	Lamprey, sea			VDGIF
Fish	*Phoxinus oreas*	Dace, mountain redbelly			VDGIF
Fish	*Pimephales notatus*	Minnow, bluntnose			VDGIF
Fish	*Pimephales promelas*	Minnow, fathead			VDGIF
Fish	*Pomoxis nigromaculatus*	Crappie, black			VDGIF
Fish	*Rhinichthys atratulus*	Dace, blacknose			VDGIF
Fish	*Semotilus atromaculatus*	Chub, creek			VDGIF
Fish	*Semotilus corporalis*	Fallfish			VDGIF
Fish	*Trinectes maculatus*	Hogchoker			VDGIF
Fish	*Umbra pygmaea*	Mudminnow, eastern			VDGIF
Insects	*Anax longipes*	Comet darner	G5		VAHP
Insects	*Callophrys irus*	Frosted elfin	G3		VAHP
Insects	*Enallagma dubium*	Burgundy bluet	G5		VAHP
Insects	*Nannothemis bella*	Elfin skimmer	G4		VAHP
Insects	*Nehalennia integricollis*	Southern sprite	G5		VAHP

Tax Group	Scientific name	Common name	Grank	Federal status	Data source
Insects	*Sigara depressa*	Virginia piedmont water boatman	G1G3		VAHP
Insects	*Somatochlora filosa*	Fine-lined emerald	G5		VAHP
Insects	*Stenogomphurus rogersi*	Sable clubtail	G4		VAHP

2. Pamunkey Drainage

Tax Group	Scientific name	Common name	Grank	Federal status	Data source
Crayfish	*Cambarus bartonii bartonii*	Crayfish			VDGIF
Crayfish	*Stygobromus araeus*	Tidewater interstitial amphipod	G2G3		VAHP
Mussel	*Alasmidonta heterodon*	Mussel, dwarf wedge		LE	VDGIF
Mussel	*Alasmidonta heterodon*	Dwarf wedgemussel	G1G2	LE	VAHP
Mussel	*Elliptio complanata*	Mussel, eastern elliptio			VDGIF
Mussel	*Elliptio lanceolata*	Mussel, yellow lance			VDGIF
Mussel	*Elliptio lanceolata*	Yellow lance	G2G3		VAHP
Mussel	*Lampsilis cariosa*	Yellow lampmussel	G3G4		VAHP
Mussel	*Lampsilis radiata*	Eastern lampmussel	G5		VAHP
Mussel	*Lasmigona subviridis*	Green floater	G3		VAHP
Fish	*Acantharchus pomotis*	Sunfish, mud			VDGIF
Fish	*Acipenser oxyrhynchus*	Sturgeon, atlantic			VDGIF
Fish	*Alosa aestivalis*	Herring, blueback			VDGIF
Fish	*Alosa mediocris*	Shad, hickory			VDGIF
Fish	*Alosa pseudoharengus*	Alewife			VDGIF
Fish	*Alosa sapidissima*	Shad, american			VDGIF
Fish	*Ameiurus catus*	Catfish, white			VDGIF
Fish	*Ameiurus natalis*	Bullhead, yellow			VDGIF
Fish	*Ameiurus nebulosus*	Bullhead, brown			VDGIF
Fish	*Amia calva*	Bowfin			VDGIF
Fish	*Anguilla rostrata*	Eel, american			VDGIF
Fish	*Aphredoderus sayanus sayanus*	Perch, pirate			VDGIF
Fish	*Brevoortia tyrannus*	Menhaden, atlantic			VDGIF
Fish	*Carpiodes cyprinus*	Quillback			VDGIF
Fish	*Catostomus commersoni*	Sucker, white			VDGIF
Fish	*Centrarchus macropterus*	Flier			VDGIF
Fish	*Clinostomus funduloides*	Dace, rosyside			VDGIF
Fish	*Cyprinella analostamas*	Shiner, satinfin			VDGIF
Fish	*Cyprinus carpio*	Carp, common			VDGIF
Fish	*Dorosoma cepedianum*	Shad, gizzard			VDGIF
Fish	*Dorosoma petenense*	Shad, threadfin			VDGIF
Fish	*Enneacanthus gloriosus*	Sunfish, bluespotted			VDGIF
Fish	*Enneacanthus obesus*	Sunfish, banded			VDGIF
Fish	*Erimyzon oblongus*	Chubsucker, creek			VDGIF
Fish	*Esox americanus americanus*	Pickerel, redfin			VDGIF
Fish	*Esox lucius*	Pike, northern			VDGIF
Fish	*Esox niger*	Pickerel, chain			VDGIF
Fish	*Etheostoma olmstedi*	Darter, tessellated			VDGIF

Tax Group	Scientific name	Common name	Grank	Federal status	Data source
Fish	*Etheostoma vitreum*	Darter, glassy			VDGIF
Fish	*Exoglossum maxillingua*	Minnow, cutlips			VDGIF
Fish	*Fundulus diaphanus*	Killifish, banded			VDGIF
Fish	*Fundulus heteroclitus*	Mummichog			VDGIF
Fish	*Gambusia holbrooki*	Mosquitofish, eastern			VDGIF
Fish	*Hybognathus regius*	Minnow, eastern silvery			VDGIF
Fish	*Hypentelium nigricans*	Sucker, northern hog			VDGIF
Fish	*Ictalurus furcatus*	Catfish, blue			VDGIF
Fish	*Ictalurus punctatus*	Catfish, channel			VDGIF
Fish	*Lampetra aepyptera*	Lamprey, least brook			VDGIF
Fish	*Lampetra appendix*	Lamprey, american brook			VDGIF
Fish	*Lepisosteus osseus*	Gar, longnose			VDGIF
Fish	*Lepomis auritus*	Sunfish, redbreast			VDGIF
Fish	*Lepomis gibbosus*	Pumpkinseed			VDGIF
Fish	*Lepomis gulosus*	Warmouth			VDGIF
Fish	*Lepomis macrochirus*	Bluegill			VDGIF
Fish	*Lepomis megalotis*	Sunfish, longear			VDGIF
Fish	*Lepomis microlophus*	Sunfish, redear			VDGIF
Fish	*Luxilus cornutus*	Shiner, common			VDGIF
Fish	*Lythrurus ardens*	Shiner, rosefin			VDGIF
Fish	*Menidia beryllina*	Silverside, inland			VDGIF
Fish	*Micropterus dolomieu*	Bass, smallmouth			VDGIF
Fish	*Micropterus punctulatus*	Bass, spotted			VDGIF
Fish	*Micropterus salmoides*	Bass, largemouth			VDGIF
Fish	*Morone americana*	Perch, white			VDGIF
Fish	*Morone saxatilis*	Bass, striped			VDGIF
Fish	*Moxostoma macrolepidotum*	Redhorse, shorthead			VDGIF
Fish	*Nocomis leptocephalus*	Chub, bluehead			VDGIF
Fish	*Nocomis micropogon*	Chub, river			VDGIF
Fish	*Notemigonus crysoleucas*	Shiner, golden			VDGIF
Fish	*Notropis amoenus*	Shiner, comely			VDGIF
Fish	*Notropis bifrenatus*	Shiner, bridle			VDGIF
Fish	*Notropis hudsonius*	Shiner, spottail			VDGIF
Fish	*Notropis procne*	Shiner, swallowtail			VDGIF
Fish	*Notropis rubellus*	Shiner, rosyface			VDGIF
Fish	*Noturus gyrinus*	Madtom, tadpole			VDGIF
Fish	*Noturus insignis*	Madtom, margined			VDGIF
Fish	*Perca flavescens*	Perch, yellow			VDGIF
Fish	*Percina notogramma*	Darter, stripeback			VDGIF
Fish	*Percina peltata*	Darter, shield			VDGIF
Fish	*Petromyzon marinus*	Lamprey, sea			VDGIF
Fish	*Phoxinus oreas*	Dace, mountain redbelly			VDGIF
Fish	*Pimephales notatus*	Minnow, bluntnose			VDGIF
Fish	*Pomoxis annularis*	Crappie, white			VDGIF
Fish	*Pomoxis nigromaculatus*	Crappie, black			VDGIF
Fish	*Rhinichthys atratulus*	Dace, blacknose			VDGIF
Fish	*Semotilus atromaculatus*	Chub, creek			VDGIF

Tax Group	Scientific name	Common name	Grank	Federal status	Data source
Fish	*Semotilus corporalis*	Fallfish			VDGIF
Fish	*Stizostedion vitreum vitreum*	Walleye			VDGIF
Fish	*Trinectes maculatus*	Hogchoker			VDGIF
Fish	*Umbra pygmaea*	Mudminnow, eastern			VDGIF
Insects	*Boloria selene*	Silver-bordered fritillary	G5		VAHP
Insects	*Helocordulia selysii*	Selys' sundragon	G4		VAHP
Insects	*Sigara depressa*	Virginia piedmont water boatman	G1G3		VAHP
Insects	*Stylurus laurae*	Laura's clubtail	G4		VAHP

3. York Drainage

Tax Group	Scientific name	Common name	Grank	Federal status	Data source
Crayfish	*Stygobromus araeus*	Tidewater interstitial amphipod	G2G3		VAHP
Fish	*Alosa aestivalis*	Herring, blueback			VDGIF
Fish	*Alosa pseudoharengus*	Alewife			VDGIF
Fish	*Alosa sapidissima*	Shad, american			VDGIF
Fish	*Ameiurus catus*	Catfish, white			VDGIF
Fish	*Ameiurus natalis*	Bullhead, yellow			VDGIF
Fish	*Ameiurus nebulosus*	Bullhead, brown			VDGIF
Fish	*Amia calva*	Bowfin			VDGIF
Fish	*Anchoa mitchilli*	Anchovy, bay			VDGIF
Fish	*Anguilla rostrata*	Eel, american			VDGIF
Fish	*Aphredoderus sayanus sayanus*	Perch, pirate			VDGIF
Fish	*Bairdiella chrysoura*	Perch, silver			VDGIF
Fish	*Cyprinus carpio*	Carp, common			VDGIF
Fish	*Dorosoma cepedianum*	Shad, gizzard			VDGIF
Fish	*Enneacanthus gloriosus*	Sunfish, bluespotted			VDGIF
Fish	*Erimyzon oblongus*	Chubsucker, creek			VDGIF
Fish	*Esox americanus americanus*	Pickerel, redfin			VDGIF
Fish	*Etheostoma olmstedi*	Darter, tessellated			VDGIF
Fish	*Fundulus diaphanus*	Killifish, banded			VDGIF
Fish	*Fundulus heteroclitus*	Mummichog			VDGIF
Fish	*Fundulus majalis*	Killifish, striped			VDGIF
Fish	*Gambusia holbrooki*	Mosquitofish, eastern			VDGIF
Fish	*Ictalurus punctatus*	Catfish, channel			VDGIF
Fish	*Lampetra aepyptera*	Lamprey, least brook			VDGIF
Fish	*Leiostomus xanthurus*	Spot			VDGIF
Fish	*Lepisosteus osseus*	Gar, longnose			VDGIF
Fish	*Lepomis gibbosus*	Pumpkinseed			VDGIF
Fish	*Lepomis gulosus*	Warmouth			VDGIF
Fish	*Lepomis macrochirus*	Bluegill			VDGIF
Fish	*Lepomis microlophus*	Sunfish, redear			VDGIF
Fish	*Menidia beryllina*	Silverside, inland			VDGIF
Fish	*Micropogonias undulatus*	Croaker, atlantic			VDGIF
Fish	*Micropterus salmoides*	Bass, largemouth			VDGIF

Tax Group	Scientific name	Common name	Grank	Federal status	Data source
Fish	*Morone americana*	Perch, white			VDGIF
Fish	*Morone saxatilis*	Bass, striped			VDGIF
Fish	*Notemigonus crysoleucas*	Shiner, golden			VDGIF
Fish	*Notropis hudsonius*	Shiner, spottail			VDGIF
Fish	*Noturus gyrinus*	Madtom, tadpole			VDGIF
Fish	*Perca flavescens*	Perch, yellow			VDGIF
Fish	*Petromyzon marinus*	Lamprey, sea			VDGIF
Fish	*Pomoxis nigromaculatus*	Crappie, black			VDGIF
Fish	*Trinectes maculatus*	Hogchoker			VDGIF
Fish	*Umbra pygmaea*	Mudminnow, eastern			VDGIF

4. Great Wicomico-Piankatank Drainage

Tax Group	Scientific name	Common name	Grank	Federal status	Data source
Crayfish	*Stygobromus araeus*	Tidewater interstitial amphipod	G2G3		VAHP
Crayfish	*Stygobromus indentatus*	Tidewater amphipod	G2G3		VAHP
Mussel	*Elliptio complanata*	Mussel, eastern elliptio			VDGIF
Fish	*Alosa aestivalis*	Herring, blueback			VDGIF
Fish	*Alosa pseudoharengus*	Alewife			VDGIF
Fish	*Alosa sapidissima*	Shad, american			VDGIF
Fish	*Ameiurus catus*	Catfish, white			VDGIF
Fish	*Ameiurus natalis*	Bullhead, yellow			VDGIF
Fish	*Ameiurus nebulosus*	Bullhead, brown			VDGIF
Fish	*Anguilla rostrata*	Eel, american			VDGIF
Fish	*Aphredoderus sayanus sayanus*	Perch, pirate			VDGIF
Fish	*Cynoscion regalis*	Weakfish			VDGIF
Fish	*Cyprinella analostamas*	Shiner, satinfin			VDGIF
Fish	*Cyprinus carpio*	Carp, common			VDGIF
Fish	*Dorosoma cepedianum*	Shad, gizzard			VDGIF
Fish	*Enneacanthus gloriosus*	Sunfish, bluespotted			VDGIF
Fish	*Enneacanthus obesus*	Sunfish, banded			VDGIF
Fish	*Erimyzon oblongus*	Chubsucker, creek			VDGIF
Fish	*Esox americanus americanus*	Pickerel, redfin			VDGIF
Fish	*Esox niger*	Pickerel, chain			VDGIF
Fish	*Etheostoma fusiforme*	Darter, swamp			VDGIF
Fish	*Etheostoma olmstedi*	Darter, tessellated			VDGIF
Fish	*Fundulus diaphanus*	Killifish, banded			VDGIF
Fish	*Fundulus heteroclitus*	Mummichog			VDGIF
Fish	*Fundulus luciae*	Killifish, spotfin			VDGIF
Fish	*Fundulus majalis*	Killifish, striped			VDGIF
Fish	*Gambusia holbrooki*	Mosquitofish, eastern			VDGIF
Fish	*Hybognathus regius*	Minnow, eastern silvery			VDGIF
Fish	*Ictalurus punctatus*	Catfish, channel			VDGIF
Fish	*Lampetra aepyptera*	Lamprey, least brook			VDGIF

Tax Group	Scientific name	Common name	Grank	Federal status	Data source
Fish	*Leiostomus xanthurus*	Spot			VDGIF
Fish	*Lepomis auritus*	Sunfish, redbreast			VDGIF
Fish	*Lepomis gibbosus*	Pumpkinseed			VDGIF
Fish	*Lepomis gulosus*	Warmouth			VDGIF
Fish	*Lepomis macrochirus*	Bluegill			VDGIF
Fish	*Lepomis microlophus*	Sunfish, redear			VDGIF
Fish	*Menidia menidia*	Silverside, atlantic			VDGIF
Fish	*Micropogonias undulatus*	Croaker, atlantic			VDGIF
Fish	*Micropterus salmoides*	Bass, largemouth			VDGIF
Fish	*Morone americana*	Perch, white			VDGIF
Fish	*Morone saxatilis*	Bass, striped			VDGIF
Fish	*Notemigonus crysoleucas*	Shiner, golden			VDGIF
Fish	*Notropis amoenus*	Shiner, comely			VDGIF
Fish	*Notropis chalybaeus*	Shiner, ironcolor			VDGIF
Fish	*Notropis hudsonius*	Shiner, spottail			VDGIF
Fish	*Notropis procne*	Shiner, swallowtail			VDGIF
Fish	*Noturus gyrinus*	Madtom, tadpole			VDGIF
Fish	*Noturus insignis*	Madtom, margined			VDGIF
Fish	*Perca flavescens*	Perch, yellow			VDGIF
Fish	*Percina notogramma*	Darter, stripeback			VDGIF
Fish	*Percina peltata*	Darter, shield			VDGIF
Fish	*Petromyzon marinus*	Lamprey, sea			VDGIF
Fish	*Rhinichthys atratulus*	Dace, blacknose			VDGIF
Fish	*Semotilus atromaculatus*	Chub, creek			VDGIF
Fish	*Semotilus corporalis*	Fallfish			VDGIF
Fish	*Umbra pygmaea*	Mudminnow, eastern			VDGIF
Insects	*Atlides halesus*	Great purple hairstreak	G5		VAHP
Insects	*Cicindela dorsalis dorsalis*	Northeastern beach tiger beetle	G4T2	LT	VAHP
Insects	*Epitheca spinosa*	Robust baskettail	G4		VAHP
Insects	*Helocordulia selysii*	Selys' sundragon	G4		VAHP
Insects	*Isoparce cupressi*	Cypress sphynx	G4		VAHP

4. Lower Rappahannock Drainage

Tax Group	Scientific name	Common name	Grank	Federal status	Data source
Crayfish	*Stygobromus indentatus*	Tidewater amphipod	G2G3		VAHP
Mussel	*Alasmidonta heterodon*	Mussel, dwarf wedge		LE	VDGIF
Mussel	*Alasmidonta heterodon*	Dwarf wedgemussel	G1G2	LE	VAHP
Mussel	*Alasmidonta undulata*	Mussel, triangle floater			VDGIF
Mussel	*Corbicula fluminea*	Clam, asian			VDGIF
Mussel	*Elliptio complanata*	Mussel, eastern elliptio			VDGIF
Mussel	*Elliptio fisheriana*	Mussel, northern lance			VDGIF
Mussel	*Elliptio lanceolata*	Yellow lance	G2G3		VAHP
Fish	*Acantharchus pomotis*	Sunfish, mud			VDGIF
Fish	*Alosa aestivalis*	Herring, blueback			VDGIF
Fish	*Alosa mediocris*	Shad, hickory			VDGIF

Tax Group	Scientific name	Common name	Grank	Federal status	Data source
Fish	*Alosa pseudoharengus*	Alewife			VDGIF
Fish	*Alosa sapidissima*	Shad, american			VDGIF
Fish	*Ambloplites rupestris*	Bass, rock			VDGIF
Fish	*Ameiurus catus*	Catfish, white			VDGIF
Fish	*Ameiurus natalis*	Bullhead, yellow			VDGIF
Fish	*Ameiurus nebulosus*	Bullhead, brown			VDGIF
Fish	*Amia calva*	Bowfin			VDGIF
Fish	*Anchoa mitchilli*	Anchovy, bay			VDGIF
Fish	*Anguilla rostrata*	Eel, american			VDGIF
Fish	*Aphredoderus sayanus sayanus*	Perch, pirate			VDGIF
Fish	*Brevoortia tyrannus*	Menhaden, atlantic			VDGIF
Fish	*Catostomus commersoni*	Sucker, white			VDGIF
Fish	*Centrarchus macropterus*	Flier			VDGIF
Fish	*Clinostomus funduloides*	Dace, rosyside			VDGIF
Fish	*Cynoscion regalis*	Weakfish			VDGIF
Fish	*Cyprinella analostamas*	Shiner, satinfin			VDGIF
Fish	*Cyprinus carpio*	Carp, common			VDGIF
Fish	*Dorosoma cepedianum*	Shad, gizzard			VDGIF
Fish	*Enneacanthus gloriosus*	Sunfish, bluespotted			VDGIF
Fish	*Erimyzon oblongus*	Chubsucker, creek			VDGIF
Fish	*Esox americanus americanus*	Pickerel, redfin			VDGIF
Fish	*Esox niger*	Pickerel, chain			VDGIF
Fish	*Etheostoma olmstedi*	Darter, tessellated			VDGIF
Fish	*Etheostoma vitreum*	Darter, glassy			VDGIF
Fish	*Etrumeus teres*	Herring, round			VDGIF
Fish	*Exoglossum maxillingua*	Minnow, cutlips			VDGIF
Fish	*Fundulus diaphanus*	Killifish, banded			VDGIF
Fish	*Fundulus heteroclitus*	Mummichog			VDGIF
Fish	*Fundulus majalis*	Killifish, striped			VDGIF
Fish	*Gambusia holbrooki*	Mosquitofish, eastern			VDGIF
Fish	*Hybognathus regius*	Minnow, eastern silvery			VDGIF
Fish	*Hypentelium nigricans*	Sucker, northern hog			VDGIF
Fish	*Ictalurus furcatus*	Catfish, blue			VDGIF
Fish	*Ictalurus punctatus*	Catfish, channel			VDGIF
Fish	*Lampetra aepyptera*	Lamprey, least brook			VDGIF
Fish	*Lampetra appendix*	Lamprey, american brook			VDGIF
Fish	*Leiostomus xanthurus*	Spot			VDGIF
Fish	*Lepisosteus osseus*	Gar, longnose			VDGIF
Fish	*Lepomis auritus*	Sunfish, redbreast			VDGIF
Fish	*Lepomis cyanellus*	Sunfish, green			VDGIF
Fish	*Lepomis gibbosus*	Pumpkinseed			VDGIF
Fish	*Lepomis gulosus*	Warmouth			VDGIF
Fish	*Lepomis macrochirus*	Bluegill			VDGIF
Fish	*Lepomis microlophus*	Sunfish, redear			VDGIF
Fish	*Lucania parva*	Killifish, rainwater			VDGIF
Fish	*Luxilus cornutus*	Shiner, common			VDGIF
Fish	*Lythrurus ardens*	Shiner, rosefin			VDGIF

Tax Group	Scientific name	Common name	Grank	Federal status	Data source
Fish	*Menidia beryllina*	Silverside, inland			VDGIF
Fish	*Menidia menidia*	Silverside, atlantic			VDGIF
Fish	*Micropogonias undulatus*	Croaker, atlantic			VDGIF
Fish	*Micropterus dolomieu*	Bass, smallmouth			VDGIF
Fish	*Micropterus salmoides*	Bass, largemouth			VDGIF
Fish	*Morone americana*	Perch, white			VDGIF
Fish	*Morone saxatilis*	Bass, striped			VDGIF
Fish	*Moxostoma macrolepidotum*	Redhorse, shorthead			VDGIF
Fish	*Nocomis leptocephalus*	Chub, bluehead			VDGIF
Fish	*Nocomis micropogon*	Chub, river			VDGIF
Fish	*Notemigonus crysoleucas*	Shiner, golden			VDGIF
Fish	*Notropis amoenus*	Shiner, comely			VDGIF
Fish	*Notropis bifrenatus*	Shiner, bridle			VDGIF
Fish	*Notropis chalybaeus*	Shiner, ironcolor			VDGIF
Fish	*Notropis hudsonius*	Shiner, spottail			VDGIF
Fish	*Notropis procne*	Shiner, swallowtail			VDGIF
Fish	*Notropis rubellus*	Shiner, rosyface			VDGIF
Fish	*Noturus gyrinus*	Madtom, tadpole			VDGIF
Fish	*Noturus insignis*	Madtom, margined			VDGIF
Fish	*Perca flavescens*	Perch, yellow			VDGIF
Fish	*Percina notogramma*	Darter, stripeback			VDGIF
Fish	*Percina peltata*	Darter, shield			VDGIF
Fish	*Petromyzon marinus*	Lamprey, sea			VDGIF
Fish	*Phoxinus oreas*	Dace, mountain redbelly			VDGIF
Fish	*Pimephales notatus*	Minnow, bluntnose			VDGIF
Fish	*Pomoxis annularis*	Crappie, white			VDGIF
Fish	*Pomoxis nigromaculatus*	Crappie, black			VDGIF
Fish	*Rhinichthys atratulus*	Dace, blacknose			VDGIF
Fish	*Semotilus atromaculatus*	Chub, creek			VDGIF
Fish	*Semotilus corporalis*	Fallfish			VDGIF
Fish	*Trinectes maculatus*	Hogchoker			VDGIF
Fish	*Umbra pygmaea*	Mudminnow, eastern			VDGIF
Insects	*Cicindela dorsalis dorsalis*	Northeastern beach tiger beetle	G4T2	LT	VAHP
Insects	*Enallagma dubium*	Burgundy bluet	G5		VAHP
Insects	*Libellula exusta*	White corporal skimmer	G4		VAHP
Insects	*Lordithon niger*	Black lordithon rove beetle	G1		VAHP
Insects	*Nehalennia gracilis*	Sphagnum sprite	G5		VAHP
Insects	*Somatochlora provocans*	Treetop emerald	G4		VAHP
Insects	*Stenogomphurus rogersi*	Sable clubtail	G4		VAHP

APPENDIX E. AQUATICS EXPERT MEETING INFORMATION

PLEASE NOTE:

The following information was compiled from an aquatic experts meeting held at the TNC-VA office on October 18th, 2000. The objective of the meeting was to determine which aquatic conservation targets should be selected for the Chesapeake Rivesr site conservation plan. Several professors from Virginia universities, DGIF biologists and staff from the Freshwater Initiative attended. Both individual species and aquatic systems were discussed as potential conservation targets. In addition, the Freshwater Initiative performed a classification of the aquatic systems and macrohabitats of the Rappahannock and York Drainages.

Information on this meeting is divided into 2 sections:

I. Synopsis of Chesapeake Rivers aquatic target selection meeting

II. Freshwater aquatic systems classification (methods and results)

Appendix E. I. Synopsis of Chesapeake Rivers aquatic target selection meeting

The Nature Conservancy-Virginia Chapter, Charlottesville, Virginia
October 18, 2000.

In attendance: Paul Angermeier (VT), Braven Beaty (TNC-Clinch), Gwynn Crichton (TNC-VAFO), Brian van Eerden (TNC-Chesapeake), Dean Fowler (VDGIF), Greg Garman (VCU), Chas Gowan (Randolph-Macon), Steve McIninch (VCU), Monte McGregor (VDGIF), Jen Perot (TNC-FWI), Brian Richter (TNC-FWI), Steve Roble (VDCR-Heritage), and Andy Warner (TNC-FWI)

Overall summary

The group considered potential conservation targets at the species, community and systems level for the Pamunkey, Mattaponi and Rappahannock drainages. The general conclusions were that besides anadromous fishes, no individual species or species assemblages of aquatic biota should be designated as conservation targets. The data and expertise of the participants show that there are no truly endemic or unique species to the Chesapeake rivers, though there are a couple of federally listed species (Atlantic sturgeon and dwarf wedge mussel—addressed below).

Jen Perot presented the 13 abiotic aquatic systems developed through the Freshwater Initiative's classification method using GIS. While the group is very much in favor of this methodology, they were not confident that the systems represented truly different biological communities. It was suggested that the systems be tested using available and historical biological data of species occurrences to determine if they in fact represent distinct, legitimate ecological communities. Moreover, it was pointed out that the model used to classify the systems should be modified for the coastal plain to reflect the fact that pH and stream permanence are more indicative of species distribution than stream size. Overall, it was the general opinion of everyone that the coastal plain and the Piedmont are both homogeneous compositionally and could easily be considered as 2 systems. Given this, and TNC's limited ability to test the systems or revise the model at this point, recognizing these 2 systems is most realistic and practical approach for us to take.

TNC's primary goal at this site is to conserve the best remaining functional freshwater systems of the coastal plain in the Chesapeake drainage. Having stated this, the two clear conservation targets that emerged were anadromous fishes (including the Atlantic sturgeon) and the coastal plain aquatic system. While protection of the anadromous fish will of course warrant the inclusion of the mainstem rivers into the Piedmont as part of the Chesapeake Rivers site, there is no clear rationale for including Piedmont headwater streams and watersheds as conservation targets. Moreover, it was pointed out that there is little to no connection between the processes governing viability of the upper portions of the Chesapeake rivers' watersheds in the Piedmont and the lower watersheds in the coastal plain except for the mainstems themselves. Rather than designating the aquatic systems in the Piedmont as targets, TNC will work in these areas as necessary to abate threats and improve the viability of focal conservation targets in the coastal plain.

Though we have "rolled-up" these aquatic targets, they have yet to be integrated with the other vegetation communities/terrestrial systems. The other potential targets are as follows:

- Tidal freshwater system
- Non-tidal freshwater system (includes palustrine wetlands)
- Submerged aquatic vegetation
- Estuarine systems (salt marshes and sandy beaches)
- Non-tidal bottomland hardwood forest
- Upland forest (mesic mixed hardwoods and oak/pine/ericad forests)
- Calcareous ravines

It is questionable whether "coastal plain aquatic system" will stand as its own target or be integrated into the tidal freshwater and non-tidal system targets (split to reference the very distinctive vegetative communities found in each system). This should be determined based on whether or not there are significant differences in the environmental

and ecological processes governing the health and persistence of the aquatic fauna versus the vegetation communities. I welcome your suggestions on this issue.

Finally, I have listed the invasive species that we discussed considering as "negative" targets for threat abatement. Once we have a final list of our conservation targets, the next step will be to do a qualitative baseline assessment of the targets' viability followed by a detailed threat evaluation. As part of this process, it will be critical to examine what makes these invasive species such successful competitors and identify exactly how they threaten the persistence of native aquatic species.

I. Potential Aquatic Conservation Targets of the Chesapeake Rivers

A. Coastal Plain Aquatic System
Definition:

- Includes full tidal gradient in the Chesapeake Bay Lowlands ecoregion from the estuary to the fall line.
- Includes the 4 freshwaters systems identified by through the FWI classification (i.e., blackwaters, mainstems (Rappahannock and Mattaponi/Pamunkey,respectively), and river tributaries/headwaters
- Includes all native, representative aquatic fauna
- Does not include species considered to be invasive (e.g. blue catfish, grass carp)
- Includes all environmental and ecological processes that maintain aquatic biota

Justification:
This aquatic system will capture the characteristic *native* aquatic biodiversity of the coastal plain portion of the Chesapeake drainage (see attached list of species). While there are likely more distinctive systems within this broad system, we cannot verify with certainty their legitimacy at this time. For example, past data analysis of fish communities by Dr. Steve McIninch has indicated that that no tidal fish assemblage can be distinguished from other coastal plain fish communities. Overall, the aquatic biological diversity is lower relative to the James and the Potomac and is homogeneous throughout the area rivers and tributaries. The value of these biota is that collectively they are representative of the coastal plain and that they occur in high quality, in tact environments with functional ecological processes relative to other coastal plain rivers and tributaries of the Chesapeake Bay.

The group suggested a few aquatic species/assemblages/communities that are or potentially may be significant components of the "coastal plain aquatic system". They are as follows:

1. **Coastal plain mussel assemblage**. This characteristic assemblage of the coastal plain includes the *Lampsilis cariosa* complex (yellow lamp mussel), *Lampsilis radiata* (eastern lamp mussel), *Leptodea ochracea* (tidewater mucket), and *Ligumia nasuta* (eastern pond mussel). *Lampsilis cariosa* is a major taxonomic question and may represent multiple species in the coastal plain. It also is in need of state protection. Overall, however, aquatic systems and fish assemblages are considered to be adequate surrogates for this mussel assemblage.
2. **SAV dependent species assemblages (including blackwater minnows).** Assemblages of species dependent on SAV have a more localized and patchy distribution throughout the coastal plain rivers. Since the quality and abundance of SAV is highly threatened due to nutrient loading and sedimentation, so too is the habitat and food source for many aquatic species. Visual feeders like the red fin pickerel, the banded sunfish, the long-nose gar, the iron-colored shiner and the bridle shiner are all dependent on SAV, while other species such as the eastern silvery minnow, the swallowtail shiner and spot tail shiner are considered SAV associates rather than dependents as their distribution is more common and widespread. Two minnows, the iron-colored shiner and the bridle shiner, also have a close association with blackwater conditions (i.e. highly acidic). However, there is very little data available on the distribution of pH in these rivers to determine the how acidic conditions vary with SAV and minnow assemblages.
3. **Alkaline associated species/communities.** While, it has been proposed that there may be unique species assemblages in alkaline waters, there is no data to support this currently, partly due to inventory and the lack of good pH information for the river systems. Often alkaline waters are more productive and have a higher diversity of species.
4. **Low oxygen adapted fish species assemblage**. These species can persist in naturally occurring low oxygen zones in small intermittent streams and pools in the headwaters of the coastal plain rivers. They include mud

minnows, bowfin, American eel, pirate perch, flyer, long nosed gar, chain pickerel and warmouth. While none of these species individually is rare, their collective occurrence under low oxygen conditions is noteworthy. However, targeting this type of assemblage would be very difficult in that nutrient loading from agriculture creates many low oxygen areas.

5. **Lampreys**. These uncommon and potentially declining species (i.e. least brook lamprey and American brook lamprey) are of interest as they are sensitive indicators of water quality, requiring clear, clean sand-gravel substrate in small low to medium gradient brooks and small streams. Lampreys on the whole have been under-sampled and more information is needed on their distribution throughout the Chesapeake River systems. However, they are most likely captured within the coastal plain aquatic system target.

B. Anadromous Fish

Definition:

Includes the *Alosa aestivalis* (blueback herring), *Alosa pseudoharengus* (alewife), *Alosa mediocris* (hickory shad), and *Alosa sapidissima* (American shad)

Justification:

The Pamunkey, Mattaponi and Rappahannock represent one of the few remaining areas on the Atlantic slope providing long, largely unaltered natural passages for this assemblage of anadromous fish. In addition, this may the only place where one can find all 5 of these species together. Moreover, Atlantic sturgeon, a federally and state listed species of concern, is extremely rare in the York and Rappahannock drainages due to overfishing damming, and pollution. Overall, anadromous fish may be the best indicators of a functional natural flow regime and the connectivity of the river systems at a regional scale, migrating from the Chesapeake Bay all the way into the upper reaches of the rivers and associated tributaries to spawn in the springtime. Their ability to reproduce is seriously imperiled by hydrologic alteration such as impoundments and channelization. Currently, the major dam impeding the upstream migration of the fish is Embrey Dam on the Rappahannock in Fredricksburg. However, this dam is scheduled to be removed in 2002. The anadromous fish also play an important ecological role as host fish for mussels, and therefore are targeted as surrogates for mussel diversity through the rivers systems as well.

II. Other species/assemblages of conservation interest:

***Alasmidonta heterondon* (dwarf wedge mussel)**

This is a globally rare mussel that is federally listed as endangered. In the Chesapeake rivers area, it is found primarily in the Po River system along the fall zone and into the Piedmont, close to the southern end of its distribution. This is an ecoregional target for the Chesapeake Bay Lowlands ecoregion due to the coastal plain populations found in Maryland, but in Virginia, it is primarily found in the Piedmont and fall zone; therefore, it may not be an appropriate target if our primary focus is the coastal plain. Regardless of this issue, we need to think carefully about designating an individual species as a conservation target. What special processes or habitat does this mussel species require to be viable that would not be accounted for by a system level target or by the anadromous fish target?

Cambarus diogenes

This crayfish may need special attention, as it requires different habitat than most coastal plain mussels and crayfish, burrowing in floodplains and palustrine wetlands. However, palustrine wetlands will most likely be a terrestrial conservation target that will in turn account for populations of *C. diogenes***.**

Leptoxis carinata

This snail is found in non-fish areas in riffles and on boulders and is useful as an indicator of water pollution.

Swampfish

This is an uncommon to rare species that lives in lowland blackwater swampy creeks, rivers, ponds, etc., and is associated almost exclusively with low oxygen waters. It is mostly found in the Chowan Basin but may occur in the Chesapeake Rivers as well.

American eel
This catadromous species has a widespread distribution (Greenland to Brail to the Great Lakes!) and very unique life history strategies. It is more common in the coastal plain than in the upper watersheds of the Atlantic drainage where it is rare and localized due to dams. It is appealing as a potential target because of its regional distribution and sensitivity to hydrologic alteration; however, it will most likely be well represented by the anadromous fish conservation target.

III. Other general comments on the aquatic biota of the project area:

- Most crayfish found in the York/Rappahannock drainages are common to the coastal plain. This are represents the southernmost limit for *Orconectes limosus* and the easternmost limit for *Cambarus bartonii*. There are new records from DGIF that need to be added to the collections database.
- Snails are woefully under-inventoried. No comprehensive survey has been conducted. There are about 7 representative species in the Chesapeake Rivers area.
- Virtually no data exists on aquatic insects in the coastal plain drainages. No formal inventory has been conducted and there are no resident experts on insects in Virginia. There may be 200-300 genera in this area. Insect diversity is known to be tightly linked to habitats and fish species; therefore, the use of an abiotic or ecological classification of aquatic systems should be considered the best alternative to capturing native aquatic insect diversity. However, local non-fish ponds, emphemeral pools and wetlands were cited as having potentially unique assemblages of aquatic insects and snails that could not otherwise occur with fish predation.

IV. Problem invasive species (or potential "negative" targets):

Fish
- Blue catfish
- Grass carp
- Red shiner
- Flat-head catfish
- Threat-fin shad
- Common carp
- Channel catfish
- Large-mouth bass
- Spotted bass

Mollusks
- Chinese/Japanese mystery snail
- Asian clam

Crayfish
- Orconectes virilis

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Appendix E. II. Freshwater Aquatic Systems Classification (methods and results)

Aquatic Conservation Targets in the Chesapeake Bay Lowlands ecoregion

The Nature Conservancy is developing an aquatic conservation plan for the Chesapeake Bay Lowlands by assessing the ecological patterns within the ecoregion. The ecoregions being used by the Conservancy are modifications of the USDA Forest Service ecoregions, and represent areas of distinct ecological patterns within broad regions of similar climate, geology and landform. Identifying the suite of priority aquatic conservation sites that will represent an ecoregion's aquatic biodiversity requires a comprehensive picture of aquatic ecosystem and biological diversity. However, many ecoregions have limited, or currently unavailable spatially-referenced information about the distribution of aquatic species, and most, generally lack data on natural aquatic assemblages.

We do know that environmental gradients of climate, elevation, and geology shape aquatic ecosystems at several spatial scales, and the influence of physical habitat on the diversity of aquatic species and communities has been well documented. Based on these relationships, we have developed a method to create an approximate comprehensive picture of ***potential*** aquatic community diversity across an ecoregion. We use spatial data to describe units of aquatic ecosystems in terms of the regional driving factors that influence community distribution and composition. We first develop macrohabitats, and then look for patterns in the macrohabitat types and classification attributes to identify ecological systems. This classification approach has already been used to classify streams and lakes in many ecoregions. Once we have determined the potential diversity and distribution of aquatic systems within the ecoregions, we perform a quality assessment to identify the highest quality examples of the different systems. If no high quality systems are remaining, the best area for restoration is identified.

Macrohabitats

Macrohabitats are units of streams and lakes that are relatively homogeneous with respect to size, and thermal, chemical, and hydrological regimes. Stream macrohabitats were mapped in the Chesapeake Bay Lowlands based on three primary spatial data sets: hydrography, geology and elevation. Four stream variables were derived from these layers: stream size, connectivity (network position), gradient, and hydrologic and chemical regime. Lines representing stream reaches were attributed automatically in a GIS and aggregated into macrohabitat types as unique combinations of the four classification attributes described below.

1. Stream Size

We analyzed the hydrography data layer to describe two important variables: size and connectivity. We defined four stream size classes based on link number, which is a count of the number of first order streams upstream of a point. The classes are:

1	Headwater	Link 1 – 10
2	Creek	Link 11 – 100
3	Small river	Link 101 – 1000
4	Medium river	Link 1001 – 2500
5	Large river	Link >2500

2. Connectivity

Stream connectivity describes the position in the drainage network, which was measured as the link number of the downstream reach. We used the same hydrography data layer and classes for stream connectivity as for stream size.

4. Gradient:

In the Chesapeake Bay Lowlands, we measured only one topographic factor, gradient, that is the change in elevation of a stream reach over its length. Gradient is a useful single measure of channel morphology because it is correlated to sinuosity, pool-riffle pattern, confinement, substrate size, and water velocity. We calculated the gradient for each stream reach automatically from a digital elevation model (DEM) in the GIS, then averaged the gradient value for each macrohabitat. The four gradient classes we used to classify the macrohabitats are

1 Very low gradient <0.005
2 Low gradient 0.005 – 0.02
3 Moderate gradient >0.02 – 0.04
4 High gradient >0.04

4. Hydrologic and Chemical Regime

We used the surficial and bedrock geology texture and stream size to infer the hydrologic and chemical regime of each macrohabitat in terms of relative inputs of ground and surface water. The geologic codes in the Chesapeake Bay Lowlands and adjoining Piedmont ecoregion are:

Coastal Plain Surficial Geology Classes:
5 alluvial coarse
6 alluvial fine
7 alluvial/estuarine fine
8 beach & dune
9 marine fine
10 saline marsh
11 silt/clay

Piedmont Bedrock Geology Classes:
100 acidic sed/metased
200 acidic shale
300 calcareous sed/metased
400 mod calcareous sed/metased
500 acidic granitic
600 mafic/intermediate granitic
700 ultramafic
900 coarse sed

The hydrologic regime and chemistry was classified for macrohabitats using the following rules:

4a. Rules for 1st through 3rd order streams:

If areal coverage of geology in watershed at and above the reach is >40 % stable (coastal classes: 1, 5 & bedrock classes: 300, 400, 900), then flow in the reach is stable, otherwise flow is unstable.

If areal coverage of geology in watershed at and above reach is >40 % calcareous - neutral (coastal classes: 1, 2, 4, 5, 8, 12 & bedrock classes: 300, 400, 700), then chemistry is calcareous – neutral, otherwise acidic.

This results in four possible combinations for the hydrologic and chemical regime macrohabitat type:

1 Stable hydrology, calcareous - neutral chemistry (1, 5 & 300, 400)
2 Unstable hydrology, calcareous - neutral chemistry (2, 4, 8, 12 & 700)
3 Stable hydrology, acidic chemistry (900)
4 Unstable hydrology, acidic chemistry (100, 200, 500, 600)

A fifth code is assigned to reaches at the Coastal Plain Saline Marsh.

4b. Rules for 4th and 5th order rivers:

We assumed stable hydrology and calcareous-neutral chemistry unless:

For hydrologic regime, if areal extent of watershed at or above reach is >70% unstable (2, 4,8, 12 & 200) then code the reach unstable, otherwise stable.

For chemistry, if areal extent of watershed at or above reach is >70% acidic (100, 200, 500, 600, 900) then code the reach acidic, otherwise neutral

4c. Rules for 6th order or larger rivers:

We assumed stable hydrology and calcareous-neutral chemistry for all sixth order or larger rivers.

Ecological Systems

Aquatic ecological systems are dynamic spatial assemblages of multiple ecological communities that: 1) occur together in an aquatic landscape with similar geomorphological patterns; 2) are tied together by similar ecological processes (e.g., hydrologic and nutrient regimes, access to floodplains and other lateral environments) or environmental gradients (e.g., temperature, chemical and habitat volume); and 3) form a robust, cohesive and distinguishable unit on a hydrography map.

Within the ecoregion of the Chesapeake Bay Lowlands, there are ranges in the types of aquatic ecosystems. Ecological Systems summarize the range of macrohabitat types for sets of hydrologically-connected streams. Each system type represents a different pattern of physical settings thought to contain a distinct set of biological communities and is therefore a distinct conservation target. We looked for patterns in the macrohabitat types and 4 attributes used to classify the macrohabitats to identify ecological system types. Table 1 identifies and describes 13 different system types in the Chesapeake Rivers watersheds. The enclosed map illustrates the 13 system types. System type #12 is a unique system types. The map shows multiple examples of the remaining 12 system types.

Table E.1. Aquatic systems of the Chesapeake Rivers. Please cross-reference with Map 9 for a spatial display of the systems.

Code	Size	Geology	Hydrology	Chemistry	Gradient	Elevation	Notes	Examples
1	small river	acidic granite	stable	acidic	very low	bottomland	Rivers with headwaters in western Piedmont	South Anna River, North Anna River
2	small river	acidic granite, mafic hardrock - acidic sed/metased massive, non-massive - acidic granite	stable	acidic	very low, some low	bottomland, some low	Rivers with headwaters on Blue Ridge	Rappahannock River, Rapidan River
3	small river	acidic granitic, unconsolidated sands and gravels	stable	acidic	very low	bottomland	Fall Zone rivers; transitional streams from eastern Piedmont granites to coastal plain sands/gravels	South Anna R, North Anna R, and Rappahannock R
4	headwater, creek	acidic granitic, mafic hardrock, some acidic sed/metased	unstable	acidic	moderate, high, some low in creeks	moderate, low	River headwaters on Blue Ridge escarpment and foothills	Headwaters of Hazel River, Thornton River, Robinson River, Rapidan River
5	headwater, creek	mafic hardrock; massive and non-massive/erodible acidic sed/metased	unstable	acidic, some streams neutral	low, very low	low, some bottomland	Streams of the Mesozoic Basin - sandstones, shales as well as diabase intrusions	Tinpot Run, Walsh Run, Flat Run, Muddy Run, Jonas Run, Potato Run, Summerduck Run,
6	headwater, creek	acidic granitic, unconsolidated sands and gravels	moderately stable	acidic	very low	bottomland	Fall Zone streams; transitional streams from eastern Piedmont granites to coastal plain sands/gravels	Fall Zone tribs of South Anna R (lower Newfound R, Stone Horse, Cedar, and Beech Creeks), North Anna R (lower Little Creek, Bull Run, Long Creek), Mattaponi R (lower Ni and Po Rivers, Motto and South River headwaters), Rappahannock R (upper Massaponax Creek, Hazel, Mine, Deep and Rocky Pen Runs)

Code	Size	Geology	Hydrology	Chemistry	Gradient	Elevation	Notes	Examples
7	headwater, creek	massive acidic sed/metased, acidic granitic, some mafic hardrock	unstable	acidic, some streams neutral	low, very low	bottomland, some low	Streams of central and eastern Piedmont	North Anna R and all tributaries above Lake Anna, South Anna R and all tribs aboveFork Creek (Louisa Co.), headwaters of Po, Ni, and Ta Rivers, and tribs of Hazel River (Flat, Mine, Mountain, and Hazel Runs) and Rappahannock River (Deep, Rock, and Summerduck Runs, and lower Walsh Run) just above confluence, upper Newfound River and Little River, and small eastern Piedmont tribs of the Mattaponi R (upper Mat R)
8	headwater, creek	massive and some non-massive sed/metased, mafic hardrock, and some acidic granitic	unstable	acidic, some streams neutral	low, some very low, some high and moderate	low	Streams of western Piedmont and Blue Ridge foothills, some higher gradient headwaters along monadnocks, some very low gradient creeks along Piedmont floor	middle Piedmont tribs of: Rappahannock R (Carter Run, South Run, Great Run), Hazel R (Mountain Run, Indian Run, Waterford Run), Robinson R (Crooked Run, Deep Run, Little Dark Run, Beaverdam Run), and Rapidan R (Blue Run, Marsh Run)
9	headwater, creek	silt/clay, some alluvial/estuarine fine	unstable	neutral	low, very low	bottomland	Coastal Plain streams, some are tidal	Tributaries in Coastal Plain of Rappahannock, York, Mattaponi and Pamunkey (Corrotoman, Poropotank, Totuskey, Polecat, Marshy Swamp, Cat Point, Massaponax, Goldenvale, Mill, Elmwood, Occupacia, Mount Landing, Hoskins, Piscataway, South, Herring, Marracossic, Pantico Run, Corbin, Chapel Hill, Beverly Run, Matatequin)

Code	Size	Geology	Hydrology	Chemistry	Gradient	Elevation	Notes	Examples
10	headwater, creek	silt/clay, some alluvial/estuarine fine and alluvial coarse	moderately stable	acidic	very low	bottomland	Blackwater system with numerous wetlands along mainstem	Piankatank and its tributaries
11	small and medium river	alluvial coarse	stable	neutral	very low	bottomland	Tidal to approximately US 360 (not as far as the Fall Line). Headwaters start in Piedmont	Mainstems of Mattaponi, Pamunkey, and York Rivers
12	small and medium river	alluvial coarse	stable	neutral	very low	bottomland	Tidal to Fall Line. Headwaters start in Blue Ridge and flow across Piedmont	Mainstem of Rappahannock River
13	headwater, creek	silt/clay, some marine fine	unstable	neutral	low, very low	bottomland	Tidal streams connected to Chesapeake Bay	Ware and Great Wicomico Rivers

APPENDIX B. Rare Species and Community List

Table 4 indicates the rare species and natural communities that have been found in the Dragon Run watershed, according to the Virginia Division of Natural Heritage (Belden, Jr. et al., 2001; Belden, Jr. et al., 2003).

SCIENTIFIC NAME	COMMON NAME	STATUS
Animals		
Atlides halesus	Great purple hairstreak	S2, S3
Enallagma weewa	Blackwater bluet	S1
Epitheca spinosa	Robust baskettail	S2
Haliaeetus leucocephalus	Bald eagle	S2
Helocordulia selysii	Selys' sunfly	S2
Isoparce cupressi	Cypress sphinx	S1, S3
Somatochlora filosa	Fine-lined emerald	S2
Wyeomyia haynei	Southern pitcher-plant mosquito	S1
Plants		
Bolboschoenus fluviatillis	River bulrush	S2
Cardamine pratensis	Cuckooflower	S1
Carex decomposita	Cypress-knee sedge	S2
Chelone oblique	Red turtlehead	S1
Desmodium strictum	Pineland tick-trefoil	S2
Eriocaulon parkei	Parker's pipewort	S2
Sarracenia purpurea var. purpurea	Northern purple pitcher-plant	S2
**Hottonia inflata	Featherfoil	S3
**Ranunculus flabellaris	Yellow water crowfoot	S3
Natural Communities		
Baldcypress-Tupelo Swamp		
Fluvial Terrace Woodland		
Tidal Baldcypress-Tupelo Swamp		
Tidal Baldcypress Woodland/Savanna		
Tidal Freshwater Marsh		

S1 = Extremely rare; usually 5 or fewer occurrences in the state; or may have a few remaining individuals; often especially vulnerable to extirpation.

S2 = Very rare; usually between 5 and 20 occurrences; or few occurrences with many individuals; often susceptible to becoming endangered.

S3 = Rare to uncommon; usually between 20 to 100 occurrences; may have fewer occurrences, but with a large number of individuals in some populations; may be susceptible to large-scale disturbances

** = No longer tracked by the Division of Natural Heritage; placed on watchlist due to an increased number of documented occurrences within the state since 2001

Table 4. Rare species and natural communities in the Dragon Run watershed.

The following descriptions of natural communities are taken from *The Natural Communities of Virginia* (Fleming et al., 2001).

Bald Cypress-Tupelo Swamps

Seasonally to semipermanently flooded forests of backswamps, sloughs, and low terraces of Coastal Plain rivers and large streams. These swamp forests are distributed throughout southeastern Virginia, north to Dragon Swamp (Gloucester, King and Queen, and Middlesex Counties). Habitats are deeply flooded (up to 1m) for part of the year; most retain at least some standing water throughout the growing season. Microtopography is often pronounced with small channels, swales, tree-base hummocks, and numerous bald cypress "knees." Tree canopies vary from mixed stands of bald cypress (Taxodium distichum), water tupelo (Nyssa aquatica), and swamp tupelo (N. biflora) to nearly pure stands of one species or another. The three dominants have complex competitive and successional relationships. As a rule, the two tupelos are less shade-tolerant than bald cypress and regenerate more readily by sprouting in cut-over stands. Thus, tupelos tend to become dominant when bald cypress stands are heavily logged. Green ash (Fraxinus pennsylvanica) and red maple (Acer rubrum) are occasional canopy associates and frequent understory trees. Carolina ash (F. caroliniana) is often dominant in the small tree and shrub layers, while vines of climbing hydrangea (Decumaria Barbara) are often abundant. Herb layers vary from sparse to rather lush. Most herbaceous plants of bald cypress-tupelo swamps are tolerant of muck soils and fluctuating water levels, or are capable of becoming established on tree hummocks, stumps, and logs. A few of the typical herbs are lizard's tail (Saururus cernuus), false nettle (Boehmeria cylindrical), Walter's St. John's-wort (Triadenum walteri), swamp beggar-ticks (Bidens discoidea), weak stellate sedge (Carex seorsa), giant sedge (Carex gigantean), taperleaf bugleweed (Lycopus rubellus), and pale mannagrass (Torreyochloa pallida). Although community types in this group are relatively common, high-quality specimens of the dominant trees are known to provide nesting habitats for the globally uncommon, state-rare eastern big-eared bat (Corynorhinus rafinesquii macrotis) and southern myotis (Myotis austroparius). Old-growth stands of bald cypress-tupelo swamp with trees up to 800 years old occur along the Blackwater River in Surry and Isle of Wight Counties. References: Fleming and Moorhead (1998), Parker and Wyatt (1975), Plunkett and Hall (1995).

Tidal Bald Cypress Forests and Woodlands

Coniferous or mixed swamp forests and woodlands occurring along the upper tidal reaches of rivers in southeastern Virginia. Examples are documented from the Dragon Swamp/Piankatank River (Gloucester, King and Queen, and Middlesex Counties), the Chickahominy River (Charles City, James City, and New Kent Counties), the James River (Isle of Wight and Surry Counties), and the wind-tidal Northwest River (City of Chesapeake). At some sites, these communities occur in ecotones between tidal marshes and non-tidal backswamps or uplands. Bald cypress (Taxodium distichum) dominates the open to very open canopy, with or without hardwood associates such as swamp tupelo (Nyssa biflora), water tupelo (Nyssa aquatica), and green ash (Fraxinus pennsylvanica). Stand structure and canopy cover range from closed forest to very open woodland. Shrub and herb layers are variable but generally contain a mixture of species characteristic of both marshes and swamps. Some well-developed tidal bald cypress forests appear floristically similar to palustrine bald cypress-tupelo swamps. Other stands have a nearly monospecific herb dominance by shoreline sedge (Carex hyalinolepis). In a unique, possibly fire-influenced, savanna-like stand on the Northwest River, the herbaceous dominants, in rough seasonal order, are silvery sedge (Carex canescens spp. Disjuncta), spikerushes (Eleocharis fallax and E. rostellata), marsh rattlesnake-master (Eryngium aquaticum var. aquaticum), and wild rice (Zizania aquatica var. aquatica). The environmental dynamics, compositional variation,

and state-wide distribution of this group are poorly known and need intensive study. Reference: Fleming and Moorhead (1998).

Fluvial Terrace Woodlands

A somewhat enigmatic group of communities occurring on flat, sandy terraces and islands along Coastal Plain rivers in eastern Virginia. These habitats are elevated well above the level of adjacent swamps and are characterized by xeric, sandy soils and open forest or woodland vegetation. Single occurrences have been documented along the Nottoway River (Sussex County), Chickahominy River (New Kent County), Dragon Swamp (Middlesex County), and Mattaponi River (Caroline County). At all four sites, hickories (Carya pallida and C. alba) are dominant trees, with drought-tolerant oaks (Quercus falcate, Q. nigra, Q. marilandica, Q. alba) present in smaller numbers. Shrubs occurring at all or most sites include sand post oak (Q. margarettiae), horse-sugar (Symplocos tinctoria), American holly (Ilex opaca var. opaca), and eastern red cedar (Juniperus virginiana var. virginiana). Typical herbs include sedges (Carex albicans var. australis, C. pensylvanica, and C. tonsa), Canada frostweed (Helianthemum canadense), butterfly-pea (Clitoria mariana), late goldenrod (Solidago tarda), and prickly-pear (Opuntia humifusa). The Dragon Run site is anomalous in the presence (despite low soil pH and base status) of several calciphiles such as eastern redbud (Cercis canadensis var. canadensis), wild columbine (Aquilegia canadensis), smooth rock-cress (Arabis laevigata var. laevigata), robin's-plantain (Erigeron pulchellus var. pulchellus), and elm-leaved goldenrod (Solidago ulmifolia var. ulmifolia). A full understanding of the status and compositional relationships of this group will require additional inventory and assessment.

Tidal Freshwater Marshes

A diverse group of herbaceous wetlands subject to regular diurnal flooding along upper tidal reaches of inner Coastal Plain river and tributaries. Freshwater marshes occur in the uppermost portion of the estuarine zone, where the inflow of saltwater from tidal influence is diluted by a much larger volume of freshwater from upstream. Strictly speaking, freshwater conditions have salt concerntrations <0.5 ppt, but pulses of higher salinity may occur during spring tides or periods of unusually low river discharge. The most common species are arrow-arum (Peltandra virginica), dotted smartweed (Polygonum punctatum), wild rice (Zizania aquatic var. aquatica), pickerelweed (Pontederia cordata), rice cutgrass (Leersia oryzoides), tearthumbs (Polygonum arifolium and P. sagittatum), and beggar-ticks (Bidens spp.). Locally, sweetflag (Acorus calamus) and southern wild rice (Zizaniopsis miliacea) may form large dominance patches. Species diversity and vegetation stature vary with salinity, duration of inundation, and disturbance; the most diverse marshes occupy more elevated surfaces in strictly freshwater regimes. Mud flats that are fully exposed only at low tide support nearly monospecific stands of spatterdock (Nuphar advena), although cryptic submerged aquatic species may also be present. Tidal freshwater marshes are best developed on sediments deposited by large meanders of the Pamunkey and Mattaponi Rivers, although outstanding examples also occur along the Potomac, Rappahannock, Chickahominy, and James Rivers. These communities provide the principal habitat for the globally rare plant sensitive joint-vetch (Aeschynomene virginica). Chronic sea-level rise is advancing the salinity gradient upstream in rivers on the Atlantic Coast, leading to shifts in vegetation composition and the conversion of some tidal freshwater marshes into oligohaline marshes. Tidal Freshwater Marshes are also threatened by the invasive exotic marsh dewflower (Murdannia keisak). Several communities in this group are chiefly restricted to the Chesapeake Bay drainage basin and are considered globally rare or uncommon. References: Parker and Wyatt (1975), Perry and Atkinson (1997), Perry and Hershner (1999), McCoy and Fleming (2000).

APPENDIX C. Natural Heritage Rarity Ranks and Status Explanation

Natural Heritage Rarity Ranks and Status Explanation

Each of the significant natural features (species, community type, etc.) monitored by DCR-DNH is considered an element of natural diversity, or simply an element. Each element is assigned a rank that indicates its relative rarity on a five-point scale (1 = extremely rare; 5 = abundant; Table 1). The primary criterion for ranking elements is the number of occurrences, i.e., the number of known distinct localities or populations. Also of great importance is the number of individuals at each locality or, for highly mobile organisms, the total number of individuals. Other considerations include the condition of the occurrences, the number of protected occurrences, and threats. However, the emphasis remains on the number of occurrences, so that ranks essentially are an index of known biological rarity. These ranks are assigned in terms of the element's rarity within Virginia (its State or S-rank), the element's rarity within a Nation (its National or N-rank), and the element's rarity across its entire range (its Global or G-rank). Subspecies and varieties are assigned a Taxonomic (T-) rank in addition to their G-rank. A Q indicates taxonomic uncertainty. Taken together, these ranks give an instant picture of an element's rarity. For example, a designated rank of G5S1 indicates an element which is abundant and secure range-wide, but rare in Virginia. In some cases, ranks are provisional or lacking, due to ongoing efforts by the Natural Heritage network to classify community syntaxa and cryptic plants or animals. Rarity ranks used by DCR-DNH are not legal designations, and they are continuously updated to reflect new information.

Table E-1. Definition of Natural Heritage state rarity ranks. Global ranks are similar to state ranks, but refer to a species' range-wide status. Note that GA and GN are not used and GX means extinct. GM and GW are ranks used only for communities, and refer to highly modified (GM) and ruderal (GW) vegetation respectively. National ranks are similar as well, and refer to a species' rarity within a nation, such as the United States or Canada. Sometimes ranks are combined (e.g., S1S2) to indicate intermediate or somewhat unclear status. Elements with uncertain taxonomic validity are denoted by the letter Q, after the global rank. These ranks should not be interpreted as legal designations.

S1 Extremely rare; usually 5 or fewer occurrences in the state, or in the case of communities, covering less than 50 hectares in aggregate; or may have a few remaining individuals; often especially vulnerable to extirpation.

S2 Very rare; usually between 5 and 20 occurrences, or in the case of communities, covering less than 250 hectares in aggregate; or few occurrences with many individuals; often susceptible to becoming endangered.

S3 Rare to uncommon; usually between 20 and 100 occurrences; may have fewer occurrences, but with a large number of individuals in some populations; may be susceptible to large-scale disturbances.

S4 Common; usually more than 100 occurrences, but may be fewer with many large populations; may be restricted to only a portion of the state; usually not susceptible to immediate threats.

S5 Very common; demonstrably secure under present conditions.

SA Accidental in the state.

SH Historically known from the state, but not verified for an extended period, usually more than 15 years; this rank is used primarily when inventory has been attempted recently.

SM Applied to vegetation extensively modified by disturbance but considered recoverable by management, time, or restoration of ecological processes.

SN Regularly occurring migrants or transient species which are non-breeding, seasonal residents. (Note that congregation and staging areas are monitored separately).

SU Status uncertain, often because of low search effort or cryptic nature of the element.

SW Applied to vegetation dominated by ruderal or exotic species.

SX Apparently extirpated from the state.

The spot on the landscape that supports a natural heritage resource is an element occurrence. DCR-DNH has mapped over 7,500 element occurrences in Virginia. Information on the location and quality of these element occurrences is computerized within the Division's BCD system, and additional information is recorded on maps and in manual files.

In addition to ranking each element's rarity, each element occurrence is ranked to differentiate large, outstanding occurrences from small, vulnerable ones. In this way, protection efforts can be aimed not only at the rarest elements, but at the best examples of each. Species occurrences are ranked in terms of quality (size, vigor, etc.) of the population; the condition (pristine to disturbed) of the habitat; the viability of the population; and the defensibility (ease or difficulty of protecting) of the occurrence. Community occurrences are ranked according to their size and overall natural condition. These element occurrence ranks range from A (excellent) to D (poor). Sometimes these ranks are combined to indicate intermediate or somewhat unclear status, (e.g., AB or CD). In a few cases, especially those involving cryptic animal elements, field data may not be sufficient to reliably rank an occurrence. In such cases a rank of E (extant) may be given. A rank of H (historical) is used to indicate an historical occurrence that could not be relocated by recent survey. Element occurrence ranks reflect the current condition of the species' population or community. A poorly-ranked element occurrence can, with time, become highly-ranked as a result of successful management or restoration.

Element ranks and element occurrence ranks form the basis for ranking the overall significance of sites. Site biodiversity ranks (B-ranks) are used to prioritize protection efforts, and are defined in Table E-2.

Table E-2. Biodiversity ranks used to indicate site significance.

B1 Outstanding Significance: only site known for an element; an excellent occurrence of a G1 species; or the world's best example of a community type.

B2 Very High Significance: excellent example of a rare community type; good occurrence of a G1 species; or excellent occurrence of a G2 or G3 species.

B3 High Significance: excellent example of any community type; good occurrence of a G3 species.

B4 Moderate Significance: good example of a community type; excellent or good occurrence of state-rare species.

B5	General Biodiversity Significance: good or marginal occurrence of a community type or state-rare species.

The U.S. Fish and Wildlife Service (USFWS) is responsible for the listing of endangered and threatened species under the Endangered Species Act of 1973, as amended. Federally listed species (including subspecific taxa) are afforded a degree of legal protection under the Act, and therefore sites supporting these species need to be highlighted. USFWS also maintains a review listing of potential endangered and threatened taxa known as candidate species. Table E-3 illustrates the various status categories used by USFWS and followed in this report. The status category of candidate species is based largely on the Service's current knowledge about the biological vulnerability and threats to a species.

As of February 27, 1996, species formerly referred to as Category 2 (C2) candidates for listing as threatened or endangered are no longer considered "candidates" under the Endangered Species Act. The USFWS no longer maintains a formal, comprehensive list of such species. However, the Virginia Field Office of the USFWS intends to maintain an informal list of these and other "Species of Concern" that may warrant future consideration as candidates. These "Species of Concern" can be regarded as species for which the Service has insufficient scientific information to support a listing proposal. Former Category 1 (C1) species are now considered "candidates" (C) for listing. "Candidate" species are species for which the USFWS has enough scientific information to warrant a proposal for listing. The designation of Category 3 species (3A, 3B, 3C) has been discontinued. However, the USFWS will continue to maintain its files on these species in case new information indicates a need for reevaluation.

Table E-3. U.S. Fish and Wildlife Service species status codes, with abbreviated definitions

LE	Listed endangered
LT	Listed threatened
PE	Proposed to be listed as endangered
PT	Proposed to the listed as threatened
C	Candidate: status data supports listing of taxon as endangered or threatened
SOC	Species of Concern: no official status, evidence of vulnerability, but insufficient data exists.

In Virginia, two acts have authorized the creation of official state endangered and threatened species lists. One act (Code of Virginia ' 29.1-563 through 570), administered by the Virginia Department of Game and Inland Fisheries (DGIF), authorizes listing of fish and wildlife species, not including insects. The other act (Code of Virginia ' 3.1-1020 through 1030), administered by the Virginia Department of Agriculture and Consumer Services (VDACS), allows for listing of plant and insect species. In general, these acts prohibit or regulate taking, possessing, buying, selling, transporting, exporting, or shipping of any endangered or threatened species appearing on the official lists. Species protected by these acts are indicated as either listed endangered (LE) or listed threatened (LT). Species under consideration for listing are indicated as candidates (C).

APPENDIX D. Dragon Run Watershed Management Plan

DRAGON RUN WATERSHED MANAGEMENT PLAN

NOVEMBER 2003

Photo credit: Teta Kain

This project was funded by the Virginia Coastal Program of the Department of Environmental Quality through Grants #NA17OZ1142-01 and #NA17OZ2355 of the National Oceanic and Atmospheric Administration, Office of Ocean and Coastal Resource Management, under the Coastal Zone Management Act of 1972, as amended. The views expressed herein are those of the authors and do not necessarily reflect the views of NOAA or any of its subagencies.

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DRAGON RUN WATERSHED MANAGEMENT PLAN

NOVEMBER 2003

DRAGON RUN STEERING COMMITTEE,
MIDDLE PENINSULA PLANNING DISTRICT COMMISSION

MARGARET DAVIS, CHAIR
WILLIAM F. HERRIN, VICE-CHAIR

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This project was funded by the Virginia Coastal Program of the Department of Environmental Quality through Grants #NA17OZ1142-01 and #NA17OZ2355 of the National Oceanic and Atmospheric Administration, Office of Ocean and Coastal Resource Management, under the Coastal Zone Management Act of 1972, as amended. The views expressed herein are those of the authors and do not necessarily reflect the views of NOAA or any of its subagencies.

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David Fuss, Director of the Dragon Run Special Area Management Plan, at the Middle Peninsula Planning District Commission, compiled this report for the Dragon Run Steering Committee. The Dragon Run Steering Committee members are:

County	***Elected Official***	***Landowner***	***Landowner***
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Gloucester	Rick Allen	Elizabeth DeHardit	Jerry Horner
King and Queen	Keith Haden	William F. Herrin	Russell Williams
Middlesex	Jack Miller	Robert Major	Davis Wilson

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The Dragon Run Steering Committee

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Executive Summary

As one of the Chesapeake Bay watershed's most pristine waterways, the spring-fed Dragon Run flows forty miles along and through nontidal and tidal cypress swamp situated in portions of Essex, King and Queen, Middlesex, and Gloucester Counties. The Dragon Run plays a central role in the Middle Peninsula's culture and identity. Natural resources - forestry and farming - have been the bedrock of the watershed's economy. These land uses, together with extensive swamps and unique natural resources, are the main reasons that the Dragon Run remains wild and secluded.

The Dragon Run's unique character evokes strong feelings to protect the pristine watershed in both long-time residents and first-time visitors alike. Yet, opinions differ about how to address the threats of encroaching development and habitat fragmentation. An innate difference in point of view between property rights advocates and conservationists centers on how to maintain a pristine watershed into the future. Yet, substantial common ground exists for proactively preserving the Dragon Run for future generations that safeguards both natural resources and traditional uses of the land and water, including the property rights of landowners.

The Dragon Run Watershed Special Area Management Plan (SAMP), a partnership between the Virginia Coastal Program and the Dragon Run Steering Committee of the Middle Peninsula Planning District Commission, is designed to address both the differences of opinion and the common ground that exist concerning the future of the watershed. The Steering Committee believes that the best approach is to bring stakeholders to the table for proactive discussions of the issues. The Steering Committee and its Advisory Group, representing a broad cross-section of the community, have proactively developed a mission, goals, objectives, and action plans to address the priority issues facing the Dragon Run.

This watershed management plan for the Dragon Run watershed represents a body of work by citizens, stakeholders, and decision-makers to achieve a common vision for the future – the preservation of the traditional uses and unique resources in the pristine Dragon Run. It is a symbol of regional cooperation and coordination that crosses jurisdictional boundaries. It is not a static document. Rather, it is a modifiable guidebook that harnesses the passion and energy for the Dragon Run of those who live, work, and play in its watershed.

MISSION

To support and promote community-based efforts to preserve the cultural, historic, and natural character of the Dragon Run, while preserving property rights and the traditional uses within the watershed.

GOALS

1. Establish a high level of cooperation and communication among the four counties within the Dragon Run Watershed to achieve consistency across county boundaries.
2. Foster educational partnerships and opportunities to establish the community's connection to and respect for the land and water of the Dragon Run.
3. Promote the concept of landowner stewardship that has served to preserve the Dragon Run Watershed as a regional treasure.

ACTIONS

Underway/Completed
1. Memorandum of Agreement
2. Establish Baseline Watershed Information
3. SAMP Project Awareness Campaign
Recommended
1. Land Use and Resource Preservation
A. Designate a Unified "Dragon Run Planning Area"
B. Implement Tools to Preserve Farm, Forest, and Natural Resources
C. Address Public and Landowner Access Issues
D. Control Invasive Species
2. Education and Landowner Stewardship
3. Encourage and Support Sustainable Economic Development
4. Monitor Plan Implementation

PART I

SECTION 1: Watershed Description

Section 1 describes the Dragon Run watershed's setting, its role in local history and culture, and its unique natural resources. The potential source of conflict is change in land ownership that threatens to fragment productive farm and forest land and natural habitat. The community's vision for the watershed is to preserve the traditional land uses – forestry, farming, hunting – and the unique natural resources. This section highlights both the differences of opinion on how to address the threat to the watershed and the common ground that defines the community's vision.

As one of the Chesapeake Bay watershed's most pristine waterways, the Dragon Run "encompasses some of the most extensive and unspoiled swamp forest and woodland communities in Virginia" (Belden, Jr. et al, 2001). Effectively bisecting Virginia's Middle Peninsula located between the York and Rappahannock Rivers, this fresh and brackish water stream (**Figure 1**) meanders forty miles along and through nontidal and tidal cypress swamp. The watershed is mainly undeveloped, almost entirely privately owned, and encompasses approximately 140 square miles (90,000 acres) of rural landscape – mostly forests, farms, and wetlands. The spring-fed Dragon Run flows through portions of Essex, King and Queen, Middlesex, and Gloucester Counties, emptying into the estuarine Piankatank River and ultimately the Chesapeake Bay.

Figure 1. The Dragon Run

The Dragon Run plays a central role in the Middle Peninsula's culture and identity. Its intriguing name is frequently borrowed by local enterprises and establishments and is often overheard in community conversations. Since European settlement in the early 1600's and Native American inhabitation up to 10,000 years before that, natural resources have been the bedrock of the watershed's economy. For older generations, forestry, farming, hunting, trapping and fishing were the primary ventures. Today, forestry and farming continue to generate wealth and drive the watershed's economy. Upholding an ancient tradition, hunters range over prime hunting grounds stalking prized game. These land uses, together with extensive swamps, are the main reasons that the Dragon Run remains wild and secluded.

The watershed's wilderness is both expansive and unique. The Dragon Run contains the northernmost example of the Baldcypress-Tupelo Swamp natural community in Virginia and the best example north of the James River (Belden, Jr. et al., 2001). Moreover, 14 rare species and 5 rare natural communities are found here (**Appendix A**). Based on his investigations of the watershed's aquatic communities, one researcher

observes that the Dragon Run is a “100 year old time capsule,” resembling coastal plain streams in the Chesapeake Bay region at the turn of the 20th century (Garman, 2003).

The Dragon Run’s unique character evokes strong feelings to protect the pristine watershed in both long-time residents and first-time visitors alike. Although development pressure in the watershed is currently low, the potential for significant land ownership changes (>25% in 10 years due to aging and absentee corporate landowners) threatens to disrupt the rural character and fragment productive farm and forest land. Likewise, habitat fragmentation jeopardizes the Dragon Run’s unique natural communities. Landowner opinions about how to address these threats vary widely, ranging from the belief that “the Dragon takes care of itself” by its wild nature and voluntary landowner stewardship to enacting and enforcing regulations with “teeth.”

The difference in point of view between property rights advocates and conservationists centers on how to maintain a pristine watershed into the future. Yet, as the Dragon Run Special Area Management Plan unfolds, the community is learning that substantial common ground exists for proactively preserving the Dragon Run for future generations that safeguards both natural resources and traditional uses of the land and water, including the property rights of landowners.

SECTION 2: Planning Approach

Section 2 describes the Dragon Run Steering Committee's planning approach. The Dragon Run Watershed Special Area Management Plan (SAMP), a partnership between the Virginia Coastal Program and the Dragon Run Steering Committee of the Middle Peninsula Planning District Commission, is designed to address both the differing viewpoints and the common ground that exist concerning the future of the watershed. The Steering Committee's approach to the SAMP is to stimulate and coordinate community involvement in the proactive development and implementation of goals, objectives, and action plans for a watershed management plan. The Steering Committee finds that the watershed approach is the most effective way to manage natural resources and traditional land uses. A Memorandum of Agreement describing the goals and objectives of the SAMP was signed by Essex, Gloucester, King and Queen, and Middlesex Counties and the Middle Peninsula Planning District Commission. The Steering Committee and its Advisory Group then developed watershed action plans designed to achieve those goals and objectives.

The Dragon Run Watershed Special Area Management Plan (SAMP), a partnership between the Virginia Coastal Program and the Dragon Run Steering Committee of the Middle Peninsula Planning District Commission, is designed to address both the differing viewpoints and the common ground that exist concerning the future of the watershed. The project began in January 2002 with a grant from the Virginia Coastal Program under authority of the National Oceanic and Atmospheric Administration (NOAA). Enabled by the federal Coastal Zone Management Act of 1972 as amended, SAMPs aim to protect significant coastal resources through a collaborative, multi-level planning process to develop and implement new enforceable policies.

One of the fundamental elements of a SAMP is that a strong regional entity must exist that is willing to sponsor the planning program. In the Dragon Run watershed's case, that regional entity is the Middle Peninsula Planning District Commission through its Dragon Run Steering Committee. Formed in 1985, the Dragon Run Steering Committee consists of landowners and local elected officials and is the key vehicle for cooperation and coordination among the four counties concerning watershed issues. The Steering Committee's approach to the SAMP is to stimulate and coordinate community involvement in the proactive development and implementation of goals, objectives, and action plans for a watershed management plan.

Another major element of a SAMP is that conflict exists concerning the area's proposed uses. The Steering Committee believes that the best approach is to proactively head off conflict before it grows by enabling stakeholders to openly discuss the issues. Potential conflicts in the Dragon Run watershed are: 1) the differences between conservation and property rights advocates; and 2) the private use of land versus the public use of the water. The Steering Committee finds that the watershed approach is the most effective way to manage natural resources and traditional land uses.

In this spirit, the Dragon Run Watershed SAMP (**Figure 2**) began with public planning forums in December 2001 and January 2002. Newspaper announcements were published and representatives from many sectors of the community were specifically invited. These planning forums led to two primary outcomes: 1) the development and confirmation of common themes for watershed issues; and 2) the establishment of a SAMP Advisory Group representing a broad cross-section of the community.

Building upon the foundation established by the planning forums, the SAMP Advisory Group developed a mission statement (see **Section 3**). The Advisory Group developed a list of three goals, each with several objectives. With minor modifications, the Steering Committee approved the goals and objectives, which were incorporated into a Memorandum of Agreement (**Appendix B**). Each county – Essex, Gloucester, King and Queen, and Middlesex - and the Middle Peninsula Planning District Commission signed the Agreement during the late summer and fall of 2002 and will consider the actions (see **Section 4**) recommended by the Steering Committee. The actions address the goals and objectives in the Memorandum of Agreement.

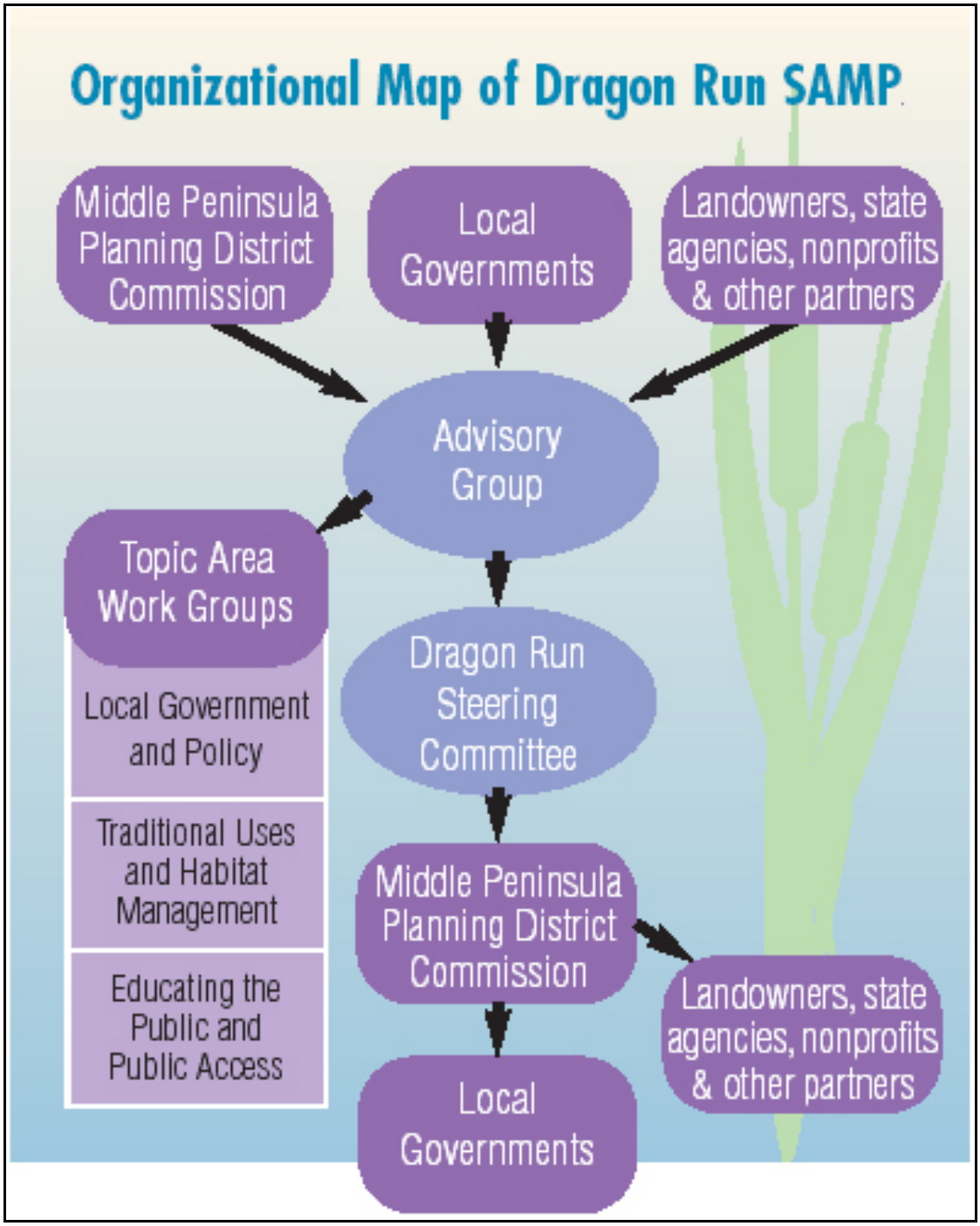


Figure 2. Organizational Map of the Dragon Run SAMP

SECTION 3: Goals and Objectives

Section 3 contains the mission, goals and objectives featured in the Memorandum of Agreement. This section serves as the basis for the proposed actions in Section 4.

MISSION
To support and promote community-based efforts to preserve the cultural, historic, and natural character of the Dragon Run, while preserving property rights and the traditional uses within the watershed.

GOAL I
Establish a high level of cooperation and communication among the four counties within the Dragon Run Watershed to achieve consistency across county boundaries.

> **OBJECTIVE A**
> Develop a plan to address the inevitable future development pressure to change the traditional use of land in the Dragon Run Watershed.
>
> **OBJECTIVE B**
> Achieve consistency across county boundaries among land use plans and regulations in order to maintain farming and forestry and to preserve natural heritage areas by protecting plants, animals, natural communities, and aquatic systems.
>
> **OBJECTIVE C**
> Provide ongoing monitoring of existing plans and planning tools in order to assess traditional land uses and watershed health and take action necessary to preserve the watershed.
>
> **OBJECTIVE D**
> Comprehensively implement Best Management Practices (BMPs) for water quality, wildlife habitat, and soil conservation.

GOAL II
Foster educational partnerships and opportunities to establish the community's connection to and respect for the land and water of the Dragon Run.

> **OBJECTIVE A**
> Encourage experience-based education consistent with the Stewardship and Community Engagement goals of the Chesapeake 2000 Agreement.
>
> **OBJECTIVE B**
> Promote the community and economic benefits of the Dragon Run derived from its natural characteristics and traditional uses such as farming, forestry, hunting and fishing.

GOAL III
Promote the concept of landowner stewardship that has served to preserve the Dragon Run Watershed as a regional treasure.

OBJECTIVE A
Address the potential dilemma of preserving the watershed's sense of peace and serenity by protecting open space and reducing fragmentation of farms, forests, and wildlife habitat versus the landowners' rights in determining or influencing future land use.

OBJECTIVE B
Educate landowners about the regional importance of the Dragon Run.

SECTION 4: Actions

Section 4 explains and justifies the actions proposed to achieve the goals and objectives in Section 3. The proposed actions are:

Underway/Completed
1. Memorandum of Agreement
2. Establish Baseline Watershed Information
3. SAMP Project Awareness Campaign
Recommended
1. Land Use and Resource Preservation
A. Designate a Unified “Dragon Run Planning Area”
B. Implement Tools to Preserve Farm, Forest, and Natural Resources
C. Address Public and Landowner Access Issues
D. Control Invasive Species
2. Education and Landowner Stewardship
3. Encourage and Support Sustainable Economic Development
4. Monitor Plan Implementation

The actions in this **Section** address the Goals and Objectives in **Section 3**. Notations after each action indicate links to goals and objectives and responsibilities.

ACTIONS UNDERWAY OR COMPLETED

1. Memorandum of Agreement

The Middle Peninsula Planning District Commission entered into an agreement (**Appendix B**) with the Counties of Essex, Gloucester, King and Queen, and Middlesex to participate in the Dragon Run SAMP. The agreement established the signatories' acceptance of the goals and objectives of the SAMP (see **Section 3**) and willingness to consider the Steering Committee's recommendations for actions (**Section 4**).

This action addresses Goal I(B), II
Responsibility: Middle Peninsula Planning District Commission, Local Governments

2. Establish Baseline Watershed Information

The Dragon Run Steering Committee has identified the following studies that have been completed or are underway to help to establish baseline watershed information:

Title (citation)	Description
Natural Areas of the Chesapeake Bay Region: Ecological Priorities (Jenkins, 1974)	Natural area survey throughout the Chesapeake Bay watershed; Dragon Run ranks 2nd of 232 in importance
County comprehensive plans, land use policies and ordinances	Maps and narratives addressing environmental and land use policies
Dragon Run Access Plan (MPPDC, 1994)	Describes access to the Dragon Run and factors influencing its availability
Dragon Run Watershed Management Plan (DeHardit et al., 1996)	Evaluates watershed and land use issues; offers recommendations; not implemented
Dragon Run Land/Water Quality Preservation Project (MPPDC, 2001)	Comprehensive evaluation of water quality using historical and recent data
A Natural Heritage Inventory of the Dragon Run Watershed (Belden, Jr. et al., 2001)	Survey of rare species and natural communities for the main stem and adjacent wetlands
Dragon Run Management Framework (MPPDC, 2002)	GIS CD-ROM and report with 18 data sets; evaluates economic contributions of traditional uses
Dragon Run Watershed Land Use Policy Audit (MPPDC, 2003)	Evaluates existing land use policies; recommends improvements to protect natural resources and traditional uses
Living Resources Inventory of the Dragon Run (Garman et al., 2003)	Survey and analysis of fish and benthic macroinvertebrate communities
A Natural Heritage Inventory of 14 Headwater Sites in the Dragon Run Watershed (Belden, Jr. et al., 2003)	Survey of rare species and natural communities for headwaters

Title	Description
Virginia Dept. of Environmental Quality Water Quality Monitoring (ongoing)	Ambient water quality monitoring at U.S. 17 and Rt. 603
U.S. Geological Survey Gaging Station (ongoing)	Real-time gage height and discharge by volume at Mascot, Virginia

This action addresses Goal I(A,C)
Responsibility: Middle Peninsula Planning District Commission, universities, state and federal agencies

3. SAMP Project Awareness Campaign
Middle Peninsula Planning District Commission staff delivered presentations, brochures, and fact sheets to Boards of Supervisors, Planning Commissions, and community groups that explained key components of the SAMP project and critical watershed issues.

This action addresses Goal II(B), III(B)
Responsibility: Middle Peninsula Planning District Commission, Dragon Run Steering Committee

RECOMMENDED ACTIONS

1. Land Use and Resource Preservation
Currently, the watershed is 99% wetlands, forests, and farms (MPPDC, 2002) that support a variety of unique natural resources, including rare and threatened species (Belden, Jr. et al., 2001). To protect the unique natural resources and traditional land uses of the Dragon Run, it is crucial to work proactively to implement strong land use policies while development pressure and land use intensity are still low, rather than wait to react to intensifying development pressure (MPPDC, 2003). The Dragon Run Steering Committee **recommends** that counties proactively strengthen and better coordinate their land use policies within the watershed.

A. Designate a Unified "Dragon Run Planning Area"
All of the four counties share the goals of protecting traditional uses, rural character, and natural resources in the Dragon Run. Yet, none of the counties identifies the Dragon Run watershed as a distinct planning area. Based on the Dragon Run Land Use Policy Audit (MPPDC, 2003), the Dragon Run Steering Committee **recommends** a watershed approach to achieve better coordination of land use policies by designating the Dragon Run as a special planning area with a step-by-step implementation strategy.

Step 1	Adopt Watershed Management Plan
Step 2	Amend Comprehensive Plan
Step 3	Amend Zoning Ordinance

Step 1. Each county would adopt the Dragon Run Watershed Management Plan as an addendum to its comprehensive plan, requiring a simple amendment and a public hearing. This action would **not** require an amendment to the future land use maps. The purpose of Step 1 would be to formally acknowledge that the Dragon Run watershed deserves distinctive treatment.

By adopting the Watershed Management Plan, the counties would agree to the following policies:

- Recognize the overall value of maintaining the traditional rural character and forested and farmed landscape of the Dragon Run watershed
- Preserve the ecological integrity of the Dragon Run watershed
- Acknowledge the community and economic benefits of the Dragon Run watershed: for the production of agricultural and forest products; as a valued natural resource; for wildlife habitat; for maintaining water quality; and for scenic and aesthetic values
- Continue to fully enforce existing regulations and policies
- Protect forested and farmed land from fragmentation due to conversion to more intensive development
- Encourage a low-density, clustered pattern of development for new residential development in the watershed to protect open space and natural resources
- Seek techniques to protect open space in the watershed without infringing upon landowner rights to maintain an economic return from their property
- Identify land uses that are incompatible or competitive with traditional resource-based land uses (e.g. forestry, farming, hunting, fishing) and consider limiting them within the watershed
- Limit rezoning to more intense uses in order to protect the rural character and integrity of farming and forestry resources in the watershed
- Limit extension of public utilities and central water and sewer in the watershed
- Explore the feasibility of limiting major residential development in the watershed by aligning the Comprehensive Plan and Zoning Ordinance with provisions in the Subdivision Ordinance that limit major subdivisions
- Publish citizen stewardship materials that explain pertinent ordinances, policies, and regulations in easy-to-understand language

Step 2. Each county would create and map a specially designated “Dragon Run Planning Area” within its comprehensive plan. Placing detailed land use policies such as permitted uses, development density, and utility service into the plan text and the official Future Land Use map would stress that protection of the Dragon Run is an important priority in each county.

Specific goals, policies, and actions, based on a thorough review and analysis by the Dragon Run Steering Committee and its SAMP Advisory Group, would be summarized in a proposed “Model Comprehensive Plan Amendment for the Establishment of the Dragon Run Planning Area.” Considerable staff and public input (e.g. public hearings) would address inconsistencies in land use policies across jurisdictions.

Step 3. Each county would adopt a model "Dragon Run Protection Zone" within its zoning ordinance involving both zoning map and zoning text amendments. The Dragon Run Protection Zone would apply beyond the main channel to the entire watershed.

This step would require considerable staff and public input (e.g. public hearings) to devise a unified set of standards (e.g. permissible uses, acceptable densities, development standards) that integrates with the existing regulatory scheme and that meets the goals of the Special Area Management Plan (see **Section 3**).

This action addresses Goal I(A,B,C), III(A)
Responsibility: Middle Peninsula Planning District Commission, Dragon Run Steering Committee, Local Governments

B. Implement Tools to Preserve Forest, Farm, and Natural Resources

A variety of tools exist with which to preserve forest and farmland (**Figure 3**) and unique natural resources within the Dragon Run watershed. These tools are highly flexible, rely mostly upon voluntary actions, and can provide ecological and cultural benefits. The Dragon Run Steering Committee **recommends** the implementation of an appropriate combination of the following tools (see **Appendix C** for description):

Tool	**Responsibility**
Conservation Easements	Landowners, non-profits, state and local governments
Purchase of Development Rights (PDR)	Local governments
Purchase of Agricultural Conservation Easements	Non-profits and federal, state and local governments
Enforcement of Chesapeake Bay Preservation Act and Other Ordinances	Local governments
Agricultural and Forestal Districts	Local governments
Land Use Assessment	Local governments
Utilize Farm Programs and Forest Stewardship Plans	State and federal agencies; local governments; landowners
Sliding Scale Property Tax Rate	Local governments
Sliding Scale Zoning	Local governments
Local "Right-to-Farm"	Local governments
State Forest	Department of Forestry
Virginia Natural Area Preserves System	Landowners, Natural Heritage Program
Virginia Estuarine and Coastal Research Reserve System	Chesapeake Bay National Estuarine Research Reserve

The Dragon Run Steering Committee also **recommends** the conservation of natural heritage resources and associated conservation sites as designated by the Virginia Natural Heritage Program (DCR, 2003a).

This action addresses Goal I(A,B,C), III(A)

Figure 3. Farming in the Dragon Run watershed.

C. Address Public and Landowner Access Issues

Public access to the Dragon Run is limited because property adjacent to the navigable stream is almost entirely privately owned. In most cases, access must be arranged by landowner consent. While generally effective, this informal arrangement has sometimes frustrated landowners and recreation-seekers alike. Private landowners express frustration with trespassers and with users who do not practice “leave no trace” recreation. In contrast, those seeking recreation are hindered by sparse access to the pristine river.

Landowners have expended time and money to resolve trespassing and vandalism problems, ranging from posting signs to instituting a formal program requiring verbal or written permission prior to visitation. Liability is often cited as a landowner concern. Virginia’s landowner liability law (Code of Virginia §29.1-509), however, dismisses a landowner’s liability when recreational users access their property with permission, express or implied, if no fee is charged to the user. Furthermore, if a landowner grants an access easement to a government agency or authority, then the landowner is held harmless from all liability and the easement holder is responsible for providing and paying for the cost of all legal services required as a result of a claim or suit.

As demand for public access has increased, recreation-seekers have encountered access limitations. Land-based public access exists at three locations: 1) Rappahannock Community College in Glenns (hiking); 2) Virginia Coastal Reserve in Mascot (education); and 3) Friends of Dragon Run property in Mascot (hiking/birding) with parking on a Virginia Department of Transportation unpaved lot. Fishing spots are limited to traditional access points, such as bridges. Also, the boating distance between traditional access points equates to nearly an entire day, causing logistical problems for novice paddlers. Occasionally, the sheriff’s department must dispatch a rescue team to retrieve boaters who are lost in the dark. Organizations that offer guided paddling trips effectively manage access with trip planning and suitability, proper equipment and safety information, appropriate consideration for private property, and response to the unexpected (e.g. medical emergencies, cold water immersion).

The Dragon Run Steering Committee seeks to balance reasonable public access to publicly owned waters with private property rights, preservation of the watershed's sense of peace and seclusion, and the watershed's ecological integrity that are highly prized by landowners and visitors alike. The following is a list of **proposed** actions:

- Erect signage notifying boaters/recreationists of trespassing issues and the physical dangers of boating in a wilderness area
  Responsibility: Dragon Run Steering Committee
- Provide land-based access as an alternative to boat-based access
  Responsibility: Middle Peninsula Chesapeake Bay Public Access Authority, Virginia Coastal Reserve (Virginia Institute of Marine Science), Virginia Dept. of Forestry, local governments, non-profit organizations
- Supervise or manage public access sites
  Responsibility: Middle Peninsula Chesapeake Bay Public Access Authority, Virginia Coastal Reserve (Virginia Institute of Marine Science), Virginia Dept. of Forestry, Virginia Dept. of Transportation, local governments, non-profit organizations
- Assess recreational carrying capacity/access to determine appropriate recreational "load"
  Responsibility: Dragon Run Steering Committee

This action addresses Goal I(A,C), II(A), III(A)

D. Control Invasive Species

Recent state legislation establishing the policy-setting Virginia Invasive Species Council signifies an era of formal concern about invasive or non-native species and their impacts on the integrity of Virginia's native ecosystems. Invasive species are purposely or accidentally introduced from other regions or countries and often physically displace or consume native species because they have few competitors or predators. The Dragon Run Steering Committee **recommends** that a Dragon Run Invasive Species Initiative be established in the watershed.

This initiative could include the following elements:

1. Form Dragon Run Invasive Species Initiative with scientific and policy experts
   Responsibility: Dragon Run Steering Committee staff, state and federal agencies, universities, non-profit conservation organizations
2. Assess status of existing invasive species or potential for new invasive species
   Responsibility: Dragon Run Invasive Species Initiative
3. Encourage the creation of state-level policies by seeking representation on the Virginia Invasive Species Council's Advisory Committee
   Responsibility: Virginia Invasive Species Council, Dragon Run Invasive Species Initiative

4. Establish education program to reduce the potential for species introduction
   Responsibility: Dragon Run Invasive Species Initiative
5. Establish monitoring and control program
   Responsibility: Dragon Run Invasive Species Initiative

Examples of common or potentially devastating invasive species that could affect the relatively intact natural communities in the Dragon Run are: blue catfish (*Ictalurus furcatus*); common reed (*Phragmites australis*); zebra mussel (*Dreissena polymorpha*); Asiatic dayflower (*Murdannia keisak*); and Japanese stiltgrass (*Microstegium vimineum*). Blue catfish, common reed, Asiatic dayflower and Japanese stiltgrass occur in the Dragon Run. These invasive species should be monitored and, to the extent practicable, controlled or excluded from the watershed.

This action addresses Goal I(C), II, III(B)

2. Education and Landowner Stewardship

In order to enhance and solidify the community's connection to and respect for the land and water of the Dragon Run, public education must be a central element of the Special Area Management Plan. Education should target citizens and stakeholders and focus on the unique ecological and recreational values in the watershed, the community and economic benefits of traditional land uses, and the need to preserve both through exemplary stewardship and proactive planning for the watershed's future. The Dragon Run Steering Committee **recommends** that a comprehensive education program be established to communicate the regional importance of the Dragon Run watershed to its citizens and to demonstrate the link between decisions about land management and the watershed's integrity and quality.

Education Program Components	Responsibility
Hands-on Experiences	Dragon Run Steering Committee
Community Watershed Festival	Dragon Run Steering Committee
Watershed Stewardship Awards	Dragon Run Steering Committee
Watershed Boundary Signs	Dragon Run Steering Committee
Promote Use of Forest Stewardship Plans	Dragon Run Steering Committee; local governments; Dept. of Forestry
Promote Use of Farm Programs	Natural Resources Conservation Service; Virginia Cooperative Extension; Soil and Water Conservation Districts; Farm Service Agency; Virginia Farm Bureau
Promote Action-based Projects	Dragon Run Steering Committee; local governments; citizens

Hands-on Experiences
The Dragon Run Steering Committee **recommends** the use of hands-on experiences to produce an understanding and appreciation of the Dragon Run, targeting:

- State and federal legislators, Boards of Supervisors, Planning Commissions, and county staff
- Landowners, hunt clubs, land management consultants, and farmers and foresters who rent or lease land
- Chamber of Commerce, service clubs, civic and church groups, and non-profit organizations
- State and federal agency representatives
- Schools, 4-H Club, Scouts, class projects
- General public

The recommended approach encompasses a variety of methods and materials. Education would focus on field experiences that incorporate activities designed to address critical watershed issues (e.g. wetland and habitat values, biodiversity, water quality and quantity, riparian buffers).

This action addresses Goal II(A,B), III(B)

Community Watershed Festival
A component of the education program should be a community watershed festival as a celebration of the watershed's natural, cultural, and historic heritage. The festival would **not** serve as a promotional tool to attract visitors. Displays and activities highlighting natural and cultural heritage would be featured. The Dragon Run Steering Committee **recommends** the festival as a way to increase citizen awareness of watershed issues and as an opportunity to acknowledge citizens for exemplary watershed stewardship.

This action addresses Goal II(B), III(B)

Watershed Stewardship Awards
The Dragon Run Steering Committee **recommends** the establishment of watershed stewardship awards that would honor landowners and land managers who have demonstrated commendable stewardship within the watershed. Awards would be bestowed annually at the watershed festival for a variety of categories that may include: forestry; farming; hunting; commercial enterprises; conservation; education; planning; and science. The awards program should serve as an incentive to implement exemplary land stewardship practices.

This action addresses Goal II(B), III(B)

Watershed Boundary Signs
The Dragon Run Steering Committee **recommends** placing watershed boundary signs along frequently traveled highway and secondary roads to increase community awareness of the location and importance of the Dragon Run watershed. By indicating

the watershed boundary, the signs would alert citizens that they are in the watershed. Teamed with other educational efforts, the signs should lead to citizen awareness that their land management practices influence the health of the watershed.

This action addresses Goal II, III(B)

Promote Forest Stewardship Plans
The watershed is more than 80% forested and has intact riparian buffers. Since forested riparian buffers provide effective water quality protection and wildlife habitat, forested lands exhibit low nutrient input to adjacent streams relative to other land uses in the watershed (MPPDC, 2001). Therefore, forest stewardship plans have the potential to significantly influence the health and profitability of the watershed's forests. To benefit landowners and the local economy and to preserve the rural landscape and the natural resources in the watershed, the Dragon Run Steering Committee **recommends** promotion and implementation of forest stewardship plans prior to timber harvesting.

Forest stewardship plans are ecosystem management plans that combine ecological function with landowner goals to attain a vision for a particular property. The Department of Forestry's Forest Stewardship Plans leverage professional resources across disciplines to provide an inventory, recommendations and reference information that address landowners' specific goals and objectives, which may include: wildlife enhancement; aesthetics; recreation; water quality protection; forest regeneration; financial investment and incentives; and fire, pest, and disease control. The Virginia Department of Forestry prepares Forest Stewardship Plans for up to 200 acres at no cost to landowners. Beyond 200 acres, the Department charges fees, so it may be cost-effective for a consulting forester to develop a Forest Stewardship Plan.

This action addresses Goal I(A,B,D), II(B), III(A)

Promote Farm Programs
Agricultural lands make up 18% of the watershed and have the potential to contribute sediments, nutrients, and bacteria to ground and surface water. Existing state and federal farm programs (see **Appendix D** for description) can positively influence the health and profitability of the watershed by providing incentives for employing Best Management Practices or for taking marginal land out of agricultural production. To benefit farming operations, water quality, wildlife habitat, and the rural landscape and character of the watershed, the Dragon Run Steering Committee **recommends** promotion and implementation of programs, such as:

Program	**Responsibility**
Conservation Reserve Program (CRP)	Natural Resources Conservation Service
Conservation Reserve Enhancement Program (CREP)	Natural Resources Conservation Service, Soil and Water Conservation Districts, Farm Service Agency
Environmental Quality Incentives Program (EQIP)	Natural Resources Conservation Service

Program	Responsibility
Farm and Ranch Lands Protection Program	Natural Resources Conservation Service
FarmLink Program	Virginia Farm Bureau
Forest Land Enhancement Program (FLEP)	Natural Resources Conservation Service; Dept. of Forestry
Wetland Reserve Program	Natural Resources Conservation Service
Wildlife Habitat Incentives Program (WHIP)	Natural Resources Conservation Service

It should be noted that the existence and availability of these programs changes depending on funding. Also, Virginia Cooperative Extension provides considerable technical assistance to farmers and actively promotes these programs.

This action addresses Goal I(A,B,D), II(B), III(A)

Promote Action-based Projects

Action-oriented projects can sustain enthusiasm for watershed activities by involving community members in active resource stewardship. For example, James City County's program entitled "Protecting Resources in Delicate Environments" strives "to improve water quality…by teaching residents about the importance of watershed protection while providing residents and neighborhoods with specific watershed restoration and protection tools (James City County, 2003)." The Dragon Run Steering Committee **recommends** encouraging action-based projects, such as:

- Trash pickup (e.g. Adopt-a-Highway, Adopt-a-Stream)
- Development of nature trails
- Construction of rain gardens to capture roof runoff
- Stream bank stabilization
- Stream restoration

This action addresses Goal I(C,D), II(A), III(B)

3. Encourage and Support Sustainable Economic Development

While natural resource-based industries have been and continue to be at the core of the watershed's economy, external economic forces threaten to fragment these traditional uses and alter the rural landscape. The Dragon Run Steering Committee **recommends** that sustainable natural resource-based development be pursued to strengthen the region's economy and boost the quality of life, while supporting the traditional land uses that preserve the Dragon Run watershed and its resources.

Support Sustainable Forestry and Farming

Agriculture is Virginia's top sales industry, makes up 11.2% of Virginia's Gross State Product, and creates about 10% of the state's jobs (DACS, 2003). Similarly, forestry supports "one of the largest manufacturing industries in the state ranking first in employment, first in wages and salaries, and accounts for $1 out of every $8 of value added through manufacturing (DOF, 2003)." Forestry (**Figure 4**) and farming are key industries in the Dragon Run watershed.

Figure 4. Forestry in the Dragon Run watershed.

As the tax base expands with rapid population growth (>14.4% in 3 of 4 watershed counties), the demands for public services also grow, often at a faster rate than tax revenues. Many rapidly growing counties have found their ability to provide adequate public services outstripped by the rapid demand for those services.

In contrast, agricultural and forestal land have been shown to demand a low cost of public services ($0.23 relative to $1.00 generated in taxes in Northampton County, VA [American Farmland Trust, 2002]). Yet, farm and forest land continue to disappear at a rapid rate, giving way to suburban-style development.

For the natural resource-based industries to continue to thrive, the watershed communities **should** develop a regional capacity to produce value-added forest and farm products to capture additional value locally. With funding from the Virginia Coastal Program, the Dragon Run Steering Committee is sponsoring a study of potential sustainable economic development opportunities within the watershed. The study will involve local and regional experts in natural resource-based industries and demonstrate how sustainable natural resource-based development can generate wealth within the community.

This action addresses Goal I(A,B,C), II(B), III(A)
Responsibility: Dragon Run Steering Committee, local governments, business/industry

Encourage Sustainable Nature-based Tourism
Nature-based tourism and agritourism can help to diversify and strengthen the economy of a region that is rich in natural resources, such as the Middle Peninsula. Nature-based tourism is the fastest growing sector of the U.S. tourism industry and Virginia is one of the top 10 destinations for travelers (DGIF, 2002b). The Dragon Run Steering Committee **recommends** encouraging and supporting appropriate nature-based tourism and agritourism to benefit from these trends.

The Dragon Run watershed contains several sites on the newly established Virginia Birding and Wildlife Trail that is designed for car travel (DGIF, 2002a). In addition, the Virginia Ecotourism Association has developed a certification course using standards that avoid negative impacts on the resources that attract tourism. Supporting these initiatives in nature-based tourism could benefit the economy and, in turn, the natural resources of the watershed. For example, surveys along the Great Texas Coastal Birding Trail indicate that travelers spend ~$1,000 per person per trip, two-thirds of which flows directly into the local economy. More importantly, rural communities that are not able to promote their destinations are gaining economic stimulation from their assocation with the Trail. Meanwhile, the Trail increased awareness of the importance of the region's natural resources and the need to conserve them (DGIF, 2002b).

This action addresses Goal I(A,B,C), II(B), III(A)
Responsibility: Dragon Run Steering Committee, local governments, business/industry

4. Monitor the Implementation of the Watershed Management Plan

An important element of any planning effort is monitoring plan effectiveness. The Dragon Run Steering Committee **recommends** that a monitoring program be developed that assesses the results of watershed management plan implementation to ensure that the plan is effectively implemented.

The monitoring program should assess factors and parameters that are easily compared to the baseline information in the watershed management plan. Examples include: designation of watershed planning area; acres enrolled in farm and forest programs; land use/land cover; water quality; number of educational trips; invasive species; amount and type of public access; and number of action-based projects. Furthermore, the Dragon Run Steering Committee should coordinate and provide oversight for the monitoring program. For instance, the Steering Committee could draft an agreement with localities whereby the Committee reviews development applications in the watershed and offers advisory comments to the localities. Stable funding for staff support will continue to be a key component of Steering Committee activities.

The results of the monitoring program should be used to refocus efforts on actions that have not been fully implemented. The monitoring program may also highlight successes and identify new or unforeseen needs (e.g. funding for new projects).

This action addresses Goal I(C)
Responsibility: Dragon Run Steering Committee, local governments

HOW DO ACTIONS SUPPORT GOALS AND OBJECTIVES?

Actions in this **Section** support the goals and objectives stated in **Section 3** as shown in **Table 1**. For example, Recommended Action 1A: *Land Use: Designate a Unified "Dragon Run Planning Area"* (pp. 16-18) supports:

- Goal I (p. 12): Establish a high level of cooperation and communication between the four counties within the Dragon Run Watershed to achieve consistency across county boundaries.
  - Objective A: Develop a plan to address the inevitable future development pressure to change the traditional use of land in the Dragon Run Watershed.
  - Objective B: Achieve consistency across county boundaries among land use plans and regulations in order to maintain farming and forestry and to preserve natural heritage areas by protecting plants, animals, natural communities, and aquatic systems.
  - Objective C: Provide ongoing monitoring of existing plans and planning tools in order to assess traditional land uses and watershed health and take action necessary to preserve the watershed.
- Goal III (p. 13): Promote the concept of landowner stewardship that has served to preserve the Dragon Run Watershed as a regional treasure.
  - Objective A: Address the potential dilemma of preserving the watershed's sense of peace and serenity by protecting open space and reducing fragmentation of farms, forests, and wildlife habitat versus the landowners' rights in determining or influencing future land use.

Action [Section 4]	**Goal (Objective)** [Section 3]
Completed/Underway	
1	I (B); II
2	I (A, C)
3	II (B); III (B)
Recommended	
1A	I (A, B, C); III (A)
1B	I (A, B, C); III (A)
1C	I (A, C); II (A); III (A)
1D	I (C); II; III (B)
2	I (A, B, C, D); II (A, B); III (A, B)
3	I (A, B, C); II (B); III (A)
4	I (C)

Table 1. How actions support the Dragon Run SAMP's goals and objectives.

PART II

SECTION 5: Framework of Institutional and Regulatory Responsibility

Section 5 describes the responsibilities of federal, state, and local government agencies for mandatory and voluntary programs, policies, and regulations.

Neither the MPPDC nor its Dragon Run Steering Committee has regulatory authority. Rather, they serve to encourage and facilitate local-local and state-local government cooperation in addressing regional issues. Consisting of elected officials and citizens appointed by member local governments, the MPPDC and the Dragon Run Steering Committee offer recommendations and technical assistance to the localities. The MPPDC's purpose is "to promote the orderly and efficient development of the physical, social and economic elements of the Planning District by planning, and encouraging, and assisting governmental subdivisions to plan for the future" (MPPDC, 1972).

The Virginia Coastal Program is a system of state laws and policies administered by a network of core agencies and coastal localities that manage a variety of coastal resources. The Department of Environmental Quality (DEQ) serves as the lead agency for Virginia's networked Coastal Program and helps agencies and localities to develop and implement coordinated coastal policies.

Within the context of the SAMP, county governments are responsible for long-range planning of public facilities, utilities, transportation, and land use, and for developing, implementing, reviewing and updating the local Comprehensive Plan, Zoning Ordinance and other ordinances. Through Boards of Supervisors, Planning Commissions, and staff, counties process and review rezoning, conditional use permits, special exceptions, site plans, and subdivisions. Therefore, counties implement land use policies and regulations.

Counties also have responsibility for implementing the Chesapeake Bay Preservation Act (Bay Act). The Chesapeake Bay Local Assistance Department (CBLAD) is charged with oversight of local implementation of the Bay Act and the Chesapeake Bay Preservation Area Designation and Management Regulations. The Bay Act (§10.1-2100 et seq.) requires that localities protect water quality by establishing and protecting Chesapeake Bay Preservation Areas, including wetlands, shorelines, and a 100-foot buffer.

The Virginia Department of Conservation and Recreation (DCR) administers: 1) the Coastal Nonpoint Source Pollution Control Program under authority of Section 6217 of the Coastal Zone Act Reauthorization Amendments of 1990; 2) the Nonpoint Source Pollution Management Program under authority of Section 319 of the Clean Water Act of 1987; 3) the Virginia Stormwater Management Program; 4) the Erosion and Sediment Control Program; 5) the Nutrient Management Program; and 6) and the Chesapeake Bay and Tributary Strategies Programs. DCR's Natural Heritage Program reviews development proposals that might affect the state's natural heritage resources (e.g. rare species and natural communities). DCR's Shoreline Erosion Advisory Service offers assistance to landowners experiencing erosion problems.

The authority to issue National Pollutant Discharge Elimination System (NPDES) permits lies with the DEQ. Furthermore, the DEQ regulates air quality, waste management (e.g. landfills), ground water management, water withdrawal, and petroleum storage tanks. The DEQ is also responsible for setting state water quality

standards and preparing the 305(b) Water Quality Assessment Report and the 303(d) Report on Impaired Waters. Impaired waters do not meet water quality standards and usually require the development of a Total Maximum Daily Load (TMDL) report. The implementation of TMDLs may require regulations governing discharges and nonpoint source pollution to impaired waters.

The Virginia Department of Game and Inland Fisheries (DGIF) regulates hunting, freshwater fishing, and boating. Furthermore, the DGIF maintains public boating access sites. The DGIF also regulates threatened and endangered species.

The U.S. Army Corps of Engineers' Norfolk District Regulatory Branch (ACOE) regulates waters and wetlands under the authority of Section 404 of the Clean Water Act and Section 10 of the Rivers and Harbors Act of 1899.

The Virginia Marine Resources Commission's Habitat Management Division (MRC) regulates physical encroachment into bottomlands, tidal wetlands, and coastal primary sand dunes under Subtitle III of Title 28.2 of the Code of Virginia. The permit process is the joint responsibility of local wetlands boards, the MRC, the DEQ (Section 401 certification), and the ACOE. Additionally, the MRC regulates saltwater fishing.

The Virginia Department of Forestry (DOF) has authority to regulate forestry operations throughout the state. Silvicultural activities are exempt from most laws such as the Clean Water Act, the Chesapeake Bay Preservation Act, and Erosion and Sediment Control. In exchange for these exemptions, silvicultural activities must comply with Best Management Practices designated by DOF in *Virginia's Forestry Best Management Practices for Water Quality, 4th Edition* (2002). DOF has responsibility for inspecting forestry operations, reporting violations, and enforcing regulatory requirements.

The Natural Resources Conservation Service (NRCS) of the U.S. Department of Agriculture administers: the Conservation Reserve Program; the Conservation Reserve Enhancement Program; the Environmental Quality Incentives Program; the Farm and Ranch Lands Protection Program; the Forest Land Enhancement Program; the Wetland Reserve Program; and the Wildlife Habitat Incentives Program. The NRCS helps private landowners conserve soil, water, and other natural resources through technical assistance, cost sharing, and financial incentives. The NRCS also provides assistance to local, state, and federal agencies.

SECTION 6: Watershed Characterization

Section 6 describes the watershed in detail to establish the Dragon Run's current status. Physical and environmental features are characterized. Land use policies and recreational and educational activities are assessed. This information is designed to serve as a baseline to which to compare the success or failure of the watershed management plan in achieving its goals and objectives. Finally, gaps in the baseline information are identified.

Physical and Environmental Factors

Located entirely within the coastal plain physiographic province, Virginia's Middle Peninsula is bracketed by the Rappahannock River to the north, the York River to the south, and the Chesapeake Bay to the east. The Dragon Run watershed is the Middle Peninsula's geographic centerpiece, expanding outward from its 40-mile fresh and brackish water stream that runs through Essex, Gloucester, King and Queen, and Middlesex Counties. The watershed encompasses 90,000 acres or 140 square miles and exhibits topography typical of coastal plain stream systems in Virginia (**Figure 5**). Watershed area by locality is shown in **Table 2**.

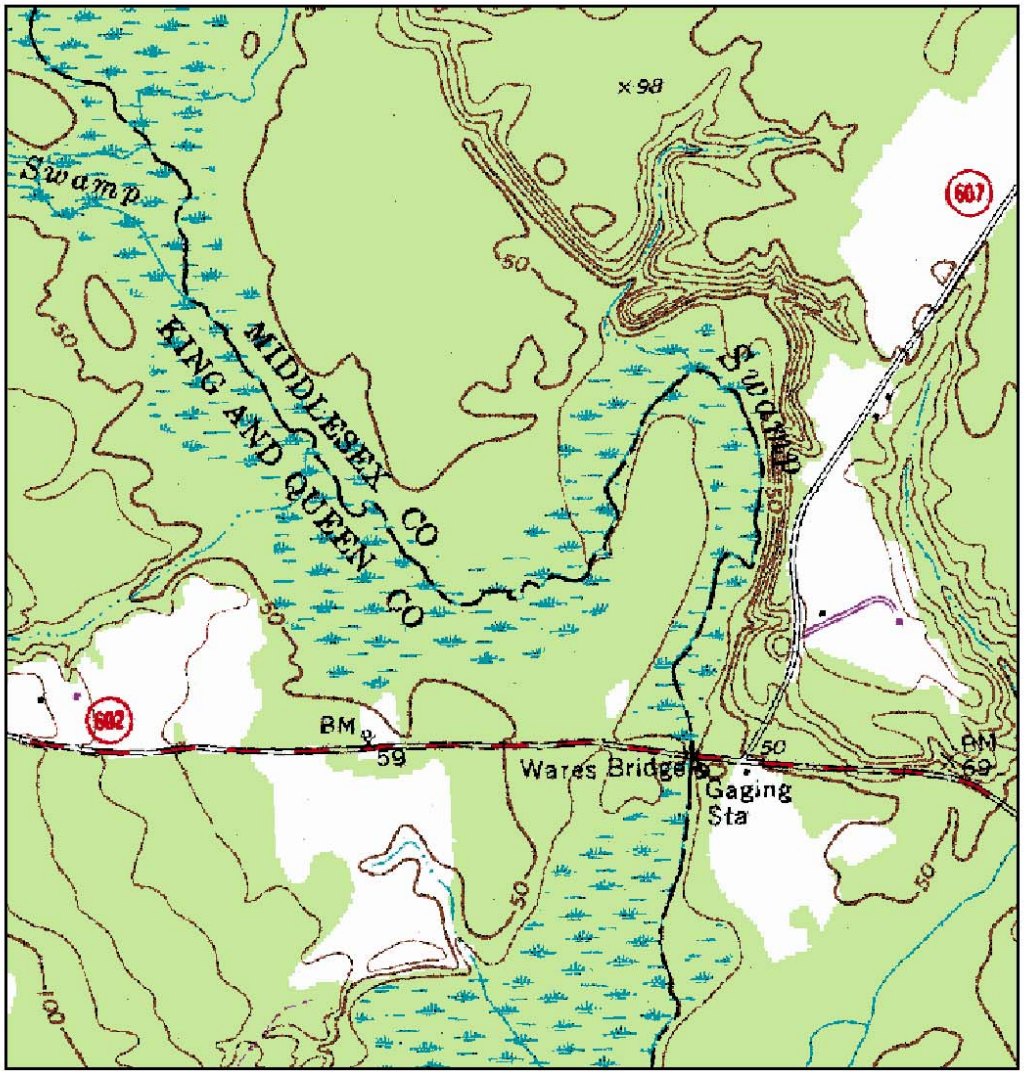
County	Area within Locality (acre)	% of Total Watershed	% of Locality within Watershed
Essex	18466.6	20.6	10.1
Gloucester	5671.7	6.3	3.1
King and Queen	46425.1	51.7	22.2
Middlesex	19207.7	21.4	16.3
Total	89771.1	100	

Table 2. Dragon Run watershed statistics by locality (from MPPDC, 2001).

The Dragon Run watershed, state hydrologic unit CO2, is a fourth-order stream system that is nontidal freshwater above the U.S. Route 17 bridge and tidal freshwater from the U.S. 17 bridge to its mouth at Meggs Bay (**Figure 6**). There it forms the Piankatank River, where it becomes estuarine, and eventually drains into the Chesapeake Bay (**Figure 7**). Underground springs, feeder swamps, and surface waters support streamflow in the Dragon Run. Significant tributaries include Dragon Swamp, Yonkers Swamp, Exol Swamp, Timber Branch Swamp, Briery Swamp, Holmes Swamp, White Marsh, Zion Branch, Carvers Creek, Mill Stream, and Meggs Bay (MPPDC, 2001).

Land cover data indicate that the watershed is 80.3-83.9% forested and wetlands, 15.1-18.4% agricultural, and 1.0-1.3 % commercial and residential (**Figure 8**) (MPPDC, 2002; DCR, 2003). The Dragon Run watershed lies within the transitional Oak-Pine vegetation region where dominant oaks share the forest with Virginia pine, shortleaf pine, and loblolly pine. Although loblolly pine originally appeared in the forest as scattered associates of oaks and other hardwoods, loblolly pine plantations are increasingly common.

Since the watershed is relatively intact, it contains many unique resources. For example, the Baldcypress-Tupelo Swamp community is extensive and is the northernmost example of this community type in Virginia and the best example north of the James River (Belden, Jr. et al., 2001). Natural heritage resources are abundant in the Dragon Run (**Figure 9**). Several rare natural communities occur in the Dragon Run, including Baldcypress-Tupelo Swamp, Tidal Baldcypress-Tupelo Swamp, Tidal



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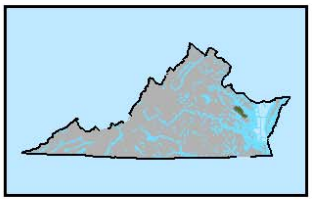
This map production is a product of the MPPDC's Dragon Run SAMP and was funded by the Virginia Department of Environmental Quality's Coastal Program through Grant #NA17OZ1142-01 of the National Oceanic and Atmospheric Administration, Office of Ocean and Coastal Resources Management, under the Coastal Zone Management Act of 1972, as amended.



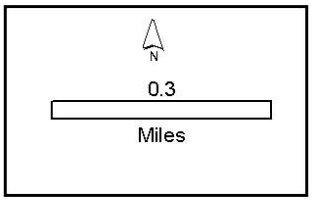


Figure 5. U.S. Geological Survey topographic map of the Dragon Run watershed in Middlesex and King and Queen Counties.

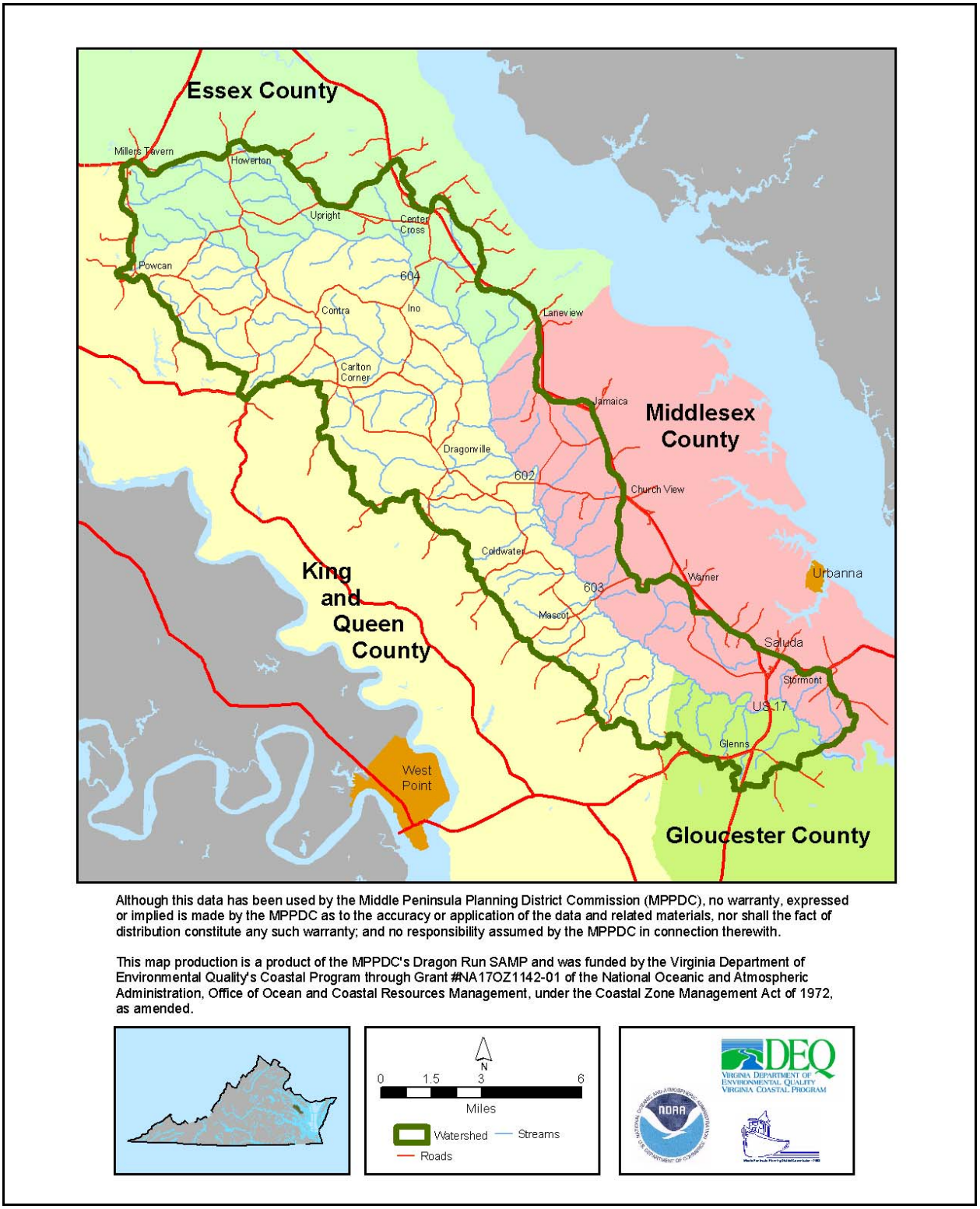


Figure 6. Map of the Dragon Run watershed boundary showing villages and towns.

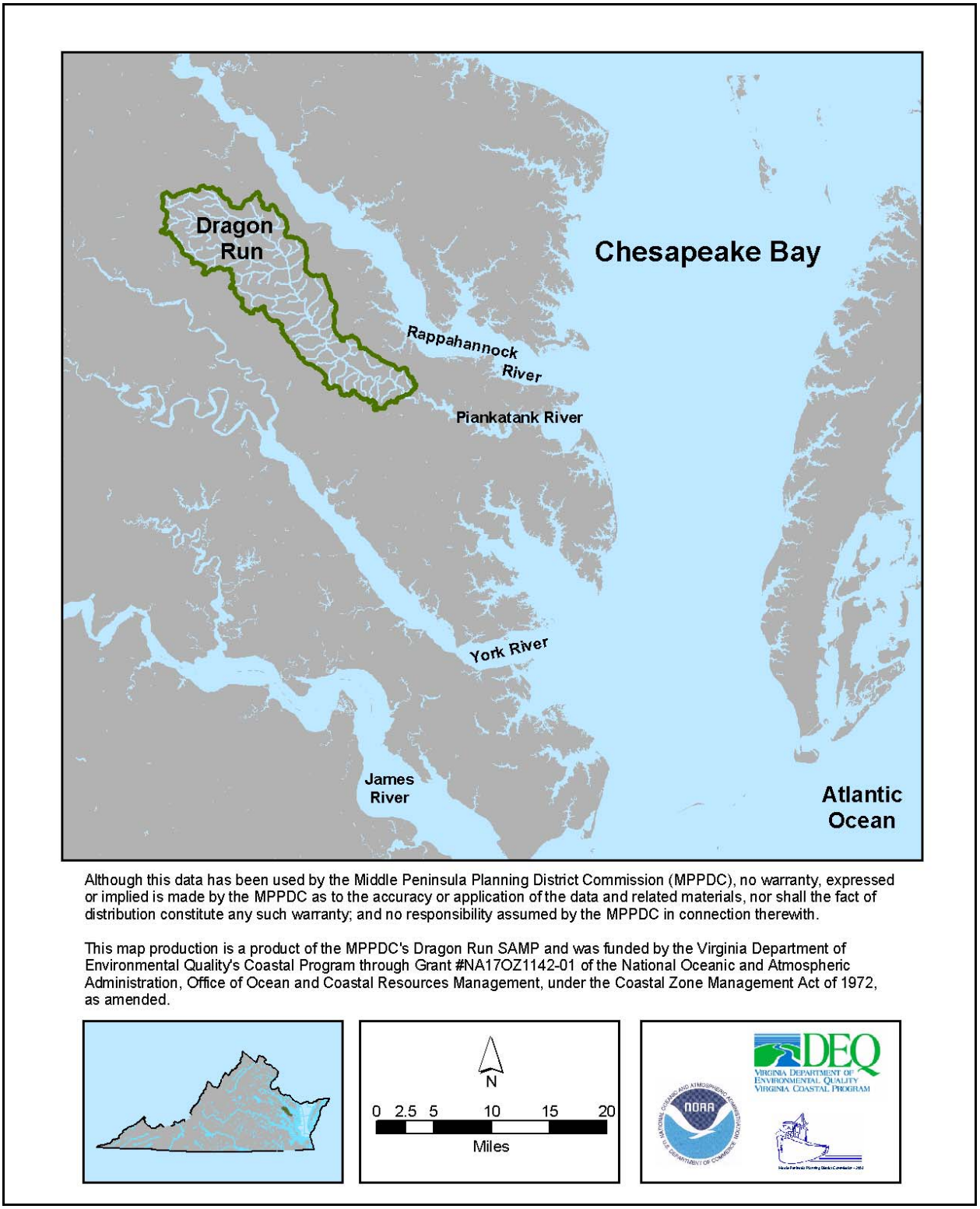


Figure 7. Map showing the Dragon Run watershed (in green) flowing into the Piankatank River and ultimately into the Chesapeake Bay.

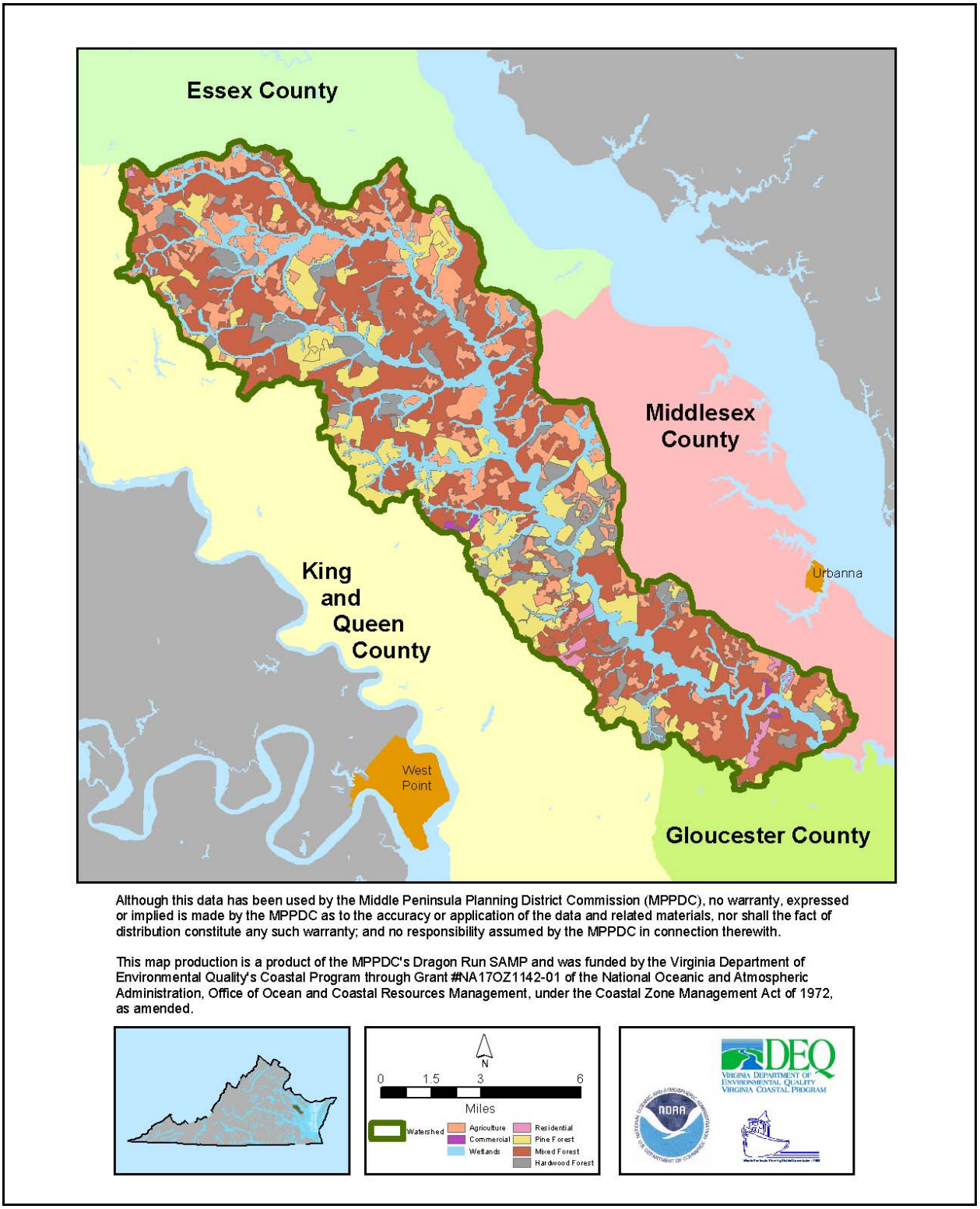


Figure 8. Land cover designations in the Dragon Run watershed.

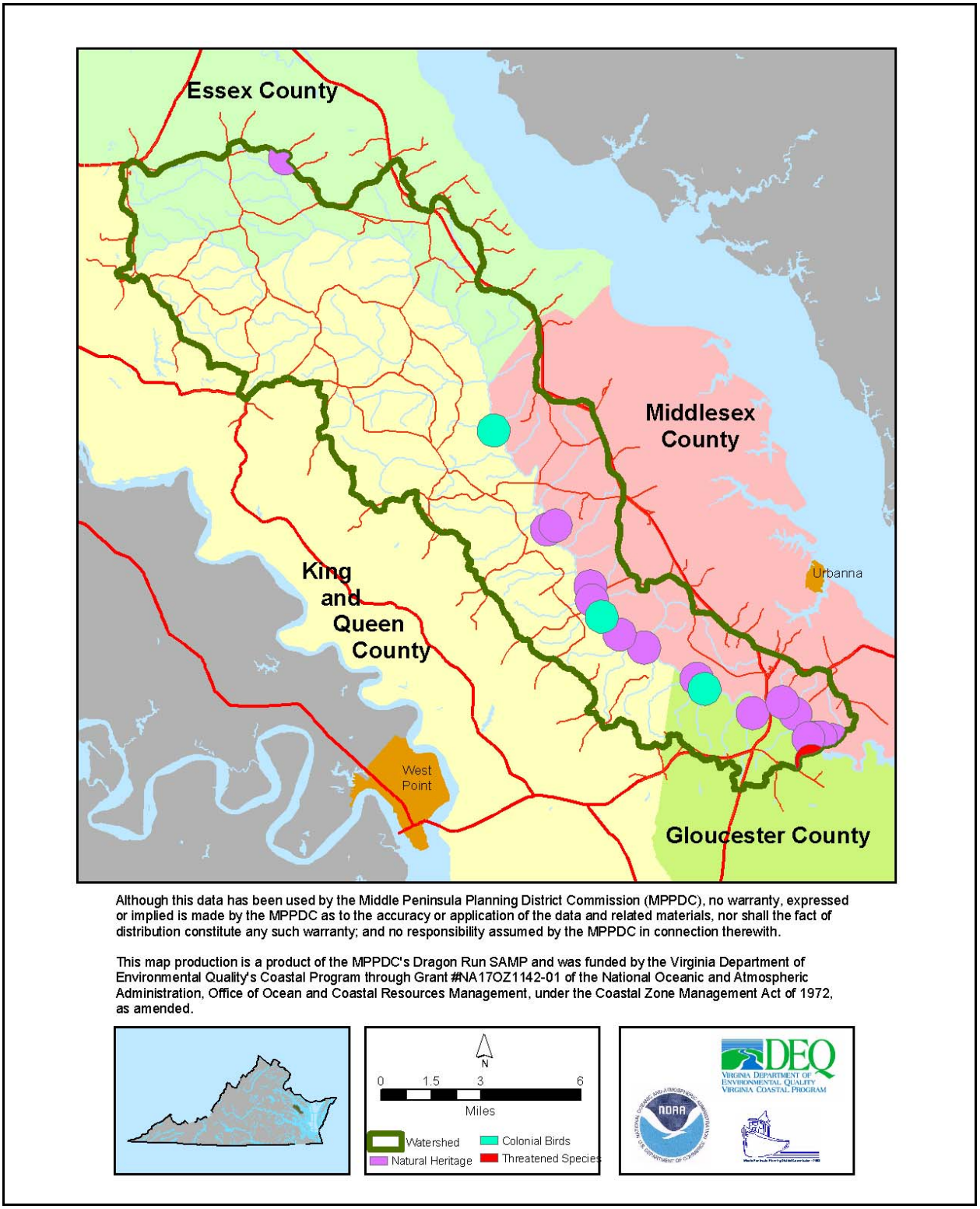


Figure 9. Occurrences of natural heritage resources in the Dragon Run watershed.

Baldcypress Woodland/Savanna, Fluvial Terrace Woodland, and Tidal Freshwater Marsh (see **Appendix A** for descriptions). The Baldcypress-Tupelo Swamp community (**Figure 10**) also harbors a number of rare plant and animal species. Rare animals include bald eagle, great purple hairstreak, blackwater bluet, robust baskettail, cypress sphinx, Selys' sunfly, fine-lined emerald and Southern pitcher-plant mosquito. Rare plants include cuckooflower, red turtlehead, Parker's pipewort, pineland tick-trefoil, river bulrush, Northern purple pitcher-plant, and cypress-knee sedge (Belden, Jr. et al., 2001; Belden, Jr. et al., 2003). The Dragon Run also harbors a number of rookeries for colonial water birds, such as egrets and herons. Other natural communities that occur in the Dragon Run include: Coastal Plain/Piedmont Bottomland Forest; Coastal Plain/Piedmont Acidic Seepage Swamp; and Coastal Plain Semipermanent Impoundment (Belden, Jr. et al., 2003).

Figure 10. Baldcypress-Tupelo Swamp community.

In addition to natural heritage resources, the Dragon Run supports a diversity of freshwater and estuarine fishes, aquatic macroinvertebrates, freshwater bivalves (primarily unionid mussels), and herptefauna (amphibians and reptiles) (McIninch et al., 2003). At least forty-five fish species from nineteen families have been collected in the Dragon Run, representing a mixed assemblage of mostly lowland freshwater forms that is highly dynamic spatially and temporally. At least sixty-five macroinvertebrate species from fourteen orders and forty-seven families have been recorded from the Dragon Run.

The watershed contains only limited examples of invasive, or non-native, species, again emphasizing a relatively intact natural system. Currently, blue catfish, common reed, Asiatic dayflower and Japanese stiltgrass occur in the Dragon Run in limited quantities (**Figure 11**).

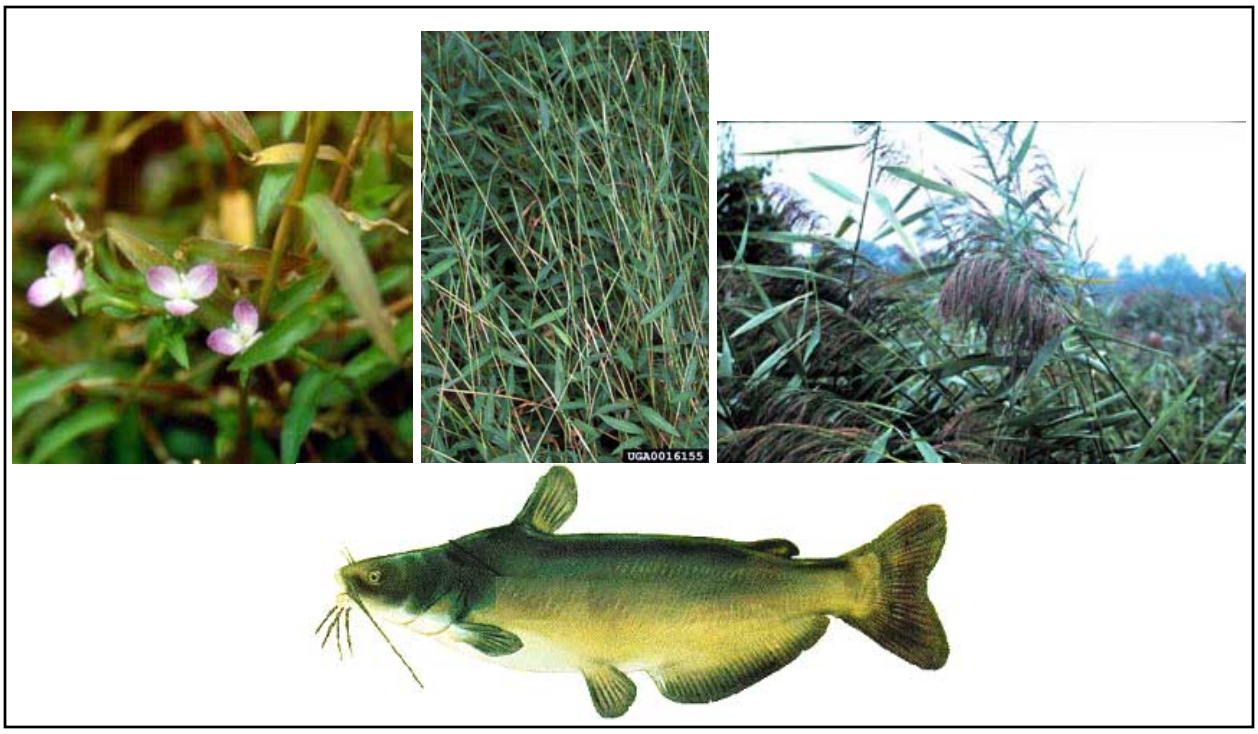


Figure 11. Invasive species of the Dragon Run - clockwise: Asiatic dayflower (Brent Steury, NPS); Japanese stiltgrass (Ted Bodner); Common reed (Joseph McCauley, USFWS); Blue catfish (www.landbigfish.com)

According to the National Wetland Inventory, wetlands along the Dragon Run (**Figure 12**) are Palustrine, mostly Forested Wetlands except for Emergent Wetlands in Meggs Bay. U.S. Route 17 is the approximate demarcation between tidal wetlands and non-tidal wetlands. The hydrologic regime of most Dragon Run wetlands is Seasonally Flooded, Seasonally Flooded-Saturated, or Temporarily Flooded (Belden, Jr. et al., 2001).

The U.S. Geological Survey (USGS) maintained a streamflow gaging station at Church View (Route 602) from 1943 to 1981 that received drainage from 60% of the watershed (84 square miles) and has maintained a streamflow gaging station at Mascot (Route 603) since 1981 that receives drainage from 75% of the watershed (105 square miles). Median daily streamflow at Mascot from 1981 to 1999 was 79 ft^3/sec and varied between 0.01-6050 ft^3/sec. Median daily streamflow at Church View from 1943 to 1981 was 57 ft^3/sec and varied from 0-3790 ft^3/sec. Compared to other coastal plain stream systems such as the Chickahominy River (New Kent County), the Mattaponi River (King William County), and Cat Point Creek (Richmond County), the Dragon Run exhibits lower median daily streamflow per square mile of drainage area. Base flow, fed primarily by groundwater discharge, accounts for two-thirds of the Dragon Run's total streamflow, with the remaining third attributable to surface water runoff. Of the annual precipitation, only one-third becomes streamflow, with two-thirds lost to evapotranspiration. Seasonally, streamflow is highest in the spring and lowest in the fall (MPPDC, 2001).

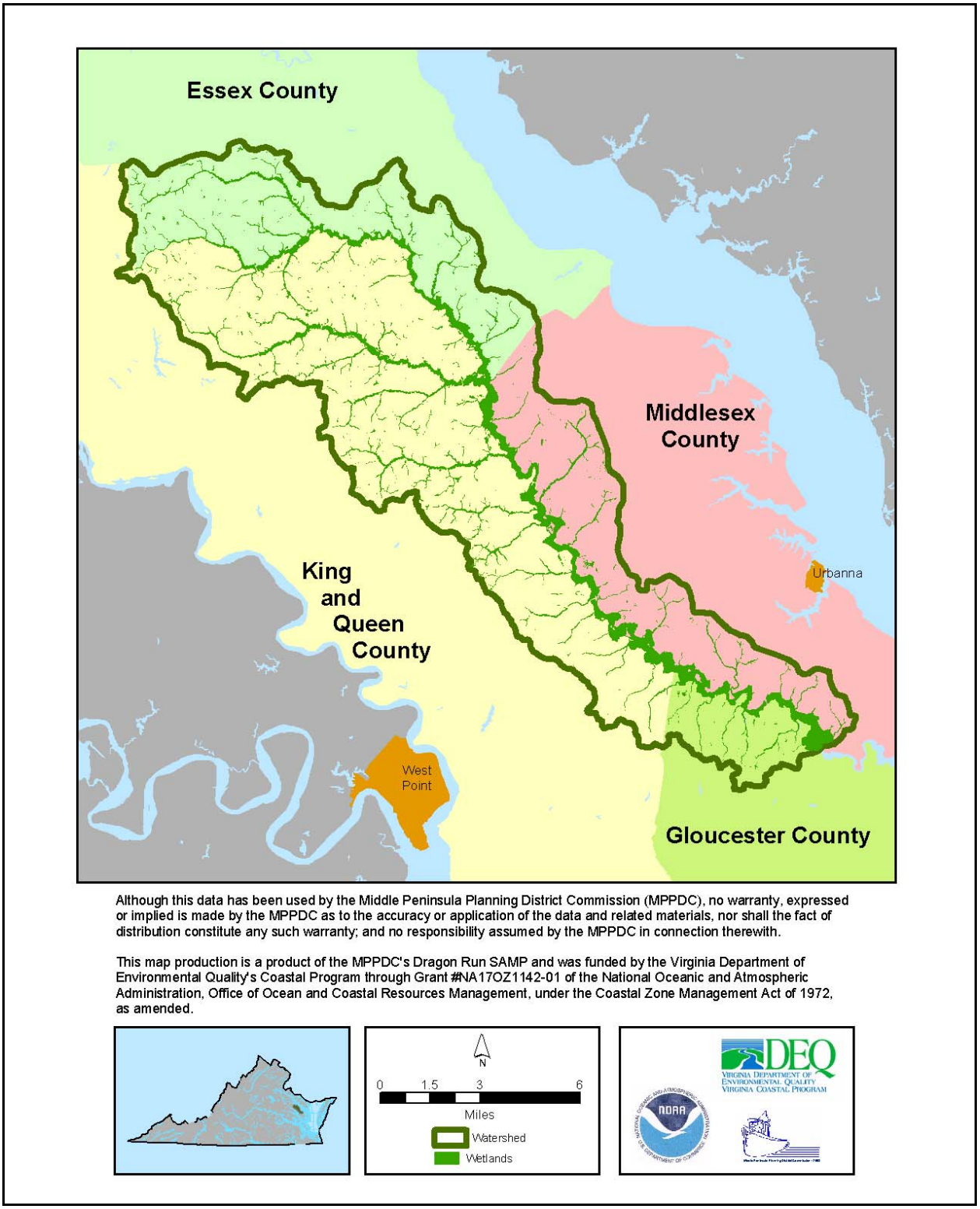


Figure 12. Wetlands in the Dragon Run watershed.

Geological features are described by the following excerpt from *A Natural Heritage Inventory of the Dragon Run Watershed* (Belden, Jr. et al., 2001):

Surficial deposits of riverine terraces bordering Dragon Run from the vicinity of the Essex-Middlesex county line to Meggs Bay belong to the Shirley Formation and the Sedgefield Member of the Tabb formation. The middle Pleistocene Shirley Formation consists of light- to dark-gray, bluish-gray and brown sand, gravel, silt, clay, and peat; the Sedgefield Member is of upper Pleistocene age and consists of pebbly to bouldery, clayey sand and fine to medium, shelly sand grading upward to sandy and clayey silt. Somewhat higher topography away from the waterway is underlain by the Chesapeake Group. This consists of fine to coarse quartzose sand, silt, and clay (variably shelly and diatomaceous) deposited in shallow waters of the upper Pliocene and lower Miocene periods. At still higher elevations, the Windsor Formation is found, consisting of gray and yellowish to reddish-brown sand, gravel, silt, and clay of lower Pleistocene or upper Pliocene age. At higher elevations southwest of Dragon Run, two other formations are prevalent, both of upper Pliocene age. The Bacons Castle Formation is characterized by gray, yellowish-orange, and reddish-brown sand, gravel, silt, and clay and the Moorings Unit by white, light gray, and grayish-yellow quartzose sand and clay to grayish-brown clayey silt and silty clay.

Watershed elevation ranges from 180 feet to near sea-level. Detailed soils information can be found in the *Soil Survey* for each county (Note: King and Queen County does not have a published *Soil Survey*). Many of these soils are considered prime farmland and are suitable for silviculture. Generally, soil associations are as follows:

<u>Essex County</u>

Emporia-Slagle-Atlee; Rumford-Suffolk-Emporia - somewhat excessively drained to moderately well drained loamy and sandy soils (Hoppe, 1989)

<u>Middlesex County</u>

Suffolk-Eunola-Remlik; Kempsville-Suffolk-Kinston; Emporia-Slagle-Nevarc - deep, well drained to poorly drained loamy or clayey soils (Newhouse et al., 1985); Pocaty-Kinston-Bibb - deep, very poorly to poorly drained organic and loamy soils that are flooded by fresh and brackish water (Newhouse et al., 1985)

<u>Gloucester County</u>

Suffolk-Eunola-Kenansville; Emporia-Hapludults-Wrightsboro - deep, well drained to moderately well drained loamy or clayey soils (Newhouse et al., 1980)

DCR's Shoreline Erosion Advisory Service identified five areas of streambank erosion in the lower Dragon Run (Vanlandingham, 2003). The lower Dragon Run undergoes an average of less than one foot per year of erosion that is mostly attributable to high water flow undercutting the stream bank during storms. These erosion "hot spots" are relatively few and small and are unlikely to cause impairment to the stream.

Water Quality

<u>Water Quality Assessment</u>

The primary water contaminant sources in the Dragon Run are point source discharges and nonpoint source pollution from precipitation (atmospheric deposition), residential land use, agricultural land use, and forested lands (MPPDC, 2002). According to the Virginia Department of Environmental Quality (DEQ), the Dragon Run generally exhibits

medium nutrient levels and is listed as “impaired” for pH, fecal coliform bacteria, mercury, and lead (DEQ, 2002). Based on agricultural, urban, and forested pollution loadings potential determined by DCR, however, the overall nonpoint source pollution potential rating is low for the Dragon Run (DCR, 2002).

Point source discharges, which are permitted and monitored by the Virginia Department of Environmental Quality, are relatively easy to quantify and, in turn, control or track. Point source discharges to the Dragon Run include: stormwater runoff from a wood treatment facility (arsenic, chromium, copper) at Pitts Lumber Company, Inc. to an intermittent stream adjacent to U.S. Route 17 in Middlesex County (Permit #VA0083011); discharge from a sewage treatment plant (biological oxygen demand, total suspended solids, ammonia nitrogen, total residual chlorine, pH, fecal coliform) at Rappahannock Community College to an intermittent stream near Glenns in Gloucester County (Permit #VA0028461); and discharge from a wellwater treatment plant (pH, total suspended solids) at the Miller’s Square Subdivision to an intermittent stream near Miller’s Tavern in Essex County (Permit #VA0075302). According to the Shoreline Sanitary Survey (Smither et al., 2003), there are 9 other indirect sources of pollution, including five animal pollution sources (Middlesex County near Saluda and Stormont and Gloucester County near Glenns); a solid waste dumpsite in Middlesex County near Stormont; and a potential pollution source in Middlesex County in Saluda. Furthermore, a network of water quality monitoring wells is maintained at the Browning-Ferris Industries landfill in King and Queen County.

Throughout the Chesapeake Bay, atmospheric deposition (e.g. precipitation) contributes a significant amount of the total nutrient loadings in coastal waters (MPPDC, 2001). Air quality is not currently monitored in the watershed.

More than 90% of residents in Gloucester, King and Queen, and Middlesex Counties use on-site wastewater treatment systems, commonly known as septic systems (MPPDC, 2001). When operated properly, conventional septic systems remove nutrients and fecal coliform. Conventional septic systems can pose potential environmental and health risks due to inappropriate design, poor maintenance, poor soils, or inefficient nitrogen removal. Driven by changes to Department of Health regulations for on-site wastewater treatment systems (12 VAC 5-610-10 et seq. effective July 2000), the popularity of “engineered” on-site wastewater treatment systems is increasing. These alternative systems, when properly maintained, can be effective at removing nutrients and fecal coliform in areas where conventional septic systems are ineffective. Regardless of the type, however, improperly maintained or failing septic systems pose significant environmental and health risks by contributing nutrients, pathogenic bacteria, and viruses to groundwater.

Forested lands, representing a significant land area, yield low nutrient input to streams relative to other land uses in the watershed. Best Management Practices (BMPs) are designed to minimize these inputs. For example, forested riparian buffers provide effective protection for water quality. The watershed currently exhibits intact riparian buffers.

By contrast, agricultural land use in rural and semirural areas in Virginia can be the source of significant sediments, fecal coliform bacteria, and nutrients such as nitrogen and phosphorus. Nitrogen is transported through the groundwater, whereas phosphorus is generally transported on soil particles in surface water. BMPs such as fencing cattle out of streams, conservation tillage, and expanded riparian buffers are designed to minimize these inputs.

Residential and commercial land uses typically contribute less nutrients and sediments than agriculture, but more than forestry. These residential and commercial contributions are mainly attributable to reduced or no riparian buffers, chemical application for landscaping, and stormwater runoff.

Water Quality Monitoring

Water quality data sets in the watershed are sparse in quantity, duration, and parameters measured. Existing data sets include: STORET, a database managed by the Virginia Department of Environmental Quality (DEQ); data collections during fish surveys by the Virginia Department of Game and Inland Fisheries (DGIF) and Virginia Commonwealth University (VCU); data collections by the Chesapeake Bay National Estuarine Research Reserve in Virginia at the Virginia Institute of Marine Science (VIMS); and a now-defunct volunteer water quality monitoring program in the watershed (MPPDC, 2001).

Two stations are currently sampled regularly by the DEQ. Station DRN003.40 is located at the U.S. Route 17 bridge and Station DRN010.48 is located at the Route 603 bridge near Mascot. Data are available from DRN003.40 for the period 1968-1974 and 1992-present and from DRN010.48 for the period 1992-present. Samples are evaluated bimonthly for nutrients, fecal coliform, suspended solids, dissolved oxygen, pH, salinity, and temperature and are occasionally evaluated for pesticides, toxic metals, and other harmful compounds (MPPDC, 2001). The data sets collected at these sampling stations were used by the DEQ to list the Dragon Run as “impaired” for pH and fecal coliform bacteria. Fish tissue samples were used by the DEQ to list the Dragon Run as “impaired” for mercury and lead. The Virginia Department of Health issued a health advisory for the Dragon Run for mercury contamination in largemouth bass (DOH, 2003). The DEQ attributes the pH impairment to natural causes, citing the acidic nature of water in swamps. The DEQ lists the cause of the fecal coliform and mercury and lead impairments as unknown. Potential sources of fecal coliform bacteria include: wildlife; failing septic systems; and livestock. Potential sources of metals include: atmospheric deposition; automobile and roadway deposits; and industrial operations.

Data collected by the DGIF in 1995-1996 and 1998 includes temperature, Secchi depth, pH, dissolved oxygen, conductivity, salinity, alkalinity, hardness, and total dissolved solids. Nutrient data are very limited and were frequently below detection limits. Dissolved oxygen at sampling stations with no or low flow frequently violated daily minimum standards to support aquatic life (MPPDC, 2001).

VIMS data from 2000-2001 measured temperature, salinity, total dissolved solids, pH, dissolved inorganic nitrogen, and fecal coliform bacteria. Of specific note, samples from Briery Swamp exhibited high nitrate and fecal coliform levels, indicating the presence of subsurface agricultural or wastewater drainage (MPPDC, 2001).

A weekly volunteer water quality monitoring program collected data throughout the watershed during the period 1994-1997, although monitoring was not continuous at all eight sites. Measurements included dissolved oxygen, Secchi depth, water and air temperature, pH, and water color. The findings indicated: low dissolved oxygen during warm temperatures and high dissolved oxygen during cold temperatures; low Secchi depth values during the summer associated with algal blooms and storm events; and acidic pH values in the upper Dragon Run with slightly more basic pH values in the tidal waters (MPPDC, 2001).

Impervious Cover

One key indicator of water quality status and stream health is the percentage of impervious surface in a watershed. The Dragon Run watershed exhibits a very low level of impervious cover and, in turn, is in good condition (e.g. natural heritage resources).

Impervious surfaces (e.g. paved streets and parking lots, rooftops) are hardened areas that do not allow infiltration of rainwater and promote runoff to streams. This runoff often occurs at a higher volume and velocity than normal stream flow and can lead to stream erosion and instability. Runoff also carries pollutants that are not absorbed by soil and plants and can lead to degraded water quality. The Center for Watershed Protection (2002) has developed a watershed vulnerability analysis that relies on an impervious cover model. The model indicates that watersheds are generally in good condition when impervious cover is less than 10%. From 10-25% impervious cover, watersheds are generally impacted, which means that they only partially support their intended uses (e.g. drinking, swimming, shellfish harvest). Above 25% impervious cover, watersheds generally do not support their intended uses at all.

Impervious cover can be estimated for the Dragon Run watershed. Based on the 1994 aerial photography, we learn that 1.3% of the watershed is commercial or residential development. Assuming 100% imperviousness, a highly conservative estimate, the watershed is approximately 1.3% impervious surface. The sparse road network is likely to add modestly to this estimate. Since the Dragon Run watershed exhibits less than 10% impervious cover, the Center for Watershed Protection's model (2002) predicts that it is in good condition, which is confirmed by the MPPDC's Dragon Run Watershed Land-Water Quality Preservation Project (MPPDC, 2001).

Recreation and Access

Significant recreational activities and opportunities exist in the Dragon Run watershed, including hunting, fishing, hiking, and boating. Educational opportunities and activities also exist. Meanwhile, access often requires landowner permission; public access is limited.

Hunting represents a significant recreational activity that generates at least $300,000 per year in the watershed. Seventeen hunt clubs lease approximately 42,000 acres, or 46%, of land in the watershed for hunting - mainly deer, turkey, and waterfowl (MPPDC, 2002). Hunt club leases provide income to landowners and offer hunting access to many acres of private lands.

Fishing is also a significant recreational activity in the Dragon Run. According to the DGIF, the Dragon Run's share of the state's fishing value is more than $1.6 million, including trip related expenses such as food and lodging and transportation (MPPDC, 2002). Fishing by boat is popular in the lower Dragon, while bank and fly fishing are more common in the upper Dragon. Fishermen regularly use the public, unpaved lot at Route 603 near Mascot, and a public boat ramp exists at Harcum in the Piankatank River (Gloucester County). Otherwise, landowner permission is generally required.

The Virginia Birding and Wildlife Trail for the Coastal Area, published in 2002 (DGIF, 2002a), describes two sites within the Dragon Run watershed. First, Rappahannock Community College (public), located in Glenns on State Route 33 in Gloucester County, offers wooded trails adjacent to a tributary to the Dragon Run. Second, the Friends of Dragon Run (private) offer a birding trail with views of the Dragon Run and the Baldcypress-Tupelo Swamp community. The site is located near Mascot on Route 603 with parking in a public, unpaved lot. It is important to note that the Friends' site and adjacent properties are privately owned.

Additionally, a 121-acre tract on Route 603 near Mascot is part of the Virginia Estuarine and Coastal Research Reserve System (public). The site can be accessed with permission and is used for research, long-term monitoring and education.

Besides the sites near Route 603, the Dragon Run Access Plan (MPPDC, 1994) indicates other traditional access sites in the watershed. Landowner permission is generally required at these sites, which include: Route 604 at the Essex/King and Queen county line (Byrd's Bridge); Route 602 at the Middlesex/King and Queen county line (Ware's Bridge); and U.S. Route 17 at the Middlesex/Gloucester county line (James Vincent Morgan Bridges).

Boating is also a significant recreational activity in the watershed. Motorized pleasure craft seasonally utilize the lower Dragon. Self-propelled boating is common from Route 602 to Meggs Bay. For example, waterfowl hunters often make short trips in canoes or jon boats, while guided and unguided paddling trips also occur. Several organizations offer guided paddling trips on the Dragon Run (**Figure 13**), including Gloucester County Parks and Recreation (2 trips/summer; ~30 people/summer); Chesapeake Bay Foundation (since 1995, 56 trips; 1080 people; for middle and high school students in Middlesex and Gloucester Counties); Rappahannock Community College (1 3-day trip/year; ~20 people); and Friends of Dragon Run (15-20 trips/year; ~200 people/year). Some outdoor outfitters offer guided trips by appointment.

Figure 13. Guided paddling trip on the Dragon Run.

Watershed Education

Limited watershed education efforts include workshops, field trips, and publications. Soil and Water Conservation Districts, Virginia Cooperative Extension, and the Natural Resources Conservation Service offer a variety of workshops, seminars, and publications related to watersheds, nonpoint source pollution, agriculture, and forestry. These programs mainly target those involved in agriculture and forestry activities. Rappahannock Community College and the Chesapeake Bay Foundation both lead students on paddle trips. The Friends of Dragon Run offer paddle trips to citizens and decision-makers. Finally, local governments provide publications explaining land use regulations. For example, King and Queen and Middlesex Counties distribute fact sheets about pertinent ordinances to new and prospective property owners.

Infrastructure and Planning

To effectively characterize the watershed's landscape and how it may change in the future, existing infrastructure and plans guiding future development must be assessed.

Future Land Use

Local comprehensive plans are intended to serve as the county's guide to its vision for the future. One of the most important elements of a comprehensive plan is future land use designation. In general, future land use throughout the Dragon Run watershed is primarily designated as rural in the comprehensive plans of the four counties. There exists, however, a wide range of specific land use designations within the watershed, ranging from industrial to commercial to town-like development, rural residential and rural preservation (**Figure 14**).

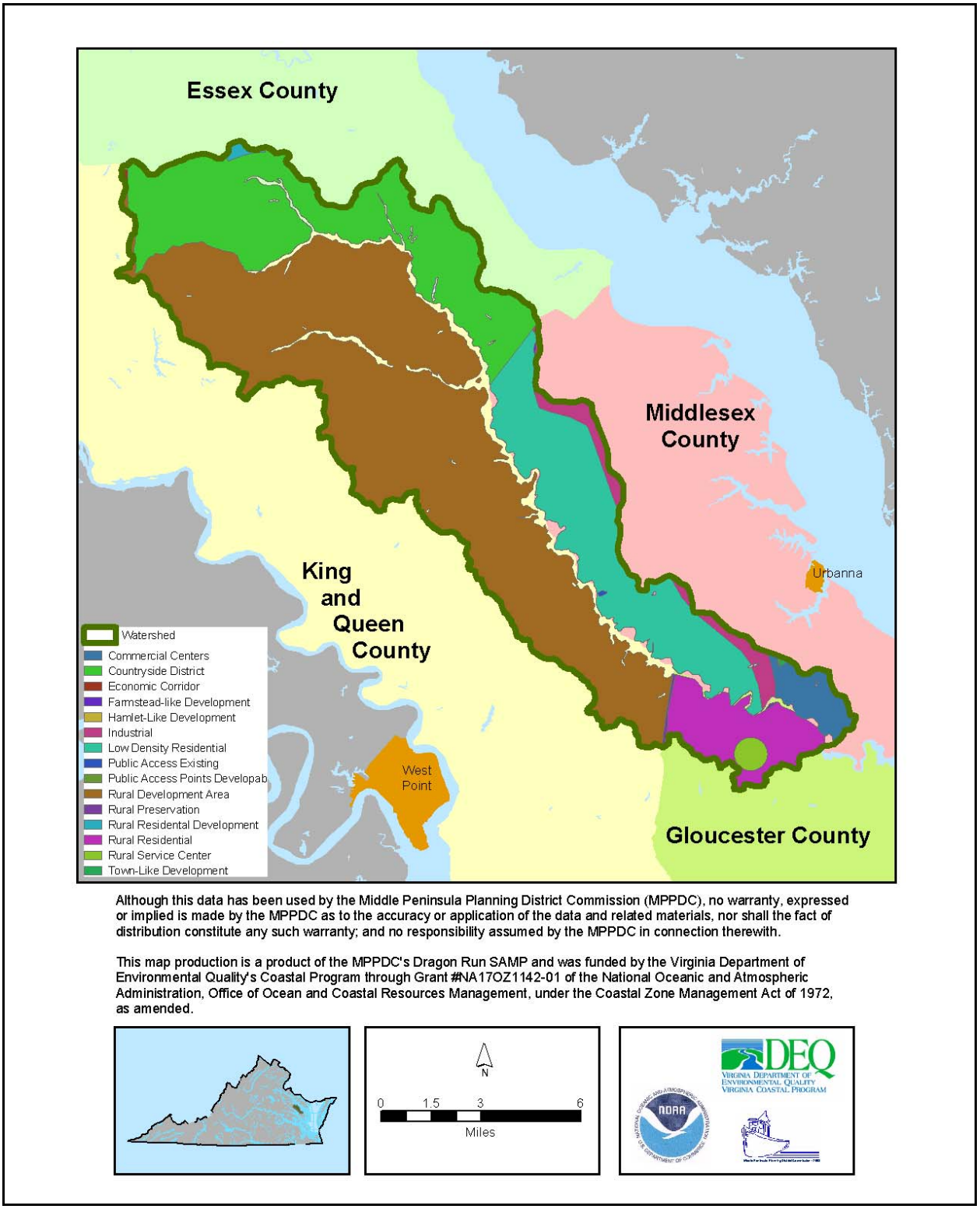


Figure 14. Future land use in the Dragon Run watershed.

Land use designations are tied to existing land uses, infrastructure, and anticipated growth patterns. It is clear through the comprehensive plans that localities expect that the majority of the watershed will remain rural, dominated by farming and forestry. Specific areas, like those along major roadways such as U.S. Route 17 and VA Route 33, are more suited to industrial and commercial development. Conversely, the swamps and streams of the Dragon Run do not lend themselves to development.

Zoning

Zoning is designed to regulate the use of land to ensure land use compatibility. Logically, then, zoning is the regulatory implementation of provisions in the comprehensive plan. Therefore, the Dragon Run watershed is zoned primarily in rural districts, with limited areas in conservation, industrial, commercial and residential districts (**Figure 15**).

The majority of the watershed is zoned for agricultural uses, with varying restrictions and allowances across county boundaries. Significant commercial and industrial zoning occurs along U.S. Route 17 throughout Gloucester and Middlesex Counties. Furthermore, the landfill in King and Queen County owned by Browning-Ferris Industries is zoned industrial. Both King and Queen and Middlesex Counties maintain the Dragon Run Conservation District along the main channel of the Dragon Run. King and Queen's Dragon Run Conservation District is not mapped.

Distinctions between major and minor subdivisions, density requirements, and permitted uses vary widely across zoning district types and among counties. As a result, on-the-ground conditions can and do vary considerably across county boundaries. For instance, the maximum number of lots permitted by right (e.g. minor subdivisions) in agricultural and conservation districts ranges from 2-6 lots.

Other Ordinances and Regulations

The counties also employ other ordinances and regulations. These include Chesapeake Bay Preservation Act provisions or ordinances, wetlands ordinances, erosion and sediment control provisions and ordinances, subdivision ordinances, and site plan review. Some of the major effects of these regulations include land use restrictions and development standards in Chesapeake Bay Preservation Areas and the prohibition of major subdivisions in agricultural zoning districts.

A major difference between the counties is how the Resource Management Areas (RMA) are defined. Gloucester County defines RMA as any area outside of the Resource Protection Area (RPA) countywide. Essex County effectively applies RMA restrictions countywide, while King and Queen and Middlesex Counties apply a buffer landward of the RPA.

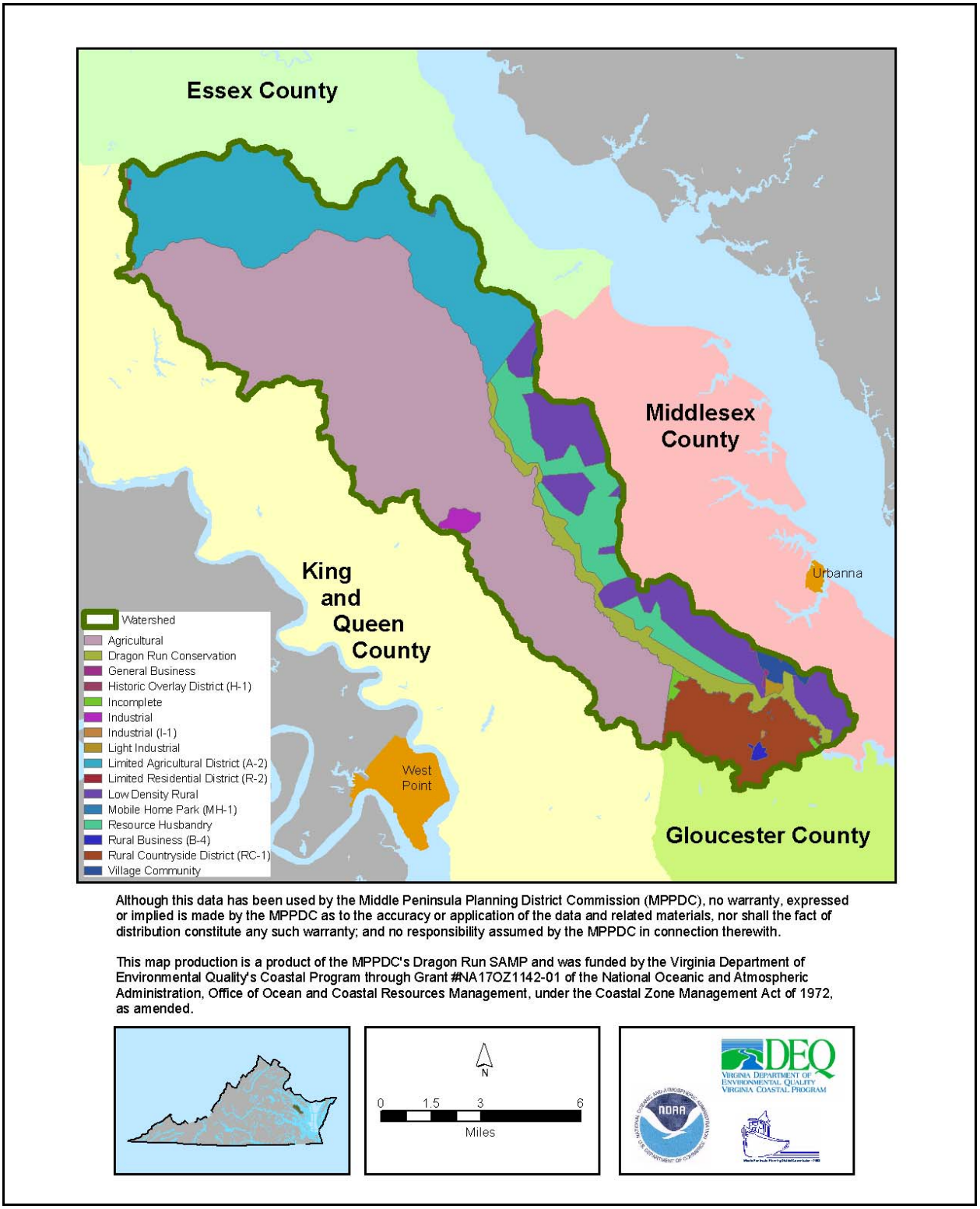


Figure 15. Zoning classifications in the Dragon Run watershed.

Road Network

The road network within the watershed could be described as sparse (**Figure 16**), with few primary highways. The primary highways are U.S. Route 17, which runs north and south through Gloucester, Middlesex, and Essex Counties, and State Route 33, which runs east and west through King and Queen, Gloucester, and Middlesex Counties. Logically, these highways contain the most development within the watershed and are designated for that purpose in the comprehensive plans. These two highways intersect at Glenns in Gloucester County and Saluda in Middlesex County, which are both designated as rural business districts. A short length of State Route 198, a primary highway, runs east from Glenns in Gloucester County before leaving the watershed.

There is a sparse network of secondary roads, some of which serve as connectors along the road network. Route 603 and Route 602 both cross the middle Dragon Run and connect King and Queen and Middlesex Counties. Route 604 and Route 612 both cross the upper Dragon Run and connect Essex and King and Queen Counties. Route 684 serves as a connector between U.S. Route 17 and U.S. Route 360 in Essex County. Several other secondary roads serve as significant links within the road network. Examples of these are: Route 644 in Middlesex County; Routes 609, 610, 616, and 617 in King and Queen County; and Route 607 in Essex County. Finally, there is a network of unpaved logging, farm, and residential roads that access the more remote parts of the watershed.

Land Parcels

According to data collected in 2001, there are 3,073 parcels of land in the Dragon Run watershed (**Figure 17**) (MPPDC, 2002). The distribution of parcels is: Essex (25%); Gloucester (11%); King and Queen (38%); and Middlesex (26%). The land area within the watershed is distributed as follows: Essex (21%); Gloucester (6%); King and Queen (52%); and Middlesex (21%). Comparing the distribution of parcels to the distribution of land area within the watershed, we find that Essex, Gloucester, and Middlesex Counties have a higher percentage of parcels than of land area, meaning that they have smaller average parcel sizes than King and Queen County. King and Queen County has a much higher percentage of land area than of parcels, indicating a much larger average parcel size than the other three counties.

Land ownership is almost entirely private. A considerable amount of private land is owned by timber interests. For example, the single largest owner, John Hancock Life Insurance Company, owns approximately 26,000 acres (28.9% of the watershed). Much of this timber land is, in turn, leased to hunt clubs. Public ownership includes the College of William and Mary (121 acres) and the Virginia Department of Transportation (fee simple and prescriptive easements for roads and right-of-way).

Conservation

The Virginia Division of Natural Heritage has established conservation planning boundaries (**Figure 18**) around natural heritage resources - rare species and natural communities - based on their habitat needs to ensure their preservation. These conservation sites represent the ideal conservation scenario for these state and globally

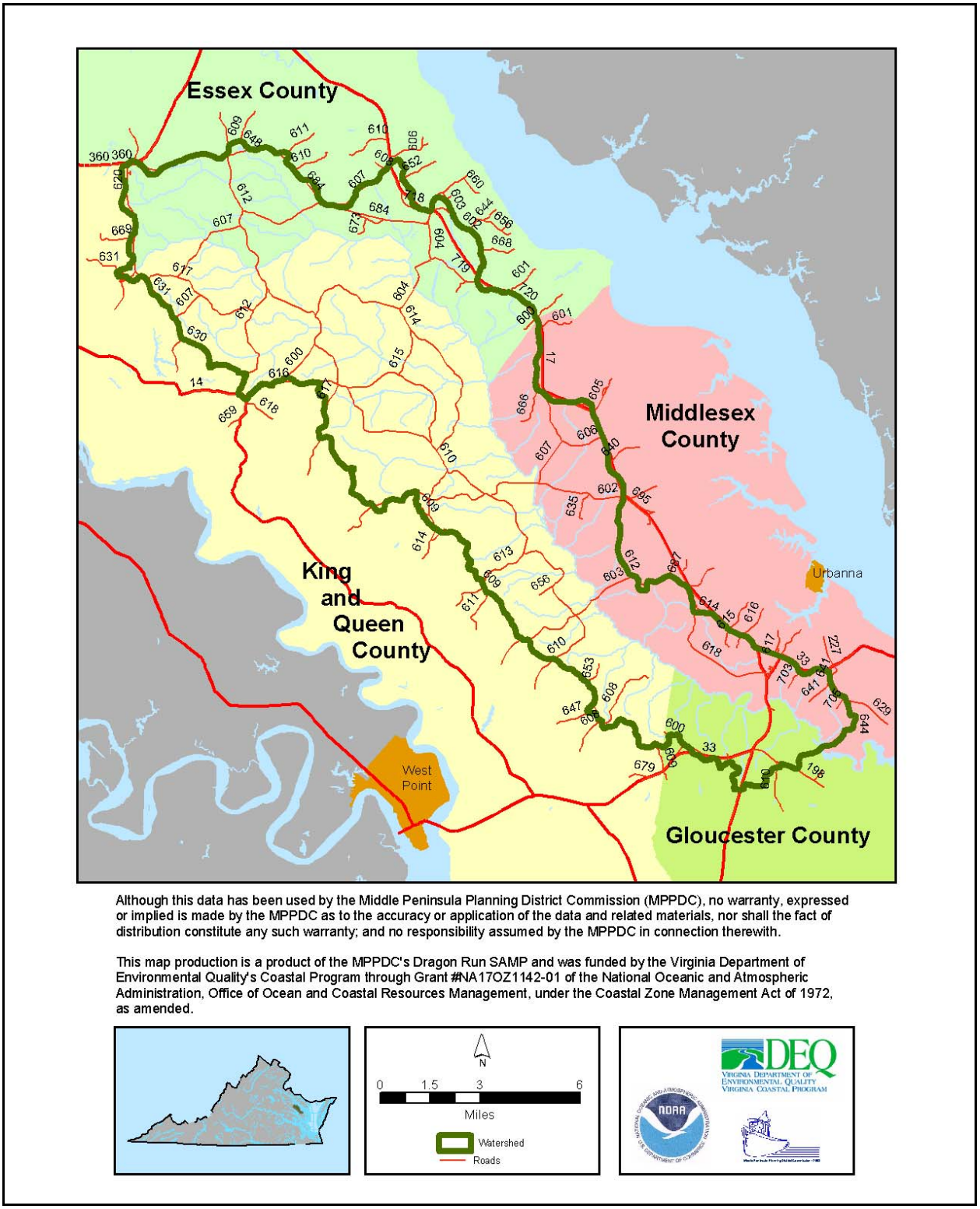


Figure 16. Road network in the Dragon Run watershed.

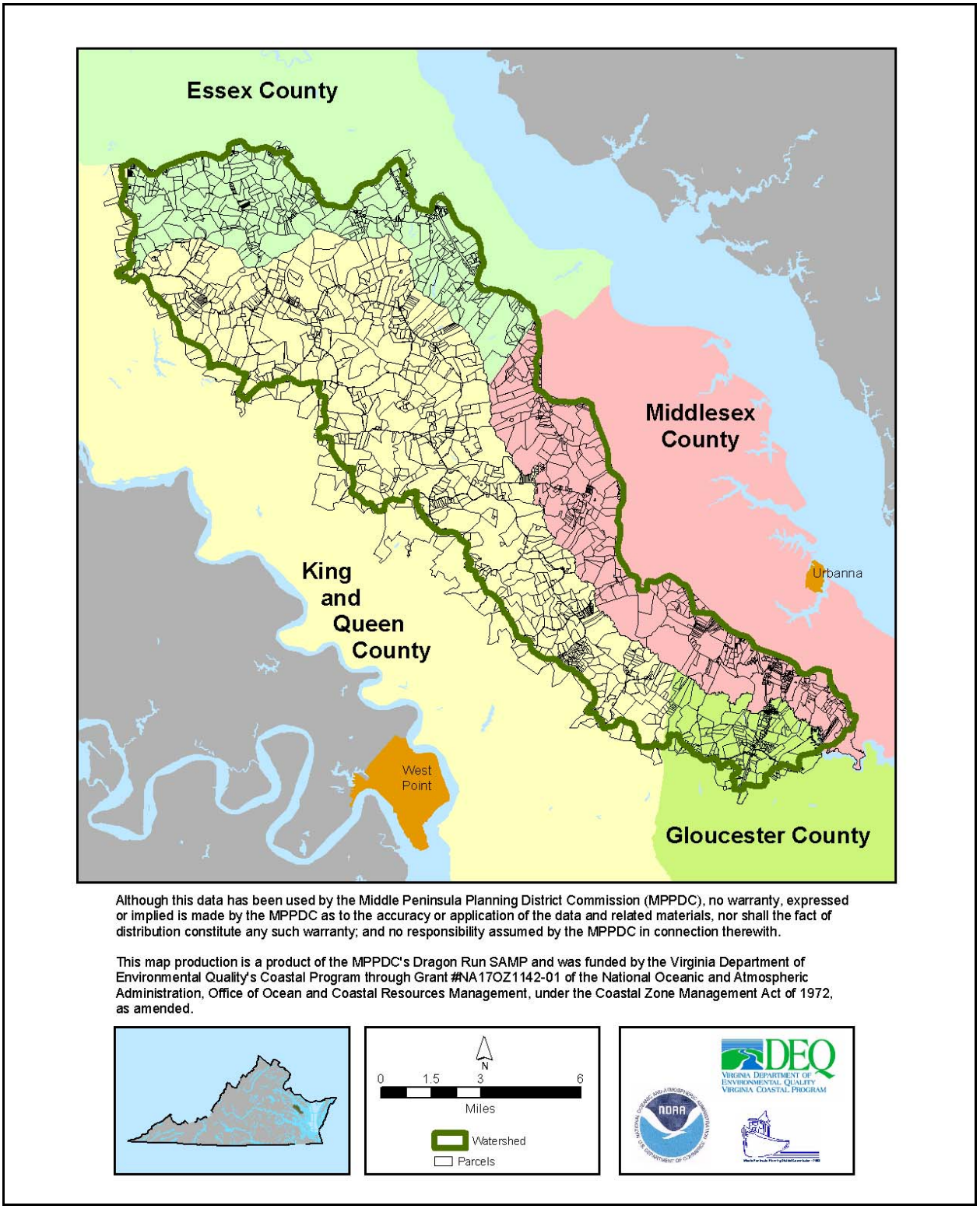


Figure 17. Parcels of land in the Dragon Run watershed.

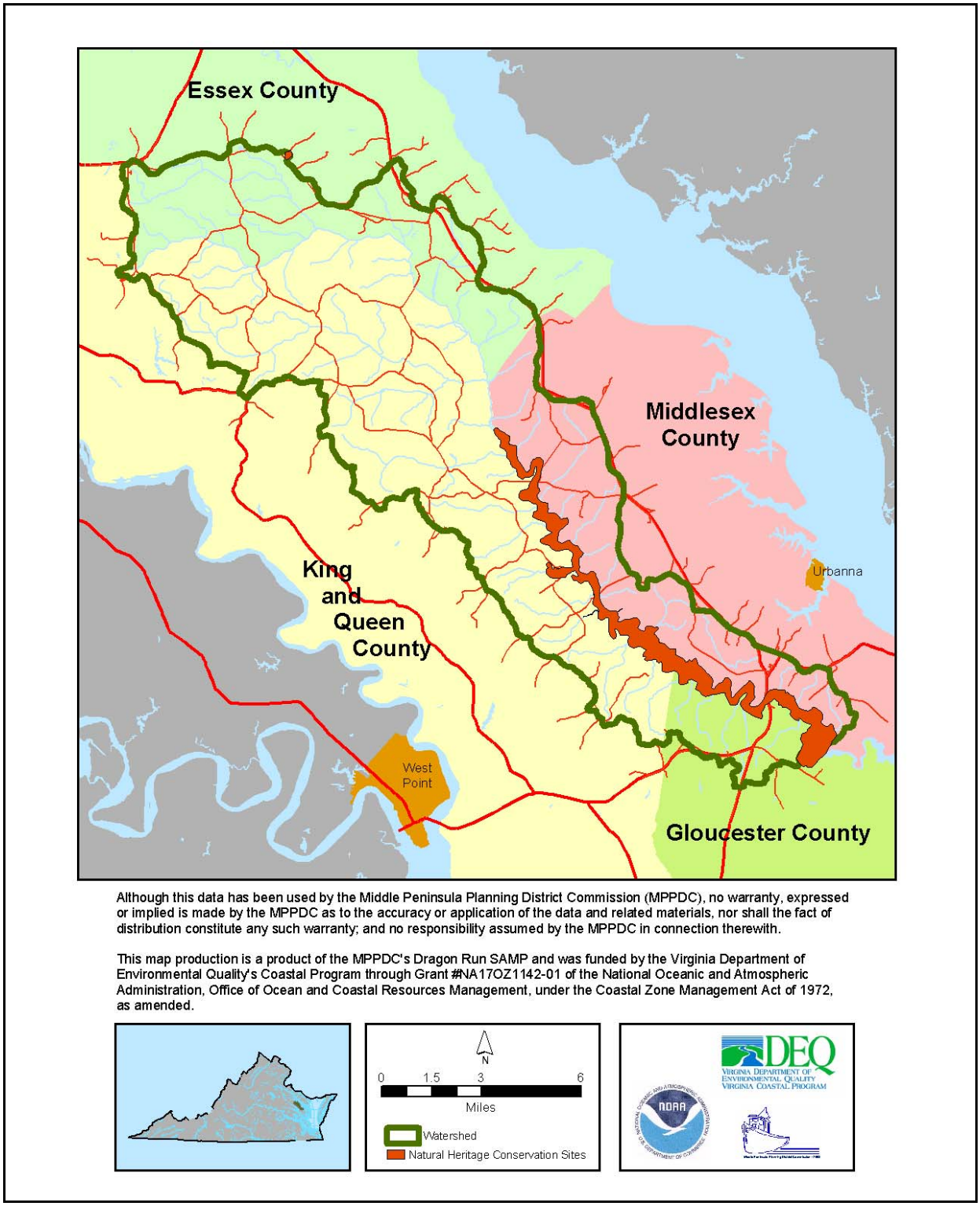


Figure 18. Natural heritage conservation sites for the Dragon Run watershed.

rare resources. Some of these resources have been conserved, either through fee simple purchase or purchase of conservation easements (**Figure 19).** Conservation easements are held on 235 acres by the Virginia Outdoors Foundation, 72 acres by Friends of Dragon Run, and 32 acres by the Chesapeake Bay Foundation.

Structures

Interpretation of digital orthophoto quadrangles from 1994 revealed that there were 1,311 structures or clusters of structures (e.g. barns and accessory buildings) in the Dragon Run watershed (**Figure 20**) (MPPDC, 2002). As expected, the majority of the structures are located along the primary highways and, to a lesser degree, along the secondary road network. It is likely that population growth and accompanying residential structures will continue to follow this pattern.

Sustainable Economic Development

Landowners find it increasingly difficult to sustain farm and forest operations. Virginia's River County, the Middle Peninsula's business development partnership, finds that sustainable economic development in the region is limited and the farming and forestry industries are suffering losses (VRC, 2002). Virginia's River Country indicates in its strategic plan that one of its priorities is to promote sustainable growth in resource-based industries (e.g. forestry, farming, nature-based tourism) to preserve natural resources from the pressures of development. In other words, the region has opportunities to develop the capacity to produce sustainable and value-added forest and agricultural products.

Buildout analysis

A buildout analysis offers an assessment of the potential number of lots allowed by land use regulations. Assessments may be based upon the number of lots allowed by right or upon the number of lots allowed by exception or by rezoning.

Based on a supplement to the *Dragon Run Land Use Policy Audit* (MPPDC, 2003), it is estimated that there is a potential for 3,916 parcels allowed by right (i.e. without the need for an exception or rezoning). This estimate is founded upon the number of lots and the minimum lot size permitted by right for minor subdivisions. The result represents a 27% increase in the potential number of parcels. An example of potential development under current land use policies in the watershed is featured in **Figure 21**.

As part of the *Dragon Run Management Framework* (MPPDC, 2002), a buildout analysis was completed based on both the potential number of lots allowed by right, by exception, or by rezoning. The analysis evaluated buildout based on both "build-compatible" values (i.e. wetlands) and "environmental" values (i.e. wetlands, topography [slope], floodplains, land cover, conservation easements, threatened and endangered species locations, and conservation species sites). An index was created based on these values and those that ranked low for development unsuitability were assessed for their development potential under current zoning designations. Based on zoning and subdivision rules, "theoretical lots" were then calculated within

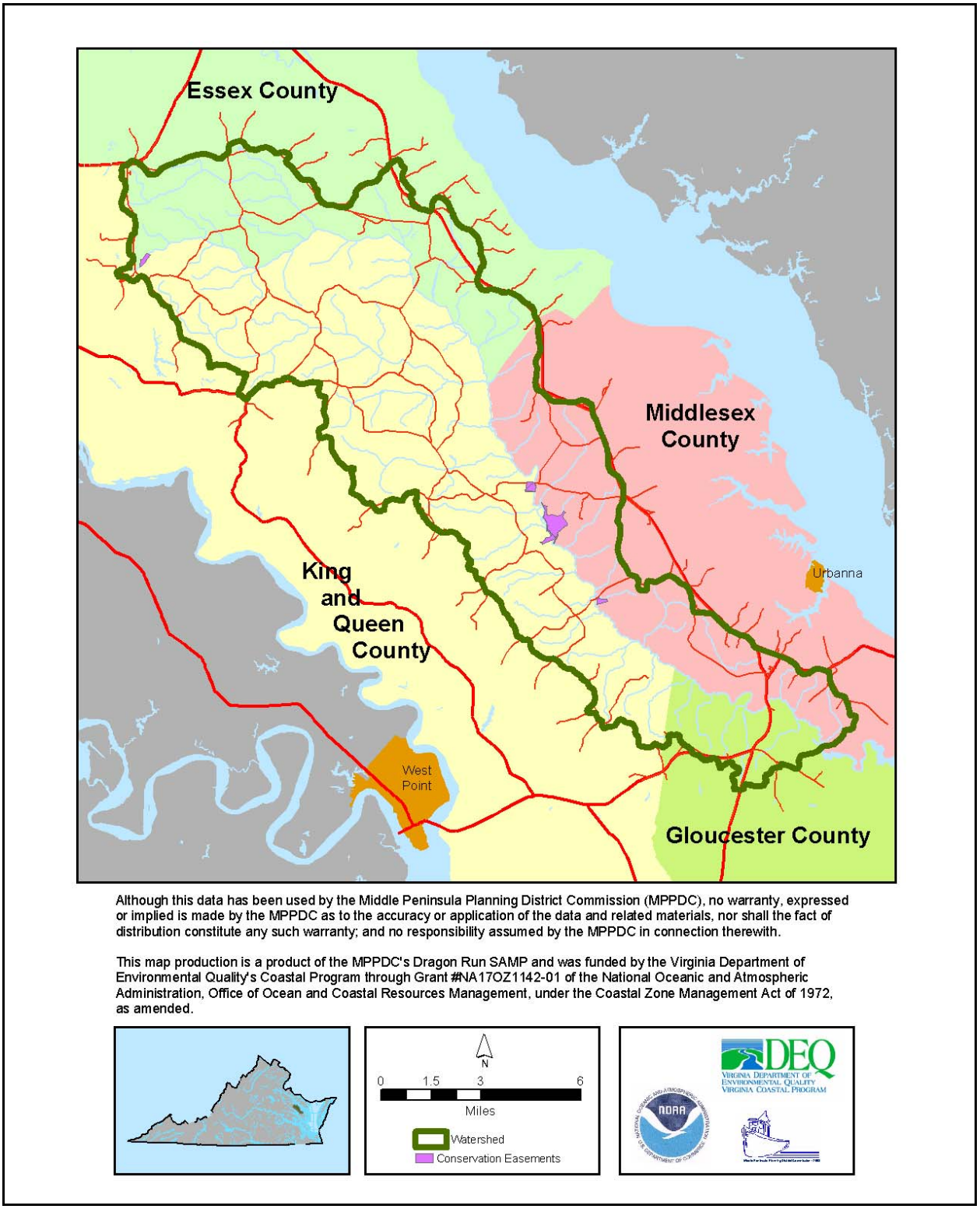


Figure 19. Conservation easements in the Dragon Run watershed.

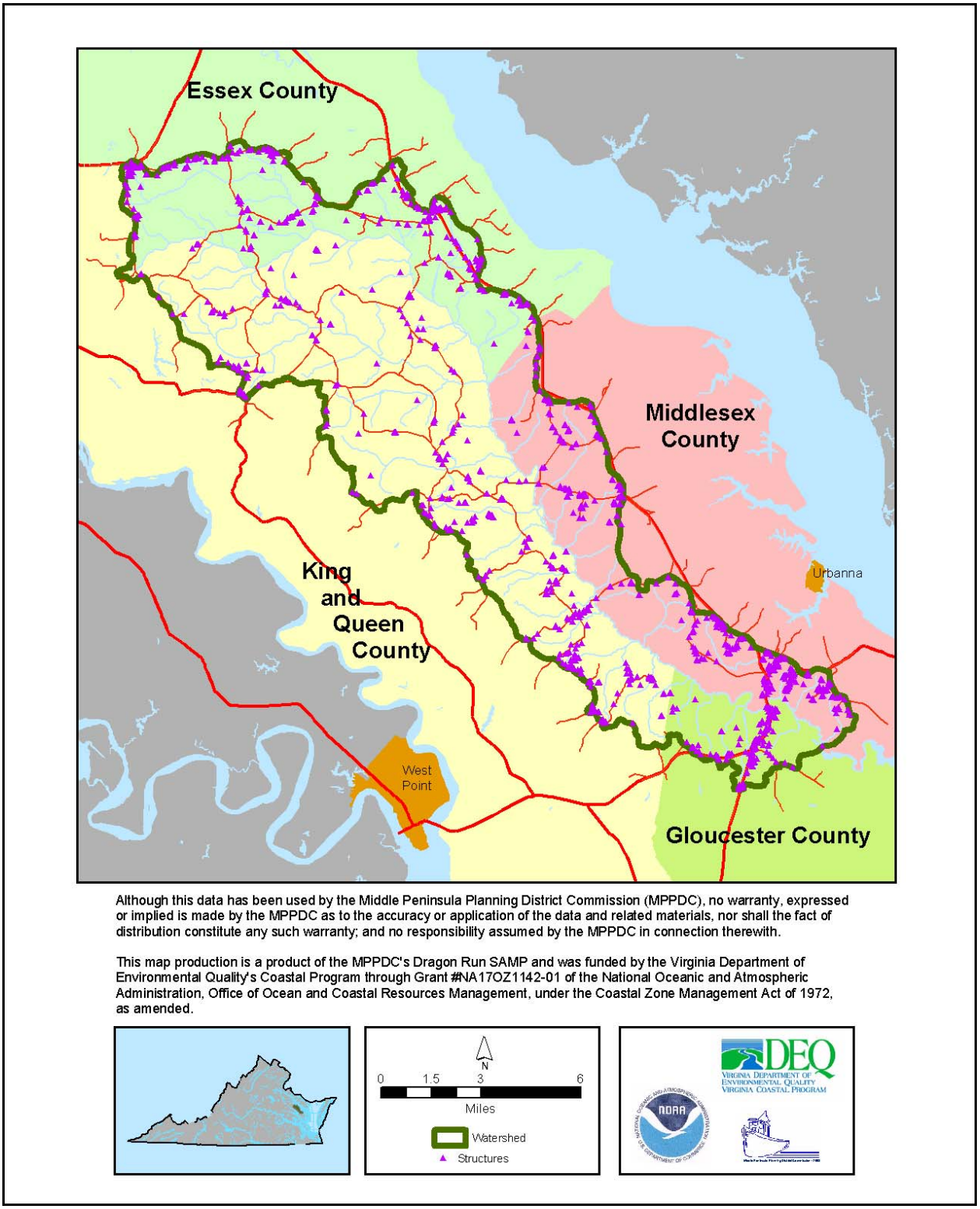


Figure 20. Structures in the Dragon Run watershed.

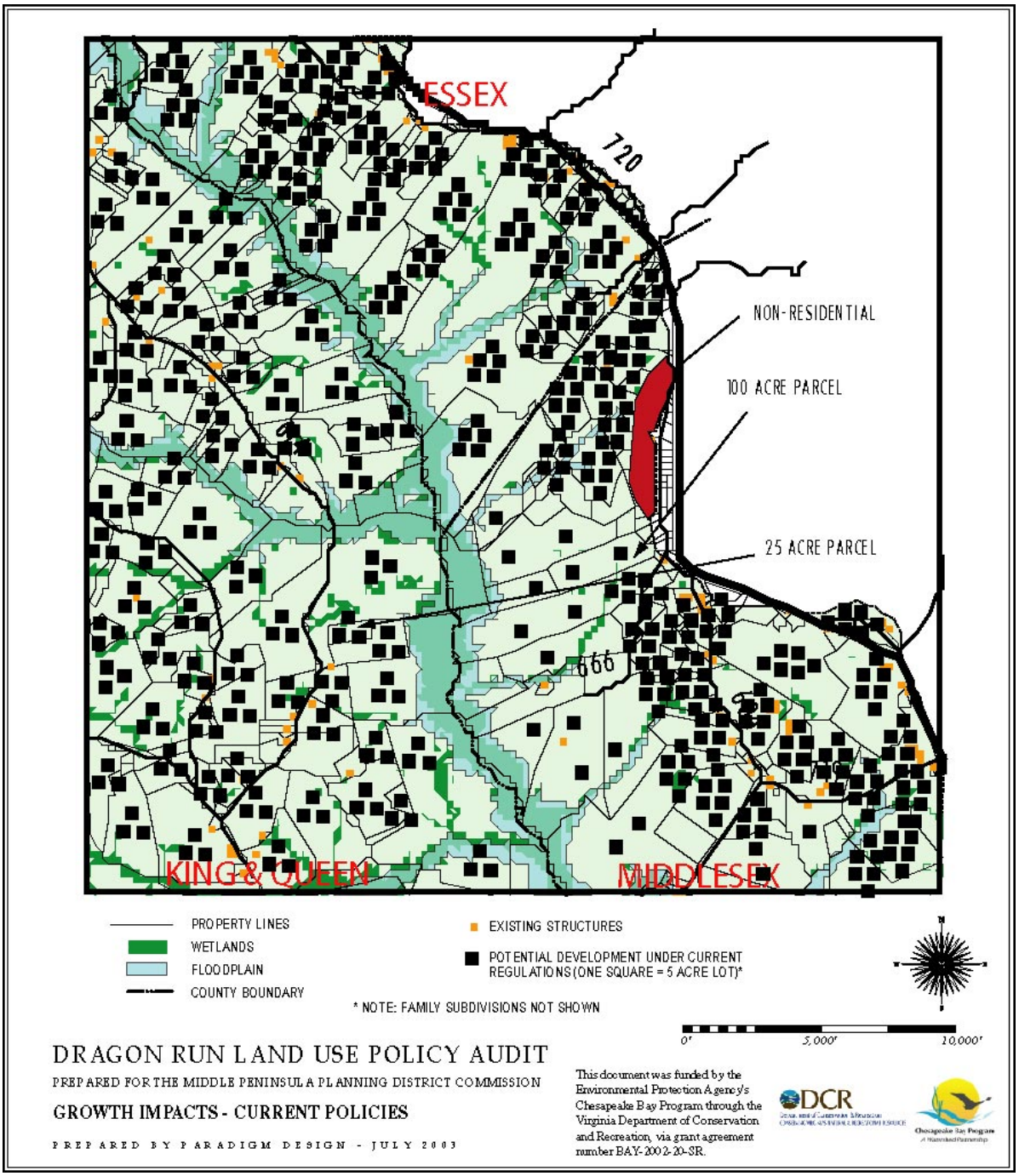


Figure 21. Potential development under current land use policies in the Dragon Run watershed (from MPPDC, 2003).

those areas that were ranked as suitable for development under both scenarios. The "build-compatible" analysis yielded a total of 40,851 theoretical lots that could be developed under current zoning, while the "environmental" analysis yielded 38,208 theoretical lots. The results of the analysis represent a 1,143% increase in the potential number of parcels based on "environmental" values and a 1,229% increase in the potential number of parcels based on "build-compatible" values.

Identified Data Gaps

Several gaps in the available data were identified. Two of these data gaps, fish communities and benthic macroinvertebrates including freshwater mussels, are being addressed by a research project being undertaken by Virginia Commonwealth University's Center for Environmental Studies (VCU). This project is anticipated to be completed during the fall of 2003. Its final report will also summarize previous data collection efforts by VCU and the Virginia Department of Game and Inland Fisheries.

Natural heritage information is available for the main channel of the Dragon Run and its adjacent swamps, but not for headwater streams and adjacent uplands. This data gap is being addressed by a natural heritage inventory of 14 sites in the upper reaches of the watershed being undertaken by the Department of Conservation and Recreation's Division of Natural Heritage. A technical report titled "A Natural Heritage Inventory of Fourteen Headwater Sites in the Dragon Run Watershed" will be completed by December 2003.

The status of invasive species in the Dragon Run is partially known. Efforts to gather more detailed information about invasive species, primarily common reed and blue catfish, are underway.

Other data gaps are not being addressed at this time. For example, there is scant information about migratory birds, other than highly specific research (e.g. bald eagle nesting assessment, colonial bird nesting assessment) and amateur observational records. The scope of a research project to comprehensively assess migratory bird activity in the watershed is tremendous and would require funding that is not available at this time.

Another data gap that is not currently being addressed is the source of water quality impairments (e.g. pH, fecal coliform, mercury, lead) for stream segments on the Virginia 303(d) list (DEQ, 2002). It is assumed that pH impairment is from natural sources (i.e. swamps are naturally acidic). Development of Total Maximum Daily Loads (TMDL) for impairments in Dragon Run stream segments are planned by the Virginia Department of Environmental Quality (DEQ) in 2010.

Finally, the effect of tax policies on the viability of farming and forestry operations is not fully understood in the watershed. The impact of tax incentive programs (e.g. land use taxation) and tax policies (e.g. taxation based on full development potential) on the sustainability of agriculture and silviculture has not been assessed.

SECTION 7: Resource Needs

Section 7 itemizes the resources needed to implement the actions in the watershed management plan. This section also identifies responsible parties and possible funding sources.

Table 3 lists Actions (**Section 4)** with responsibilities, estimates of funding needs, and possible funding sources.

ACTION	RESPONSIBILITY	FUNDING	FUNDING SOURCE
1. Land Use and Resource Preservation			
A. Designate a Unified "Dragon Run Planning Area"	MPPDC; Dragon Run Steering Committee; local governments	Minimal to moderate	MPPDC (VA Coastal Program); local governments
B. Implement Tools to Preserve Forest, Farm, and Natural Resources	Local, state, federal government; non-profits; landowners	Varies from minimal (local "right-to-farm") to considerable (PDR program)	Local, state governments; non-profits; EPA; Forest Legacy Program
C. Address Public and Landowner Access Issues	Dragon Run Steering Committee; local, regional, state gov'ts	Varies from low (signs) to considerable (land acquisition, site development)	VA Coastal Program; Public Access Authority
D. Control Invasive Species	Dragon Run Steering Committee; Invasive Species Initiative	Moderate	VA Coastal Program; DGIF; VMRC; DCR; U.S. Fish and Wildlife Service
2. Education and Landowner Stewardship	Dragon Run Steering Committee; local, state, federal gov'ts; citizens	~$20K/year; programmatic	VA Coastal Program; Dept. of Forestry; USDA/NRCS; DCR; EPA; US FWS
3.Encourage and Support Sustainable Economic Development	Dragon Run Steering Committee; local gov'ts; business	$18,000 in 2003-2004	VA Coastal Program
4. Monitor Plan Implementation	Dragon Run Steering Committee; local gov'ts	Minimal to moderate	MPPDC (VA Coastal Program); local gov'ts

Table 3. Resource needs for Dragon Run Watershed Management Plan.

SECTION 8: Progress Benchmarks

Section 8 serves as a monitoring framework for assessing the implementation of the watershed management plan.

Table 4 lists Actions from **Section 4** and their corresponding progress benchmarks, including responsible parties and anticipated completion time. This table serves as a monitoring plan framework.

ACTION	RESPONSIBILITY	BENCHMARK	COMPLETION
1. Land Use and Resource Preservation			
A. Designate a Unified "Dragon Run Planning Area"	MPPDC; Dragon Run Steering Committee; local governments	Adoption of phases of strategy in all four counties	Level 1 - September 2004; Levels 2 & 3 – 2005-2006?
B. Implement Tools to Preserve Forest, Farm, and Natural Resources	Local, state, federal government; non-profits; landowners	Use 1 or more tools to preserve 50 acres/year	Ongoing
C. Address Public and Landowner Access Issues	Dragon Run Steering Committee; local, regional, state gov'ts	Acquisition of 1 land-based site; erect trespassing signs at access points	December 2004
D. Control Invasive Species	Dragon Run Steering Committee; Invasive Species Initiative	Representation on Council; establish education materials	September 2004; ongoing
2. Education and Landowner Stewardship	Dragon Run Steering Committee; local, state, federal gov'ts; citizens	Establish festival and awards; perform 6 trips/year; post signs along major roadways; develop forest stewardship plans (5/year); enrollment in farm programs (100 acres/year); complete one action-based project/year	December 2004; ongoing
3. Encourage and Support Sustainable Economic Development	Dragon Run Steering Committee; local gov'ts; business	Complete sustainable economic development report; promote Coastal Birding Trail	September 2004; ongoing
4. Monitor Plan Implementation	Dragon Run Steering Committee; local gov'ts	Complete Table 4	As designated

Table 4. Benchmarks for monitoring the Dragon Run Watershed Management Plan.

SECTION 9: Conclusions

Section 9 reminds readers of the watershed management plan's purpose. This section recalls the plan's citizen-initiated beginnings and that it serves as a vision for the future of the Dragon Run watershed.

This watershed management plan for the Dragon Run watershed represents a body of work by citizens, stakeholders, and decision-makers to achieve a common vision for the future – the preservation of the traditional uses and unique resources in the pristine Dragon Run. It is a symbol of regional cooperation and coordination that crosses jurisdictional boundaries. It is the next logical step on the path towards protecting the Dragon Run watershed and preserving its cultural, historic, and natural heritage for future generations.

The plan's goals and objectives (**Section 3**) speak to the major issues at play in the watershed. Its actions (**Section 4**) attempt to address those issues. Together, they are a road map for the watershed.

The plan also captures the current status and state of knowledge of the watershed (**Section 6**). It highlights what we know and what we do not know. It also offers a mechanism for monitoring plan implementation by comparing the baseline watershed information to future results. Progress benchmarks are the basis for this monitoring (**Section 8**). The plan designates responsibility for plan implementation (**Sections 7 & 8**) and estimates costs and funding sources (**Section 7**).

The watershed management plan is not a static document. It is not an end in and of itself. It is a citizen-initiated vision for the future of the watershed that may be modified as situations change or as new information becomes available. It is a vision that harnesses the passion and energy for the Dragon Run (**Figure 22**) of those who live, work and play in its watershed.

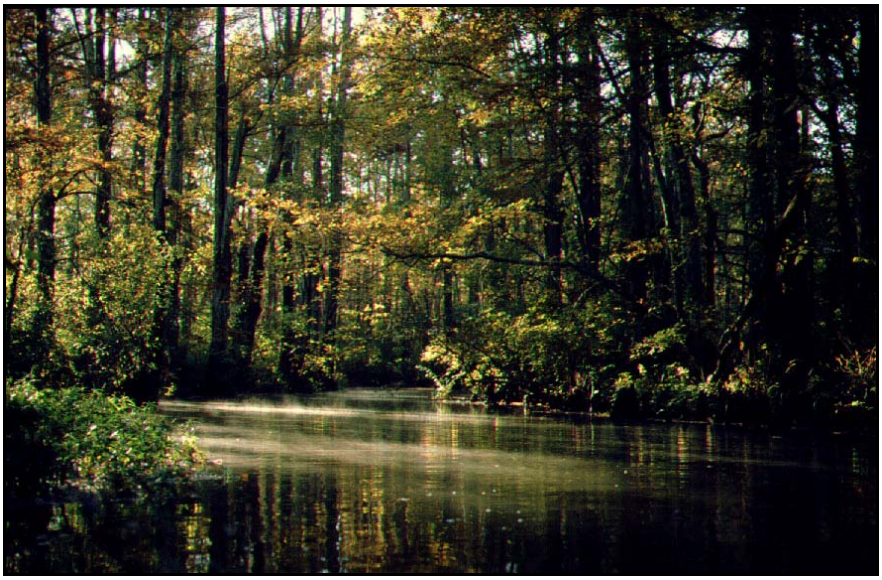


Figure 22. A misty morning on the Dragon Run (Credit: Teta Kain)

SECTION 10: Literature Cited

Belden, A. Jr., A.C. Chazal, G.P. Fleming, C.S. Hobson, and K.M. McCoy. 2001. A Natural Heritage Inventory of the Dragon Run Watershed. Second edition. Natural Heritage Technical Report 01-03. Virginia Department of Conservation and Recreation, Division of Natural Heritage, Richmond, VA. 64 pp. plus appendix.

Belden, A. Jr., A.C. Chazal, and C.S. Hobson. 2003. A Natural Heritage Inventory of Fourteen Headwater Sites in the Dragon Run Watershed. Natural Heritage Technical Report 03-16. Virginia Department of Conservation and Recreation, Division of Natural Heritage, Richmond, VA.

Center for Watershed Protection. 2002. Watershed Vulnerability Analysis. Center for Watershed Protection, Ellicott City, MD. http://www.cwp.org.

DeHardit, E., D. Miller, and J. Uzel. 1996. Dragon Run Watershed Management Plan. Middle Peninsula Planning District Commission, Saluda, Virginia.

Department of Agriculture and Consumer Services. October 23, 2003. Virginia Agriculture: Facts and Figures web page. Virginia Department of Agriculture and Consumer Services, Richmond, VA. http://www.vdacs.state.va.us/agfacts/index.html.

Department of Conservation and Recreation. 2002. The Biennial Nonpoint Source Pollution Water Quality Assessment Report. Virginia Department of Conservation and Recreation, Division of Soil and Water Conservation, Richmond, VA.

Department of Conservation and Recreation. 2003a. Natural Heritage Resources Maps. Virginia Department of Conservation and Recreation, Division of Natural Heritage, Richmond, VA.

Department of Conservation and Recreation. 2003b. Virginia 2002 Nonpoint Source (NPS) Assessment Landuse/Area web site. Virginia Department of Conservation and Recreation, Division of Soil and Water Conservation, Richmond, VA. http://192.206.31.52/cfprog/dswc/lutype.cfm.

Department of Environmental Quality. 2002. 2002 303(d) Report on Impaired Waters. Virginia Department of Environmental Quality, Richmond, VA. http://www.deq.state.va.us/water/303d.html.

Department of Forestry. 2002. Virginia's Forestry Best Management Practices for Water Quality, Fourth Edition. Virginia Department of Forestry, Charlottesville, VA, July 2002.

Department of Forestry. October 23, 2003. Economic Impact of the Forest Industry in Virginia web page. Virginia Department of Forestry, Charlottesville, VA. http://www.dof.state.va.us/resinfo/economic-impact.shtml.

Department of Game and Inland Fisheries. 2002a. Virginia Birding and Wildlife Trail: Coastal Area. Virginia Department of Game and Inland Fisheries, Richmond, VA. http://www.dgif.state.va.us/wildlife/vbwt/trail.asp.

Department of Game and Inland Fisheries. 2002b. Watchable Wildlife…What's in Your Field of Vision?: An Introduction to Wildlife Viewing and the Virginia Birding and Wildlife Trail. Presentation to Northampton County, October 2002. Virginia Department of Game and Inland Fisheries, Richmond, VA.

Fleming, G.P., P.P. Coulling, D.P. Walton, K.M. McCoy, and M.R. Parrish. 2001. The natural communities of Virginia: classification of ecological community groups. First approximation. Natural Heritage Technical Report 01-1. Virginia Department of Conservation and Recreation, Division of Natural Heritage, Richmond, VA. Unpublished report. January 2001. 76 pp.

Garman, G.C. 2003. Aquatic Living Resources Inventories in the Dragon System: Virginia Commonwealth University On-going Activities. Dragon Run Natural Resources Symposium, February 11, 2003, Virginia Institute of Marine Science, Gloucester Point, VA.

Hoppe, D.A.S. 1989. Soil Survey of Essex County, Virginia. U.S. Dept. of Agriculture, Soil Conservation Service in cooperation with Virginia Polytechnic Institute and State University, Blacksburg, VA.

Jenkins, D.W. 1974. Natural Areas of the Chesapeake Bay Region: Ecological Priorities. Center for Natural Areas, Ecology Program, Smithsonian Institution, Washington, D.C.

James City County. October 23, 2003. Protecting Resources in Delicate Environments: PRIDE web page. James City County Department of Development Management, Williamsburg, VA. http://www.protectedwithpride.org/.

McIninch, S.P., G.C. Garman, L. Smock, and W. Shuart. 2003. Preliminary Aquatic Living Resources Inventory. Virginia Commonwealth University, Center for Environmental Studies, Richmond, VA. Prepared for Middle Peninsula Planning District Commission.

Middle Peninsula Planning District Commission. 1972. Charter Agreement of the Middle Peninsula Planning District Commission. Middle Peninsula Planning District Commission, Saluda, VA, April 1, 1972.

Middle Peninsula Planning District Commission. 1994. Dragon Run Access Plan. Middle Peninsula Planning District Commission, Saluda, Virginia.

Middle Peninsula Planning District Commission. 2001. Dragon Run Watershed Land-Water Quality Preservation Project. Middle Peninsula Planning District Commission, Saluda, Virginia.

Middle Peninsula Planning District Commission. 2002. Dragon Run Management Framework. Middle Peninsula Planning District Commission, Saluda, Virginia. Prepared by Anderson and Associates, Richmond, Virginia.

Middle Peninsula Planning District Commission. 2003. Dragon Run Land Use Policy Audit. Middle Peninsula Planning District Commission, Saluda, Virginia. Prepared by Paradigm Design, Reston, Virginia.

Natural Resources Conservation Service. October 23, 2003a. U.S. Department of Agriculture, Natural Resources Conservation Service, Washington, D.C. October 23, 2003. http://www.nrcs.usda.gov/.

Natural Resources Conservation Service. October 23, 2003b. Electronic Field Office Technical Guides web site. U.S. Department of Agriculture, Natural Resources Conservation Service, Washington, D.C. http://www.nrcs.usda.gov/technical/efotg/.

Newhouse, M.E., P.R. Cobb, L.F. Baldwin, and D.V. McCloy. 1985. Soil Survey of Middlesex County, Virginia. U.S. Dept. of Agriculture, Soil Conservation Service in cooperation with Virginia Polytechnic Institute and State University, Blacksburg, VA.

Newhouse, M.E., P.R. Cobb, W.S. Barnes, and D.V. McCloy. 1980. Soil Survey of Gloucester County, Virginia. U.S. Dept. of Agriculture, Soil Conservation Service in cooperation with Virginia Polytechnic Institute and State University, Blacksburg, VA.

Smither, J.M., R.M. Thomas, D.B. Geeson, and R.S. Morris. 2003. Shoreline Sanitary Survey: Piankatank River, Upper; Gloucester, Mathews, and Middlesex Counties. Virginia Department of Health, Division of Shellfish Sanitation, White Stone, VA.

Vanlandingham, M.L. 2003. SEAS Report #T03063. Virginia Department of Conservation and Recreation, York/Rappahannock Watershed Office, Tappahannock, VA, April 18, 2003.

Virginia Farm Bureau. October 23, 2003. Virginia Farm Bureau, Richmond, VA. http://www.vafb.com.

APPENDIX A: Rare Species and Natural Communities

Table 4 indicates the rare species and natural communities that have been found in the Dragon Run watershed, according to the Virginia Division of Natural Heritage (Belden, Jr. et al., 2001; Belden, Jr. et al., 2003).

SCIENTIFIC NAME	COMMON NAME	STATUS
Animals		
Atlides halesus	Great purple hairstreak	S2, S3
Enallagma weewa	Blackwater bluet	S1
Epitheca spinosa	Robust baskettail	S2
Haliaeetus leucocephalus	Bald eagle	S2
Helocordulia selysii	Selys' sunfly	S2
Isoparce cupressi	Cypress sphinx	S1, S3
Somatochlora filosa	Fine-lined emerald	S2
Wyeomyia haynei	Southern pitcher-plant mosquito	S1
Plants		
Bolboschoenus fluviatillis	River bulrush	S2
Cardamine pratensis	Cuckooflower	S1
Carex decomposita	Cypress-knee sedge	S2
Chelone oblique	Red turtlehead	S1
Desmodium strictum	Pineland tick-trefoil	S2
Eriocaulon parkei	Parker's pipewort	S2
Sarracenia purpurea var. purpurea	Northern purple pitcher-plant	S2
**Hottonia inflata	Featherfoil	S3
**Ranunculus flabellaris	Yellow water crowfoot	S3
Natural Communities		
Baldcypress-Tupelo Swamp		
Fluvial Terrace Woodland		
Tidal Baldcypress-Tupelo Swamp		
Tidal Baldcypress Woodland/Savanna		
Tidal Freshwater Marsh		

S1 = Extremely rare; usually 5 or fewer occurrences in the state; or may have a few remaining individuals; often especially vulnerable to extirpation.

S2 = Very rare; usually between 5 and 20 occurrences; or few occurrences with many individuals; often susceptible to becoming endangered.

S3 = Rare to uncommon; usually between 20 to 100 occurrences; may have fewer occurrences, but with a large number of individuals in some populations; may be susceptible to large-scale disturbances

** = No longer tracked by the Division of Natural Heritage; placed on watchlist due to an increased number of documented occurrences within the state since 2001

Table 4. Rare species and natural communities in the Dragon Run watershed.

The following descriptions of natural communities are taken from *The Natural Communities of Virginia* (Fleming et al., 2001).

Bald Cypress-Tupelo Swamps

Seasonally to semipermanently flooded forests of backswamps, sloughs, and low terraces of Coastal Plain rivers and large streams. These swamp forests are distributed throughout southeastern Virginia, north to Dragon Swamp (Gloucester, King and Queen, and Middlesex Counties). Habitats are deeply flooded (up to 1m) for part of the year; most retain at least some standing water throughout the growing season. Microtopography is often pronounced with small channels, swales, tree-base hummocks, and numerous bald cypress "knees." Tree canopies vary from mixed stands of bald cypress (Taxodium distichum), water tupelo (Nyssa aquatica), and swamp tupelo (N. biflora) to nearly pure stands of one species or another. The three dominants have complex competitive and successional relationships. As a rule, the two tupelos are less shade-tolerant than bald cypress and regenerate more readily by sprouting in cut-over stands. Thus, tupelos tend to become dominant when bald cypress stands are heavily logged. Green ash (Fraxinus pennsylvanica) and red maple (Acer rubrum) are occasional canopy associates and frequent understory trees. Carolina ash (F. caroliniana) is often dominant in the small tree and shrub layers, while vines of climbing hydrangea (Decumaria Barbara) are often abundant. Herb layers vary from sparse to rather lush. Most herbaceous plants of bald cypress-tupelo swamps are tolerant of muck soils and fluctuating water levels, or are capable of becoming established on tree hummocks, stumps, and logs. A few of the typical herbs are lizard's tail (Saururus cernuus), false nettle (Boehmeria cylindrical), Walter's St. John's-wort (Triadenum walteri), swamp beggar-ticks (Bidens discoidea), weak stellate sedge (Carex seorsa), giant sedge (Carex gigantean), taperleaf bugleweed (Lycopus rubellus), and pale mannagrass (Torreyochloa pallida). Although community types in this group are relatively common, high-quality specimens of the dominant trees are known to provide nesting habitats for the globally uncommon, state-rare eastern big-eared bat (Corynorhinus rafinesquii macrotis) and southern myotis (Myotis austroparius). Old-growth stands of bald cypress-tupelo swamp with trees up to 800 years old occur along the Blackwater River in Surry and Isle of Wight Counties. References: Fleming and Moorhead (1998), Parker and Wyatt (1975), Plunkett and Hall (1995).

Tidal Bald Cypress Forests and Woodlands

Coniferous or mixed swamp forests and woodlands occurring along the upper tidal reaches of rivers in southeastern Virginia. Examples are documented from the Dragon Swamp/Piankatank River (Gloucester, King and Queen, and Middlesex Counties), the Chickahominy River (Charles City, James City, and New Kent Counties), the James River (Isle of Wight and Surry Counties), and the wind-tidal Northwest River (City of Chesapeake). At some sites, these communities occur in ecotones between tidal marshes and non-tidal backswamps or uplands. Bald cypress (Taxodium distichum) dominates the open to very open canopy, with or without hardwood associates such as swamp tupelo (Nyssa biflora), water tupelo (Nyssa aquatica), and green ash (Fraxinus pennsylvanica). Stand structure and canopy cover range from closed forest to very open woodland. Shrub and herb layers are variable but generally contain a mixture of species characteristic of both marshes and swamps. Some well-developed tidal bald cypress forests appear floristically similar to palustrine bald cypress-tupelo swamps. Other stands have a nearly monospecific herb dominance by shoreline sedge (Carex hyalinolepis). In a unique, possibly fire-influenced, savanna-like stand on the Northwest River, the herbaceous dominants, in rough seasonal order, are silvery sedge (Carex canescens spp. Disjuncta), spikerushes (Eleocharis fallax and E. rostellata), marsh rattlesnake-master (Eryngium aquaticum var. aquaticum), and wild rice (Zizania aquatica var. aquatica). The environmental dynamics, compositional variation,

and state-wide distribution of this group are poorly known and need intensive study. Reference: Fleming and Moorhead (1998).

Fluvial Terrace Woodlands

A somewhat enigmatic group of communities occurring on flat, sandy terraces and islands along Coastal Plain rivers in eastern Virginia. These habitats are elevated well above the level of adjacent swamps and are characterized by xeric, sandy soils and open forest or woodland vegetation. Single occurrences have been documented along the Nottoway River (Sussex County), Chickahominy River (New Kent County), Dragon Swamp (Middlesex County), and Mattaponi River (Caroline County). At all four sites, hickories (Carya pallida and C. alba) are dominant trees, with drought-tolerant oaks (Quercus falcate, Q. nigra, Q. marilandica, Q. alba) present in smaller numbers. Shrubs occurring at all or most sites include sand post oak (Q. margarettiae), horse-sugar (Symplocos tinctoria), American holly (Ilex opaca var. opaca), and eastern red cedar (Juniperus virginiana var. virginiana). Typical herbs include sedges (Carex albicans var. australis, C. pensylvanica, and C. tonsa), Canada frostweed (Helianthemum canadense), butterfly-pea (Clitoria mariana), late goldenrod (Solidago tarda), and prickly-pear (Opuntia humifusa). The Dragon Run site is anomalous in the presence (despite low soil pH and base status) of several calciphiles such as eastern redbud (Cercis canadensis var. canadensis), wild columbine (Aquilegia canadensis), smooth rock-cress (Arabis laevigata var. laevigata), robin's-plantain (Erigeron pulchellus var. pulchellus), and elm-leaved goldenrod (Solidago ulmifolia var. ulmifolia). A full understanding of the status and compositional relationships of this group will require additional inventory and assessment.

Tidal Freshwater Marshes

A diverse group of herbaceous wetlands subject to regular diurnal flooding along upper tidal reaches of inner Coastal Plain river and tributaries. Freshwater marshes occur in the uppermost portion of the estuarine zone, where the inflow of saltwater from tidal influence is diluted by a much larger volume of freshwater from upstream. Strictly speaking, freshwater conditions have salt concerntrations <0.5 ppt, but pulses of higher salinity may occur during spring tides or periods of unusually low river discharge. The most common species are arrow-arum (Peltandra virginica), dotted smartweed (Polygonum punctatum), wild rice (Zizania aquatic var. aquatica), pickerelweed (Pontederia cordata), rice cutgrass (Leersia oryzoides), tearthumbs (Polygonum arifolium and P. sagittatum), and beggar-ticks (Bidens spp.). Locally, sweetflag (Acorus calamus) and southern wild rice (Zizaniopsis miliacea) may form large dominance patches. Species diversity and vegetation stature vary with salinity, duration of inundation, and disturbance; the most diverse marshes occupy more elevated surfaces in strictly freshwater regimes. Mud flats that are fully exposed only at low tide support nearly monospecific stands of spatterdock (Nuphar advena), although cryptic submerged aquatic species may also be present. Tidal freshwater marshes are best developed on sediments deposited by large meanders of the Pamunkey and Mattaponi Rivers, although outstanding examples also occur along the Potomac, Rappahannock, Chickahominy, and James Rivers. These communities provide the principal habitat for the globally rare plant sensitive joint-vetch (Aeschynomene virginica). Chronic sea-level rise is advancing the salinity gradient upstream in rivers on the Atlantic Coast, leading to shifts in vegetation composition and the conversion of some tidal freshwater marshes into oligohaline marshes. Tidal Freshwater Marshes are also threatened by the invasive exotic marsh dewflower (Murdannia keisak). Several communities in this group are chiefly restricted to the Chesapeake Bay drainage basin and are considered globally rare or uncommon. References: Parker and Wyatt (1975), Perry and Atkinson (1997), Perry and Hershner (1999), McCoy and Fleming (2000).

APPENDIX B: Memorandum of Agreement

Memorandum of Agreement

Between

Middle Peninsula
Planning District Commission

County of Essex, Virginia

County of Gloucester, Virginia

County of King and Queen, Virginia

County of Middlesex, Virginia

To Participate in the

Dragon Run Watershed
Special Area Management Plan

Memorandum of Agreement
Between

Middle Peninsula Planning District Commission
County of Essex, Virginia
County of Gloucester, Virginia
County of King and Queen, Virginia
County of Middlesex, Virginia

To Participate in the
Dragon Run Watershed Special Area Management Plan

1. PARTIES TO THE AGREEMENT

This Memorandum of Agreement (MOA) is between the following entities:

- Middle Peninsula Planning District Commission
- County of Essex, Virginia
- County of Gloucester, Virginia
- County of King and Queen, Virginia
- County of Middlesex, Virginia

2. ENABLING AUTHORITY

Counties of Essex, Gloucester, King and Queen, and Middlesex

Section 15.2-1300 of the Code of Virginia enables local governments to enter into cooperative agreements to exercise those powers that each may be enabled to exercise.

Middle Peninsula Planning District Commission

Section 15.2-4205 of the Code of Virginia enables the Middle Peninsula Planning District Commission to enter into cooperative agreements with local governments to exercise those powers that each may be enabled to exercise.

3. CONTEXT

The Dragon Run is a brackish water stream that flows forty miles through the Virginia Middle Peninsula counties of Essex, King and Queen, Middlesex, and Gloucester and eventually empties into the Piankatank River. The Dragon Run Watershed has been defined for the purposes of this Agreement as the Commonwealth Hydrologic Unit ID ‘CO2’ described by the Virginia Department of Conservation and Recreation from the streams’ headwaters down to and including Meggs Bay (see Appendix).

The Dragon Run's pristine nature can, in large part, be attributed to exemplary landowner stewardship and difficult access and is a central part of the region's culture and identity. Ecologically unique, the Dragon Run was ranked second of 232 ecologically significant areas throughout the Chesapeake Bay region by the Smithsonian Institution and is characterized by extensive tidal and nontidal cypress swamp, which is otherwise rare this far north. Furthermore, the Virginia Division of Natural Heritage recognizes the importance of the Dragon Run due to occurrences of one endangered animal species, five rare animal species, eight rare plant species, and five rare natural communities. Moreover, the Dragon Run Watershed supports a high quality of life for its residents. For example, recreational activities, such as hunting, fishing, and paddling, are popular in the Dragon Run.

The Middle Peninsula Planning District Commission, advised by the Dragon Run Steering Committee, obtained a Virginia Coastal Resources Management Program grant for the development of the Dragon Run Watershed Special Area Management Plan (SAMP). Each county in the watershed makes three appointments – one elected official and two landowners along the Dragon Run – to the Dragon Run Steering Committee. The SAMP Advisory Group, which reports to the Steering Committee, represents a cross-section of the community, including: Steering Committee members; local government elected officials and planning staff; landowners; state agencies; farming; forestry; education; non-profit organizations; and ecotourism.

4. PURPOSE AND TERMS OF THE AGREEMENT

The project's mission, as recommended by the SAMP Advisory Group to the Dragon Run Steering Committee, is to support and promote community-based efforts to preserve the cultural, historic, and natural character of the Dragon Run, while preserving property rights and the traditional uses within the watershed.

Each of the signatory entities in this Memorandum of Agreement agrees to participate in the Special Area Management Plan to promote the distinctive treatment deserving of the Dragon Run Watershed through the support and efforts of local government, the fostering of educational partnerships and grassroots support and the involvement of landowners whose stewardship has served to preserve the wonder of the Dragon. The signatories will consider the recommendations of the Dragon Run Steering Committee's SAMP Advisory Group to achieve the following goals and objectives that it developed by consensus:

GOAL I
Establish a high level of cooperation and communication between the four counties within the Dragon Run Watershed to achieve consistency across county boundaries.

OBJECTIVE A
Develop a plan to address the inevitable future development pressure to change the traditional use of land in the Dragon Run Watershed.

OBJECTIVE B
Achieve consistency across county boundaries among land use plans and regulations in order to maintain farming and forestry and to preserve natural heritage areas by protecting plants, animals, natural communities, and aquatic systems.

OBJECTIVE C
Provide ongoing monitoring of existing plans and planning tools in order to assess traditional land uses and watershed health and take action necessary to preserve the watershed.

OBJECTIVE D
Comprehensively implement Best Management Practices (BMPs) for water quality, wildlife habitat, and soil conservation.

GOAL II
Foster educational partnerships and opportunities to establish the community's connection to and respect for the land and water of the Dragon Run.

OBJECTIVE A
Encourage experience-based education consistent with the Stewardship and Community Engagement goals of the Chesapeake 2000 Agreement.

OBJECTIVE B
Promote the community and economic benefits of the Dragon Run derived from its natural characteristics and traditional uses such as farming, forestry, hunting and fishing.

GOAL III
Promote the concept of landowner stewardship that has served to preserve the Dragon Run Watershed as a regional treasure.

OBJECTIVE A
Address the potential dilemma of preserving the watershed's sense of peace and serenity by protecting open space and reducing fragmentation of farms, forests, and wildlife habitat versus the landowners rights in determining or influencing future land use.

OBJECTIVE B
Educate landowners about the regional importance of the Dragon Run.

The Advisory Group's recommendations to achieve the goals and objectives will be delivered by the Dragon Run Steering Committee to the signatory entities for their consideration.

5. MODIFICATIONS

Modifications to this Memorandum of Agreement must be submitted in writing and approved by all parties to the Memorandum of Agreement.

6. EFFECTIVE DATE

The effective date of the Memorandum of Agreement shall be the date of the signing of the Memorandum of Agreement by the Counties of Essex, Gloucester, King and Queen, and Middlesex and the Middle Peninsula Planning District Commission.

7. DURATION AND TERMINATION OF THE AGREEMENT

The duration of this Memorandum of Agreement will be until such time as it is terminated upon agreement of all parties; however, any party to the Memorandum of Agreement may terminate its participation by written notice to all other parties.

8. MANNER OF FINANCING

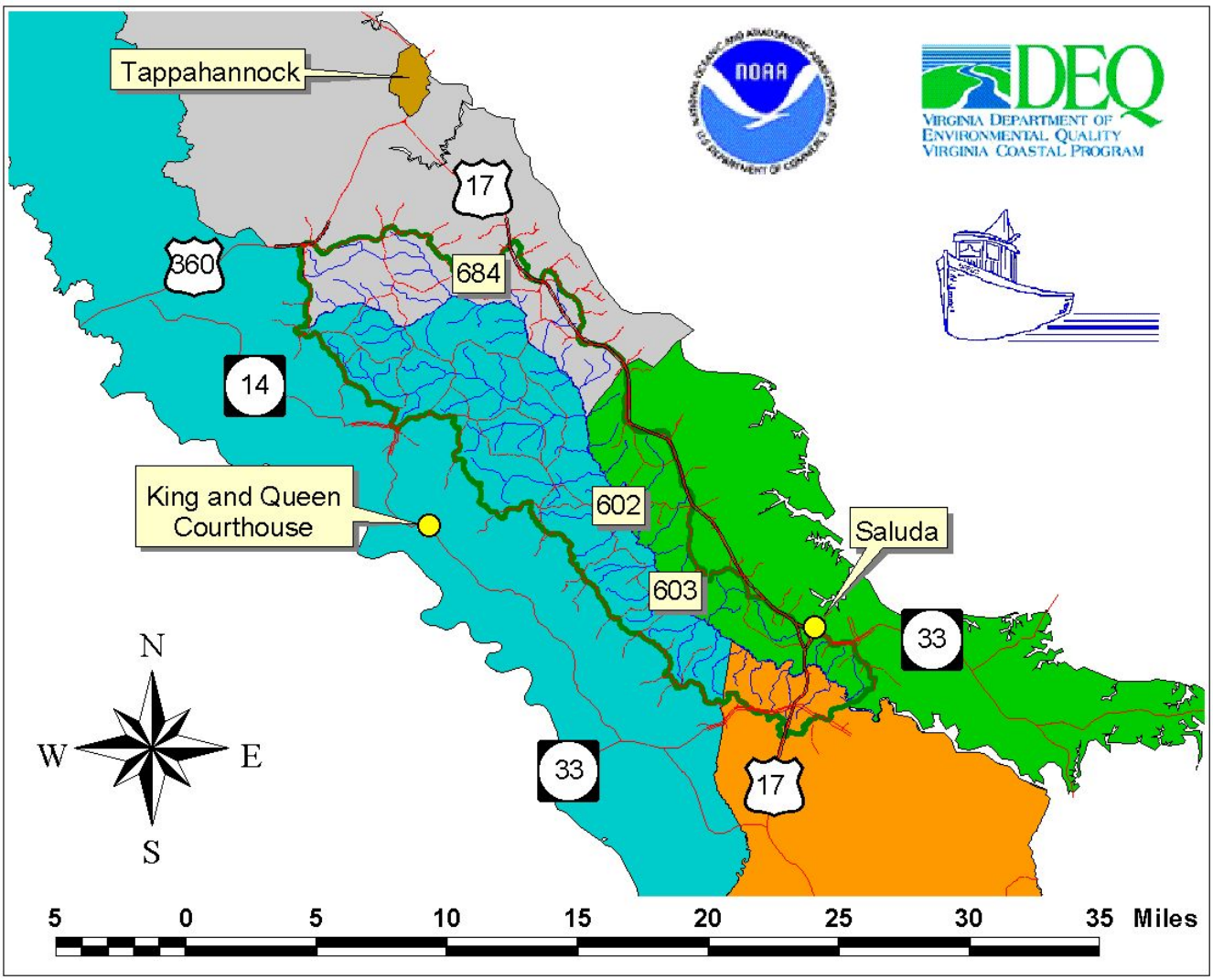
This Memorandum of Agreement will not require financing or budgeting from or by the signatory agencies; however, this clause will not preclude, under a separate document or agreement, grant funding or other financial assistance from one signatory to another for the purpose of carrying out the purposes of the Memorandum of Agreement.

9. OWNERSHIP OF PROPERTY

It is not the intent of the signatory parties that this Memorandum of Agreement will result in the purchase, ownership, holding or conveying of any real or personal property.

10. APPENDIX

Map of the Dragon Run Watershed - defined as Commonwealth Hydrologic Unit ID 'CO2' described by the Virginia Department of Conservation and Recreation from the streams' headwaters down to and including Meggs Bay.



LIST OF SIGNATORIES

Middle Peninsula Planning District Commission

County of Essex, Virginia

County of Gloucester, Virginia

County of King and Queen, Virginia

County of Middlesex, Virginia

SIGNATURE PAGE FOR THE MIDDLE PENINSULA PLANNING DISTRICT COMMISSION

IN WITNESS WHEREOF, the following individuals execute this agreement

Chairman, Middle Peninsula Planning District Commission

County Administrator, County of Essex, Virginia

County Administrator, County of Gloucester, Virginia

County Administrator, County of King and Queen, Virginia

County Administrator, County of Middlesex, Virginia

MIDDLE PENINULA PLANNING DISTRICT COMMISSION

By: Charles E. Ingram

Date: 8-1-2002

Attest: [illegible]

Date: 8/1/02

SIGNATURE PAGE FOR THE COUNTY OF ESSEX, VIRGINIA

IN WITNESS WHEREOF, the following individuals execute this agreement

Chairman, Middle Peninsula Planning District Commission

County Administrator, County of Essex, Virginia

County Administrator, County of Gloucester, Virginia

County Administrator, County of King and Queen, Virginia

County Administrator, County of Middlesex, Virginia

COUNTY OF ESSEX, VIRGINIA

By: Margaret Dimmio

Date: AUGUST 20, 2002

Attest: Linda E. Pumpelin

Date: AUGUST 20, 2002

SIGNATURE PAGE FOR THE COUNTY OF GLOUCESTER, VIRGINIA

IN WITNESS WHEREOF, the following individuals execute this agreement

Chairman, Middle Peninsula Planning District Commission

County Administrator, County of Essex, Virginia

County Administrator, County of Gloucester, Virginia

County Administrator, County of King and Queen, Virginia

County Administrator, County of Middlesex, Virginia

COUNTY OF GLOUCESTER, VIRGINIA

By: _____

Date: 10-3-02

Attest: _____

Date: _____

SIGNATURE PAGE FOR THE COUNTY OF KING AND QUEEN, VIRGINIA

IN WITNESS WHEREOF, the following individuals execute this agreement

Chairman, Middle Peninsula Planning District Commission

County Administrator, County of Essex, Virginia

County Administrator, County of Gloucester, Virginia

County Administrator, County of King and Queen, Virginia

County Administrator, County of Middlesex, Virginia

COUNTY OF KING AND QUEEN, VIRGINIA

By: _____

Date: 9/9/02

Attest: K. Deane Gabe

Date: 9-9-02

SIGNATURE PAGE FOR THE COUNTY OF MIDDLESEX, VIRGINIA

IN WITNESS WHEREOF, the following individuals execute this agreement

Chairman, Middle Peninsula Planning District Commission

County Administrator, County of Essex, Virginia

County Administrator, County of Gloucester, Virginia

County Administrator, County of King and Queen, Virginia

County Administrator, County of Middlesex, Virginia

COUNTY OF MIDDLESEX, VIRGINIA

By: _____

Date: 10-2-02

Attest: Betty S. Collins

Date: 10-2-02

APPENDIX C: Description of Natural Resource Preservation Tools

Conservation Easements: According to the Virginia Conservation Easement Act (§10.1-1009 et seq.), a conservation easement "means a nonpossessory interest of a holder in real property, whether easement appurtenant or in gross, acquired through gift, purchase, devise, or bequest imposing limitations or affirmative obligations, the purposes of which include retaining or protecting natural or open-space values of real property, assuring its availability for agricultural, forestal, recreational, or open-space use, protecting natural resources, maintaining or enhancing air or water quality, or preserving the historical, architectural or archaeological aspects of real property." There are significant tax benefits associated with the donation of conservation easements. The terms of the easement are highly flexible and dictate the permissible uses of the land. The easement is attached to the deed for the property.

Purchase of Development Rights (PDR) or Purchase of Agricultural Conservation Easements (PACE): A voluntary land conservation program that pays landowners to protect the cultural and natural resource assets of their property. The purpose is to protect open-space, agricultural, historic, scenic, and natural resources. In particular cases, the purpose is to maintain the economic viability of farm and forest operations. The program allows landowners to enter into agreements to sell the development potential of qualifying property to the County while maintaining the right to continue to use, own, sell, mortgage, and bequeath the property. PDR programs accommodate a variety of conservation categories and generally protect land in perpetuity, while PACE programs are specifically geared to agricultural operations and sometimes offer a buyback option at the current fair market value after a specified period of time.

Chesapeake Bay Preservation Act: The Chesapeake Bay Preservation Act (§10.1-2100 et seq.) requires that "(i) the counties, cities, and towns of Tidewater Virginia incorporate general water quality protection measures into their comprehensive plans, zoning ordinances, and subdivision ordinances; (ii) the counties, cities, and towns of Tidewater Virginia establish programs, in accordance with criteria established by the Commonwealth, that define and protect certain lands, hereinafter called Chesapeake Bay Preservation Areas, which if improperly developed may result in substantial damage to the water quality of the Chesapeake Bay and its tributaries." Furthermore, the Act states that "Local governments have the initiative for planning and for implementing the provisions of this chapter, and the Commonwealth shall act primarily in a supportive role by providing oversight for local governmental programs, by establishing criteria as required by this chapter, and by providing those resources necessary to carry out and enforce the provisions of this chapter."

Agricultural and Forestal Districts: The Local Agricultural and Forestal Districts Act (§15.2-4400 et seq.) indicates that "It is state policy to encourage localities of the Commonwealth to conserve and protect and to encourage the development and improvement of their agricultural and forestal lands for the production of food and other agricultural and forestal products. It is also state policy to encourage localities of the Commonwealth to conserve and protect agricultural and forestal lands as valued natural and ecological resources which provide essential open spaces for clean air sheds, watershed protection, wildlife habitat, aesthetic quality and other environmental

purposes. It is the purpose of this chapter to provide a means by which localities may protect and enhance agricultural and forestal lands of local significance as a viable segment of the local economy and as an important economic and environmental resource." Agricultural/forestal districts qualify for reduction in property tax rate under land use assessment.

Land Use Assessment: Authorized by the Code of Virginia (§58.1-3229 et seq.), a land use assessment program provides for the deferral of real estate taxes on real estate that qualifies for agricultural, horticultural, forestry and/or open space uses. Assessed values under the program are generally less than those estimated at fair market value. The purpose of such a program is generally to encourage the preservation of land, the protection of natural resources, the supply of safe water, and the promotion of orderly land use planning and development.

Sliding Scale Property Tax Rate: Used in conjunction with a land use assessment program, local governments may reduce the tax rate on properties that agree to remain in their current use for up to 20 years. The sliding scale of tax rates is based upon the length of the agreement.

Sliding Scale Zoning: This zoning method targets land in agricultural zoning districts and is designed to preserve agricultural land and open space. Sliding scale zoning allows a range of density depending on the size of the original lot. As parcel size increases, the density of allowable dwelling units decreases, enabling the preservation of large contiguous tracts of land that can still be farmed or simply preserved as open space. Lots that have been created from a parent parcel cannot be subdivided.

Local "Right-to-Farm": Virginia's Right-to-Farm laws (§3.1-22.28 et seq.) make any agricultural or silvicultural operation a "by right" use in agriculturally zoned areas. Special use permits cannot be required for operations in these areas and these operations cannot be found guilty of nuisance. The local variation of Right-to-Farm triggers notification to new or potential purchasers of land in agricultural zones of daily farming activities and possible "inconveniences" (e.g. dust, odors, noise).

State Forest: The Virginia Dept. of Forestry (DOF) manages state forests by balancing a self-supporting operation with multiple benefits, such as timber management, recreation, aesthetics, wildlife, water quality, and stability of the local economy. Operations are funded by the sale of forest products, with twenty-five percent of this revenue returned to the county in which the state forest is located. Special demonstration, research, and recreation areas are sometimes featured in state forests.

Virginia Natural Area Preserves System: Administered by the Department of Conservation and Recreation's Division of Natural Heritage, the Virginia Natural Area Preserves System protects examples of some of the rarest natural communities and rare species habitats in the Commonwealth. Natural Area Preserves are managed for their rare plants, animals and natural communities. Natural Area Preserve dedication places legally binding restrictions on future activities on a property. Preserve ownership

includes the Department of Conservation and Recreation, local governments, universities, private citizens, and non-profit conservation organizations. Access ranges from low-intensity public access to owner permission.

Virginia Estuarine and Coastal Research Reserve System: The Virginia Estuarine and Coastal Research Reserve System (VECRRS), created in the Code of Virginia (28.2-1103 et seq.), protects estuarine and coastal lands for research and long-term monitoring that supports the Commonwealth's coastal resource management efforts. The Virginia Institute of Marine Science administers the Reserve System, which is coordinated with the Chesapeake Bay National Estuarine Research Reserve in Virginia. A 121-acre research reserve site is located in the Dragon Run watershed.

APPENDIX D: Description of Farm Programs

The **Conservation Reserve Program** (NRCS, 2003a) reduces soil erosion, protects the Nation's ability to produce food and fiber, reduces sedimentation in streams and lakes, improves water quality, establishes wildlife habitat, and enhances forest and wetland resources. It encourages farmers to convert highly erodible cropland or other environmentally sensitive acreage to vegetative cover, such as tame or native grasses, wildlife plantings, trees, filterstrips, or riparian buffers. Farmers receive an annual rental payment for the term of the multi-year contract. Cost sharing is provided to establish the vegetative cover practices.

The **Conservation Reserve Enhancement Program (CREP)** (NRCS, 2003a) aims to improve Virginia's water quality and wildlife habitat by offering rental payments to farmers who voluntarily restore riparian buffers, filter strips and wetlands through the installation of approved conservation practices. CREP is an enhancement to the federal *Conservation Reserve Program*.

The Virginia CREP has two programs. The *Chesapeake Bay CREP* targets Virginia's entire bay watershed and calls for the planting of 22,000 acres of riparian buffer and filter strips as well as 3,000 acres of wetland restoration. The *Southern Rivers CREP* targets watersheds outside the bay drainage basin and will establish 8,500 acres of riparian buffer and filter strip plantings and 1,500 acres of wetland restoration.

The **Environmental Quality Incentives Program (EQIP)** (NRCS, 2003a) was reauthorized in the Farm Security and Rural Investment Act of 2002 (Farm Bill) to provide a voluntary conservation program for farmers and ranchers that promotes agricultural production and environmental quality as compatible national goals. EQIP offers financial and technical help to assist eligible participants install or implement structural and management practices on eligible agricultural land.

EQIP offers contracts with a minimum term that ends one year after the implementation of the last scheduled practices and a maximum term of ten years. These contracts provide incentive payments and cost-shares to implement conservation practices. Those engaged in livestock or agricultural production on eligible land may participate. EQIP activities are carried out according to an environmental quality incentives program plan of operations developed in conjunction with the producer that identifies the appropriate conservation practice or practices to address the resource concerns. The practices are subject to NRCS technical standards adapted for local conditions. The local conservation district approves the plan.

EQIP may cost-share up to 75 percent of the costs of certain conservation practices. Incentive payments may be provided for up to three years to encourage producers to carry out management practices they may not otherwise use without the incentive. However, limited resource producers and beginning farmers and ranchers may be eligible for cost-shares up to 90 percent. Farmers and ranchers may elect to use a certified third-party provider for technical assistance. An individual or entity may not receive, directly or indirectly, cost-share or incentive payments that, in the aggregate, exceed $450,000 for all EQIP contracts entered during the term of the Farm Bill.

The program targets watersheds, regions, and areas of special environmental sensitivity or other areas facing significant soil, water or related natural resources concerns. By encouraging voluntary landowner participation in these areas, EQIP supports the development and implementation of conservation plans in critical areas. Developed in cooperation with professional resource managers, the plans encompass both scientific management principles, and landowner objectives.

The **Farm and Ranch Lands Protection Program** (NRCS, 2003a) provides matching funds to help purchase development rights to keep productive farm and ranchland in agricultural uses. Working through existing programs, the U.S. Department of Agriculture (USDA) partners with State, tribal, or local governments and non-governmental organizations to acquire conservation easements or other interests in land from landowners. USDA provides up to 50 percent of the fair market easement value.

To qualify, farmland must: be part of a pending offer from a State, tribe, or local farmland protection program; be privately owned; have a conservation plan for highly erodible land; be large enough to sustain agricultural production; be accessible to markets for what the land produces; have adequate infrastructure and agricultural support services; and have surrounding parcels of land that can support long-term agricultural production.

The **FarmLink Program** (Virginia Farm Bureau, 2003) connects farmers who are looking to sell, but wish to see their farms remain active, with people who would like to farm. Currently, the "highest and best use" of most farmland is considered to be in housing lots and shopping malls. As farmers retire or move on, they are often forced to divide up their farmland to pay off debt. In other cases, the land is worth so much more as a "development" site that the farmer finds it impossible to turn this option down. The goal of the FarmLink Program is to curb this trend and maintain the state's agricultural heritage for generations to come.

Prospective farmers and farmers searching for options for their farms each fill out an application form. This information is entered into a database so that farms may be sorted by location, size, type and other features that a potential buyer might be seeking. When it appears that a match is possible, the buyer and seller are both contacted by the FarmLink coordinator. If the farm owner agrees to meet the potential buyer, they are connected. Because many people who are looking to farm cannot afford to buy a farm outright, sellers are asked to consider long-term leases and work-in options in addition to immediate sale.

The **Forest Land Enhancement Program** (FLEP) (NRCS, 2003a) was part of Title VIII of the 2002 Farm Bill. FLEP embodies a commitment to sustainable forest management to enhance the productivity of timber, fish and wildlife habitat, soil and water quality, wetlands, recreational resources, and aesthetic values of forest land. It also establishes a coordinated and cooperative Federal, State, and local sustainable forestry program for

the establishment, management, maintenance, enhancement, and restoration of forests on nonindustrial private forest land.

FLEP is a voluntary program designed to provide technical, educational, and cost-share assistance to promote sustainability of non-industrial private forest. State forestry agencies develop State Priority Plans that provide details for how the FLEP funds will be utilized, including minimum acres, maximum acres, aggregate payment, use for technical, educational and cost-share assistance, and all other factors for the program. Landowners are required to have a forest management plan to be eligible for cost-share. The practices to be cost-shared and the cost-share rate are described in the State Priority Plan.

The cost-share practices are limited to the treatment of 1,000 acres per year on non-industrial private forest (NIPF) with an aggregate payment not to exceed $100,000 for the life of this Farm Bill. A waiver for the treatment of up to 5,000 acres is available if significant public benefit is shown. There is no limit to the amount of forest land owned by an individual as long as the person qualifies as an NIPF owner.

The **Wetlands Reserve Program** (NRCS, 2003a) is a voluntary program offering landowners the opportunity to protect, restore, and enhance wetlands on their property. The USDA Natural Resources Conservation Service (NRCS) provides technical and financial support to help landowners with their wetland restoration efforts. The NRCS goal is to achieve the greatest wetland functions and values, along with optimum wildlife habitat, on every acre enrolled in the program. This program offers landowners an opportunity to establish long-term conservation and wildlife practices and protection.

The **Wildlife Habitat Incentives Program (WHIP)** (NRCS, 2003a) is a voluntary program for people who want to develop and improve wildlife habitat primarily on private land. NRCS provides both technical assistance and up to 75 percent cost-share assistance to establish and improve fish and wildlife habitat. WHIP agreements between NRCS and the participant generally last from 5 to 10 years from the date the agreement is signed.

APPENDIX E. Deer Hunting Plan Samples and Sample Lease

Special Managed Waterfowl Hunt: KEY IDEAS

WHY CONDUCT A WATERFOWL HUNT ON A NATURAL AREA?

- Historical use: prior to acquisition and/or management by the state as a natural area; private interests hunted ducks and geese here regularly.

- VIMS is now responsible for regulating and managing the use of portions of the property by the public. These uses must be compatible with the objectives for which the property was acquired by the state in the first place.

- Virginia law provides that anyone can hunt waterfowl in public waters during established seasons and using legal methods so long as they are not within 500 yards of an existing licensed waterfowl blind. Therefore, if VIMS does not license, establish, and use (for the purpose of hunting) waterfowl blinds along the shoreline at Goodwin Islands Reserve, then any member of the public has the opportunity to obtain a license and build a stationary hunting blind in the public waters surrounding the Reserve. Where stationary blinds are not built, anyone could legally hunt from licensed floating blinds (boats) in the waters adjacent to the Reserve.

- The result of VIMS not establishing and managing the use of shore blinds at portions of Goodwin Islands Reserve is expected to be the rapid licensing and construction of blinds, and the frequent use of these blinds in the public waters surrounding the Reserve, making it a *de facto* waterfowl hunting area from November through January of every year. This unregulated use would not be in the interest of VIMS and visitor/researcher safety would be of high concern.

The Department of Conservation and Recreation, Division of Natural Heritage allows managed waterfowl and deer hunting at selected Natural Area Preserves. The information that follows are examples of information that DCR-DNH distributes to potential and/or registered hunters participating in these hunts.

---------- Natural Area Preserve
Managed Deer Hunt Rules and Regulations

1. All hunters must sign in at the check-in kiosk when arriving at the Preserve and sign out when leaving.

2. All hunters in the party must possess a valid DCR hunting permit. Each permit will bear the name of the Chief-of-Party, who will be responsible for providing the name and Virginia Hunting License number of each party member on their hunting permit.

3. Each hunter must have on his/her person proof of successfully completing a Hunter Education Course (certificate or copy of certificate).

4. Hunters hunting alone must be 16 years of age by the date of the hunt. Youth hunters aged 12-15 must be accompanied by an adult at all times. Both the youth and the adult must possess a DCR hunting permit and proof of completing a Hunter Education Course.

5. Hunters must have all necessary state licenses and abide by all state and DCR regulations.

6. Allowable weapons are shotguns with rifled slugs or buckshot.

7. All deer targeted must be within the Preserve boundaries, which are marked by conspicuous white signs and yellow boundary paint.

8. A limit of two (2) deer per hunter, per day, one of which must be antlerless, may be harvested. **The objective of the hunt is to reduce the size of the deer herd. Therefore, the harvesting of antlerless deer is strongly encouraged.**

9. All deer harvested should be tagged immediately at the point of kill.

10. Hunters are asked to voluntarily provide the following data for harvested deer:
    - sex
    - weight (dressed)
    - number of points (bucks), lactation status, pregnancy & number of young (does)
    - general health and condition

Additional notes:

Data sheets will be available at the check-in kiosk. Scales for weighing deer will not be provided. It is requested that hunters bring their own scales to provide this key harvest statistic. If necessary and only if scales are unavailable, hunters should estimate the field dressed weights of harvested deer in order to complete the data sheet.

Hunter Information Summary Sheet
2004 Lottery Deer Hunt
---------- Natural Area Preserve

Dates: December 6-11, 2004 (Monday - Saturday)
December 13-18, 2004 (Monday - Saturday)

Type of Hunt:
●This is a **lottery** hunt.
●A non-refundable $5.00 State Park Reservation fee will be required at the time of application in order to enter the lottery. Applications and payment must be received by **5:00 PM on Friday, October 8, 2004**. Make checks payable to *Treasurer of Virginia*. Telephone applications and payment by credit card is also acceptable.
●Each selected applicant will be assigned one (1) hunt day during the 2-week hunting period. Selected applicants will be notified within two (2) weeks of the random drawing.
●Each selected applicant may request up to five (5) permits for their assigned hunt day, for a party of up to five hunters. For each member of the hunting party, a $10.00 Natural Area Preserve hunting permit fee must be remitted.
●Hunting permit fee payments must be received by Friday, November 5, 2004. Hunting permit fees must be made by personal check, payable to *Natural Area Preservation Fund*, and mailed to the Department of Conservation and Recreation, 217 Governor Street, Richmond, VA, 23219 – Attention: ---------- Deer Hunt

Participation Requirements:
All members of the hunting party:
1. Must possess all necessary state licenses.
2. Must possess issued hunt permit from DCR.
3. **Must show proof of having completed a Hunter Education Course**.
4. Must be 16 years of age or older to hunt alone. Hunters 12-15 years of age may hunt as a member of the party, but must be under the direct supervision of a hunting adult.
5. Must abide by and meet all rules and regulations, including but not limited to, weapons and ammunition restrictions/specifications and blaze orange requirements (vest and hat).

How to Participate:
●By filling out a lottery application and returning it to the State Parks Reservation Center – along with a non-refundable $5.00 application fee. Applications may also be made by telephone with application fees paid by credit card (call 1-800-933-PARK).
Applications must be received by 5:00 PM on October 8, 2004.
●Selected hunters will be notified by October 22, 2004. Each hunter must render payment of the Natural Area Preserve fee ($10.00 per hunter) to: DCR-Division of Natural Heritage, 217 Governor Street, Richmond, Virginia 23219. Payment must be received by November 5, 2004 or the hunt date will be forfeited and offered to hunters on a stand-by list. Payment should be by personal check made out to *Natural Area Preservation Fund*. Please specify -------- Deer Hunt on the memo line.
●The selected applicant will be considered the Chief-of-Party and will be responsible for all payment to DCR and distributing permits to hunt party members.

●Once payment is made, the Chief-of-Party will be sent an information packet, including maps and hunting permits.

Allowable Weapons:
Allowable weapons are shotguns with rifled slugs or buckshot.
Hunters may ground hunt or use portable tree stands with approved safety belts.

Hunt Zones:
Hunters may hunt anywhere within the preserve boundaries (299 acres). All deer targeted must be within the preserve boundaries. There will only be 1 hunting party on any given day (the hunting party consisting of the successful applicant and up to four other hunters if the applicant chooses).

Allowable Harvest:
A limit of two (2) deer per hunter, one of which must be antlerless, may be harvested. The objective of the hunt is to reduce the size of the herd. Therefore, the harvesting of does is strongly encouraged.

Additional Harvest Information:
All deer harvested must be tagged immediately. Field dressing of deer should occur at the point of kill.

Hunter's will be required to provide the following information for harvested deer:
●sex
●weight **(either live or dressed; hunter's must provide scale)**
●number of antler points, lactation status, pregnancy (as applicable)
●general health and condition.
Data sheets will be available at the Hunter Check-in Kiosk.

Disabled Hunters:
Hunting at ------- NAP requires traversing rough terrain (thick underbrush, sand dunes, drainage ditches, wetlands).

Scouting and Additional Information:
To arrange a scouting date or for additional information, call: -----

VIRGINIA HUNTING LEASE **10/18/07**

1. **LESSOR:** The Nature Conservancy, a nonprofit corporation, organized and existing under the laws of the District of Columbia

Contact: Andrew D. Lacatell Title: Director, Chesapeake Rivers Program
Address: 530 East Main Street, Suite 800
Richmond, VA 23219
Phone: 804-644-5800 ext. 18

2. **LESSEE:**

Contact:

Phone: (H) (W)

3. **PROPERTY:** More fully shown on attached Exhibit A

Site Name	Tract Name	Acres Leased	County
Dragon Run	Boyer	230.232	Middlesex
Dragon Run	Hall	222.57	Middlesex
Dragon Run	Keiningham	42.00	Middlesex
	Total Acres Leased:	494.802	

4. **TERM:** 12 months, commencing September 1, 2007 and terminating August 30, 2008 (unless sooner terminated as provided herein) at 11:59 p.m., local time.

5. **ANNUAL RENTAL:** $XXXX, due and payable in full, in advance and without notice or offset on or before the commencement date in paragraph 4. The ANNUAL RENTAL is based on the number of acres leased (495), times $X. The ANNUAL RENTAL also includes $X/acre for liability and accident insurance.

Throughout this Lease, the terms "LESSOR," LESSEE," "PROPERTY," "TERM," and "ANNUAL RENTAL" shall have the meanings set forth in paragraphs 1 through 5. THE TERMS AND CONDITIONS FROM THE REMAINING PAGES OF THIS LEASE, INCLUDING EXHIBIT B, ARE INCORPORATED HEREIN.

LESSOR: THE NATURE CONSERVANCY

By: _____

Its _____

LESSEE:

By: _____

Its _____

6. LESSOR hereby leases to LESSEE, for the ANNUAL RENTAL and upon the terms and conditions herein stated including Exhibit "B", all of the hunting rights and privileges on the PROPERTY.

7. The hunting privileges granted hereby are for exclusive use of members of LESSEE, their immediate families and accompanied guests, and do not include the right to sell or otherwise grant or license hunting privileges to non-members or permit commercialization of these hunting privileges in any way. A complete list of all members who will have hunting privileges will be submitted to the LESSOR with lease payment. Members are restricted to one guest at any one time.

8. In addition to the ANNUAL RENTAL, and as further consideration for this Lease, LESSEE will properly protect the PROPERTY, including the timber and trees thereon, from trespass and damage, post property boundaries with signs or paint provided by LESSOR, remove all trash and garbage and all spent shells or cartridge casings, and perform any additional duties set forth on Exhibit B.

9. LESSEE agrees to abide by all applicable federal, state or local laws regarding hunting and LESSEE further agrees to abide by rules established by LESSOR from time to time. As of the date of this Lease, such rules are stated on Exhibit B. The LESSOR reserves the right to change such rules, in its discretion, by notice to LESSEE. Any violation of federal, state or local hunting laws or of LESSOR's rules shall be a breach of this Lease.

10. Unless specifically permitted by Exhibit B, LESSEE and its members shall not construct any buildings or other permanent or semi-permanent structures on the PROPERTY and shall not construct permanent tree stands in any tree situated on the leased premises, or drive spikes, nails (except aluminum nails used for posting signs) wires or other foreign objects into any such tree. The use of farm tractors and other vehicles on the PROPERTY is prohibited, except as permitted by Exhibit B.

11. LESSEE, its successors and assigns, agrees to indemnify and hold LESSOR harmless from any and all claims, losses, damages, costs, liabilities or expenses made against or sustained by LESSOR by reason of injury or death to any person or persons, or damages to any person or property from any cause whatsoever occasioned by or arising out of the occupation or use of the PROPERTY by LESSEE, its members, guests, agents or employees.

    LESSEE will automatically be covered by the Hunt Liability Insurance program offered by the Davis-Garvin Agency while engaged in hunting activities on the PROPERTY. As an Additional Named Insured on the policy, LESSEE is afforded the same coverage and limitations as LESSOR. All administration of this insurance program is handled by Davis-Garvin. Direct any and all questions concerning this insurance program, any requests for certificates of insurance, or inquiries about coverage to:

    Mr. Ed Wilson or Ms. Jody Byrd
    Davis-Garvin Agency
    P.O. Box 21627
    Columbia, SC 29221
    Phone: (800) 845-3163 or (803) 732-0060
    Fax: (803) 781-6712

    If LESSEE desires a certificate of insurance, it must contact the Davis-Garvin Agency; it will not automatically receive one. LESSOR makes no representations as to the sufficiency of the coverage afforded to LESSEE as an Additional Named Insured under the policy. It is LESSEE'S responsibility to assess its own insurance needs and to obtain additional insurance, if necessary, to provide the types and levels of coverage appropriate to satisfy its particular circumstances.

12. The rights and privileges conferred by this Lease are to be exercised by LESSEE in such a way as not to interfere with the authorized cutting and removal of timber, or with other use of the PROPERTY by guests, licensees or other lessees of LESSOR, or with any sale or disposition LESSOR might make of the PROPERTY during the TERM; this Lease being specifically subject to any action of LESSOR related to the sale, lease or other disposition or development of the PROPERTY, it being understood and agreed that if LESSOR should sell, lease or make other disposition of the PROPERTY, it shall have the right to cancel this Lease at any time upon giving written notice addressed to LESSEE at its address set out above and upon the mailing of such notice, this Lease shall automatically be terminated.

In the event of such termination, LESSOR shall refund the ANNUAL RENTAL in proportion to the fraction in which the numerator is the number of days remaining in the hunting season as of the date of termination and the denominator is the total days in the entire hunting season.

13. LESSEE's breach of any term and condition of this Lease may, in LESSOR's sole and absolute discretion, result in the immediate termination of this lease without refund. LESSOR will provide written notification to LESSEE of any breach and of LESSOR's decision to terminate, and the Lease shall automatically be terminated upon receipt by LESSEE of such notification. Without limiting the generality of the foregoing, if any guest or non-guest hunting on the PROPERTY is found in violation of any rule or condition of this Lease, this Lease may be terminated by the LESSOR, in the LESSOR'S sole and absolute discretion, without refund of any portion of the ANNUAL RENTAL. This includes violation of any federal, state or local law, ordinance, or regulation committed on the PROPERTY or any violation of Virginia Department of Game and Inland Fisheries regulations.

14. LESSEE agrees to obtain all necessary licenses and permits required by federal, state and local laws, ordinances and regulations for any activity undertaken by said LESSEE whatsoever arising out of the use by LESSEE of the PROPERTY in accordance with this Lease.

15. No renewal, extension, addition or modification of this Lease shall be binding upon LESSOR, unless executed in writing by its authorized representative.

16. Where access to the PROPERTY is across lands owned by LESSOR but leased to others, such access shall be limited to roads designated by LESSOR.

17. Any notice required or permitted hereunder shall be deemed properly given when deposited in the U.S. mail, postage paid, certified, return receipt requested, to the addresses set forth in the first and second paragraphs of this Lease. Either party may change the address to which notices should be sent by proper notice to the other.

18. No provision of this Lease may be amended or waived except by an instrument in writing, signed by both parties. No act or failure to act by LESSOR shall be deemed a waiver of its rights and no waiver of any one provision or on any one occasion shall be deemed a waiver of other provisions or on other occasions. LESSOR shall have available, in addition to the right to terminate set forth in paragraph 13, all rights and remedies at law or in equity, and no exercise of one right or remedy shall be deemed an election of remedies precluding other remedies.

EXHIBIT "B"

NATURE CONSERVANCY RULES

DEER: Deer may be taken in accordance with published Virginia Department of Game and Inland Fisheries Regulations, "Hunting and Trapping in Virginia, July 2007 to June 2008 Regulations" (VDGIF Regulations)

TURKEY: No harming, killing or removing of turkey from The Nature Conservancy property in any way.

WATERFOWL: No harming, killing or removing of turkey from The Nature Conservancy property in any way.

BEAR: No harming, killing or removing of bears from The Nature Conservancy property in any way.

TRAPPING: Beavers may be removed in accordance with VDGIF Regulations. No trapping of other furbearers, predators or any other animals from The Nature Conservancy property is permitted.

FISHING: No fishing permitted on The Nature Conservancy property in any way.

BAITING: No baiting permitted on The Nature Conservancy property in any way.

MAINTENANCE: Maintain all existing roads, fences, gates and locks. Post all boundaries. If a lock is replaced, provide LESSOR with two keys within five days by certified mail, return receipt requested.

PARTICIPATION IN DMAP PROGRAM: Prior to the commencement of the term of this Lease, **LESSEE shall enroll in the Virginia Department of Game and Inland Fisheries (DGIF) Deer Management Assistance Program (DMAP), unless LESSEE is already enrolled in a similar DGIF program**.

ADDITIONAL OBLIGATIONS OF LESSEE: Completion of The Nature Conservancy Disclosure Form for Real Estate Transactions and Liability and Indemnity Agreement.

ADDITIONAL LEASE ON PROPERTY: Lessee recognizes there is a separate hunting lease for turkey. Lessee of the Deer hunting lease will not hunt on the Property from during the Spring Gobbler Season as outlined in the VDGIF Regulations.

PERMITTED VEHICULAR USE: Farm equipment (including tractors and backhoes) may be used on the property for the purpose of maintaining roads. There shall be no use of All-Terrain Vehicles (aka, "four-wheelers). All other vehicles must stay on existing roads.

APPENDIX F. Public Use Guide

What can the public do on rivers that are navigable for title purposes?
The three activities that the courts have traditionally mentioned are navigation, fishing, and commerce. The public can fish, from the river or from the shore below the "ordinary low water line." (Note that the fish and wildlife are owned by the state in any case.) But the courts have ruled that any and all non-destructive activities in these areas are legally protected.

What about getting to and from the river?
Normally there is no right to cross private land to get to or from a river. For example, there is no right to walk across a farmer's field to get from a public highway to a river.

However, the state has a duty to maintain public access routes to rivers under certain conditions, as part of its public trust duties. Courts have found it unlawful for a state to close off an existing public access route when there are no other public access routes nearby.

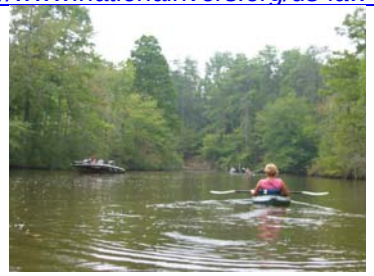
What about river pollution and leaving trash?
Local, state and federal regulations limit or prohibit water pollution. Hefty fines can apply.

Balancing private property and public rights through a Code of Conduct in the Dragon Run
The sense of being invaded by trespassers strikes a deep emotional chord in many a landowner who has a river flowing through his property. Some Dragon Run landowners tend to lump all river users together - those who canoe quietly down the middle of the river, those who stand quietly below the ordinary low water line to fish, those who stay on or near the river but litter and make noise, and those who proceed well away from the river onto private land. However, the right of the public for the use of title navigable waterways soundly exists in the Public Trust Doctrine. This right may be compared to the right to use a public roadway. Individuals have the right to use the roadway in its defined boundaries, but not drive through adjacent private yards or throw litter out of the window as they are passing through.

Additionally, while public roadways are generally well defined, the line between navigable and non-navigable waterways becomes increasingly vague as one travels further from the natural and ordinary Dragon Run mainstem, thereby increasing the potential for conflict between landowners and users.

Ultimately, the practice of responsible recreation coupled with an awareness of the public and private rights, including its vagueness in some locations, is the key to reducing conflict.

Acknowledgement: Adapted from *Who Owns the River?* From the National Rivers Website:
http://www.nationalrivers.org/us-law-who-



This work was funded by the Virginia Coastal Zone Management Program at the Department of Environmental Quality through Grant # NA06NOS4190241 Task 95 of the National Oceanic and Atmospheric Administration, Office of Ocean and Coastal Resource Management, under the Coastal Zone Management Act of 1972, as amended. The views expressed are those of the author(s) and do not necessarily reflect the views of NOAA or any of its subagencies.

Public Use Guide

Mission: To support and promote community-based efforts to preserve the cultural, historic, and natural character of the Dragon Run, while preserving property rights and the traditional uses within the watershed.

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DRAGON RUN SPECIAL AREA MANAGEMENT PROGRAM

DRAGON RUN SPECIAL AREA MANAGEMENT PROGRAM

What is the Dragon Run Special Area Management Program (SAMP)?
This partnership between the Virginia Coastal Zone Management Program and the Dragon Run Steering Committee of the Middle Peninsula Planning District Commission is designed to address both the differing viewpoints and common ground that exist concerning the future of the watershed.

What is the Dragon Run Steering Committee?
Formed in 1985, the Dragon Run Steering Committee consists of landowners and local elected officials and is the key vehicle for cooperation and coordination among the four counties concerning watershed issues.

What counties are in the watershed?
The counties of Essex, Gloucester, King and Queen, and Middlesex contain the watershed.

STEERING COMMITTEE

Essex County – Prue Davis (Chair)(S), Fred Hudson (P), Dorothy Miller (L), M. Scott Owen (L)
Gloucester County – Charles "Rick" Allen (S), Dr. Eric Weisel (P), Terry DuRose (L), Dr. Willy Reay (L)
King and Queen County – Keith Haden (S), Kempton Shields (P), Robert Gibson (L), William "Frank" Herrin (L)
Middlesex – John D. "Jack" Miller (S), John England (P), R. D. Johnson (L), William Bagby (L)

(S) denotes Supervisor
(P) denotes Planning Commissioner
(L) denotes Land Interest

Staff – Sara Stamp

PUBLIC RIGHTS FOR USE OF THE DRAGON RUN

Which rivers are owned by the public?
The U.S. Supreme Court has held that the bed and banks under all rivers, lakes, and streams that are navigable, for title purposes, are owned by the states, held in trust for the public through the Public Trust Doctrine. Title in this context means ownership. In Virginia, this public-trust ownership extends up to the ordinary low water line, (or ordinary low water mark,) encompassing what is commonly referred to as the submerged and submersible land, as opposed to the upland.

What does navigability, for title purposes, mean?
Through various court cases, federal courts have articulated the following test, which is known as the federal test of navigability for title purposes:

* Navigability is determined as of the date of statehood
* Waters must be navigable in their natural and ordinary condition;
* The waterway must be usable for transportation conducted in customary modes of trade and travel on water; and
* The waterway must be capable of or susceptible to use as a highway for the transportation of people or goods.

The courts have determined that the use or potential for use by almost any type of watercraft is sufficient to determine this type of navigability.

Do shallows, rapids, and other obstacles make a river non-navigable for title purposes?
No. The courts make no requirements that a river be uniformly deep, or flat, or that navigation be practical going upstream as well as downstream. The presence of rapids, even numerous rapids and waterfalls, or blockages does not disqualify a river.

What if the river is only physically navigable during the wet season of the year?
It still qualifies as navigable for title purposes. But a normally dry creek bed or "wash" that is only temporarily navigable during extreme weather does not qualify. (If it's normally dry because of upstream dams, then it does qualify. The legal test is based on the river's natural condition.)

What if the current property owner's deed reads to the middle of a river, or seems to surround and include the river?

If the physical characteristics of the river are such that it meets the federal test of title navigability, it is public land up to the ordinary low water line. Since a deed can only convey interests actually owned by the seller, and since the bed and banks of all navigable rivers passed to the states at the time of statehood, it is likely that the state is the true owner. The state's ownership is a "prior existing right" and is frequently mentioned as such on deeds. Somewhere along the chain of property transactions, a deed may have been changed to include the riverbed. If this happened it was likely done incorrectly.

APPENDIX G. Dragon Flats Forestry Management Plan

Management Plan

"Dragon Run Block"
Boyer, Hall, Keiningham Tracts

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9/2006

Management Plan

Introduction

This management plan covers three contiguous tracts located in Middlesex County, Virginia currently owned by The Nature Conservancy. They are:

1. Dragon Run (Boyer) 230 +/- acres
2. Dragon Run (Hall) 224 +/- acres
3. Dragon Run (Keiningham) 42 +/- acres

Although the above acreages combined total 496 a recent survey and the ArcMap Geographic Information System (GIS) show 495 total acres.

Background

"The Dragon Run is a brackish water, tidal/nontidal stream which flows forty miles through the Virginia Middle Peninsula counties of Essex, King and Queen, Middlesex, and Gloucester. Fed by underground springs, surface runoff and numerous feeder swamps, the Dragon Run twists and turns, meandering through the four-county area, eventually emptying at the headwaters of the Piankatank River. The stream, along with the surrounding Dragon Run Swamp, forms an ecologically unique system. A system of excellent water quality and numerous and diverse species of flora and fauna. It is characterized by dense stands of hardwoods with occasional upland ridges extending to the stream's edge. It supports both recreational fishing and excellent game and nongame wildlife. There is very little evidence of man's presence, essentially maintaining a primitive character throughout the entire system.

In 1974 the Smithsonian Institution reviewed and subsequently ranked 232 ecologically significant areas throughout the Chesapeake Bay region. The Dragon Run System was ranked second.

Prior to and since that time, concern has been voiced regarding the protection of this valuable natural resource. Early efforts to offer protection came in 1970, and most recently, again in 1985, to have the Dragon Run designated as a scenic river by the Virginia General Assembly." [1]

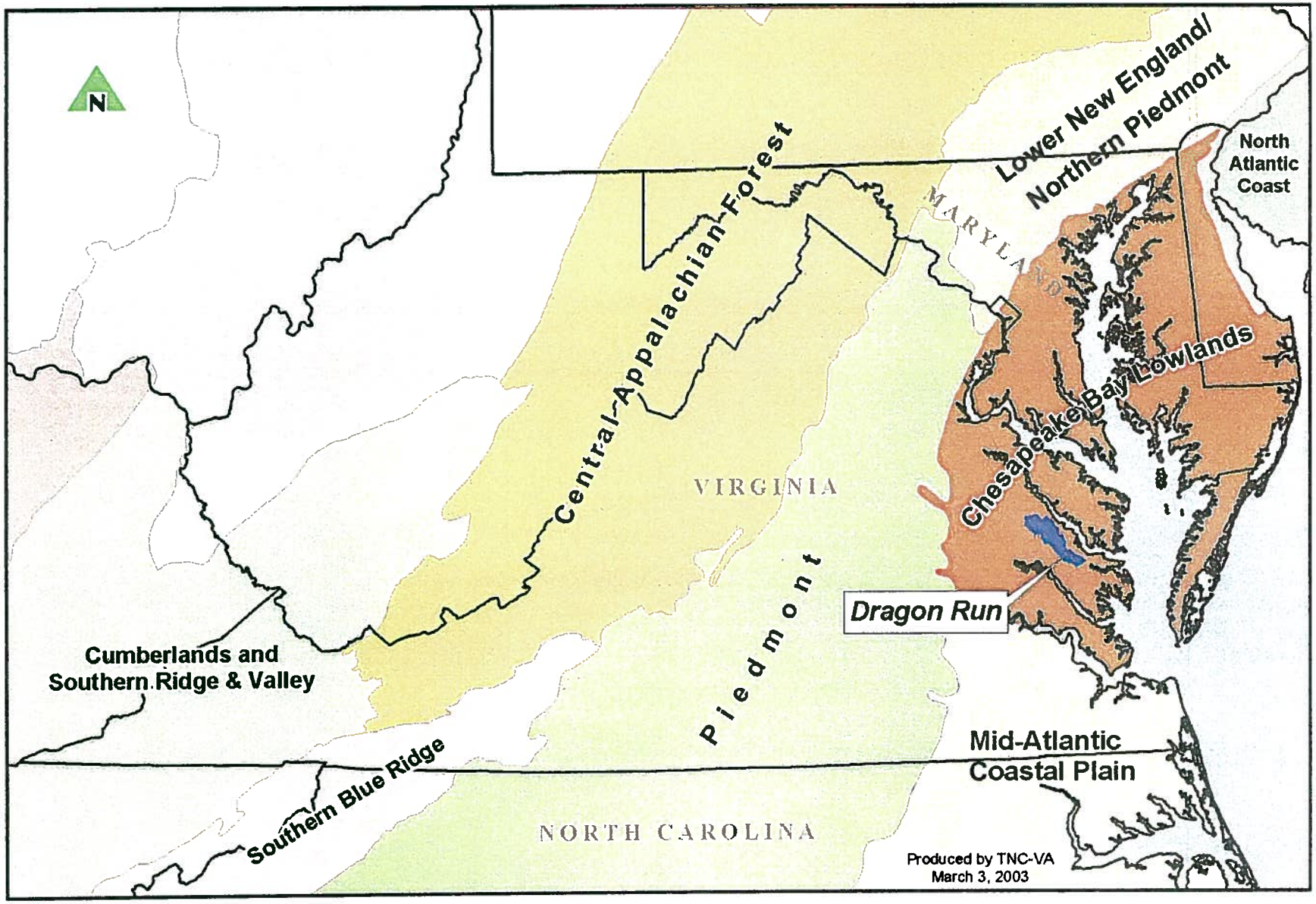
The Nature Conservancy purchased the tracts in 2003 due to their ecological significance. They adjoin the Dragon Run watershed which is at the Northern end of the North American range for bald cypress communities that are influenced by tidal changes. The Piankatank River is a tributary for the Chesapeake Bay. The Dragon Run watershed contains 22 rare plants and animals and more than 55 species of fish. There is an active bald eagle nest on the Hall property. One rare plant; the Pineland Tick-trefoil as well as a rare damselfly, the Blackwater Bluet, have been located less than 800 feet to the west of these tracts. The Cypress Sphinx, a rare moth species that is attracted to Mistletoe has been located on the site. This site is also visited by several species of neo-tropical migratory birds.
One of The Nature Conservancy's primary goals is to protect water quality and the ecosystem adjoining The Dragon Run in order to ensure habitat for the aforementioned species.

[1] "Dragon Run Watershed Management Plan" 1996 Jim Uzel Director of Regional Planning Middle Peninsula Planning District Commission

Mona Griswold
9/2006

The Nature Conservancy

SAVING THE LAST GREAT PLACES ON EARTH



Current State

Stand Descriptions (see map on page 7):

Beaver Pond	(.5 acres) Small impoundment containing an active beaver colony.
BH1	(88.3 acres) Bottom land hardwood along Dragon Run. Primarily contains mature bald cypress, ash, swamp white oak and poplar.
BH2	(44.5 acres) Bottomland hardwood- Primarily contains young poplar and maple.
H1	(12.1 acres) Hardwood in low areas and along creeks containing small poplar and oak species.
H2	(8.8 acres) Small hardwood. Some of this stand was planted in pine in 2000 but apparently did not have good survival.
H-SMZ	(26.2 acres) Hardwood in Streamside Management Zones.
P	(16 acres) This is a natural stand containing mature pine sawtimber and chip 'n saw as well as mature poplar. Some of the pine trees contain four or five sawlogs each with diameters up to 22 inches at 4.5 feet off the ground (DBH). The pine basal area average is 80.
P-1968	(18.5 acres) Loblolly pine stand planted 1968. Some of this stand has been thinned. Other sections of this stand contain average basal areas of 120. The stand contains a mixture of pulpwood, chip n' saw , and sawtimber.

P-1974 (6.7 acres) Loblolly pine stand established in 1974. Areas of this stand are dead due to an infestation of Ips beetles and wind damage. Stocking is variable. Some areas have a basal area of 160 and others average 10 inches in DBH of scattered pine.

P-1975 (7.4 acres) Loblolly pine stand planted in 1975. Basal area averages 85. This stand was thinned for the second time in 2003.

P-1983 (78.6 acres) Loblolly stand planted in 1983. This stand has been thinned (5th row and select) within the past two years and the basal area averages 95.

P-1984 (98.6 acres) Loblolly pine stand planted in 1984. The basal area averages 110. There is a high volume of pine pulpwood and chip n' saw material. Parts of this stand have been thinned.

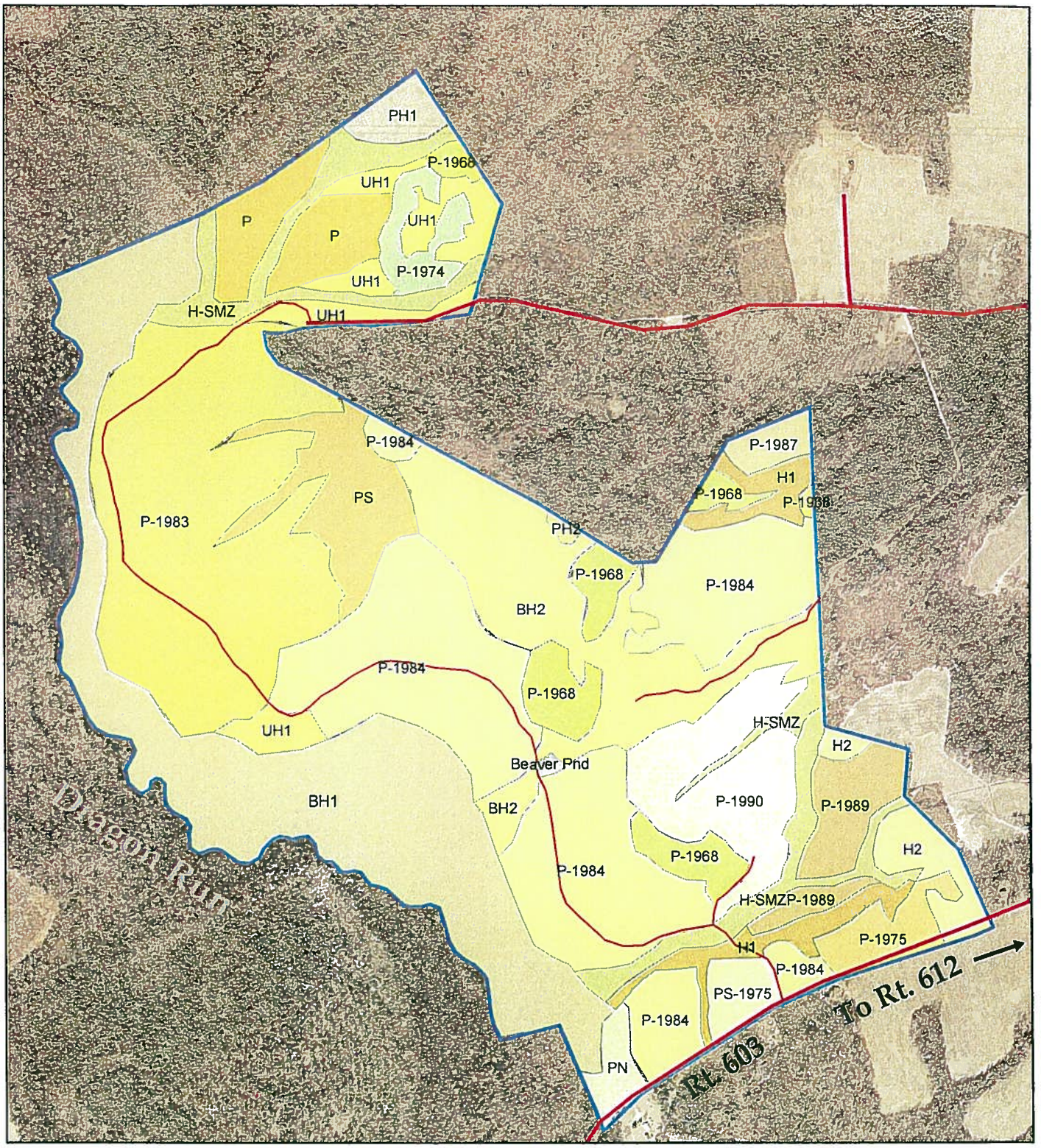
P-1987 (3.6 acres) Loblolly pine stand planted in 1987. This stand is overstocked and the diameter is small but the average basal area is 140.

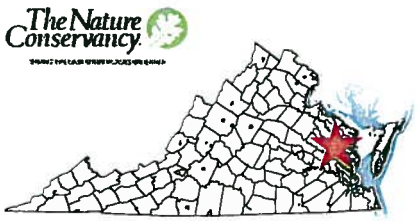
P-1989 (12.2 acres) Loblolly pine stand planted in 1989. The stocking is highly variable and ranges from 40 to 140 basal area. This stand contains pine pulpwood and unmerchantable pine.

P-1990 (24.5 acres) Loblolly pine stand planted in 1990. The basal area averages 100. The pine is mostly pulpwood with some chip 'n saw material.

PH1 (4.5 acres) Mature pine- hardwood stand containing loblolly pine, poplar, red and white oak. The merchantable volume contains mostly pine chip n' saw and sawtimber and hardwood pulpwood and sawtimber. The volume is comprised of half pine and half hardwood.

PH2	(.6 acres) A small stand of medium aged pine- hardwood with 70 basal area of pine and 45 basal area of hardwood.
PN	(4.1 acres) A natural stand containing mature Loblolly and Virginia pine as well as red oak and yellow poplar. This stand was select cut in 2003.
PS	(17.6 acres) Loblolly pine stand planted in 1984. Survival in this stand was not good so the pine is very scattered and mixed with hardwood.
PS-1975	(4.9 acres) Loblolly pine stand planted in 1975. This stand was select cut in 2003 and has since sustained wind and ice damage and is understocked.
UH1	(16.8 acres) A highly variable medium aged stand containing pine and white oak, poplar, red oak, maple and beech much of which has been high- graded in the past leaving trees with poor form. The basal area averages 60.





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0 1,500 Feet

Dragon Run Block Stand Map

Access paths

Boundary

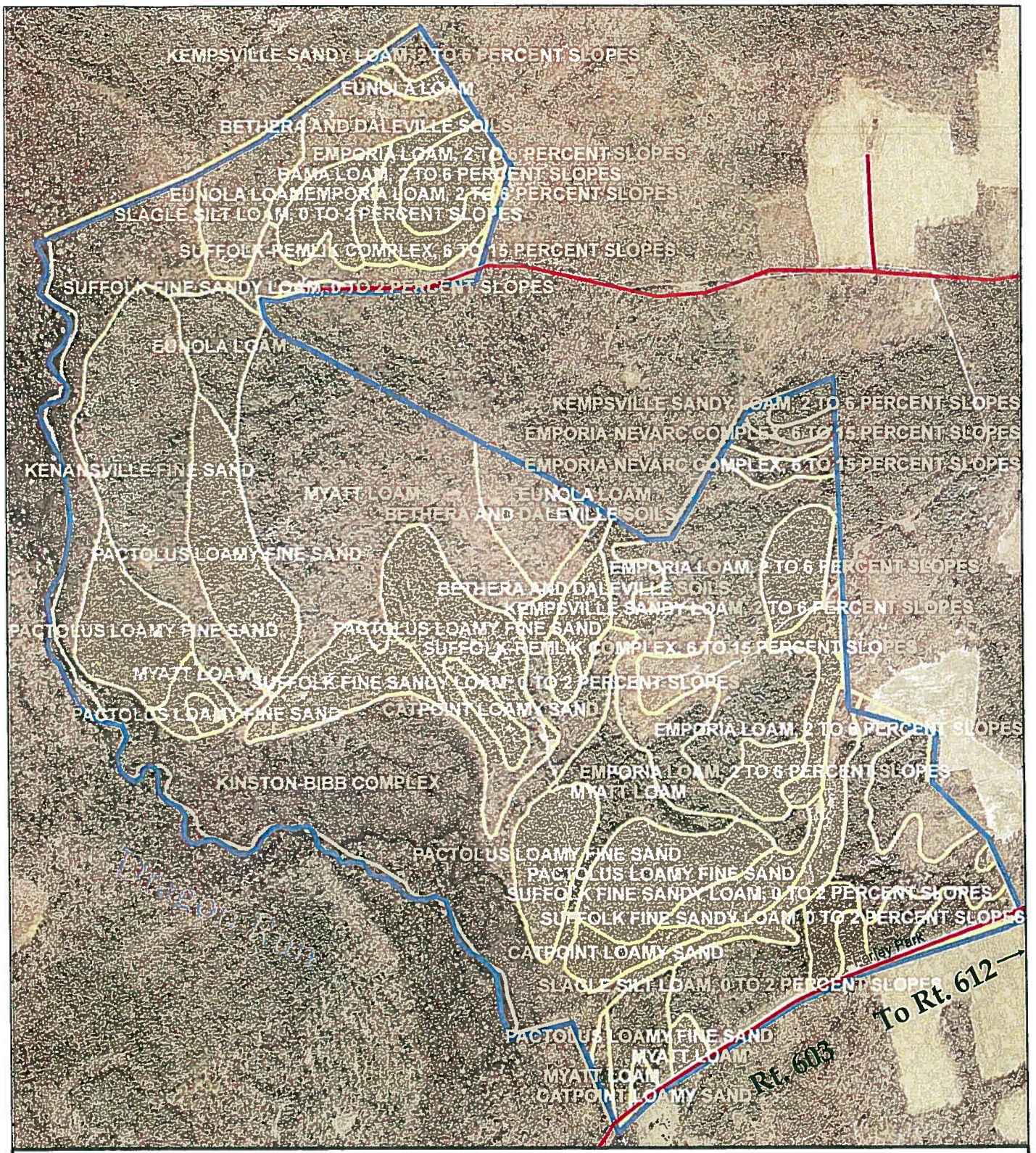
N

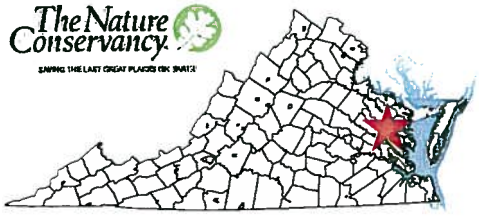
Soils:

There are several soil types found in this management block. They range from pure sand to pure loam including mixtures of the two in the form of loamy sands and sandy loams (see the map entitled "Dragon Run Block Soil Types).

Sandy soils have a low capacity to store water and plant nutrients due to the small surface are of the particles. Leaching of plant nutrients is an issue with sand. On this site this is not much of an issue due to the high content of organic matter in some of these soils as well as the low elevations.

Loam soils are highly desirable for plant growth. They contain enough clay to store water and plant nutrients while allowing for good aeration.





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Feet

0 1,000

Dragon Run Block

Soil Types

N

Ecological Goals

The ecological goals for this tract include promoting healthy ecosystems that preserve and/or enhance the number of rare and endangered species found on or near the site. They also include ensuring that the water quality in the Dragon Run and feeder streams remains excellent.

Some of the target species include the bald eagle, cypress sphinx moth (Isoparce cupressi), blackwater bluet and pineland tick-trefoil. The cypress sphinx moth is found in areas containing mistletoe (Phoradendron serotinum). This species of mistletoe (which is parasitic) is hosted by several species of hardwood.

The bottomland areas along the Dragon Run need to be preserved and protected to provide habitat for bald eagle, Blackwater Bluet (*Enallagma weewa*) (southern damselfly)and pineland tick-trefoil (*Desmodium strictum*). The Blackwater Bluet likes tannin-rich, dark water.

The flats adjacent to the Dragon Run contain wetland species primarily (bald cypress, ash and swamp white oak to name a few). The upland hardwood areas contain several species of red oak and white oak primarily along with yellow poplar.

Management Options

In the following sections I will discuss two options for managing this block of Dragon Run property. They include the "Working Forest" and a "Combination of a Working Forest and Ecological Ideal".

The working forest is primarily based on generating income for the Nature Conservancy. The combination of a working forest and ecological ideal combines' income generation with developing stands that best fit for the site ecologically.

Working Forest

This section of the management plan is devoted to describing how to finish converting the block containing the Boyer, Hall and Keiningham tracts into a working forest resulting in the highest return for investment for The Nature Conservancy. Much of this tract has been converted to pine plantation already. Most of the soil is very conducive to growing loblolly pine (Pinus taeda) which, from an economic standpoint, would be the best choice.

Assumptions:

- All Virginia Best Management Practices (BMP's) will be followed.
- Areas designated as wetlands by the NWI will be left untouched.
- Areas harvested or site prepared will be planted in pine. All pine seedlings planted will be from second generation, high quality loblolly pine families and will be planted between February 1st and March 15th. Spacing used will be 8 feet x 10 feet (544 seedlings per acre).
- The Dragon Run wetland area and its buffer will be left untouched.

- Areas to be prescribed burned will be "cool" burned so the residual pine is not damaged.
- Final harvest age will be determined by financial drive rather than a strict rotation age. If a strict rotation age type of management is desired then the final harvest should be conducted when the trees are at least 35 years old (which may change some of the recommendations listed below).

Harvesting and Planting Recommendations:

In order to convert the remaining stands, with the exception of the Dragon Run (BH1), Beaver Pond, and streamside management zones (H-SMZ), I recommend the following actions:

- Areas of the stand named BH2 that are not designated as wetlands should be converted to pine plantation. This would require site preparation and bedding before planting.

- Clearcut P, UH1, PH1, P-1968 and the P-1974 stands located on the Hall tract (area north of the access path in the northernmost section of tract). These areas should then be burned and planted with loblolly pine seedlings (see assumptions). Make sure that all of the streams running through this block are buffered according to Virginia's recommended BMP's. Intermittent streams should have a 25' wide buffer and perennial streams should be protected by a 50' wide buffer.

- Stand PS-1975 was damaged by wind and ice and should be harvested, burned and replanted at the same time.

- Harvest Stand PS, PN and the portions of stand H1 that are not within the buffer zone for H-SMZ. Site prepare (if necessary) and replant these areas.

- Part of H2 is a failed pine plantation. All of H2 needs to be site prepared and planted.

Thinning Recommendations:

P- 1968 Parts of this stand has been thinned. Other sections of this stand contain average basal areas of 120 and would benefit from one final thinning. The stand contains a mixture of pulpwood, chip n' saw, and sawtimber. Burning the understory is recommended. This stand is old enough to harvest at any time if there is a financial need to do so.

P-1983 This stand has been thinned within the last two years and should be ready for a second (and final) thinning within 3 or 4 years.

P- 1984 Parts of this stand have been thinned but it would benefit from a second thinning once there is enough volume per acre to remove to make it attractive to a logging contractor. This may not be practical until 2009. This stand is primarily pine pulpwood and Chip n' saw material with some sawtimber. The average basal area is 100. Burn the understory after thinning.

P-1987 This stand is overstocked and the diameter is small but the average basal area is 140. This stand needs to be thinned where practical and burned after thinning.

P-1989 The stocking is highly variable and ranges from 40 to 140 basal area. This stand contains pine pulpwood and unmerchantable pine. Some areas of this stand should be thinned. The understory needs to be burned to reduce competition and reduce the fire hazard.

P-1990 The basal area averages 100. The pine is mostly pulpwood with some chip 'n saw material. This stand should be thinned and the understory burned.

Mona Griswold
9/2006

Road Building Recommendations:

To facilitate future management work and harvesting two roads need to be built.

The current access path entering the tract from the east side of the Boyer tract should be connected to the main access path. Unfortunately, this will not be easy since the area between the two paths contains creeks and low land. I recommend asking personnel from the Department of Forestry to advise you on the best placement for this connection since they will enforce the BMP's regarding culvert size and soil stabilization.

A spur road off of the main access path should be constructed in the general vicinity of what is shown on the "Dragon Run Block Road Building" map to provide access to the eastern section of the tract.

Maintenance

Road maintenance:

Portions of the road have been rutted by the hunt club and need to be graded and surfaced with rock or sand.

There is a section of road on the north side Stand P-1983 that is too close to the Dragon Run and is a potential source of sedimentation. Measures should be taken to assure that this does not occur. There are a couple of solutions. Following the recommended BMP's is one option. This would entail erecting a silt fence and stabilizing the erodable areas with vegetation, rock or geotextile material. Moving a section of the road to the east one hundred feet is another solution. The old section of the road would have to be stabilized to prevent erosion.

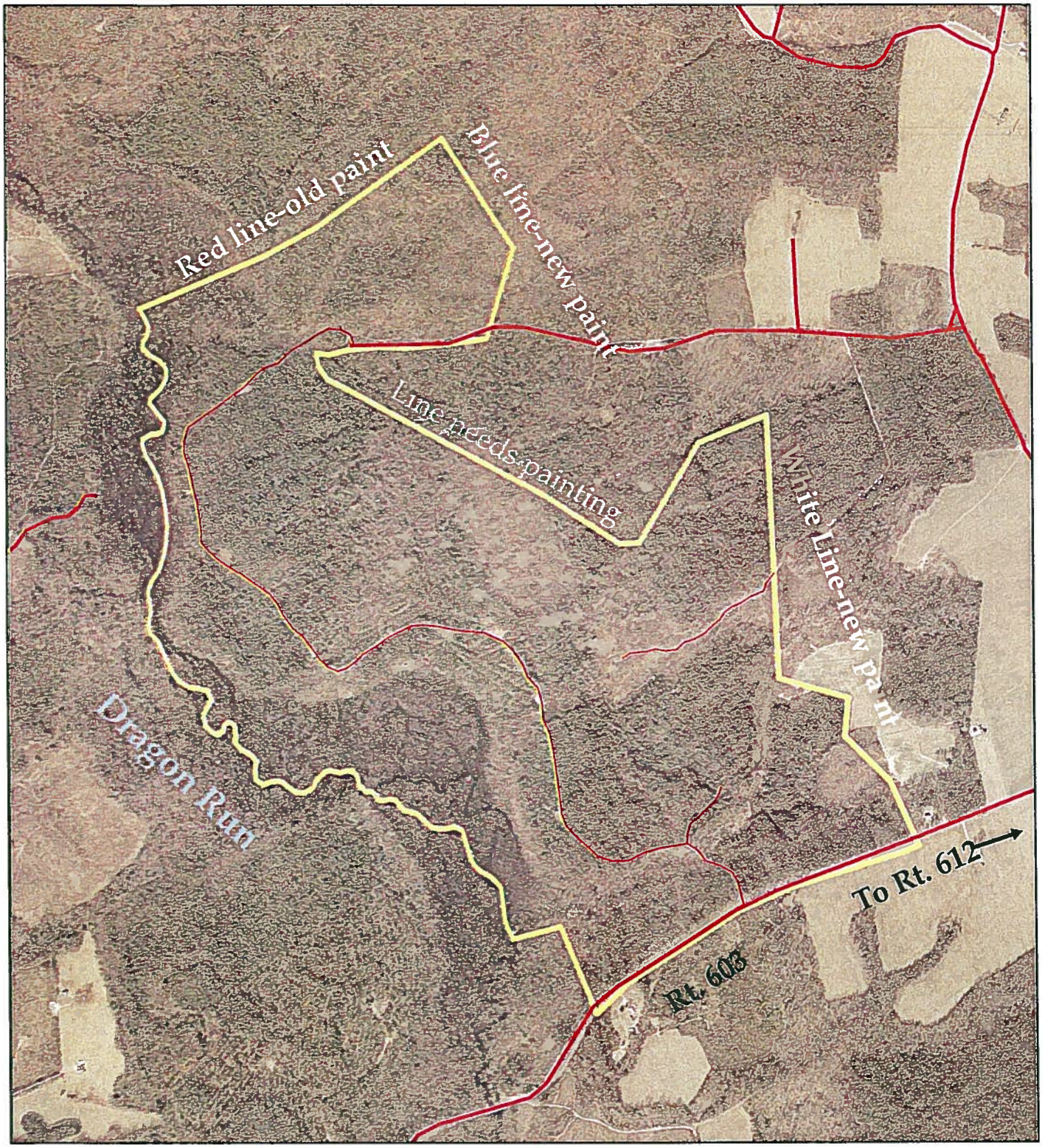
Remove any trees that have fallen across the access path.

Trash control:

There is a small trash pile containing a chair and tires that needs to be removed. It is located on the right side of the path leading north from Route 603 after crossing the first stream.

Boundary Line Maintenance:

The boundary lines are painted in a mixture of colors (see the map entitled "Dragon Run Block Boundary Line Paint") but most of them are in good shape. The east line of the Hall tract needs to be painted as soon as possible. The northwestern property line of the Hall tract will need to be repainted within the next two years. They should be repainted every 5 years.



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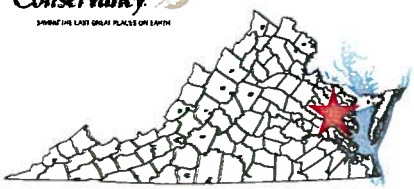

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Feet

0 1,500

Dragon Run Block Boundary Line Paint

Boundary

N

Combination of Working Forest and Ecological Ideal

In order for this combination to work I suggest preserving the entire bottomland hardwood area (BH1) and adding a 100 foot wide no-cut buffer along the high water line of the Dragon Run. I also recommend:

- Leave all wetlands areas and streamside management zones untouched.
- Convert the areas with soils best suited for hardwood growth to hardwood (see the map entitled "Dragon Run Block Combination Management"). Species most suited to these soils include yellow poplar (Liriodendron tulipifera) and southern red oak (Quercus falcata). Some of these areas already have these species growing on them which helps. Please see the harvesting recommendations listed below.
- Continue to grow pine on the other areas (with soils best suited to pine growth) in a sustainable manner with 100 foot wide hardwood travel corridors in between for mammal migration.
- Leave the beaver pond as is but control the beaver population to avoid immersion of pine areas.
- Control invasive species found in the Dragon Run Block. Invasive species found in other portions of the Dragon Run watershed include Phragmites, Blue Catfish, Asiatic Blueflower and Japanese Stiltgrass.

Harvesting and Planting Recommendations:

Harvest the portions of stands P, P-1968, P-1975, P-1984, P-1987, P-1989, P-1990 that fall within the areas designated for hardwood. Harvest pine only in the section of PS that falls within the wetland area as long as it will not cause soil damage. Allow these to regenerate naturally in hardwood. A couple of years after harvest timber stand improvement may become necessary to ensure that the desired species become dominant (oak-poplar). Future harvests in these stands should be limited to select cuts to promote the desired species.

Follow the management recommendations listed above under "Working Forest" for the pine management areas. There are several natural travel corridors currently in place. Make sure that the corridors are marked on the ground and left primarily in hardwood when harvesting adjoining stands.

Additional roads will not be necessary for this scenario but the recommendations for road maintenance, boundary line maintenance and trash control will remain the same as the Working Forest.

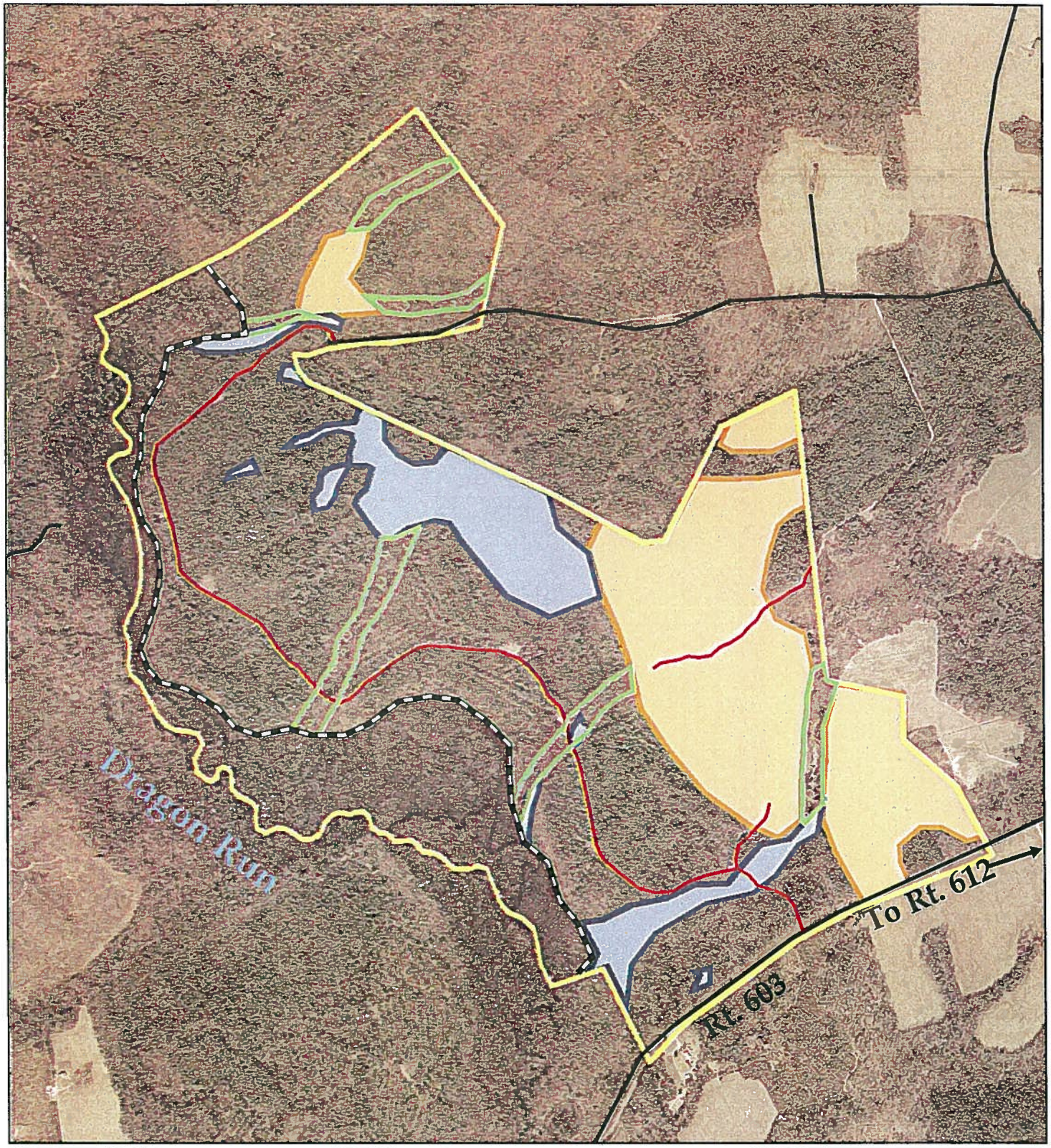
Showcase options:

Some suggestions if this block becomes a showcase site for The Nature Conservancy:

- Construct a viewing platform for the bald eagle nest.
- Plant native grasses on old deck sites and on sections of the road that will no longer be utilized.
- Leave aesthetic buffers along Route 603 and the access path (if the public is allowed on the site) when stands are clearcut.
- Construct a viewing platform for the beaver pond.

Note: Photographs taken by Virginia Chapter of The Nature Conservancy personnel during a field trip to the Dragon Run Block on 4/27/2006

Mona Griswold
9/2006



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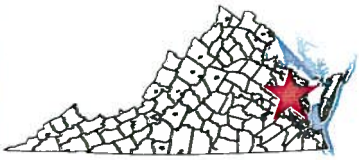

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Feet

0 1,000

Dragon Run Block Combination Management

- Dragon Run High Water Line
- Wetlands
- Hardwood Stands
- Travel Corridor

N

Task 5: Biodiesel

Narrative Summary

MPPDC staff continued to work with Al Christopher, a consultant with Virginia Clean Cities (VCC) and other project partners on the development of a feasibility study and design of a pilot program to provide economic benefit to the agricultural community by encouraging the expanded use of biodiesel in the Dragon Run Watershed and seeking grant and endowment programs that can provide a direct economic feedback to the watershed farmers.

VCC compiled assorted data on the production of soybeans, the production of biodiesel and the potential consumption of biodiesel in the watershed area. VCC also submitted a grant to the EPA that included a request for funds for a biodiesel buy-down program to provide an incentive for the watershed school districts to use biodiesel in their school bus fleets. MPPDC staff coordinated meetings with school superintendents, as well as the watershed county school boards (except Middlesex, which is scheduled for November), to convey the benefits of the partnership program and the positive impacts of the use of biodiesel on the natural resource-based industries in the Dragon Run. While both Essex and Gloucester school boards have been provided with a presentation and positive feedback was received, both are going to consider the adoption of the resolution at their November meetings. King and Queen's school board adopted the resolution at its October meeting. Although the resolution has yet to go before the Middlesex County school board, there has been positive feedback from the superintendent and school bus fleet manager. In fact, the county may initiate the use of biodiesel before the resolution is approved.

A website has been developed to house all project reports and data for the partnership initiative. It address is: http://www.hrccc.org/biodiesel/dragonrunbiodiesel.html

Biodiesel and Sustainable Economic Development in Dragon Run Watershed

Task 1, Identify stakeholders, communicate project objectives, collect stakeholder input and generate ideas, conduct general and targeted outreach meetings

Deliverables 1-6:

- **Summary of initial stakeholder session**
- **Summary of follow-up meetings**
- **Summary of public and targeted outreach**
- **List of ideas**
- **List of stakeholders for PDC review**
- **Newsletter for stakeholders**

For additional background, see *Opportunities for Sustainable Natural Resource-Based Development in the Dragon Run Watershed*, an economic development study, which can be found on the Dragon Run Special Area Management Plan website: www.mppdc.com/dragon**)**

Date: March 31, 2007

Contract No: C07-02-05 Dragon Run

Contractor: Virginia Clean Cities
401 Keith Ave.
Kilmarnock VA 22482
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Issued by: Middle Peninsula Planning District Commission
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Background

The Dragon Run Watershed Special Area Management Plan (SAMP) project's mission is to support and promote community-based efforts to preserve the cultural, historic and natural character of the Dragon Run, while preserving property rights and the traditional uses within the watershed.

As part of the Dragon Run Special Area Management Plan managed by the Middle Peninsula Planning District Commission (MPPDC), a study titled "Opportunities for Sustainable Natural Resource-Based Development in the Dragon Run Watershed" (referred hereafter as the Yellow Wood study) was conducted in October 2005. The overall purpose of the project was to identify and explore economic development activities and opportunities that sustain traditional land uses while enhancing the natural resource base or at least minimizing adverse impacts. Seven areas were selected for further exploration, including biodiesel utilization (and production) for municipal vehicles. The Yellow Wood study found biodiesel utilization to be an example of enterprise that fits within the overall goal of sustainable natural resource-based economic development for the Watershed, whether carried out within the public or private sectors.

The Yellow Wood study reviews the basics of biodiesel including a description of fuel properties, storing the fuel, operations and maintenance considerations, engine warranty concerns, converting diesel fueling stations to biodiesel, environmental benefits of biodiesel, and other applications of biodiesel. The study concluded that because biodiesel involved relatively minor changes compared to other alternative fuels, and has documented environmental and health benefits, biodiesel is a logical choice for communities that are interested in promoting sustainability. Furthermore, the raw materials for biodiesel are primarily soybeans, which are grown extensively in the region. This study did not, however, delve into the deeper implications of how biodiesel could potentially impact traditional land uses in the Dragon Run Watershed, namely farming, forestry and recreation.

Virginia Clean Cities was contracted by the MPPDC to continue further exploration of biodiesel market viability and present recommendations based on survey summaries and stakeholder interest detailing potential to fulfill the goal to provide sustainable natural resource-based economic benefit to the watershed community centered around the use or production of biodiesel as a cleaner, healthier, domestic alternative to fossil fuel.

The Dragon Run Watershed and Geographic Boundaries for Biodiesel Utilization

Located in the Middle Peninsula of Virginia, the Dragon Run Watershed encompasses parts of Essex, King and Queen, Middlesex, and Gloucester Counties. The geographic boundaries of this analysis include the Dragon Run Watershed counties, as well as Mathews and King William Counties, which also are in the Middle Peninsula Planning District, and regions surrounding the Middle Peninsula which include key stakeholders such as Virginia Biodiesel Refinery LLC in New Kent County and Lancaster County Schools in the Northern Neck Planning District.

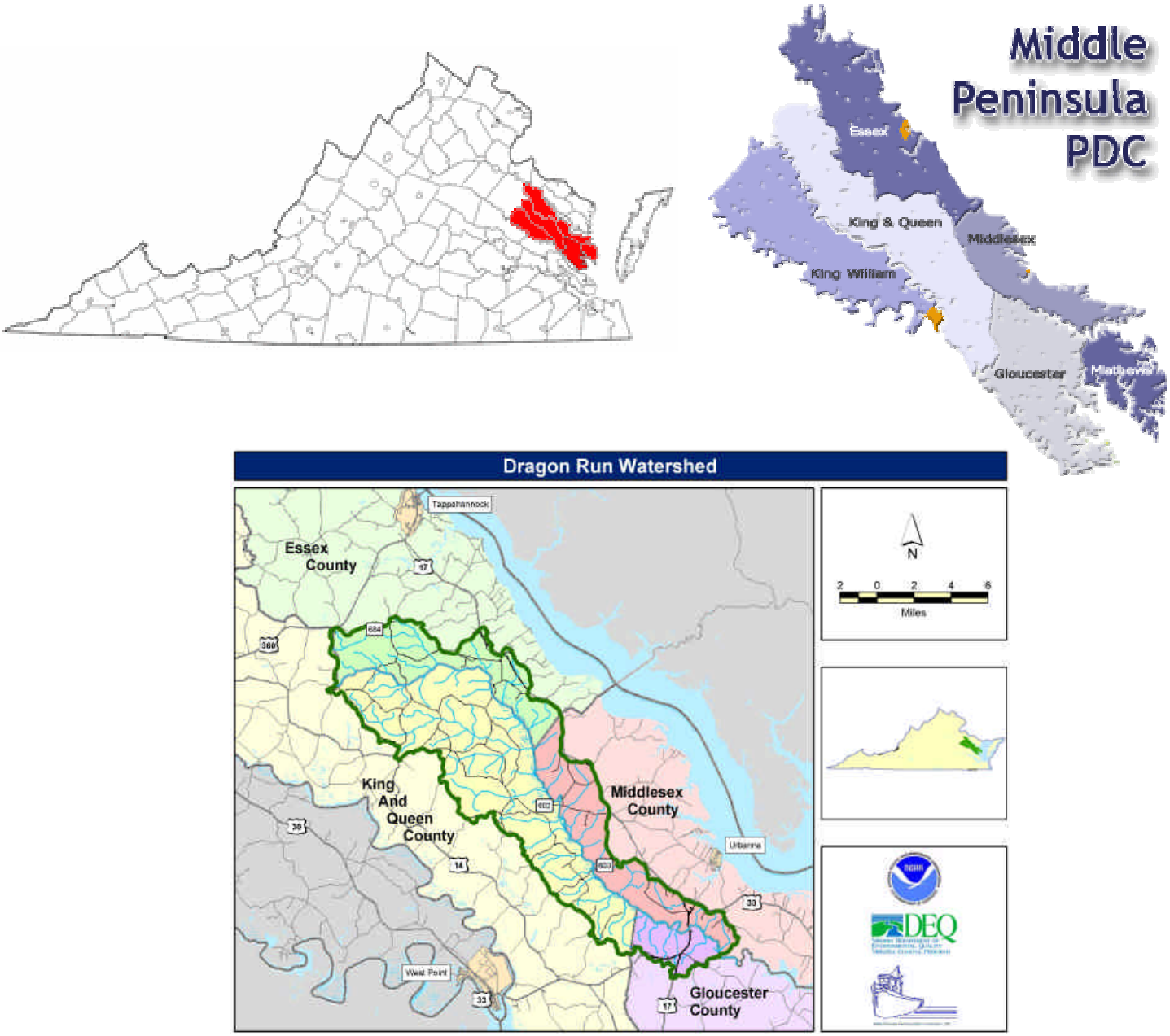

Figure 1. Middle Peninsula (top) in Virginia and Dragon Run Watershed (bottom)

Introduction

Central to the Dragon Run project and this report on early-stage project preparation work tasks and deliverables is a question. How can development of the biodiesel market and production industry achieve two goals: provide economic benefit to the watershed community and help to preserve natural resources in the sensitive watershed by sustaining current land uses, predominantly agriculture, forestry and outdoor recreation?

Summary of "brainstorming" session with Dragon Run Steering Committee and PDC staff

1-18-07 Initial PDC project kickoff meeting following contract award. Present: consultants, Sara Stamp and Lewis Lawrence. Reviewed schedule of early deliverables and upcoming meetings and considered upcoming opportunities for outreach to community and stakeholders.

2-7-07 Dragon Run Steering Committee meeting at Cook's Corner. First meeting with DRSC included consultant presentation on basics of biodiesel, possible funding sources, review of Virginia biodiesel projects and other agricultural initiatives that offer potential applications to Dragon Run or collaborative opportunities. Several DRSC members and project manager Sara Stamp suggested names of stakeholders to contact and upcoming opportunities for community outreach and additional stakeholder identification.

Summary of follow-up meetings and other outreach and Summary of targeted stakeholder and public meeting outreach (Combined Deliverables 2 and 4 from SOW)

2-5-07 Jon Turkel of parks service in Frederick County contacted by consultant regarding possible collaboration with Dragon Run stakeholders if small-scale production from waste vegetable oil is considered in the Dragon Run. Turkel is studying the feasibility of municipal-scale production of biodiesel and expressed an interest in possible collaboration with other groups exploring the idea.

2-21-07 Lowery's Restaurant annual Riverland Insurance farmer meeting was attended by Sara Stamp and consultant, who made brief presentation to 100 or more farmers and handed out notice of March 19 stakeholder meeting.

2-21-07 June Parker Oil Company in Tappahannock was visited by Sara Stamp and consultant to gauge the owner's interest in retailing biodiesel blends at the Mobil gas station and offering biodiesel blends in home heating oil. Owner was interested, but had concerns about cost and lack of consumer awareness and education about the benefits of biodiesel.

2-22-07 Shenandoah Waste Solutions Forum-sponsored symposium in Harrisonburg. Consultant staffed informational booth, monitored presentations to farmers and networked with attendees. Result was contact with Chris Bachmann of JMU alternative fuels lab regarding potential farm-scale technology licensing opportunity for biodiesel production. Also, learned of portable oil seed press concept under exploration by a group in western Virginia.

3-1-07 PDC office meeting to review initial strategy, refine stakeholder list and prepare for March and April outreach opportunities.. Consultant, MPPDC Executive Director Dan Cavanaugh, Sara Stamp attended meeting.

3-9-07 Local County Government Administrators (LCGA) regular meeting at PDC. Consultant briefed government administrators and asked for support to use biodiesel in school bus fleets and other diesel vehicles operated by local government and private fleets.

3-19-07 First biodiesel project stakeholder meeting at PDC office in Saluda. The manager of the biodiesel refinery in New Kent County, members of DRSC, PDC staff and other key stakeholders discuss how to increase use of biodiesel by fleets and private vehicle owners and ways to communicate to the public. Ideas include creation of a biodiesel quick guide that explains the benefits of using biodiesel.

3-28-07 Piankatank River Golf Club annual dinner meeting. Primarily a social event, but consultant made brief presentation about next phases of Dragon Run feasibility project. Sara Stamp and consultant made contact with Ellen Davis and Kent Ware of USDA Rural Development Richmond office and Jeff Jobs of USDA in MidWest region, who expressed interest in assisting project with grant funding search support.

<u>List of ideas from stakeholders, PDC staff and consultant</u>

1.) Trust Fund to equalize cost of biodiesel

A trust fund finance mechanism could be created to buy down cost of biodiesel relative to cost of petroleum for farmers. This proposal was offered by Sara Stamp. It could take many forms, but the underlying premise is to secure a source of funds to generate interest income that could be used to provide economic benefit to Dragon Run farmers in the form of more competitive biodiesel prices. Biodiesel typically costs about the same or slightly more than conventional petroleum diesel, but there are times when the differential cost can be unfavorably high for biodiesel.

2.) EPA Clean School Bus Grant

The Clean School Bus USA grant program offers financial support to reduce unhealthy exhaust emissions from school buses. The current round of proposals is

due no later than June 26, 2007. Consultant recommends that consultant and stakeholders assemble a grant proposal for one or more school districts in Dragon Run. The EPA Clean School Bus program encourages emissions reductions practices including: use of biodiesel, addition of after-market particulate traps and diesel oxidation catalysts, repowering school buses with cleaner engines and bus replacement. The program also accepts proposals that would use grant funds to equalize the cost of alternative fuels like biodiesel with conventional petroleum fuels to encourage wider use of the cleaner alternatives to reduce emissions.

3.) Hybrid Co-operative

Buyer and Producer Co-ops have been parts of successful programs to develop the biodiesel market in many areas of the country. Consultant recommends a hybrid co-operative approach that partners a retailer, fuel distributor, Virginia Biodiesel Refinery LLC and end users of biodiesel blends. This mechanism is less costly in capital equipment because no small tanks and pumps would be supplied or purchased, which typically is the case for user co-operatives. It would reduce the chance of poor quality issues that can result when inexperienced users store, handle and dispense biodiesel blends, especially during cold weather. Economic risk would be widely spread and the key risk takers also would have the opportunity to reap economic rewards in exchange for their risk. It should be possible to design a hybrid biodiesel co-op that could take great advantage of the type of marketing discussed next:

4.) Branding the Idea (not the product)

The difficulty of creating a direct economic benefit to farmers and a possible indirect approach employing the concept of "Branding" the act of purchasing biodiesel as an idea was presented by consultant and described here in the text of an email from consultant to PM Sara Stamp:

On the matters of a refinery partnership and direct benefit to farmers:

The owners and managers of Virginia Biodiesel Refinery LLC in the town of Eltham in New Kent County have indicated that they will be active Dragon Run partners and help out in any way.

The refinery has a self interest in any effort to encourage greater use of biodiesel. But a direct link and direct benefit going the other way --- from refinery to farmer – is much harder to find or create. The refinery does not buy soybeans from farmers. It buys refined soybean oil from Perdue, which produces the oil from soybeans grown in Dragon Run and elsewhere. (Part of the feasibility study includes a look at whether soybeans or another potential feedstock such as Canola could be crushed locally to produce oil, but it is not now known whether that might be practical and make economic sense.)

The most direct linkage, refinery to Dragon Run farmer, I can think of is not direct enough to base a valid calculation of potential economic value to the farmer. The link as I see it is: Demand for biodiesel results in demand for soybean oil. Demand for soybean oil results in demand for soybeans, which results in higher revenues for farmers who grow soybeans. Therefore, farmers should work to increase demand for biodiesel by using it and encouraging others to use it. The analogy often used to describe this indirect economic link is "a rising tide raises all ships." You could apply this indirect link to any soybean region, whether or not it has a biodiesel refinery. The presence of a refinery offers advantages of biodiesel supply security and lower transportation costs, but otherwise doesn't change the indirect nature of the link from refinery to farmer very much, unless local farmers own the local refinery. Even then the refinery probably would not buy soybeans directly from farmers.

I think other linkages and connections might be as important as or more important than the refinery-farmer link. Farmers who grow or could grow soybeans have a fairly clear but still indirect financial stake in any effort to encourage greater use of biodiesel. The many other potential users and supporters of biodiesel who live and work in Dragon Run also have stakes, but it is harder to put an economic value on the benefits they could derive from greater use of biodiesel. What is the value of cleaner air and water? What is the value of a rural and native resource-based lifestyle? How much is energy diversification, resource sustainability and increased domestic energy security worth?

In order to communicate the linkages between biodiesel and Dragon Run preservation, one path we might want to consider is to "brand" the use of biodiesel (the concept not the actual product) in a way that associates the use of biodiesel with the preservation of Dragon Run and all that that means in terms of keeping more open space, fostering a more vital farm economy, preserving a rural lifestyle, sustainable use of native natural resources, cleaner air, domestic sustainable and renewable fuel production, etc. This approach might make it easier to reduce a complex linkage to a simple idea to communicate, which could make the project easier to replicate in other regions and possibly easier to implement here.

The hard part is getting the message down to a simple concept to make the "brand" catch on and "catchy." Some initial ideas for a branding tag line concept and language to get across the message that there is a linkage between the use of biodiesel and preserving Dragon Run:

Save the dragon
Run with the Dragon
Dragon Power
Put a dragon in your tank
Dragon Fire
Taste of the Dragon
Drink from the Dragon

Something like one of the above (but better) could be the tag line or basis for a simple marketing campaign that attempts to sell folks on the benefits of using biodiesel. Other parts of the message would work off of the tag line:

Use Dragon Power in your truck because:
It's good for our farmers
It's good for our energy security
It's good for our air and water
It's good for our children

A tag line – It's good to use Dragon Power -- could be incorporated into just about everything associated with the Dragon Run project: stationary used in newsletters, posters distributed to partners, decals and other point-of-sale materials used by biodiesel retailers.

Newsletter to stakeholders

Electronic communications were employed, but at this early stage of project development it was premature to use a newsletter for some of the intended purposes enumerated in the scope of work agreement, which states that a periodic newsletter "will be used in addition to or in lieu of an in-person presentation to increase outreach to additional stakeholders and communicate efforts to date. The intent is to develop a mechanism to provide good internal communication among stakeholders and make it easy for new stakeholders – organizations and individuals – to learn about, influence and support the implementation of recommendations."

Communications efforts during this phase of work included:

- A full-color brochure created by Sara Stamp, project manager, which provides background on the Dragon Run watershed and biodiesel. The cover page of the brochure was modified so that it could serve as a way to announce several stakeholder meetings and as an attachment with other communications.
- Meeting announcements and agendas
- LCGA meeting handout
- Handout for annual farm insurance breakfast at Lowery's Restaurant
- Chevron ULSD elastomer failures white paper for school bus fleet meeting
- Biodiesel Quick Guide created by Chelsea Jenkins

Middle Peninsula Planning District
Summary of biodiesel production and consumption capacity

The six counties of Virginia's Middle Peninsula produce about 1.44 million bushels of soybeans on 62,146 acres. Using the standard conversion factor of 1.4, the soybean oil that could be extracted from this crop could be processed into about 2 million gallons of biodiesel.

The four counties with land in the Dragon Run sensitive watershed – Essex, Gloucester, King & Queen and Middlesex – produce about 1.1 million bushels of soybeans on 46,475 acres. Using a 1.4 conversion factor, the soybean oil that could be extracted from this crop could be made into 1.54 million gallons of biodiesel.

Approximately 9.3 million gallons of diesel fuel and #2 heating oil are sold by fuel distributors who operate in the Middle Peninsula. Therefore, it would be possible to produce enough biodiesel from the local soybean crop to replace slightly more than 20 percent of diesel fuel and heating oil consumed on the Peninsula with biodiesel.

See highlighted sections below for detail. Note that Table 2 does not include heating oil.

Table 1. Results of Middle Peninsula oil distributor survey conducted by Virginia Clean Cities during the period of April 30-May 17, 2007. Surveys were conducted via phone and email. NOTE: Based on the response rate and the inability to track every diesel gallon moving through the Middle Peninsula, the following results are very conservative, but serve as a starting point to determine potential market penetration.

# of Distributors Included	6	
Commercial Highway Diesel Sales:	3,487,180	gallons annually
Retail Highway Diesel Sales:	3,767,180	gallons annually
Number of Retail Highway Diesel Locations:	19	stations
TOTAL HIGHWAY DIESEL	4,807,180	gallons annually
Total Off-Road Diesel Sales:	1,216,000	gallons annually
Retail Off-Road Diesel Sales:	1,035,691	gallons annually
Number of Retail Off-Road Diesel Locations:	6	stations
TOTAL OFF-ROAD DIESEL	2,136,000	gallons annually
Total #2 Heating Fuel Oil Sales:	2,387,000	gallons annually
Biodiesel Sales and Locations:	232,700	gallons annually
Biodiesel Retail Phillips Energy, Inc		

locations in Middle Peninsula, VA :	2586 George Washington Memorial Highway Hayes, VA B5 (5% biodiesel, 95% petroleum) on-road biodiesel

Table 2 presents various scenarios using the survey results and biodiesel market penetration levels. Scenarios are labeled A-E on the left column. Scenario A, for example, was calculated on the basis that all diesel sold (based on survey results) contained a 2, 5, 10, and 20% blend of biodiesel. Highway diesel and off-road diesel scenario results are presented.

Table 2. Various scenarios of biodiesel market penetration levels using survey results from Table 1.

A	All diesel sold contains	B2	B5	B10	B20
	Highway diesel (gallons)	96143.6	240359	480718	961436
	Off-road diesel (gallons)	42720	106800	213600	427200
B	5% of diesel sold contains	B2	B5	B10	B20
	Highway diesel (gallons)	4807.18	12017.95	24035.9	48071.8
	Off-road diesel (gallons)	2136	5340	10680	21360
C	10% diesel sold contains	B2	B5	B10	B20
	Highway diesel (gallons)	9614.36	24035.9	48071.8	96143.6
	Off-road diesel (gallons)	4272	10680	21360	42720
D	20% diesel sold contains	B2	B5	B10	B20
	Highway diesel (gallons)	19228.72	48071.8	96143.6	192287.2
	Off-road diesel (gallons)	9548	23870	47740	95480
E	50% diesel sold contains	B2	B5	B10	B20
	Highway diesel (gallons)	48071.8	120179.5	240359	480718
	Off-road diesel (gallons)	23870	59675	119350	238700

Farmers

Farmers are apparent beneficiaries of biofuels since the feedstocks are grown on American soil. How can farmers become involved in a Middle Peninsula biodiesel initiative?

The first and most obvious choice is for farmers to use the product and support domestically grown and produced energy alternatives. Farmers are already a strong customer base for biodiesel, and the reason many oil distributors began carrying the product in the first place. Farmers commitment to biodiesel is also reflected in their $25 million investment in the product through checkoff dollars.[1]

A second approach for farmers is to get involved in the actual production of oilseed crops, production of biodiesel, or a biodiesel research project.

The USDA National Agricultural Statistics Service reports that Essex, Gloucester, Middlesex, Mathews, King and Queen, and King William Counties collectively have 593 farms total, comprising 145,409 acres.[2] Looking at this farmland from a biomass perspective, or more specifically an oilseed perspective, soybean appears to be the primary oilseed crop grown in the Middle Peninsula area. The NASS reported 227 soybean farms with production of 1.44 million bushels.

Table 5. USDA NASS Report Middle Peninsula farming statistics.

Total Cropland (farms)	593
Total Cropland (acres)	145,409
Total Corn for grain (farms)	204
Total Corn for grain (acres)	53,662
Total Corn for grain (bushels)	3,138,137
Total soybean for grain (farms)	227
Total soybean for grain (acres)	62,146
Total soybean for grain (bushels)	1,436,714

Of the 145,409 acres of farmland in the Middle Peninsula, 115,808 is used for corn and soybean already, the main feedstocks for biodiesel and ethanol. The main buyers of soybean in the Middle Peninsula are Purdue and Old Dominion Grain, as well as some buyers of food grade soybeans.

The Essex County Extension Agent, Keith Balderson, stated the single most important concern of soybean farmers in the Middle Peninsula, and anywhere, is anything to improve

[1] "Biodiesel on the Farm." NBB. http://www.biodiesel.org/markets/far/
[2] U.S. Dept of Agriculture. National Agricultural Statistics Service. Virginia Data – Crops. Year 2006-2007. http://www.nass.usda.gov/Census/Pull_Data_Census

the price of soybean (i.e. more demand). Soybeans are the only oilseed feedstock currently grown in the Middle Peninsula, however, Keith Balderson did discuss the ability to grow canola (Brassica napus L.) in the region. Test plots of canola were grown in Essex County in the Early 1990s for at least 2 years, and Keith Balderson remembers good yields.

Canola is a member of the Brassicaceae or mustard family and is similar to oilseed Rape. Rape was modified in Canada to make it edible by eliminating erucic acid and glucosinolates. The result was Canada oil, low acid rape, commonly known as canola. Seed of canola typically has 40-42% oil content but higher amounts are possible through breeding. Two varieties that are adapted to Virginia soils and climate, VSX-1 and VSX-2, have been developed at Virginia State University. Winter type canola varieties could replace wheat in a soybean-wheat-corn rotation. Summer types that are adapted to Virginia are under development and could some day replace soybean in the rotation. Soybean averages around 32 bu/A (1600 lb/A) and could produce about 320 lbs of oil per acre; whereas canola averages about 40 bu/A (2000 lb/A) in Virginia, and could yield up to 800 lb of oil per acre. With a lower content of saturated fatty acids and lower cloud point, biodiesel from canola feedstocks has better cold weather performance than soydiesel. With a lower iodine value canola biodiesel also has greater stability than soydiesel. Byproducts of vegetable oil biodiesel include meal and glycerin. Based on amino acid content canola meal has about 10% lower digestability than soybean meal but is usable in swine and poultry feeds. If processed into a food grade, the glycerin component can be a valuable byproduct and constitutes about 1/10 of the bioprocessing output.[3]

Furthermore, a current pilot demonstration by Virginia State University headed by Harbans Bhardwaj is demonstrating the growth potential of canola. The University received a grant to grow canola, purchase a small oilseed crusher, and a biodiesel reactor in order to demonstrate the ability of small scale production on a local scale.

A more detailed feasibility study would need to be conducted to determine Middle Peninsula potential to produce oilseed crops for the biodiesel market. A good model was completed by the Tennessee's Soybean Promotion Board, the Tennessee Farm Bureau, the Tennessee Department of Agriculture, USDA Rural Development, and the Tennessee Valley Authority. The group contracted the Agri-Industry Model and Analysis Group to conduct an economic feasibility study of producing biodiesel in Tennessee. The study concluded a 13 million gallon biodiesel plant was feasible and would use 9 million bushels of soybeans. After the study was completed, the question of producer interest in selling soybeans to a biodiesel facility arose. As a result, a study was conducted to examine Tennessee soybean growers' views on biodiesel, their interest and capability to supply sufficient production to a biodiesel plant, and their interest in formation of a cooperative to produce biodiesel.

The survey is located in Appendix D, and is a good model if the determination to involve farmers to a higher degree than use is decided.

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[3] Shokes, Fred, et al. Virginia Tech Dean's Forum on Energy Security and Sustainability. 16 October 2006. "Canola – An Alternative Oilseed Crop for Virginia with Good Biofuel Potential." http://www.research.vt.edu/energy/Applications.html

Biodiesel and Sustainable Economic Development in the Dragon Run Watershed

Part 1, Exploring the feasibility of biodiesel consumption and production as tools for natural resource-based economic development and preservation of existing land uses

For additional background, see *Opportunities for Sustainable Natural Resource-Based Development in the Dragon Run Watershed*, an economic development study, which can be found on the Dragon Run Special Area Management Plan website: www.mppdc.com/dragon**)**

Date: May 18, 2007

Contract No: C07-02-05 Dragon Run

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Executive Summary

Central to the Dragon Run project and this first phase feasibility study is a question. How can development of the biodiesel market and production industry achieve two goals: provide economic benefit to the watershed community and help to preserve natural resources in the sensitive watershed by sustaining current land uses, predominantly agriculture, forestry and outdoor recreation.

<u>How can biodiesel achieve the project goals?</u>

"A Rising Tide Lifts All Ships"

Even if local farmers can't directly sell their soybeans or other feedstocks to the nearby Eltham biodiesel refinery, more biodiesel demand means more feedstock demand and higher prices to all farmers. As seen with corn last year, the price doubled as ethanol production increased from 3 to 5 billion gallons. The USDA now projects corn prices staying above $3.50 a bushel and rising to $3.75 a bushel in 2009, driven by increased demand for ethanol. Furthermore, farmers are finally getting a price for their corn that is over their cost of production for the first time in almost 30 years.

The Multiplier Effect

A dollar spent for biodiesel produced at the Virginia Biodiesel Refinery LLC in New Kent County mostly stays in the state of Virginia. The Eltham biodiesel refinery purchases soy oil from Purdue, which buys soybeans from Virginia and elsewhere. Additionally, the refinery provides a few local jobs, pays taxes, hires contractors, etc. While it is a difficult task to pinpoint how much of the dollar stays in the local and state economy, it is quite easy to assert that most of a dollar spent on petroleum diesel leaves the country and certainly the local economy.

"Save the Dragon, Use Biodiesel"

Branding the concept of sustainable fuel selection practices by using taglines such as "Save the dragon, use biodiesel" may work in the Middle Peninsula, and possibly elsewhere in largely rural Virginia. "Sustainable" fuel selection could speak to economic, ecological, and ethical sustainability, and therefore a variety of individuals residing in the Dragon Run watershed and Middle Peninsula. If successful, an incremental increase in demand and, more importantly, a friendly climate to grow the biofuels "industry" in Virginia might result.

The biomass sector is still in its infancy, and much is still needed for the sector to truly emerge (i.e. research, crop development, infrastructure development, supportive policies, etc.) as a significant force in curbing our "oil addiction." If the climate embraces biodiesel, the Middle Peninsula and Dragon Run communities

could stand to benefit from future involvement as the biomass sector emerges and evolves.

A Sustainable Community is a Resilient Community

Energy is becoming part of the sustainable development and environmental groups chatter as communities are realizing energy is the lifeblood of any society. Unfortunately, many communities are 100% dependent on one source of energy. If supply disruption occurs, such as has happened after the 1973 Arab oil embargo and Hurricane Katrina, a community which has a diverse energy portfolio already established and accepted is in a far better place than one that does not.

Alternative Fuels May Have Price Advantage Over Petroleum in the Near Future

Experts predict oil prices will continue to rise. Rising demand from other industrializing nations, global politics, and peaking oil fields is making the light bulb illuminate for many. Bottom line, oil is a finite resource and if we do not begin the process of transitioning to other alternatives, we will, one day, run out. As global oil production begins to peak, prices will rise, and will position fuel sustainable communities for economic success while severely damaging other economies.

Considerations for Maximizing Environmental and Economic Benefits

Most recommendations for creating a successful bio-economy have noted the potential for rural development, but have failed to address how communities might participate in the process or how the bio-economy would actually benefit the rural economy.

Biofuels development has been compared to a "liquid gold rush." As the rush to grow the sector continues, "the benefits to rural communities may be muted or lost if federal, state, and local policies and programs that help determine the sector's ownership scale and structure do not sufficiently support rural development priorities."[1]

One key aspect to rural communities maximizing benefit from biofuels development is local ownership. Ownership of the refineries by local farmers and community members is seen as the key aspect to sustainable rural development. Facilities owned locally have proven to be based to some extent on local resources and needs, and much of the money generated from the facility remains in the local economy.

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[1] "Biofueling Rural Development: Making the Case for Linking Biofuel Production to Rural Revitalization." Carsey Institute. Policy Brief No. 5. Winter 2007. http://www.carseyinstitute.unh.edu/documents/Biofuels_final.pdf

John Urbanchuk has conducted several studies assessing the economic impacts on the farm community of cooperative ownership of ethanol plants. All of his studies show a higher return to communities than absentee-owned facilities. The most recent study concludes that a community-owned facility will increase the local economy half again as much (56 percent) as an absentee-owned plant.[2]

David Morris, Co-Founder of the Institute for Local Self Reliance, authored "Energizing Rural America: Local Ownership of Renewable Energy Production is Key."[3] In this report, Morris speaks about how policy makers have historically approached renewable energy as an energy security or environmental issue, with agricultural implications. Today, however, goals of displacing significant portions of our nation's energy with homegrown biofuels and renewable electricity are making agricultural implications become paramount.

With the construction of some 2,500 biorefineries throughout the nation, if predominantly locally owned, rural America would be transformed. He argues that it should be a high national priority to ensure that these positive investments in rural America are realized, and the benefits widely shared. Furthermore, Morris shows that to date, public policy has focused principally on simply achieving the quantitative goal of expanding renewable energy production. However, qualitative goals such as maximizing economic development in rural communities through the promotion of renewable energy have largely been overlooked.

For Further Reading:

Institute for Agriculture and Trade Policy
Cultivating a New Rural Economy
www.iatp.org

Carsey Institute
Biofueling Rural Development: Making the Case for Linking Biofuel Production to Rural Revitalization
http://www.carseyinstitute.unh.edu/documents/Biofuels_final.pdf

Institute for Local Self-Reliance
25 by '25: Getting the Priorities Right
http://www.newrules.org/de/speech25by25.pdf

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[2] Urbanchuk, John. "Economic Impacts on the Farm Community of Cooperative Ownership of Ethanol Production," for the National Corn Growers Association. September 2006. Online: www.ncg.com/ethanol/pdfs/2006/farmerownedethanoleconomicimpact.pdf

[3] Morris, David. "Energizing Rural America: Local Ownership of Renewable Energy Production is Key" for the Center for American Progress. January 2007. Online: http://www.americanprogress.org/issues/2007/01/pdf/rural_energy.pdf

Apollo Alliance
New Energy for America: The Apollo Jobs Report: For Good Jobs & Energy Independence
www.apolloalliance.org/jobs/index.cfm

Worldwatch Institute: Biofuels for Transporttion: Global Potential and Implications for Sustainable Agriculture and Energy in the 21st Century (2006)
www.worldwatch.org/taxonomy/term/445

The University of Tennessee, Agricultural Economics
25% Renewable Energy for the United States By 2025: Agricultural and Economic Impacts
http://www.agpolicy.org/ppap/report%2025x25.pdf

Characterization of Fleets and Potential Retail Market for Biodiesel in Dragon Run Watershed

Oil Distributor Survey

Virginia Clean Cities surveyed 14 oil companies operating in the Middle Peninsula April 30, 2007 through May 17, 2007 via phone and email. Of the 14 oil companies identified, 43% responded (6) to the survey within the time frame specified after multiple attempts.

Distributors were asked:

- Total highway diesel sales (annually, gallons)
- Total retail highway diesel sales
- Number of retail highway diesel locations supplied
- Total off-road diesel sales (annually, gallons)
- Total off-road diesel sales
- Number of off-road diesel locations supplied
- Total #2 heating fuel oil sales
- Total biodiesel sales
- Number of retail biodiesel locations supplied

Results of the survey are presented below in Table 1.

Table 1. Results of Middle Peninsula oil distributor survey conducted by Virginia Clean Cities during the period of April 30-May 17, 2007. Survey were conducted via phone and email. NOTE: Based on the response rate and the inability to track every diesel gallon moving through the Middle Peninsula, the following results are very conservative, but serve as a starting point to determine potential market penetration.

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Total #2 Heating Fuel Oil Sales:	2,387,000	gallons annually
Biodiesel Sales and Locations:	232,700	gallons annually
Biodiesel Retail locations in Middle Peninsula, VA :	Phillips Energy, Inc 2586 George Washington Memorial Highway Hayes, VA B5 (5% biodiesel, 95% petroleum) on-road biodiesel	

Table 2 presents various scenarios using the survey results and biodiesel market penetration levels. Scenarios are labeled A-E on the left column. Scenario A, for example, was calculated on the basis that all diesel sold (based on survey results) contained a 2, 5, 10, and 20% blend of biodiesel. Highway diesel and off-road diesel scenario results are presented.

Table 2. Various scenarios of biodiesel market penetration levels using survey results from Table 1.

A	All diesel sold contains	B2	B5	B10	B20
	Highway diesel (gallons)	96143.6	240359	480718	961436
	Off-road diesel (gallons)	42720	106800	213600	427200
B	5% of diesel sold contains	B2	B5	B10	B20
	Highway diesel (gallons)	4807.18	12017.95	24035.9	48071.8
	Off-road diesel (gallons)	2136	5340	10680	21360
C	10% diesel sold contains	B2	B5	B10	B20
	Highway diesel (gallons)	9614.36	24035.9	48071.8	96143.6
	Off-road diesel (gallons)	4272	10680	21360	42720
D	20% diesel sold contains	B2	B5	B10	B20
	Highway diesel (gallons)	19228.72	48071.8	96143.6	192287.2
	Off-road diesel (gallons)	9548	23870	47740	95480
E	50% diesel sold contains	B2	B5	B10	B20
	Highway diesel (gallons)	48071.8	120179.5	240359	480718
	Off-road diesel (gallons)	23870	59675	119350	238700

<u>School Fleet Manager Survey</u>

School districts in the Middle Peninsula area were surveyed to determine how many diesel vehicles or pieces of equipment were in operation, and how much fuel is used on an annual base. The aggregated results of the survey are presented below for King and Queen County Schools, Essex County Schools, Gloucester County Schools, King William County Schools, Lancaster County Schools, King William County Schools, Middlesex County Schools, and Bay Transit (not a school fleet)[4]:

[4] Bay Transit was included in the school fleet totals because Virginia Clean Cities thought it was a "marquee" fleet as the schools are and therefore has a higher level of public attention than a private fleet.

Table 3. Fleet profile survey results for Gloucester, Middlesex, King William, King and Queen, Essex, Mathews, Lancaster, Bay Transit

Fleet Profile Total: Gloucester, Middlesex, King William, King and Queen, Essex, Mathews, Lancaster, Bay Transit	
LD Gas*	222
LD Diesel	25
HD gas	33
HD diesel	337
Off road gas	1
Off road diesel	7

**excluding King William County*

Respondents that reported diesel fuel use include Lancaster, Gloucester, Middlesex, and Mathews County schools. Of the 4 school districts, a total of 303,631 gallons of diesel fuel is used on an annual basis. The figure is probably approaching over 500,000 gallons per year if the remaining fleets surveyed are included. The following calculations are based on the actual survey results of 303,631 gallons and show the amount of biodiesel demand that would be created if all diesel fuel used in the 4 school districts that responded were converted to various biodiesel blends.

Table 4. Potential biodiesel demand at various blend levels created from 4 school districts surveyed in Middle Peninsula.

Blend Level	B2	B5	B10	B20
Gallons	6072.62	15181.55	30363.1	60726.2

Characterizing the Roles of Strategic Partners

Biodiesel Manufacturer (refinery)

Biodiesel production in Virginia is still in the developmental stages. Currently, there is only 1 plant in Virginia consistently producing ASTM quality biodiesel. Virginia Biodiesel is located at 7475 Ready Mix Drive in West Point, Virginia. Virginia Biodiesel has been involved in the early stages of the Dragon Run Watershed biodiesel project. Virginia Biodiesel already supplies ASTM quality biodiesel to distributors around the Middle Peninsula and throughout Virginia. Because of its close proximity to the (20 miles from King and Queen County) Middle Peninsula counties, the refinery will play a significant role in future biodiesel supply and possibly provide economic benefit to the community.

Biodiesel Distributor

Until biodiesel use becomes more widespread, difficulties in marketing the fuel continue. Economies of scale are the vehicle by which a firm or industry lowers the unit price of the product; until that point, biodiesel sales will remain limited.

Fourteen oil distributors were identified as supplying product in the 6 county Middle Peninsula area. Six reported already distributing biodiesel product to end users or retail outlets in the Middle Peninsula area.

Biodiesel Retailer

If biodiesel is to become mainstream in the Middle Peninsula area, retailers must become interested stakeholders. Increasing the biodiesel fuel station network should be a top priority to provide as many Middle Peninsula residents who operate diesel vehicles with a choice.

Only 1 oil company reported a retail biodiesel location in the Middle Peninsula area.

Biodiesel Users/Fleets

Any diesel vehicle or piece of equipment can use biodiesel, which is one of its advantages. Potential fleet types (list specific to Middle Peninsula) which can take advantage of a biodiesel blend, and that perhaps should be considered as a target market, include:

- "Niche Markets"
    - Agriculture
    - Forestry
    - Recreation
        - Tour boats and charters
        - Marinas (for private citizen boats, see http://middlepeninsula.com/boating.htm for a listing)
        - Campgrounds (Thousand Trails Campground)
    - Institutes of higher education
        - Virginia Institute of Marine Since (VIMS)
        - Rappahannock Community College (RCC)
- Transit buses
    - Bay Transit
- School buses
    - Essex, King and Queen, Middlesex, Gloucester, Mathews, King William, and Lancaster Counties
- Refuse haulers
- Delivery vehicles (beer, beverage, snack foods)
- Long-haul trucks

- Government fleets (not a significant target market, very little diesel equipment operated by government fleets – see section of report)

Factors Affecting the Continued Growth of Biodiesel

Various factors can affect the future growth of biodiesel in the Middle Peninsula and Dragon Run watershed areas:

- Limitations of biodiesel manufacturing
- Costs and difficulties associated with transition and fuel
- Fuel quality issues
- Environmental and social factors
- Incentives

Outlets for Continued Education of Stakeholders, Partners, and End Users

Continued education of stakeholders, strategic partners, end users, and the general public should be viewed as a key priority in getting a biodiesel initiative off the ground. This section contains recommendations for outreach and education.

Conclusions

This first-phase report is meant to provide a framework to assist the contractor and MPPDC in determining directions and paths to consider in the next phases of the project.

Foremost, however, this report provides support for the decision whether to advance the project to the next planned phase or rethink project objectives, a determination to be based in part on whether there appears to be adequate market viability and stakeholder interest in developing the biodiesel market.

Some positive conclusions are easy and obvious: clearly, whether biodiesel is promoted as a sustainable fuel practice and "can help save the dragon," is used by farmers and school districts for cleaner air and reduced dependence on foreign oil, or is used as a catalyst for a cooperative initiative, biodiesel can provide economic, environmental, and social benefit to the Dragon Run watershed and Middle Peninsula communities. Stakeholder interest and willingness to support the project appear to be strong and growing.

Tailoring a biodiesel project to provide the maximum possible local economic benefit will not be as easy, however, and will require thoughtful strategic planning.

Background

The Dragon Run Watershed Special Area Management Plan (SAMP) project's mission is to support and promote community-based efforts to preserve the cultural, historic and natural character of the Dragon Run, while preserving property rights and the traditional uses within the watershed.

As part of the Dragon Run Special Area Management Plan managed by the Middle Peninsula Planning District Commission (MPPDC), a study titled "Opportunities for Sustainable Natural Resource-Based Development in the Dragon Run Watershed" (referred hereafter as the Yellow Wood study) was conducted in October 2005. The overall purpose of the project was to identify and explore economic development activities and opportunities that sustain traditional land uses while enhancing the natural resource base or at least minimizing adverse impacts. Seven areas were selected for further exploration, including biodiesel utilization (and production) for municipal vehicles. The Yellow Wood study found biodiesel utilization to be an example of enterprise that fits within the overall goal of sustainable natural resource-based economic development for the Watershed, whether carried out within the public or private sectors.

The Yellow Wood study reviews the basics of biodiesel including a description of fuel properties, storing the fuel, operations and maintenance considerations, engine warranty concerns, converting diesel fueling stations to biodiesel, environmental benefits of biodiesel, and other applications of biodiesel. The study concluded that because biodiesel involved relatively minor changes compared to other alternative fuels, and has documented environmental and health benefits, biodiesel is a logical choice for communities that are interested in promoting sustainability. Furthermore, the raw materials for biodiesel are primarily soybeans, which are grown extensively in the region. This study did not, however, delve into the deeper implications of how biodiesel could potentially impact traditional land uses in the Dragon Run Watershed, namely farming, forestry and recreation.

Virginia Clean Cities was contracted by the MPPDC to continue further exploration of biodiesel market viability and present recommendations based on survey summaries and stakeholder interest detailing potential to fulfill the goal to provide sustainable natural resource-based economic benefit to the watershed community centered around the use and production of biodiesel as a cleaner, healthier, domestic alternative to fossil fuel.

To that end, the following analysis: 1) presents arguments for how biodiesel use and/or production could provide benefit to the Middle Peninsula and Dragon Run Watershed areas; 2) refines the roles of strategic partners; 3) attempts to characterize and quantify potential capacity, will and market for biodiesel end users, including local governments, school bus and other diesel-powered equipment, farmers, and commercial fleets; 4) assesses factors impacting biodiesel market

penetration; 5) examines cooperative approaches to traditional fuel retail sales; and 6) examines next steps and presents recommendations.

<u>The Dragon Run Watershed and Geographic Boundaries for Biodiesel Utilization</u>

Located in the Middle Peninsula of Virginia, the Dragon Run Watershed encompasses parts of Essex, King and Queen, Middlesex, and Gloucester Counties. The geographic boundaries of this analysis include the Dragon Run Watershed counties, as well as Mathews and King William Counties and regions surrounding the middle peninsula which include key stakeholders (i.e. Northern Neck, New Kent, Lancaster County).

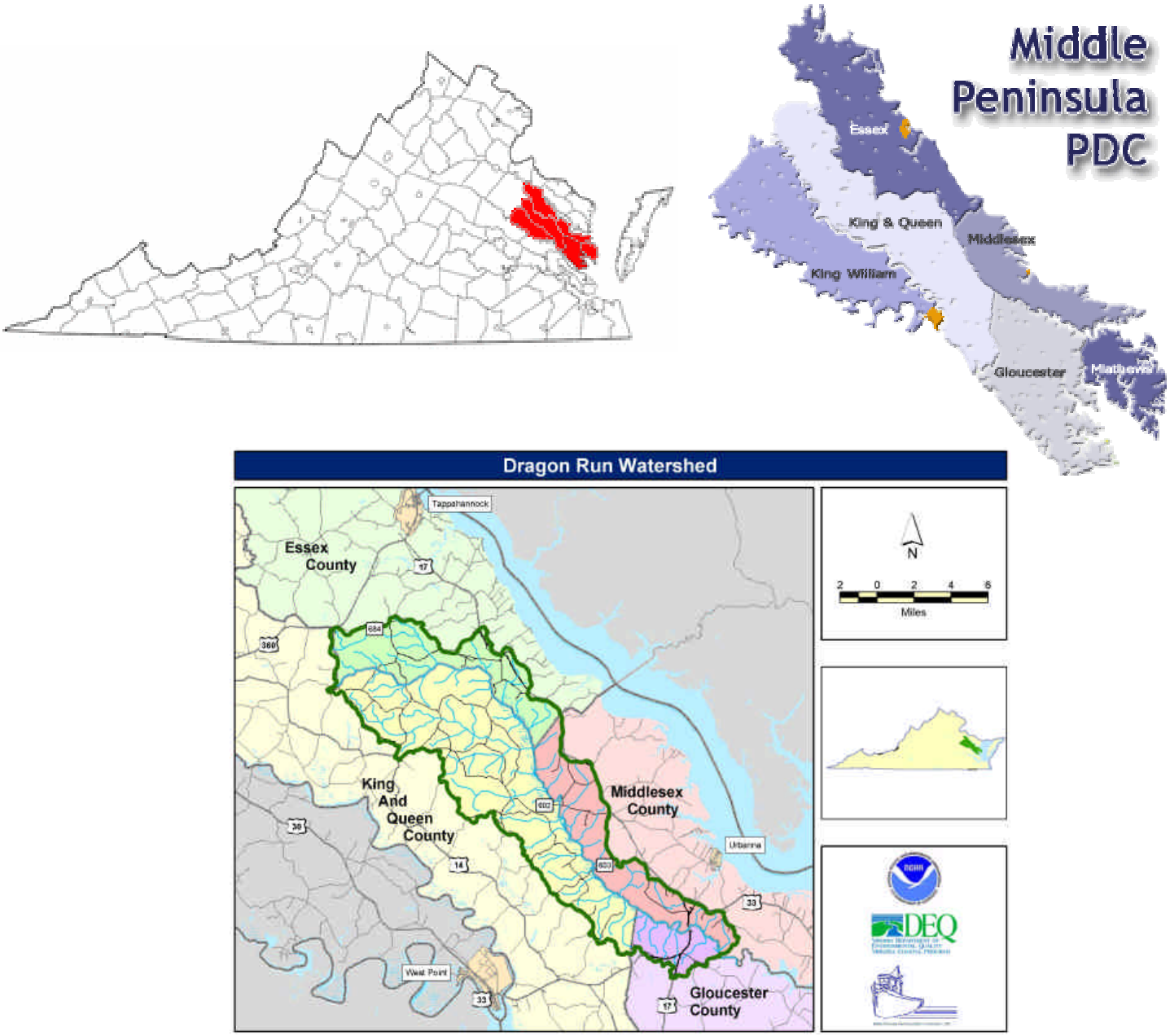

Figure 1. Middle Peninsula (top) in Virginia and Dragon Run Watershed (bottom)

Biodiesel Overview

Environmental and energy security concerns have increased interest in agricultural oils and fats for conversion to biodiesel. Biodiesel is produced by chemically modifying renewable, biologically based (biomass) oil or fats by reacting them with methanol and a catalyst and then separating/purifying the reaction products as shown in Figure 2. Following completion of reaction, glycerol and fatty acids, remain as the co-products.[5]

Biodiesel is a cleaner burning liquid fuel, which can be produced from various domestic, renewable resources like soybeans, sunflowers, and from recycled cooking oils or animal fats (see Fig. 2). Biodiesel contains no petroleum, but it can be blended at any level with petroleum diesel to create a biodiesel blend. It can be used in compression-ignition (diesel) engines with little or no modification, and in any other combustion equipment (i.e. boilers and heaters). Simple to use, biodegradable, nontoxic, essentially free of sulfur & aromatics, biodiesel also reduces serious air pollutants such as particulates, carbon monoxide, hydrocarbons, and other air toxins.

An overview of the biodiesel production process and feedstock sources is provided below.

[5] Bantz, Steve and Michael Deaton. Understanding US Biodiesel Industry Growth using Systems Dynamics Modeling.

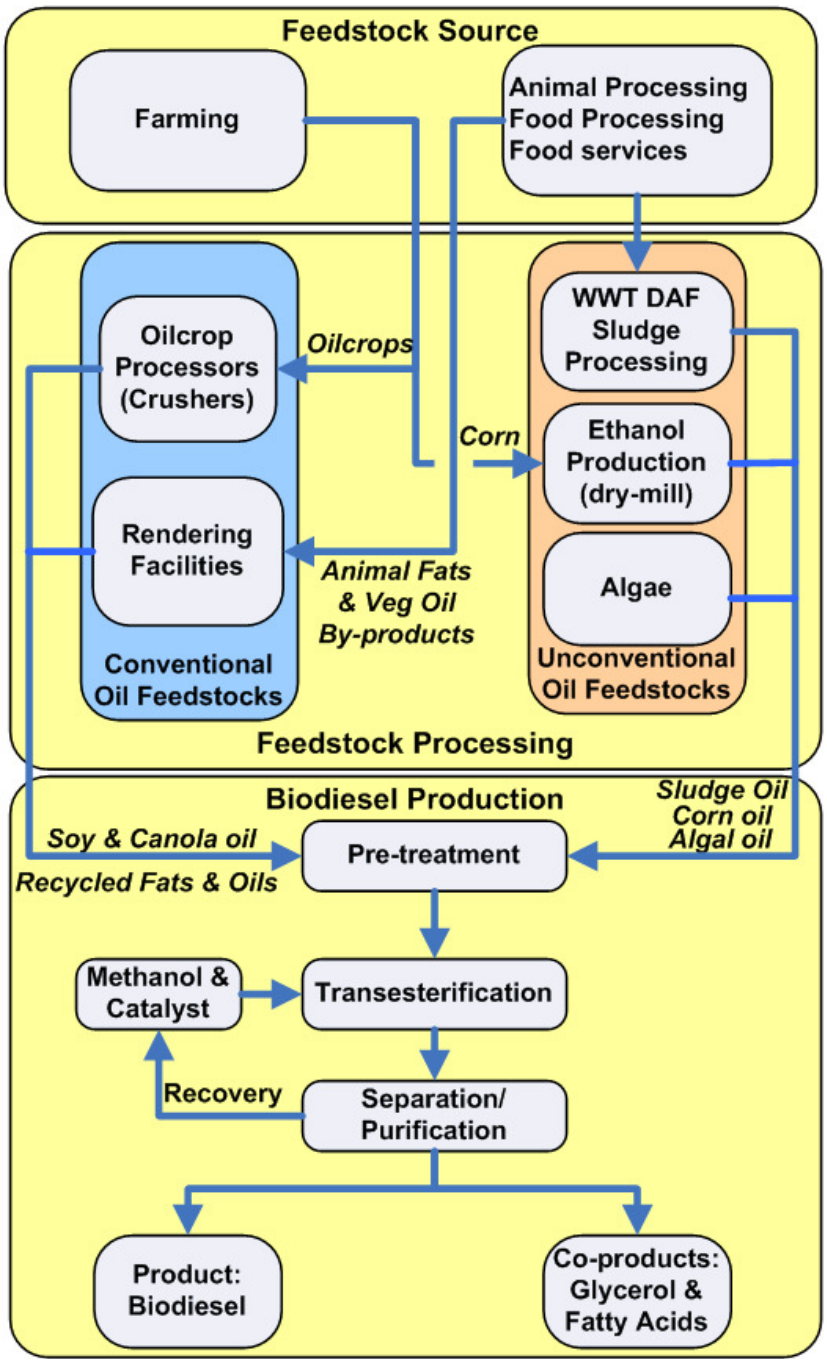

Figure 2. Biodiesel Production Process and Feedstock Sources[6]

[6] Bantz, Steve and Michael Deaton. Understanding US Biodiesel Industry Growth using Systems Dynamics Modeling.

II. Arguments for Promoting Biodiesel as a Means Toward Preservation of Traditional Land Uses of the Dragon Run Watershed

<u>"A Rising Tide Lifts all Ships"</u>
Even if local farmers can't directly sell soybeans or other feedstocks to the Eltham refinery, more biodiesel demand means more feedstock demand and higher prices to all farmers.

Rural areas are rich in biomass, a transportable renewable fuel. A great example of how the growth of biofuels has affecting farmers is ethanol. Last year, the price of corn doubled as ethanol production increased from 3 to 5 billion gallons. The USDA now projects corn prices staying above $3.50 a bushel and rising to $3.75 a bushel in 2009, driven by increased demand for ethanol.[7]

Although much of the negative has been accentuated in the media with regards to rising corn prices and ethanol demand, a positive outcome is for the first time in almost 30 years, farmers are getting a price for their corn that is over their cost of production. A recent USDA study found that in the decade before 2006, without government payments, corn farmers, on average, didn't meet cost of production except for the drought year of 1996. The USDA recently estimates that at a price of $3 per bushel, the corn farmer just marginally earns revenue over the cost of producing the crop. With corn prices above $3.50 a bushel for the foreseeable future, the marketplace has replaced the taxpayer. [8]

The Food and Agricultural Policy Research Institute (FAPRI) February 2007 Briefing Book presents a summary of ten-year baseline projections for U.S. agricultural markets. Figure 3 shows how more demand for biofuels translates to greater revenue for rural farmers as corn and soybean prices are predicted to rise again in 2007-2008.

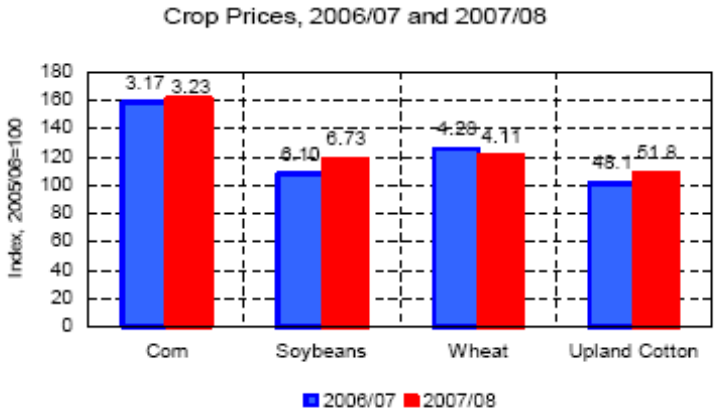

Figure 3. FAPRI prediction, crop prices 2006-2008

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[7] Morris. David. 25 by '25: Getting the Priorities Right. Institute for Local Self-Reliance. 21 March 2007. Presented at the 3rd National Renewable Energy Summit in Washington, D.C. http://www.newrules.org/de/speech25by25.pdf
[8] Ibid.

Another example of agricultural benefit created from biofuels is the Minnesota B2 mandate. In 2002, the Minnesota legislature mandated that all diesel fuels sold in the state must contain at least 2 percent biodiesel by year 2005. The biodiesel mandate became a catalyst for Minnesota's soy-diesel industry, which emerged to fulfill the 16-million-gallon-a-year mandate requirements, and later grew into a 60-million gallon a year industry. At the 60-million-gallon a year production level, soy diesel in Minnesota generates various economic impacts that include: increased demand for Minnesota's soybean crop by 13 percent annually; increased in-state soybean processing capacity by 31 percent; an annual output impact of $928 million; employment opportunities for 5,668 jobs; and the "multiplier impact" will benefit various economic sectors, such as agriculture, manufacturing, construction, transportation, trade, services, finance, insurance, and real estate. [9]

<u>The Multiplier Effect</u>

A dollar spent for biodiesel produced in New Kent County mostly stays in the state of Virginia. The Eltham biodiesel refinery purchases soy oil from Purdue, which buys soybeans from Virginia and elsewhere. Additionally, the refinery provides a few local jobs, pays taxes, hires contractors, etc. While it is a difficult task to pinpoint how much of the dollar stays in the local and state economy, it is quite easy to assert that most of a dollar spent on petroleum diesel leaves the country and certainly the local economy.

Most sectors of the United States economy stand to benefit from increased domestic renewable energy use. It's often cited that widespread use of biodiesel has the potential to reduce our dependence on imported oil while simultaneously strengthening domestic agriculture. Let's take a look at a dollar spent on crude oil from overseas, versus a dollar spent on a biomass fuel such as biodiesel**.**

The use of biodiesel in Virginia can have positive benefits for the state economy. Currently, for every $1 spent buying diesel in Virginia, large portion of the premium goes to crude oil with only $.134 staying locally through state tax and local distributor income (Figure 4). If locally produced biodiesel was used, for every $1 spent, potentially 90 cents would stay in the local or state economy (Figure 5).[10]

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[9] Ye, Su. Economic Impact of Soy Diesel in Minnesota. 2006 September. Minnesota Department of Agriculture. www.mda.state.mn.us.

[10] Biodiesel Fuel. Virginia Tech Cooperative Extension. Publication Number 442-880. October 2006. Available online: http://www.ext.vt.edu/pubs/ageng/442-880/442-880.html

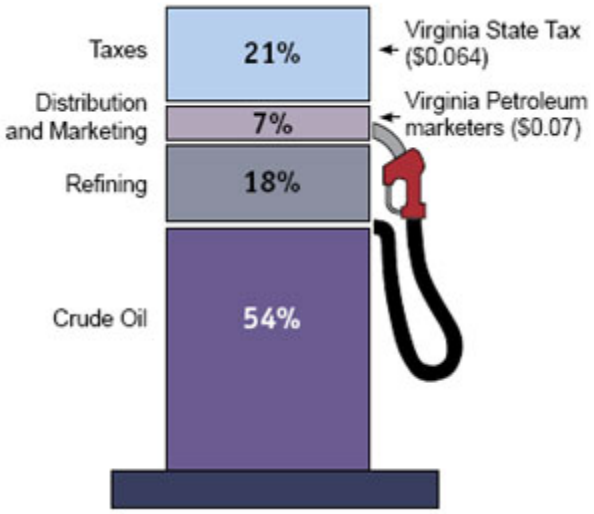

Figure 4. Distribution of $1 cost of diesel fuel at public pumps

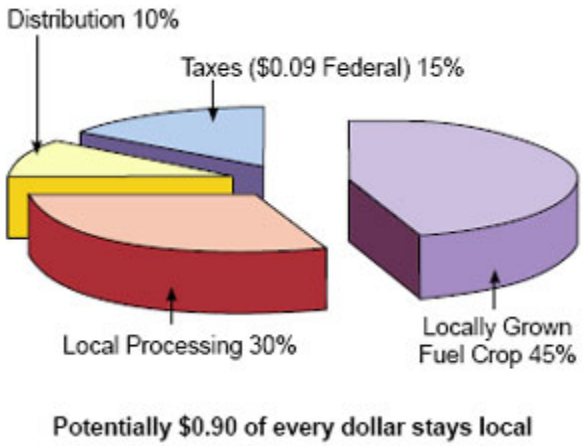

Figure 5. Distribution of $1 cost of biodiesel fuel at public pumps

In 2003, the United States imported nearly $130 billion of energy related products, accounting for nearly 25% of the $490 billion trade deficit.[11] The Energy Information Administration predicts oil imports will continue to increase over time from 11.5 million bbl/day to 20.7 million bbl per day by 2025. The DOE further projects this will lead to a trade deficit for imported crude oil and petroleum products of close to $200 billion.[12]

A DOE study estimated that U.S. oil dependence has already cost the country $3.4 trillion from 1970 to 1999. According to the report, "the present value of these losses is close to $7 trillion, almost an entire year's GDP… Clearly, oil dependence

[11] "Biomass Benefits: Economic Growth," Biomass Program, Department of Energy. http://www.eere.energy.gov/biomass/economic_growth.html
[12] "Annual Outlook 2004 with Projections to 2025," Energy Information Association. U.S. Department of Energy, http://www.eia.doe.gov/oiaf/aeo/economic.html.

ranks among the most significant economic problems the United States has faced over the past thirty years."[13]

Obviously, our local communities and our country stand to benefit from developing local renewable energy resources.

<u>"Save the Dragon, Use Biodiesel"</u>
If branding the concept of sustainable fuel selection practices ("Save the dragon, use biodiesel") works in the Middle Peninsula, it could work elsewhere in largely rural Virginia, providing incremental increase in demand and, more importantly, a friendly climate to grow the biofuels "industry" in Virginia.

As discussed in the first argument, an increased demand for biodiesel will ultimately lead to more favorable returns for biodiesel feedstock growers. If the Middle Peninsula Community embraces biodiesel and associates preservation of the Dragon Run watershed with biodiesel use, a friendly climate towards the Biofuels industry in general will develop.

Much is still needed for the biomass sector to truly emerge in terms of research, infrastructure development and supportive policies (from breeding work and appropriate equipment to contracting systems, fuel supply assessments, and facility siting and investment). The Middle Peninsula and Dragon Run communities could stand to benefit from future involvement as the biomass sector emerges and evolves.

<u>A Sustainable Community is a Resilient Community</u>
The strength a sustainable community possesses might not be apparent until the next crisis that restricts supply of petroleum, but this resiliency may be a communities saving grace.

Sustainable development is a strategy by which communities seek economic development approaches that also benefit the local environment and quality of life. Obviously, energy is the lifeblood of any community. A community which diversifies its energy portfolio is in a far better position than one which relies entirely on one source of energy.

With all of the talk from analysts, economists, the media, etc. about how volatile the petroleum market has become and will continue to be, it's important for communities to become smarter about energy choices.

A good example of how alternative fuels can help in a time of crisis is Hurricane Katrina. Before the storm, one-tenth of all the crude oil consumed in the United States and almost half of the gasoline produced in the country came from refineries

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[13] "Costs of Oil Dependence: A 2000 Update." Oak Ridge National Laboratory, Department of Energy, http://www.ornl.gov/~webworks/cpr/v823/rpt/107319.pdf, p 27.

in the states along the Gulf's shores. At least twenty offshore oil platforms were missing, sunk, or had gone adrift, according to the United States Coast Guard. The Louisiana Offshore Oil Port, which imports 11% of all U.S. oil consumption, closed on August 27, and Shell reported a reduction in production of 420,000 barrels per day. West Texas Intermediate crude oil futures reached a record high of over $70 per barrel. Long lines developed at some gas stations throughout the U.S. as customers rushed to buy gasoline, anticipating price increases in the wake of the storm.[14]

Biodiesel came to rescue and helped fuel hospitals and emergency vehicles, and spewed significant fewer toxins into the air too. [15] Biodiesel is not necessarily the answer to our petroleum problems, but is one of the solutions. Perhaps by beginning the process of alternative fuels awareness, ultimately leading to comfort and acceptance, the Middle Peninsula can begin the process of diversifying its energy portfolio and providing the community with an economic, environmental and security cushion.

Biofuels More Economic than Petroleum?

It is possible that biofuels will be cheaper than petroleum fuels eventually, positioning fuel sustainable communities for economic success.

Many experts predict oil prices will not only continue to rise, but may double or triple in our lifetimes. As demand for oil grows, acceleration in the upward direction with regards to price will occur and may be exacerbated by global oil extraction peaks. Regardless of which peak oil analyst is correct, the fact is that oil is a finite resource, and we will one day run out of a cheap and accessible supply of it.

Our industrial society faces a challenging new paradigm of possible unstable and expensive energy markets and therefore higher prices for most commodities and products. Forty-percent of global energy consumption is fueled by oil.[16] Although the demise of our "black gold" infrastructure is a "slow emergency," communities must face the facts and prepare accordingly if to avoid possible major disruptions.

David Morris, co-founder and vice president of the Institute of Local Self-Reliance asserts we will look back a decade from now and find that the most pain was experienced when we went from a 2 percent to a 5 percent Biofuels blend in our nation's fuel supply. Going from 5 to 25 percent will be less disruptive, in part because a national delivery and storage infrastructure will be in place, and in part

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[14] Laverty, Gene. "Oil, Gas May Soar as Storm Shuts U.S. Gulf Production." *Bloomberg.* August 28, 2005.

[15] Hurricane Katrina Relief Effort Fueled with Biodiesel. September 15, 2005. NBB News Release. http://www.michigansoybean.org/news/biodiesel%20News/Katrina%20Relief%20Fuedl%20with%20Biodiesel.pdf

[16] Room, David. Energy Preparedness: A municipal perspective. 25 April 2006. http://energypreparedness.net/resources/whitepaper/1?PHPSESSID=5e033a11ca51e44561842f12fc21d301

because we will have shifted to a more abundant and less controversial fuel source.[17]

The point concerning the development of a delivery and storage infrastructure is well taken. As more and more federal and state policy dictates ways in which our communities move away from traditional fossil-fueled based infrastructure to renewable-alternative fueled infrastructure, impacts will be felt at all levels of our fuel supply chain. The better prepared a community is to receive these new alternative fuels, the better positioned a community is for economic and environmental success.

[17] Morris. David. 25 by '25: Getting the Priorities Right. Institute for Local Self-Reliance. 21 March 2007. Presented at the 3rd National Renewable Energy Summit in Washington, D.C.

III. Considerations for Maximizing Environmental and Economic benefit

Many sources of biomass can grow in many parts of the United States. For this reason, biomass has an advantage over traditional fossil fuel product extraction. Fossil fuels can be found in certain parts of the world and largely not in the United States as U.S. oil peaked in the 1970s. Biomass growth could potentially be widespread and community specific. One factor that must be considered, however, is biomass is generally more suited for processing close to the feedstock production.

Creating small refineries may prove challenging as they require high levels of capital investment to be competitive in a global market. But for long-struggling rural communities, this may offer the promise of new investment, job growth and revitalization. For farmers, landowners and rural communities to truly benefit, policies and incentives need to be established that equally support rural development goals and environmental and economic considerations. Furthermore, the needs of the rural community must be clearly communicated with biomass refineries or processing facilities. Likewise, the facility must communicate clearly to the community what is necessary to continue economic success and therefore economic benefit to the community. Common goals must be agreed upon and the two parties must continue dialogue.

An interesting policy brief completed by the Carsey Institute discussed rural revitalization and biofuels. The brief discusses how politicians and biofuels proponents tout biofuels as a means towards job creation and economic growth, but unless rural development priorities are not kept as top priority, benefits may be muted. As seen in Figure 6 below, ownership of the refineries by local farmers and community members can be seen as the key aspect to sustainable rural development. Local ownership assures that the facility is based to some extent on local resources and needs, and that much of the money generated remains in the local economy.

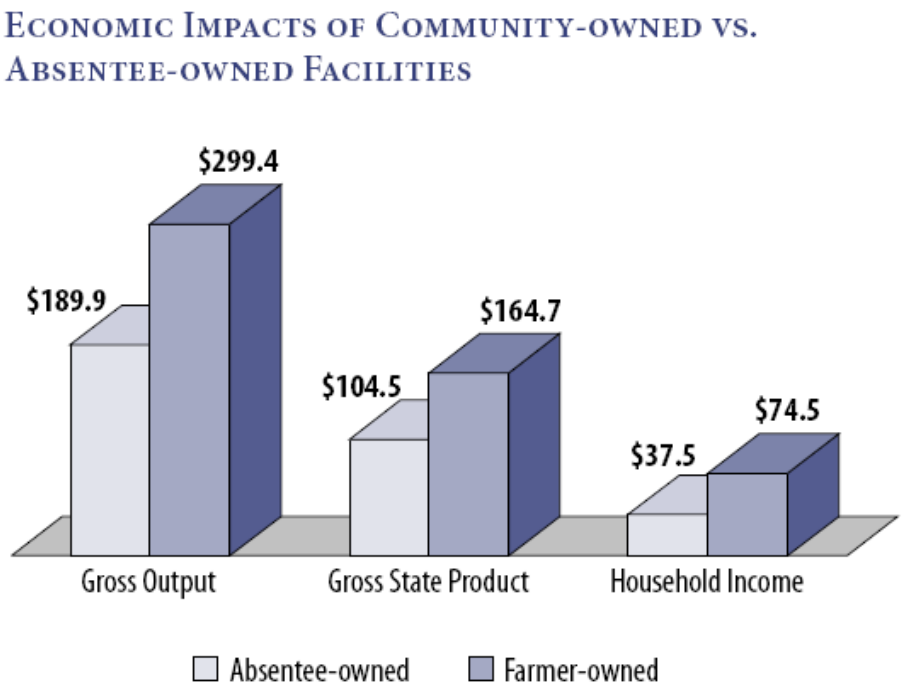

Figure 6. Economic Impacts of Community-owned vs. Absentee-owned Facilities.[18]

If the Middle Peninsula community wishes to benefit from biofuels development in the area, ownership should be seen as a key factor in maximizing benefits. Cooperative scenarios and case studies are presented in this report, and may be a direction the MPPDC wishes to explore further.

[18] Urbanchuk, John. "Economic Impacts on the Farm Community of Cooperative Ownership of Ethanol Production," for the National Corn Growers Association September 2006 (http://www.ncga.com/ethanol/pdfs/2006/FarmerOwnedEthanolEconomicImpact.pdf)

IV. Characterization of Fleets and Potential Retail Market for Biodiesel in Dragon Run Watershed

The first and obvious step in determining the potential for biodiesel market penetration is to characterize potential fleets and retail markets for biodiesel. A survey was used to determine how many diesel vehicles operated by school districts and government fleets in the 6 County district of the middle peninsula, and how many of these vehicles could potentially use biodiesel. A copy of the email survey is shown below.

<u>Fleet Manger Survey</u>
Fleet Name:
Fleet Description (area, type of fleet):
Contact Information (email):
Data Received via (email, phone, mail, fax):

1. How many vehicles and pieces of equipment are currently operating in your fleet?
2. Please help us characterize your fleet by breaking down the number of:
    a. Light-duty gasoline vehicles:
    b. Light-duty diesel vehicles:
    c. Heavy-duty gasoline vehicles:
    d. Heavy-duty diesel vehicles:
    e. Off-road gasoline vehicles:
        i. Please describe vehicle/equipment type
    f. Off-road diesel vehicles:
        i. Please describe vehicle/equipment type
3. How much fuel does your fleet use on a monthly or annual basis?
    a. Gasoline
    b. Diesel
    c. Other fuel
4. Who is your fuel distributor?
5. Are you using any biofuels (biodiesel blend or ethanol blend)?
6. Would you like to learn more about biodiesel, or are you interested in possibly using a biodiesel blend?

A fuel distributor survey was also conducted to attempt to determine how much diesel fuel flows through the Middle Peninsula area, and therefore what the outer boundaries of potential biodiesel use would be. A copy of the fleet distributor survey is shown below. Surveys were sent via email after an introductory phone call was made. A brief description of the project was included in the email along with a note that the survey is a blind and confidential survey and no oil company will be identified, and that while we are trying to establish the maximum potential of biodiesel, it would never equal the total amount of diesel sold in the Middle Peninsula.

Fuel Distributor Survey
(Call followed by an email)
Fleet Name:
Fleet Description (area, type of fleet):
Contact Information:

If possible, could we please get the following information concerning your sales in the Middle Peninsula area of Virginia?

- Total highway diesel sales (annually, gallons)
- Total retail highway diesel sales
- Number of retail highway diesel locations supplied
- Total off-road diesel sales (annually, gallons)
- Total off-road diesel sales
- Number of off-road diesel locations supplied
- Total #2 heating fuel oil sales
- Total biodiesel sales
- Number of retail biodiesel locations supplied
- Areas you serve in the Middle Peninsula (Essex, Gloucester, King and Queen, Mathews, Middlesex, King William)

Results of the surveys are presented in the next section of this report.

V. Characterizing the Roles of Strategic Partners

A successful biodiesel venture requires a number of key elements to succeed. Success with an alternative fuels project is directly dependent upon the successful planning and execution of the supply chain. Ultimately, strategic flexibility and a favorable cost structure are important in encouraging widespread use of a burgeoning alternative energy source. As can be seen in Figure 7 below, many players can be involved when getting biodiesel product from the biodiesel manufacturer, Virginia Biodiesel Refinery LLC in our case, to the end user (i.e. farmer, school bus, general public).

Infrastructure

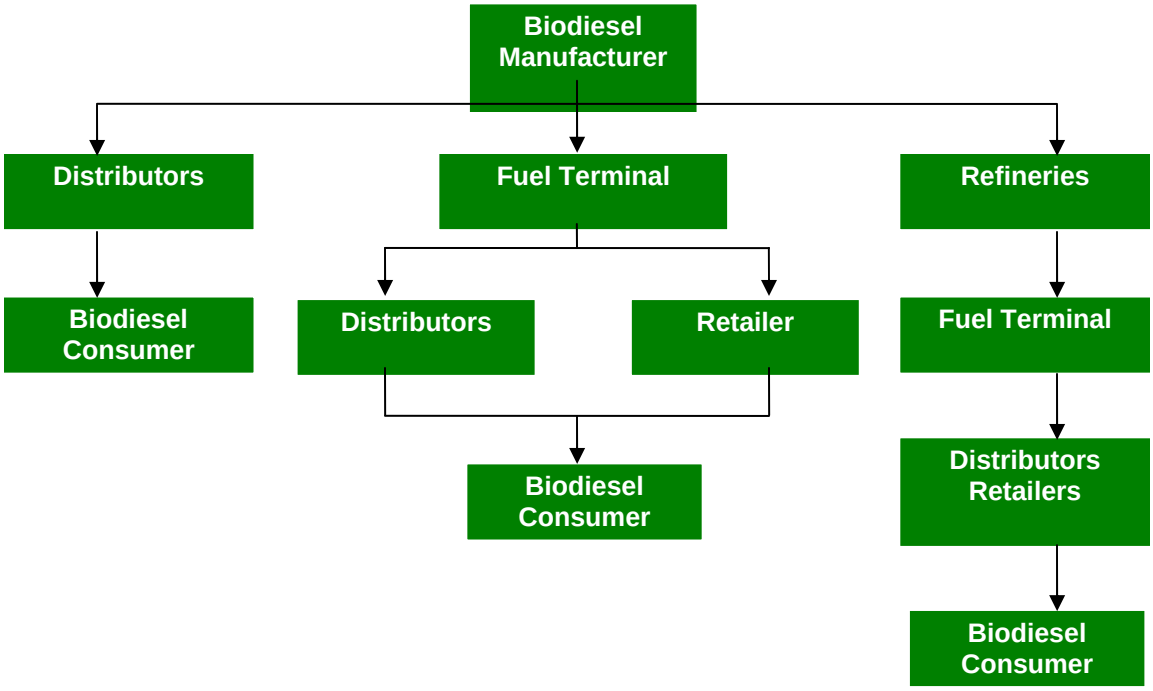

Figure 7. Biodiesel Infrastructure and Supply Chain Model.

Strategic Partners

Another factor largely affecting the success of a biodiesel venture or initiative is strategic partners. Strategic partners can facilitate or hinder a project from moving forward. For example, if very little biodiesel supply exists in an area with very high demand, an obvious rise in price and little market penetration will occur. However, if a very small portion of the community supports biodiesel but there is a large influx of supply from a new refinery, the refinery may find itself with a lot of biodiesel and noone to purchase it locally. On there other hand, there may be demand from end users and a refinery may be ready to ramp up production to meet the demand, but the economics don't pan out because of one or many factors (i.e. feedstock prices).

Biodiesel Manufacturer (refinery)

Biodiesel production in Virginia is still in the developmental stages. Currently, there is only 1 plant in Virginia consistently producing ASTM quality biodiesel.

Virginia Biodiesel is located at 7475 Ready Mix Drive in West Point, Virginia. Virginia Biodiesel has been involved in the early stages of the Dragon Run Watershed biodiesel project. Virginia Biodiesel already supplies ASTM quality biodiesel to distributors around the Middle Peninsula and throughout Virginia. Because of its close proximity to the (20 miles from King and Queen County) Middle Peninsula counties, the refinery will play a significant role in future biodiesel supply. One of the main

RECO Biotechnology, LLC has constructed a biodiesel refinery in Richmond, VA. The main impediment to production is the price of soybean oil. Currently,

The two other production plants listed on the National Biodiesel Board site could not be contacted or are not significant players in the Virginia's biodiesel production arena.[19]

With feedstock expenses accounting for around 80 percent of a biodiesel plant's operating cost, margins are highly sensitive to the prices of oils and fats. Between 75 and 90 percent of U.S. biodiesel production is based on the U.S. production of soybean oil, indicating that margins for many industry participants will be dependent on soybean oil prices.[20] The share is expected to decrease over time, as many new plants will be able to produce biodiesel using multiple feedstocks, thereby giving producers the flexibility to switch among feedstocks as relative costs dictate.

As feedstock prices exceed 30¢ per pound, the price of biodiesel needs to be above $3 per gallon for the plant to make a profit. The Food and Agricultural Policy Research Institute projects that the price of soybean oil will be 30.7¢ per pound for the 2007/08 crop year and will surpass 34¢ per gallon by the 2009/10 crop year, obviously making margins tight with soybean oil.

The current viability of the biodiesel industry depends on financial support by the government in the early stages of development.

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[19] Commercial Biodiesel Production Plants. National Biodiesel Board. Available online: http://www.nbb.org/buyingbiodiesel/producers_marketers/ProducersMap-Existing.pdf

[20] Carriquiry, Miguel. "US Biodiesel Production: Recent Developments and Propects." Iowa Ag Review. Spring Volume 2007, Vol 13 No 2. http://www.card.iastate.edu/iowa_ag_review/spring_07/article4.aspx

Biodiesel Distributor

Until biodiesel use becomes more widespread, difficulties in marketing the fuel continue. Economies of scale are the vehicle by which a firm or industry lowers the unit price of the product; until that point, biodiesel sales will remain limited.

The following companies were identified as key oil distributors in the Middle Peninsula area:

1. Phillips Energy Inc
2. June Parker Oil Company
3. Thrift Oil
4. Atkins Petroleum
5. Papco Energy Inc.
6. Frederick Northrup Inc.
7. Northern Neck Oil Co.
8. TCH Oil Co.
9. WF Parker Oil
10. ET Lawson
11. Massey Oil Co.
12. Milby Oil Co.
13. Sears Oil Co.
14. Wroten Oil Co.

Of the 14 oil companies identified, 6 reported currently distributing biodiesel or a biodiesel blend:

1. TCH Oil Co.
2. ET Lawson ("bioheat" or biodiesel blended in #2 heating fuel oil)
3. Kilduff Oil Co.
4. Wroten Oil Co.
5. Papco Energy Inc.
6. Phillips Energy Inc.

The oil distributor survey was conducted from April 30, 2007 through May 17, 2007 via phone and email. Of the 14 oil companies identified, 43% responded (6) to the survey within the time frame specified after multiple attempts.

Distributors were asked:

- Total highway diesel sales (annually, gallons)
- Total retail highway diesel sales
- Number of retail highway diesel locations supplied
- Total off-road diesel sales (annually, gallons)
- Total off-road diesel sales
- Number of off-road diesel locations supplied

- Total #2 heating fuel oil sales
- Total biodiesel sales
- Number of retail biodiesel locations supplied

Results of the survey are presented below in Table 1.

Table 1. Results of Middle Peninsula oil distributor survey conducted by Virginia Clean Cities during the period of April 30-May 17, 2007. Survey were conducted via phone and email. NOTE: Based on the response rate and the inability to track every diesel gallon moving through the Middle Peninsula, the following results are very conservative, but serve as a starting point to determine potential market penetration.

# of Distributors Included	6	
Commercial Highway Diesel Sales:	3,487,180	gallons annually
Retail Highway Diesel Sales:	3,767,180	gallons annually
Number of Retail Highway Diesel Locations:	19	stations
TOTAL HIGHWAY DIESEL	4,807,180	gallons annually
Total Off-Road Diesel Sales:	1,216,000	gallons annually
Retail Off-Road Diesel Sales:	1,035,691	gallons annually
Number of Retail Off-Road Diesel Locations:	6	stations
TOTAL OFF-ROAD DIESEL	2,136,000	gallons annually
Total #2 Heating Fuel Oil Sales:	2,387,000	gallons annually
Biodiesel Sales and Locations:	232,700	gallons annually
Biodiesel Retail locations in Middle Peninsula, VA :	Phillips Energy, Inc 2586 George Washington Memorial Highway Hayes, VA B5 (5% biodiesel, 95% petroleum) on-road biodiesel	

The survey results represent a very conservative estimate of the diesel fuel sold in the Middle Peninsula area, as response was not 100% nor was it expected that every oil company that supplies product in the Middle Peninsula area was identified. Nevertheless, these numbers can be used as a baseline to project biodiesel market penetration.

Table 2 presents various scenarios using the survey results and biodiesel market penetration levels. Scenarios are labeled A-E on the left column. Scenario A was calculated on the basis that all diesel sold (based on survey results) contained a 2, 5, 10, and 20% blend of biodiesel. Highway diesel and off-road diesel scenario results are presented.

Scenario B was calculated on the basis that 5% of all diesel sold (based on survey results) contained a 2, 5, 10, and 20% blend of biodiesel. Highway diesel and off-road diesel scenario results are presented.

Scenario C was calculated on the basis that 10% of all diesel sold (based on survey results) contained a 2, 5, 10, and 20% blend of biodiesel. Highway diesel and off-road diesel scenario results are presented.

Scenario D was calculated on the basis that 20% of all diesel sold (based on survey results) contained a 2, 5, 10, and 20% blend of biodiesel. Highway diesel and off-road diesel scenario results are presented.

Scenario E was calculated on the basis that 20% of all diesel sold (based on survey results) contained a 2, 5, 10, and 20% blend of biodiesel. Highway diesel and off-road diesel scenario results are presented.

Table 2. Various scenarios of biodiesel market penetration levels using survey results from Table 1.

A	All diesel sold contains	B2	B5	B10	B20
	Highway diesel (gallons)	96143.6	240359	480718	961436
	Off-road diesel (gallons)	42720	106800	213600	427200
B	5% of diesel sold contains	B2	B5	B10	B20
	Highway diesel (gallons)	4807.18	12017.95	24035.9	48071.8
	Off-road diesel (gallons)	2136	5340	10680	21360
C	10% diesel sold contains	B2	B5	B10	B20
	Highway diesel (gallons)	9614.36	24035.9	48071.8	96143.6
	Off-road diesel (gallons)	4272	10680	21360	42720
D	20% diesel sold contains	B2	B5	B10	B20
	Highway diesel (gallons)	19228.72	48071.8	96143.6	192287.2
	Off-road diesel (gallons)	9548	23870	47740	95480
E	50% diesel sold contains	B2	B5	B10	B20
	Highway diesel (gallons)	48071.8	120179.5	240359	480718
	Off-road diesel (gallons)	23870	59675	119350	238700

The National Biodiesel Board maintains a list of biodiesel distributors by state and is shown in Appendix A. This list is created through user input, therefore may not be comprehensive or updated.[21]

Biodiesel Retailer

If biodiesel is to become mainstream in the Middle Peninsula area, retailers must become interested stakeholders. Increasing the biodiesel fuel station network should be a top priority to provide as many Middle Peninsula residents who operate diesel vehicles with a choice.

The oil distributor survey was conducted from April 30, 2007 through May 17, 2007. Of the 14 oil companies identified, 43% responded (6) to the survey within the time frame specified after multiple attempts. Of the 6 respondents, a total of 19 on-highway diesel retail locations and 6 off-road diesel retail locations were reported.

The only retailer identified which is already providing a biodiesel blend at a traditional gas station fueling island is Phillips Energy, Inc:

Phillips Energy, Inc
2586 George Washington Memorial Highway
Hayes, VA
B5 (5% biodiesel, 95% petroleum) on-road biodiesel

The National Biodiesel Board site of biodiesel retailers in Virginia sorted by city is included in Appendix B.[22]

Biodiesel Users/Fleets

Any diesel vehicle or piece of equipment can use biodiesel, which is one of its advantages. Below is a list of potential fleet types (list specific to Middle Peninsula) which can take advantage of a biodiesel blend, and that perhaps should be considered as a target market.

Fleet Types

- "Niche Markets"
    - Agriculture
    - Forestry
    - Recreation

[21] Biodiesel Distributors. National Biodiesel Board. Updated May 8, 2007. http://www.nbb.org/buyingbiodiesel/distributors/showstate_bycity.asp?st=VA
[22] National Biodiesel Board retail fueling sties. Updated May 8, 2007. http://www.nbb.org/buyingbiodiesel/retailfuelingsites/showstate.asp?st=VA

        - Tour boats and charters
        - Marinas (for private citizen boats, see http://middlepeninsula.com/boating.htm for a listing)
        - Campgrounds (Thousand Trails Campground)
    - Institutes of higher education
        - Virginia Institute of Marine Since (VIMS)
        - Rappahannock Community College (RCC)
- Transit buses
    - Bay Transit
- School buses
    - Essex, King and Queen, Middlesex, Gloucester, Mathews, King William, and Lancaster Counties
- Refuse haulers
- Delivery vehicles (beer, beverage, snack foods)
- Long-haul trucks
- Government fleets

School Fleets

School bus and government fleets are obvious targets. School buses are one of the largest mass transit programs in the United States. Every school day, approximately 440,000 school buses transport over 24 million children. Many of these school buses are powered by heavy-duty diesel engines and burn convention #2 diesel.

School districts in the Middle Peninsula area were surveyed to determine how many diesel vehicles or pieces of equipment were in operation, and how much fuel is used on an annual base. The aggregated results of the survey are presented below for King and Queen County Schools, Essex County Schools, Gloucester County Schools, King William County Schools, Lancaster County Schools, King William County Schools, Middlesex County Schools, and Bay Transit (not a school fleet)[23]:

Table 3. Fleet profile survey results for Gloucester, Middlesex, King William, King and Queen, Essex, Mathews, Lancaster, Bay Transit

Fleet Profile Total: Gloucester, Middlesex, King William, King and Queen, Essex, Mathews, Lancaster, Bay Transit	
LD Gas*	222
LD Diesel	25
HD gas	33
HD diesel	337
Off road gas	1
Off road diesel	7

[23] Bay Transit was included in the school fleet totals because Virginia Clean Cities thought it was a "marquee" fleet as the schools are and therefore has a higher level of public attention than a private fleet.

**excluding King William County*

Respondents that reported diesel fuel use include Lancaster, Gloucester, Middlesex, and Mathews County schools. Of the 4 school districts, a total of 303,631 gallons of diesel fuel is used on an annual basis. The figure is probably approaching over 500,000 gallons per year if the remaining fleets surveyed are included. The following calculations are based on the actual survey results of 303,631 gallons and show the amount of biodiesel demand that would be created if all diesel fuel used in the 4 school districts that responded were converted to various biodiesel blends.

Table 4. Potential biodiesel demand at various blend levels created from 4 school districts surveyed in Middle Peninsula.

Blend Level	B2	B5	B10	B20
Gallons	6072.62	15181.55	30363.1	60726.2

Government Fleets

Governments are in strategic potions to be community leaders as new technologies are introduced to the marketplace by demonstrating feasibility. The majority of the government fleets surveyed only owned a handful of diesel vehicles, if any. Most owned a tractor for lawn maintenance. Since a small percentage of the government fleet is diesel, a route to consider is "bioheat" or a blend of pure biodiesel with conventional home heating oil.

A Bioheat fuel FAQ page has been posted to the NBB site, and can be accessed: http://www.nbb.org/markets/hom/faqs.asp.

General Public

The MPPDC website shows the Middle Peninsula population in 2000 to be 83,684 persons, and over 55,000 over the age of 17 and of driving age (1990 figure).[24]

Although diesel powered vehicles dominate the transportation of goods, accounting for nearly 95 percent of all freight ton-miles, only 3 percent of passenger miles are by diesel vehicle.[25] Even so, at a 3% ratio of diesel to gasoline, at least 1650 people are driving a diesel powered vehicle living in the Middle Peninsula and can use a biodiesel blend.

[24] Population Data. Middle Peninsula Planning District Commission. http://www.mppdc.com/e_data/populatn.htm

[25] Diesel Technology and the American Economy. Prepared by Charles River Associates by the Diesel Technology Forum. October 2000. http://www.dieselforum.org/fileadmin/templates/whitepapers/DTF-Economic-Study.PDF

Farmers

Farmers are apparent beneficiaries of biofuels since the feedstocks are grown on American soil. How can farmers become involved in a Middle Peninsula biodiesel initiative?

The first and most obvious choice is for farmers to use the product and support domestically grown and produced energy alternatives. Farmers are already a strong customer base for biodiesel, and the reason many oil distributors began carrying the product in the first place. Farmers commitment to biodiesel is also reflected in their $25 million investment in the product through checkoff dollars.[26]

A second approach for farmers is to get involved in the actual production of oilseed crops, production of biodiesel, or a biodiesel research project.

The USDA National Agricultural Statistics Service reports that Essex, Gloucester, Middlesex, Mathews, King and Queen, and King William Counties collectively have 593 farms total, comprising 145,409 acres.[27] Looking at this farmland from a biomass perspective, or more specifically an oilseed perspective, soybean appears to be the primary oilseed crop grown in the Middle Peninsula area. The NASS reported 227 soybean farms with production of 1.44 million bushels.

Table 5. USDA NASS Report Middle Peninsula farming statistics.

Total Cropland (farms)	593
Total Cropland (acres)	145,409
Total Corn for grain (farms)	204
Total Corn for grain (acres)	53,662
Total Corn for grain (bushels)	3,138,137
Total soybean for grain (farms)	227
Total soybean for grain (acres)	62,146
Total soybean for grain (bushels)	1,436,714

Of the 145,409 acres of farmland in the Middle Peninsula, 115,808 is used for corn and soybean already, the main feedstocks for biodiesel and ethanol. The main buyers of soybean in the Middle Peninsula are Purdue and Old Dominion Grain, as well as some buyers of food grade soybeans.

[26] "Biodiesel on the Farm." NBB. http://www.biodiesel.org/markets/far/

[27] U.S. Dept of Agriculture. National Agricultural Statistics Service. Virginia Data – Crops. Year 2006-2007. http://www.nass.usda.gov/Census/Pull_Data_Census

The Essex County Extension Agent, Keith Balderson, stated the single most important concern of soybean farmers in the Middle Peninsula, and anywhere, is anything to improve the price of soybean (i.e. more demand). Soybeans are the only oilseed feedstock currently grown in the Middle Peninsula, however, Keith Balderson did discuss the ability to grow canola (Brassica napus L.) in the region. Test plots of canola were grown in Essex County in the Early 1990s for at least 2 years, and Keith Balderson remembers good yields.

Canola is a member of the Brassicaceae or mustard family and is similar to oilseed Rape. Rape was modified in Canada to make it edible by eliminating erucic acid and glucosinolates. The result was Canada oil, low acid rape, commonly known as canola. Seed of canola typically has 40-42% oil content but higher amounts are possible through breeding. Two varieties that are adapted to Virginia soils and climate, VSX-1 and VSX-2, have been developed at Virginia State University. Winter type canola varieties could replace wheat in a soybean-wheat-corn rotation. Summer types that are adapted to Virginia are under development and could some day replace soybean in the rotation. Soybean averages around 32 bu/A (1600 lb/A) and could produce about 320 lbs of oil per acre; whereas canola averages about 40 bu/A (2000 lb/A) in Virginia, and could yield up to 800 lb of oil per acre. With a lower content of saturated fatty acids and lower cloud point, biodiesel from canola feedstocks has better cold weather performance than soydiesel. With a lower iodine value canola biodiesel also has greater stability than soydiesel. Byproducts of vegetable oil biodiesel include meal and glycerin. Based on amino acid content canola meal has about 10% lower digestability than soybean meal but is usable in swine and poultry feeds. If processed into a food grade, the glycerin component can be a valuable byproduct and constitutes about 1/10 of the bioprocessing output.[28]

Furthermore, a current pilot demonstration by Virginia State University headed by Harbans Bhardwaj is demonstrating the growth potential of canola. The University received a grant to grow canola, purchase a small oilseed crusher, and a biodiesel reactor in order to demonstrate the ability of small scale production on a local scale.

A more detailed feasibility study would need to be conducted to determine Middle Peninsula potential to produce oilseed crops for the biodiesel market. A good model was completed by the Tennessee's Soybean Promotion Board, the Tennessee Farm Bureau, the Tennessee Department of Agriculture, USDA Rural Development, and the Tennessee Valley Authority. The group contracted the Agri-Industry Model and Analysis Group to conduct an economic feasibility study of producing biodiesel in Tennessee. The study concluded a 13 million gallon biodiesel plant was feasible and would use 9 million bushels of soybeans. After the study was completed, the question of producer interest in selling soybeans to a biodiesel facility arose. As a result, a study was conducted to examine Tennessee soybean growers' views on

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[28] Shokes, Fred, et al. Virginia Tech Dean's Forum on Energy Security and Sustainability. 16 October 2006. "Canola – An Alternative Oilseed Crop for Virginia with Good Biofuel Potential." http://www.research.vt.edu/energy/Applications.html

biodiesel, their interest and capability to supply sufficient production to a biodiesel plant, and their interest in formation of a cooperative to produce biodiesel.

The survey is located in Appendix D, and is a good model if the determination to involve farmers to a higher degree than use is decided.

Appendix E contains some further information on biodiesel cooperative models that may make sense for Middle Peninsula farmers.

VI. Factors Affecting the Continued Growth of Biodiesel

1. Limitations of biodiesel manufacturing

Factors affecting the impacting the continued growth in biodiesel production capacity includes:

- Biomass oil feedstock availability
- Biodiesel/diesel and glycerol prices
- Government regulations and incentives (see discussion in section 5).

The Energy Information Administration (EIA) uses a process-costing approach to model the impacts of net feedstock production costs plus capital and operating costs. The feedstock cost of the oil or grease is the largest single component of biodiesel production costs. Yellow grease is much less expensive than soybean oil, but its supply is limited, and it has uses other than fuel—for example, yellow grease is used as an animal feed additive and in the production of soaps and detergents.[29]

Further discussion on feedstock prices and manufacturing profitability is located in Section IV "biodiesel manufacturer."

Biodiesel prices are the most obvious and largest factor impacting biodiesel market penetration and viability, especially in the context of school bus fleet which suffer from ballooning fuel budgets and underfunded programs in the first place.

2. Costs and Difficulties Associated with Transition and Fuel

The major considerations include: basic fuel efficiency, infrastructure needs to accommodate alternative fuels; and cost of vehicle modifications.[30]

Basic fuel efficiency: Reflects both the differing energy levels per unit for each fuel and the fact that only unmodified or slightly modified diesel engines are needed, rather than engines specifically designed for alternative fuels. Luckily, biodiesel requires no modifications and engine operability is very similar to that of a diesel (in general, no mileage penalty experienced such as with ethanol).

Infrastructure needs: One major advantage of biodiesel relative to other low-emissions fuels is it can use the current diesel technology and equipment without modification. By contrast, changes in infrastructure required for alternative fuels can be substantial.

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[29] Radich, Anthony. Biodiesel Performance; Costs, and Use. Energy Information Administration. 2004. http://www.eia.doe.gov/oiaf/analysispaper/biodiesel/index.html

[30] http://www.nbb.org/resources/reportsdatabase/reports/fle/19950701_fle-003.pdf

Cost of bus modifications: Costs for vehicle modifications related to biodiesel transition are very little. To make the transition to biodiesel a smooth one, follow Ric Hiller's (Arlington County) recommendations:.

- Clean fuel storage tanks thoroughly before filling them with biodiesel. Due to biodiesel's solvent effect, it will scrub off any deposits in the tank and carry them straight through to the pump and into your trucks' fuel tanks.
- Use 10-micron filters on fuel dispensers to catch tank deposits before they reach vehicle tanks.
- Stock plenty of primary and secondary fuel filters for any equipment that will use biodiesel. The cleansing property of biodiesel means filters will at first become clogged more quickly if the equipment's fuel tank and system contain sludge and sediment from years of diesel buildup.
- Educate drivers, equipment operators and technicians. Make sure they understand that if they notice any degradation in vehicle power, rough engine idling, etc., they should bring the vehicle into the shop immediately to replace the fuel filters. That will solve the problem 99.9% of the time.

<u>3. Fuel Quality Issues</u>
Proper biodiesel handling practices, blending, and cold weather prep

Assuming biodiesel comes out of a refinery meeting ASTM quality standards, the considerations for storage, handling and blending are different for biodiesel versus petroleum diesel. If improper blending techniques are used, an end user can end up with a very different blend level than expected. If the blend level is much lower than expected, the user is paying a premium for diesel fuel. If the blend level is much higher than expected, problems can occur because biodiesel is a good solvent and may loosen and/or dissolve sediments in fuel tanks and fueling systems left by conventional diesel over time.

B100 also freezes at higher temperatures than most conventional diesel fuel. Most soy-based B100 starts to cloud at around 35°F. As B100 begins to gel, the viscosity also begins to rise, and it rises to levels much higher than most diesel fuel, which can cause increased stress on fuel pumps and fuel injection systems. Improved cold weather properties are a major reason many people use biodiesel blends instead of B100.

B100 is not compatible with some hoses and gaskets. B100 may soften and degrade certain types of rubber compounds found in hoses and gaskets (i.e. buna N, nitrile, natural rubber) and may cause them to leak and become degraded to the point they crumble and become useless. This could cause a fuel spill on a hot engine, could ruin a fuel pump, or could result in filter clogging as the hose material gradually wears away.

B100 is not compatible with some metals and plastics. Biodiesel will form high sediment levels if contacted for long periods of time with copper or copper containing metals (brass, bronze) or with lead, tin, or zinc (i.e. galvanized surfaces). These high sediment levels may cause filter clogging. Diesel systems are not supposed to contain these metals, but sometimes they can occur anyway. In addition, B100 may permeate some typical types of plastics (polyethylene, polypropylene) over time and they should not be used for storing B100.

If oil distributors are educated on proper blending techniques, problems should be kept to a minimum. Virginia Clean Cities was recently awarded a grant from the National Biodiesel Foundation to conduct fuel quality education workshops, which should help alleviate this issue.

4. Environmental and Social Factors

As public pressure mounts to tackle global warming, air quality issues, and energy security, politicians will begin to respond by passing legislation favorable to alternative, renewable fuels development. As discussed below in the incentives section, policy measures are extremely effective in stimulating biofuels development. Virginia has not become as aggressive as some other states on alternative fuels policies, which have proven very successful.

5. Incentives

Scott Hughes, NBB Director of Government Affairs, testified at a Congressional hearing on alternative fuels and said two federal policy measures have been extremely effective in stimulating biodiesel's increased production and use. One is the Bioenergy Program, which stimulates crop use for energy production. The other is the biodiesel blenders tax credit, which passed in the JOBS Act of 2004. That incentive has been the primary stimulant since 2005 for the dramatic increase in new plants, jobs, and local investment in biodiesel, bringing economic opportunity to both rural and urban areas. Since it took effect, biodiesel producers have grown more than 4-fold. Today there are 105 plants capable of producing 864 million gallons of domestic biodiesel from coast to coast.[31]

Making biomass a viable industry would decrease the need for tax-supported agricultural and forestry support payments, generate jobs and tax revenues in rural communities, create cash flow back into rural areas, and in general revitalize rural economies.

Achieving these benefits sometimes takes government policies and incentives to direct, guide, or lead people in the desired direction.

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[31] Hughes, Scott. "National Biodiesel Board Testifies on Impact of Public Policy" National Biodiesel Board News Release. April 18, 2007.
http://www.biodiesel.org/resources/pressreleases/gen/20070418_alt%20fuels%20hearing%20nr2.pdf

VII. Outlets for Continued Education of Stakeholders, Partners, and End Users

Use existing networks

- Local parks & recreations
- Local Chamber of Commerce
- RC&D councils
- School boards monthly meetings

Use marquee fleets and press

- Press release/conference whenever opportunity presents itself or create the opportunity

Hold a number of stakeholder meetings throughout the year (monthly, quarterly, etc.)

Create and publish a newsletter

- Update stakeholders on progress
- Outline how stakeholders can get involved
- Create a database of contacts

Participate in local events, festivals, meetings in the area

- Clean marina program
- Dragon Run Day
- Gloucester Daffodil Festival
- West Point Crab Festival
- Mathews Markets Days
- Urbanna Oyster Festival
- Annual events and meetings held in the area

Distribute quick guides and brochures developed as part of this project (see Appendix F)

- At fuel retailer outlets, community resource areas (recreation centers, nature centers, RC&D offices, government agency offices, etc.)

Biodiesel school curriculum

Provide technical support and outreach to commercial users

Organize an expert speakers bureau

Conduct biodiesel forums or include a biodiesel educational component in town hall meetings

Create resources specifically for marine (boating) and agricultural communities

Partner with environmental, agricultural groups, and “marquee” fleet

Find successful case studies and promote them

Form a biodiesel cooperative

VIII. Summary and Conclusions

This first phase feasibility study is meant to assess market viability and stakeholder interest, and provide recommendations detailing the potential to fulfill project goal of providing economic benefit to the watershed community and, therefore, help to preserve natural resources in the sensitive watershed and sustain current land uses, predominantly agricultural, forestry and outdoor recreation. This report does not include recommendations for a final path or paths to take toward the goals.

Stakeholder meetings and survey results confirmed there is a lot of potential for biodiesel use and growth in the watershed and surrounding communities. Up to 16 distributors were identified, with only 6 confirming they had handled biodiesel in the past. Only 1 retailer of biodiesel was confirmed in the area, which can be used as a model for other retail locations.

The question of stakeholder interest is fairly easy to asses:

- Nearly half of fuel distributors already sell biodiesel
- One school district already uses biodiesel and another (Lancaster County) expressed interest in starting a pilot,
- The biodiesel refinery near West Point has attended every meeting and visited other stakeholders who have expressed an interest . Support from the refinery is key.
- Bay Transit wants to use biodiesel and is currently having a hard time finding it
- Thousand Trails Campground requested brochures and expressed desire to add biodiesel to their green marketing approach
- Phillips Energy is very aggressively pursuing biofuels including biodiesel and ethanol

This first-phase report is meant to provide a framework to assist the consultants and MPPDC in determining some potential directions and paths to consider in the next phases of the study and project. Foremost, however, this report provides support for the decision whether to advance the project to the next planned phase or rethink project objectives, a determination to be based in part on whether there appears to be adequate market viability and stakeholder interest in developing the biodiesel market . A positive conclusion seems obvious: clearly, whether biodiesel is promoted as a sustainable fuel practice and "can help save the dragon," is used by farmers and school districts for cleaner air and reduced dependence on foreign oil, or is used as a catalyst for a cooperative initiative, biodiesel can provide economic, environmental, and social benefit to the Dragon Run watershed and Middle Peninsula communities, and stakeholder interest is strong.

Appendix A.

National Biodiesel Board Virginia Database of Biodiesel Distributors

Virginia

Business Name/Location (Sort by Name, Sort by Blend)	Contact	Phone	Blend
James River Petroleum 10487 Lakeridge Pkwy Suite 100 Ashland, VA 23005	Google Maps	Bert Polk	800-825-5599	All
Foster Fuels, Inc. 113 Old Main Street Brookneal, VA 24528	Google Maps	Judy Peak	434-376-2322	All
Woodfin Watchcard 1156 River Road Charlottesville, VA 22901	Google Maps	Tim Earley	804-355-7104	All
Domestic Fuels & Lubes Inc. 400 Freeman Avenue Chesapeake, VA 23324	Google Maps	Buddy Ivey	888-231-8540	B100,B5,B10,B20
Culpeper Petroleum Cooperative 15297 Brandy Road Culpeper, VA 22701	Google Maps	Kevin W. Corbin	540-825-9651	all
Southern States Coop.Fredericksburg 11324 Tidewater Trail Fredericksburg, VA 22408	Google Maps	Rick or Ernest	540-373-3631	B-20
TCH Oil 73 Seafood Lane Irvington, VA 22480	Google Maps	Mike Christian	804-438-5231	
Noblett Oil & Propane Kilmarnock, VA 22482	Google Maps		800-633-4467	B2 & up
Noblett Appliance Kilmarnock, VA 22482	Google Maps		800-535-0084	
Woodfin Watchcard 3904 Bellson Park Dr. Midlothian, VA 23112	Google Maps	Tim Earley	804-355-7104	All
Peoples Oil Montross, VA 22520	Google Maps		800-633-4467	
Holtzman Corp 5534 Main St Mt Jackson, VA 22842	Google Maps	Darren Swartz	540-477-3131	All
Bagwell Oil Onancock, VA 23417	Google Maps			
Kilduff Oil 691 Main St Reedville, VA 22539	Google Maps	Al Christopher	888-276-3320	B2,B5,B10,B20
Woodfin Watchcard 1625 N. Hamilton St. Richmond, VA 23230	Google Maps	Tim Earley	804-355-7104	All
Central Oil of Virginia 240 Eastover Rd	Google Maps	Don Thacker	540-483-	all

Rocky Mount, VA 24151			5342	
Griffin Oil & Propane 1224 Holland Road Suffolk, VA 23434	Google Maps	Chris Pond	757-539-4761	All
Ware Oil Tappahannock, VA 22560	Google Maps		800-633-4467	
PEP-UP Temperanceville, VA 23442	Google Maps	Ralph S. Mathis, Jr	757-824-0091	
Thrift Oil Urbanna, VA 23175	Google Maps	Chappy Wake	800-210-8735	
Northern Neck Oil Company 11549 History Land Highway Warsaw, VA 22572	Google Maps	Carroll Pemberton	804-333-3835	B2-B20
Frederick Nothrup, Inc Warsaw, VA 22572	Google Maps	Stan Terhune	800-701-1033	

Appendix B.

National Biodiesel Board Virginia Database of Biodiesel Retail Locations

Virginia

Business Name/Location (Sort by Name, Sort by Blend)		Contact	Phone	Blend	Restrictions
Quarters K Citgo Mini Mart 801 S Joyce St. Arlington, VA 22204	Google Maps	Barbara	703-979-0405	B20	M-F 5:30am - 7:30pm Sat. 7:30am - 6:00pm Sun. 9:30am - 6:00pm
Village Green Exxon 17456 Richmond Road Callao, VA 22435	Google Maps	Norman Faulkner	804-529-7420	B20	24 hours, all Major Credit Cards
Woodfin Watchcard 1156 River Road Charlottesville, VA 22901	Google Maps	Tim Earley	804-355-7104	B20	24/7 Call office to acquire an access card.
Domestic Fuels & Lubes Inc 100 E. Liberty Street Chesapeake, VA 23324	Google Maps	Buddy Ivey	757-545-5100	B10	24
Domestic Fuels & Lubes Inc. 400 Freeman Avenue Chesapeake, VA 23324	Google Maps	Buddy Ivey	888-231-8540	B10	
Domestic Fuels & Lubes Inc. 808 Professional Pl. W. Chesapeake, VA 23320	Google Maps	Buddy Ivey	757-545-5100	B10	24
Culpeper Petroleum Cooperative 15297 Brandy Road Culpeper, VA 22701	Google Maps	Kevin W. Corbin	540-825-9651	B5	
Southern States Coop.Fredericksburg 11324 Tidewater Trail Fredericksburg, VA 22408	Google Maps	Rick or Ernest	540-373-3631	B-20	24--7 ALL MAJORS
Quarles Petroleum Inc. 2301 Plank Road Fredericksburg, VA 22401	Google Maps	Debbie Ouellette	540-371-1660	B10	All credit cards, 24 hours
Royal Liberty Food Mart 507 North Royal Ave Front Royal, VA 22630	Google Maps	Darren Swartz	540-635-4880	B5	
Duke's Liberty 710 Port Republic Road Harrisonburg, VA 22801	Google Maps		540-434-8805	B5	
Courtesy Service Station/Kilduff Oil 7043 Northumberland Highway Heathsville, VA 22473	Google Maps	Kevin Brey	804-580-8888	B2	Public pump
Kilmarnock Bayco 579 North Main Street Kilmarnock, VA 22482	Google Maps	Norman Faulkner	804-435-3790	B20	24 hours, all Major Credit Cards
Leesburg Liberty 2 Harrison St Leesburg, VA 22075	Google Maps	Jacque Gladu	703-777-6600	B5	
East End Exxon 717 East Main Street Luray, VA 22835	Google Maps	Bobby Smith	540-743-4993	B5	
Middletown Liberty 2135 Reliance Road Middletown, VA 22645	Google Maps	Darren Swartz	540-869-2777	B5	
Woodfin Watchcard 3904 Bellson Park Dr. Midlothian, VA 23112	Google Maps	Tim Earley	804-355-7104	B5	24/7 Call office to acquire an access card.
Holtzman Express STC 250 Conicville Road Mt. Jackson, VA 22842	Google Maps	Darren Swartz	540-477-2991	B5	

Domestic Fuels & Lubes Inc. 3455 Azalea Garden Road Norfolk, VA 23513	Google Maps	Buddy Ivey	757-545-5100	B10	24hr
Finks Fueling 2700 Victory Blvd. Portsmouth, VA 23704	Google Maps	Buddy Ivey	757-545-5100	B10	24
Kilduff Oil 691 Main Street Reedville, VA 22539	Google Maps		888-276-3320	B100	Public pump, Monday - Friday, 8:00 am - 5:00 pm
Woodfin Watchcard 1625 N. Hamilton St. Richmond, VA 23230	Google Maps	Tim Earley	804-355-7104	B5	24/7 Call office to acquire an access card.
Varina Pit Stop 3275 New Market Rd Richmond, VA 23231	Google Maps	Justin Andress	804-795-4213	B20	24 hrs, all Major CC accepted
Central Oil of Virginia 240 Eastover Rd. Rocky Mount, VA 24151	Google Maps	Don Thacker	540-483-5342		7:30am to 7:30pm
Ladysmith Pit Stop 8270 Ladysmith Rd Ruther Glen, VA 22546	Google Maps	Justin Andress	804-448-2217	B20	24 hrs, all Major CC accepted
Ruther Glen Pit Stop 24270 Rogers Clark Blvd Ruther Glen, VA 22546	Google Maps	Justin Andress	804-448-2217	B20	24 hrs, all Major CC accepted
Shenandoah Caverns Travel Ctr. 1598 Caverns Road Shenandoah Caverns, VA 22849	Google Maps	Darren Swartz	540-477-2442	B5	
Domestic Fuels & Lubes Inc. 600 Constance Road Suffolk, VA 23434	Google Maps	Buddy Ivey	757-545-5100	B10	24
Domestic Fuels & Lubes Inc. 4869 N. Witchduck Road Virginia Beach, VA 23462	Google Maps	Buddy Ivey	757-545-5100	B10	
Tri-Cities Petroleum 498 US Highway 23N Weber City, VA 24290	Google Maps	Jason Barger	276-386-9075	B20	24-7, Cash, cards, and fleet cards.
Lee Jackson 1026 Millwood Avenue Winchester, VA 22602	Google Maps	Darren Swartz	540-667-3244	B5	
Holtzman Express 1511 Martinsburg Pike Winchester, VA 22603	Google Maps	Darren Swartz	540-662-3719	B5	

Appendix C.

USDA National Agriculture Statistics Service search of "Virginia Data – Crops. Year 2006-2007"

Table 1. County Summary Highlights: 2002		
Source: http://www.nass.usda.gov/Census/Pull_Data_Census		
Geographic area ↑	Item	Data
Virginia\Essex	Farms (number)	127
Virginia\Essex	Land in farms (acres)	58,266
Virginia\Essex	Farms by size - 1 to 9 acres	1
Virginia\Essex	Farms by size - 10 to 49 acres	28
Virginia\Essex	Farms by size - 50 to 179 acres	48
Virginia\Essex	Farms by size - 180 to 499 acres	17
Virginia\Essex	Farms by size - 500 to 999 acres	15
Virginia\Essex	Farms by size - 1,000 acres or more	18
Virginia\Essex	Total cropland (farms)	102
Virginia\Essex	Total cropland (acres)	37,108
Virginia\Essex	Total cropland - Harvested cropland (farms)	75
Virginia\Essex	Total cropland - Harvested cropland (acres)	33,764
Virginia\Essex	Irrigated land (farms)	11
Virginia\Essex	Irrigated land (acres)	246
Virginia\Essex	Selected crops harvested - Corn for grain (farms)	45
Virginia\Essex	Selected crops harvested - Corn for grain (acres)	14,342
Virginia\Essex	Selected crops harvested - Corn for grain (bushels)	935,154
Virginia\Essex	Selected crops harvested - Soybeans for beans (farms)	51
Virginia\Essex	Selected crops harvested - Soybeans for beans (acres)	17,882
Virginia\Essex	Selected crops harvested - Soybeans for beans (bushels)	394,862
Virginia\Gloucester	Farms (number)	153
Virginia\Gloucester	Land in farms (acres)	25,699
Virginia\Gloucester	Farms by size - 1 to 9 acres	32
Virginia\Gloucester	Farms by size - 10 to 49 acres	56
Virginia\Gloucester	Farms by size - 50 to 179 acres	33
Virginia\Gloucester	Farms by size - 180 to 499 acres	18
Virginia\Gloucester	Farms by size - 500 to 999 acres	4
Virginia\Gloucester	Farms by size - 1,000 acres or more	10

Virginia\Gloucester	Total cropland (farms)	119
Virginia\Gloucester	Total cropland (acres)	18,456
Virginia\Gloucester	Total cropland - Harvested cropland (farms)	93
Virginia\Gloucester	Total cropland - Harvested cropland (acres)	17,212
Virginia\Gloucester	Irrigated land (farms)	13
Virginia\Gloucester	Irrigated land (acres)	98
Virginia\Gloucester	Selected crops harvested - Corn for grain (farms)	39
Virginia\Gloucester	Selected crops harvested - Corn for grain (acres)	7,698
Virginia\Gloucester	Selected crops harvested - Corn for grain (bushels)	437,223
Virginia\Gloucester	Selected crops harvested - Corn for silage or greenchop (farms)	1
Virginia\Gloucester	Selected crops harvested - Soybeans for beans (farms)	34
Virginia\Gloucester	Selected crops harvested - Soybeans for beans (acres)	7,888
Virginia\Gloucester	Selected crops harvested - Soybeans for beans (bushels)	230,530
Virginia\King and Queen	Farms (number)	154
Virginia\King and Queen	Land in farms (acres)	58,876
Virginia\King and Queen	Farms by size - 10 to 49 acres	33
Virginia\King and Queen	Farms by size - 50 to 179 acres	55
Virginia\King and Queen	Farms by size - 180 to 499 acres	44
Virginia\King and Queen	Farms by size - 500 to 999 acres	12
Virginia\King and Queen	Farms by size - 1,000 acres or more	10
Virginia\King and Queen	Total cropland (farms)	138
Virginia\King and Queen	Total cropland (acres)	32,627
Virginia\King and Queen	Total cropland - Harvested cropland (farms)	109
Virginia\King and Queen	Total cropland - Harvested cropland (acres)	30,454
Virginia\King and Queen	Irrigated land (farms)	10
Virginia\King and Queen	Irrigated land (acres)	743
Virginia\King and Queen	Selected crops harvested - Corn for grain (farms)	47
Virginia\King and Queen	Selected crops harvested - Corn for grain (acres)	12,173
Virginia\King and Queen	Selected crops harvested - Corn for grain (bushels)	539,804
Virginia\King and Queen	Selected crops harvested - Corn for silage or greenchop (farms)	1
Virginia\King and Queen	Selected crops harvested - Corn for silage or greenchop (acres)	(D)
Virginia\King and Queen	Selected crops harvested - Corn for silage or greenchop (tons)	(D)
Virginia\King and Queen	Selected crops harvested - Soybeans for beans (farms)	60
Virginia\King and Queen	Selected crops harvested - Soybeans for beans (acres)	14,533
Virginia\King and Queen	Selected crops harvested - Soybeans for beans (bushels)	323,651

Virginia\King William	Farms (number)	135
Virginia\King William	Land in farms (acres)	61,370
Virginia\King William	Farms by size - 10 to 49 acres	38
Virginia\King William	Farms by size - 50 to 179 acres	45
Virginia\King William	Farms by size - 180 to 499 acres	23
Virginia\King William	Farms by size - 500 to 999 acres	13
Virginia\King William	Farms by size - 1,000 acres or more	16
Virginia\King William	Total cropland (farms)	119
Virginia\King William	Total cropland (acres)	37,364
Virginia\King William	Total cropland - Harvested cropland (farms)	95
Virginia\King William	Total cropland - Harvested cropland (acres)	33,563
Virginia\King William	Irrigated land (farms)	19
Virginia\King William	Irrigated land (acres)	2,456
Virginia\King William	Selected crops harvested - Corn for grain (farms)	39
Virginia\King William	Selected crops harvested - Corn for grain (acres)	12,536
Virginia\King William	Selected crops harvested - Corn for grain (bushels)	736,966
Virginia\King William	Selected crops harvested - Corn for silage or greenchop (farms)	7
Virginia\King William	Selected crops harvested - Corn for silage or greenchop (acres)	1,048
Virginia\King William	Selected crops harvested - Corn for silage or greenchop (tons)	9,740
Virginia\King William	Selected crops harvested - Soybeans for beans (farms)	48
Virginia\King William	Selected crops harvested - Soybeans for beans (acres)	13,693
Virginia\King William	Selected crops harvested - Soybeans for beans (bushels)	299,715
Virginia\Mathews	Farms (number)	47
Virginia\Mathews	Land in farms (acres)	(D)
Virginia\Mathews	Farms by size - 1 to 9 acres	8
Virginia\Mathews	Farms by size - 10 to 49 acres	18
Virginia\Mathews	Farms by size - 50 to 179 acres	8
Virginia\Mathews	Farms by size - 180 to 499 acres	9
Virginia\Mathews	Farms by size - 500 to 999 acres	4
Virginia\Mathews	Farms by size - 1,000 acres or more	-
Virginia\Mathews	Total cropland (farms)	37
Virginia\Mathews	Total cropland (acres)	4,661
Virginia\Mathews	Total cropland - Harvested cropland (farms)	35
Virginia\Mathews	Total cropland - Harvested cropland (acres)	4,273
Virginia\Mathews	Irrigated land (farms)	6

Virginia\Mathews	Irrigated land (acres)	117
Virginia\Mathews	Selected crops harvested - Corn for grain (farms)	9
Virginia\Mathews	Selected crops harvested - Corn for grain (acres)	1,179
Virginia\Mathews	Selected crops harvested - Corn for grain (bushels)	86,202
Virginia\Mathews	Selected crops harvested - Corn for silage or greenchop (farms)	1
Virginia\Mathews	Selected crops harvested - Corn for silage or greenchop (acres)	(D)
Virginia\Mathews	Selected crops harvested - Corn for silage or greenchop (tons)	(D)
Virginia\Mathews	Selected crops harvested - Soybeans for beans (farms)	9
Virginia\Mathews	Selected crops harvested - Soybeans for beans (acres)	1,978
Virginia\Mathews	Selected crops harvested - Soybeans for beans (bushels)	40,533
Virginia\Middlesex	Farms (number)	101
Virginia\Middlesex	Land in farms (acres)	21,216
Virginia\Middlesex	Farms by size - 1 to 9 acres	14
Virginia\Middlesex	Farms by size - 10 to 49 acres	40
Virginia\Middlesex	Farms by size - 50 to 179 acres	24
Virginia\Middlesex	Farms by size - 180 to 499 acres	14
Virginia\Middlesex	Farms by size - 500 to 999 acres	2
Virginia\Middlesex	Farms by size - 1,000 acres or more	7
Virginia\Middlesex	Total cropland (farms)	78
Virginia\Middlesex	Total cropland (acres)	15,193
Virginia\Middlesex	Total cropland - Harvested cropland (farms)	66
Virginia\Middlesex	Total cropland - Harvested cropland (acres)	14,055
Virginia\Middlesex	Irrigated land (farms)	10
Virginia\Middlesex	Irrigated land (acres)	651
Virginia\Middlesex	Selected crops harvested - Corn for grain (farms)	25
Virginia\Middlesex	Selected crops harvested - Corn for grain (acres)	5,734
Virginia\Middlesex	Selected crops harvested - Corn for grain (bushels)	402,788
Virginia\Middlesex	Selected crops harvested - Corn for silage or greenchop (farms)	1
Virginia\Middlesex	Selected crops harvested - Corn for silage or greenchop (acres)	(D)
Virginia\Middlesex	Selected crops harvested - Corn for silage or greenchop (tons)	(D)
Virginia\Middlesex	Selected crops harvested - Soybeans for beans (farms)	25
Virginia\Middlesex	Selected crops harvested - Soybeans for beans (acres)	6,172
Virginia\Middlesex	Selected crops harvested - Soybeans for beans (bushels)	147,423

Appendix D.
Tennessee Soybean Producers' Views on Biodiesel Marketing – Survey
Source: http://beag.ag.utk.edu/pp/finalsurvey.pdf

GROWERS' VIEWS ON BIODIESEL PRODUCTION & MARKETING

The purpose of this study is to measure soybean producers' attitudes about biodiesel markets and formation of a cooperative to produce biodiesel from soybean oil in the West Tennessee area. Your response is important for obtaining an accurate measure of producers' views. Your participation is ***completely voluntary*** but will help us to serve you and other soybean growers. Only summaries of responses from the survey will be reported. Only researchers conducting the study will have direct access to the data. This questionnaire will take about 15 minutes to complete. You will be provided with an opportunity to request a copy of the study summary at the end of this questionnaire. We appreciate your participation.

SECTION I. BIODIESEL MARKETS

Biodiesel is an alternative fuel that can be made from soybean oil. Blends of up to 20% biodiesel mixed with petroleum diesel fuels (B20) can be used in nearly all diesel equipment and are compatible with most storage and distribution equipment.

1. Please circle the rating that most closely matches your opinions on the following statements.

	Strongly Agree	Agree	No Opinion	Disagree	Strongly Disagree
a. The U.S. markets for biodiesel will grow rapidly in the next 10 years	1	2	3	4	5
b. Biodiesel production will provide an important national market for soybeans in the next 10 years	1	2	3	4	5
c. If priced competitively with conventional diesel, I would be interested in using biodiesel from soybeans in a 20 percent blend on my farming operation.	1	2	3	4	5

2. Do you believe that biodiesel from soybeans could be profitably produced in West Tennessee? (Circle the answer.)
   a. YES (Continue on to question 3.)
   b. NO Please indicate reasons why _____(Go to question 11)

3. Would you be willing to sell some or all of your soybeans directly to a biodiesel processing plant?
   a. YES (Continue on to question 4)
   b. NO (Go to question 11)

4. I would prefer to sell my soybeans to a processing plant that is (Please circle the answer):
   a. Privately owned (Continue on to question 5)
   b. Cooperatively owned (Go to question 6)
   c. No preference (Go to question 6)

5. Please indicate the number of bushels you (on an average year) would be willing to sell to a plant, then go to question 11.
   a. Through marketing contracts _____bushels
   b. On a spot basis (no contract) _____bushels

6. Please indicate the number of bushels you (on an average year) would be willing to sell to a plant (Continue on to question 7)

   a. Through marketing contracts _____bushels
   b. On a spot basis (no contract) _____bushels

Section II. Cooperative Production of Biodiesel

7. Would you be interested in participating in a new generation cooperative to produce biodiesel?
   a. YES (Continue on to question 8)
   b. NO Please indicate reasons why _____ _____(Go to question 11)

8. What is the minimum percent per year you would find acceptable on any investment you made in a biodiesel production facility? _____% (for example, an 8% return would mean for every $100 invested, you would receive $8 per year). (Continue on to question 9)

9. At the rate you of return indicated above, and assuming a share price of $2.25 per bushel with minimum purchase of 2,500 shares or rights to deliver 2,500 bushels ($5,625 investment), would you be willing/able to purchase the minimum number of shares?
   a. YES (If Yes, continue on to question 10)
   b. NO (If No, go to question 11)

New Generation Cooperatives (NGC)

- Major focus is on "value-added" products, rather than commodities.
- Members sell raw products grown to their cooperatively-owned processing plant. Cooperative profits are then distributed back to members in proportion to raw product delivered.
- Shares allocate delivery rights so each share entitles & obligates a member to deliver soybeans to the cooperative
- Restricted or closed membership limits soybean deliveries to the amount the plant can absorb
- Investment may or may not include non-members. Investment by non-members is less than majority.

10. At the rate of return you stated in question 9, please indicate the number of additional shares you would be willing and able to purchase above the minimum of 2,500 (if none, indicate by answering '0')._____ additional shares (Continue on to question 11)

Section III. Farming Operation and Producer Characteristics

11. Are you currently a member of an agricultural cooperative?
    a. YES b. NO

12. Acres of soybeans harvested in 2001 _____.

13. Please indicate the number of soybean bushels you can store on-farm. _____ bushels.

14. What percent of your soybeans do you typically sell through contracts? _____%.

15. Other acreage harvested or used on the farm(s) you operate in 2001

a. Cotton	_____	e. Pasture	_____
b. Corn	_____	f. Woodland	_____
c. Wheat	_____	g. Other (Please describe)	_____
d. Other Crops Harvested (Please describe)	_____		_____

16. Number of livestock on your farming operation

a. Beef Cows	_____	e. Broilers	_____
b. Milk Cows	_____	f. Sows	_____
c. Yearlings	_____	g. Horses	_____
d. Heifers	_____	h. Other (Please describe)	_____

17. Your age in years _____.
Years experience farming _____.

18. For the farm(s) I operate, I am (Please circle the best answer)
a. A full owner (sole proprietorship)
b. A part owner in a partnership, family held corporation, or other corporation
c. A renter
d. Other (please describe): _____.

19. Net income from farming in 2001 (after taxes). (Please circle the best answer).
a. negative (less than $0)
b. $0-$9,999
c. $10,000-$14,999
d. $15,000-$24,999
e. $25,000-$34,999
f. $35,000-$49,999
g. $50,000-$74,999
h. $75,000-$99,999
i. $100,000-$149,999
j. Greater than or equal to $150,000

20. For every $100 of farm assets you have, how many dollars are financed with debt? (Please circle the answer).
a. $0
b. $1-$2.99
c. $3-$4.99
d. $5-$9.99
e. $10-$14.99
f. $15-$19.99
g. $20-$39.99
h. $40-$69.99
i. greater than $70

21. What percent of your household's income came from off farm sources in 2001 _____%

22. What is the highest education level you attained? (Please circle the answer).
a. Some high school or less
b. High school graduate
c. Some college
d. College graduate
e. Post graduate

END OF QUESTIONNAIRE. THANK YOU FOR YOUR TIME AND EFFORT.

_____Yes, I would like to receive a copy of the summarized results

Appendix E.
Cooperative Models and Case Studies

Cooperatives

Piedmont Biofuels Coop
Pittsboro, North Carolina
Website: www.biofuels.coop

Piedmont Biofuels is possibly the largest biodiesel cooperative in the U.S. At the beginning of 2005, the membership was built from a small but dedicated group of about 25—backyard fuel-makers, advocates of sustainability, environmental stewards, supporters of local agriculture and commerce, and shade-tree mechanics. From there, the membership blossomed into a community of more than 200 by the end of 2006. Probably the largest biofuels Cooperative in the nation, Piedmont Biofuels has assumed a role as a flagship of the North Carolina grassroots alternative fuels movement. The support of the membership keeps the Coop financially healthy, drives the demand for B100 in the Triangle area of North Carolina, and generously provides the labor that turns their numerous construction and improvement projects into reality. Members take on projects from cold flow research to wash water treatment to greenhouse building, and contribute to the continuing transformation of the Moncure Research Farm.

The Cooperative facilitated the creation of a B100 community trail which provides B100 to coop members throughout the state of North Carolina. They also host a very successful internship program, build biodiesel reactors for coop members and organizations all over the nation using mostly recycled materials, provide fuel making training and other education, grow oilseed varieties for biofuels research, host events and tours, speak at many events throughout the nation, teach biofuels courses at Central Carolina Community College, and provide many, many more valuable contributions to the local and state community.

San Juan Biodiesel
Colorado
Website: http://sanjuanbiodiesel.com/index.php?inc=news.htm

San Juan Biodiesel (SJB) began as a cooperative and is now a new Limited Liability Company that seeks to construct a 5 million gallon per year (mmgy) oil extrusion and biodiesel manufacturing facility in the Four Corners area of Colorado. A coalition of farmers, diesel vehicle fleet owners, and community members came together in 2005 to form SJB. With generous funding from municipalities, a school district, ski resorts, foundations, and the state of Colorado, SJB completed a comprehensive feasibility study in January of 2006.

In 2006, SJB opened an office, contracted for 3,300 acres of sunflower crops; researched and selected vendors for oil extrusion, biodiesel manufacture, and other equipment; and

prepared a comprehensive business plan. By the beginning of 2008, SJB plans to commence operation of the facility using oil seed feedstocks stored from the 2006 and 2007 harvests.

SJB plans to initiate operations mainly selling sunflower oil into food markets. SJB will slowly move into production and integration of biodiesel into fuel markets (anticipated to initially encompass 5-10% of overall vegetable oil production, possibly including canola as well), permitting us to refine the quality monitoring and control capabilities so critical in ensuring the long term success of the biodiesel industry.

Case Studies and Reports

Michigan Biofuel Production Cooperative, Education & Outreach
http://www.biomich.com/Biodiesel_COOP_Plans.pdf

The report cited above delves into the many aspects of biodiesel chemistry, production technology, handling, safety, and cold weather use. Further, this report will delve into tax and regulatory issues which relate to biodiesel production, and finally, it will present a business model for a micro-scale production cooperative. Case studies, articles of incorporation, and other business modeling will be presented to lay-out somewhat of a road map to allow the startup of a small biodiesel club, commercial venture, or member owned cooperative.

An educational effort will accompany this report which will include a number of workshops and educational presentations. In addition, an educational web site has been created and will be maintained to promote biodiesel and present this information to the general public.

Appendix F.

Example of quick guide that can be used at retail gas station selling biodiesel for public education

What is Biodiesel?

Biodiesel is a cleaner burning diesel fuel replacement. Although biodiesel includes the word "diesel," it contains no petroleum in its pure form. The word biodiesel combines the fuel's biodegradable material roots and it's use as a fuel in existing diesel engines. It can, be blended with any quantity of petroleum diesel because of the properties being so similar to diesel fuel. Biodiesel can also be used in boilers or furnaces as heating oil, or in any other diesel-fueled equipment.

Biodiesel is renewable, as biodegradable as sugar, and less toxic than table salt. Since biodiesel is made from renewable resources, it burns cleaner and is less damaging to humans and the environment. Biodiesel can be made from domestic renewable resources, which will decrease our dependence on foreign oil.

Why Biodiesel?

It's Renewable: Unlike coal and oil which took millions of years to form, biodiesel is made from renewable biological resources.
It's Healthier: Biodiesel is healthier for the environment and your health because it reduces harmful tailpipe emissions.
It's Domestic: Biodiesel can help decrease petroleum imports because it can be made from domestic renewable resources.
It's Efficient: Biodiesel provides the highest energy content of any alternative fuel.
It's Easy: Any diesel vehicle will run on biodiesel with little to no modification and some monitoring during the transition.
It's Engine Friendly: Biodiesel has excellent lubricating properties and superior burn properties.
It's Carbon Neutral: Biodiesel has a closed carbon cycle, therefore contributes very little to global warming.

Can I Use Biodiesel in My Existing Diesel Engine?

Biodiesel can be operated in any diesel engine with little or no modification to the engine or the fuel system. Before you fill up, keep a few things in mind:

- Biodiesel is NOT the same thing as raw vegetable oil. Fuel grade biodiesel must meet strict industry specifications. Be sure to buy ASTM spec biodiesel (your fuel provider should have this information).
- Biodiesel doesn't only burn cleaner; it's also a great cleaner. Biodiesel has a solvent effect that may release deposits accumulated on tank walls and pipes from previous diesel fuel storage. The release of deposits may clog filters initially and precautions should be taken. It is recommended after first switching to biodiesel that you check fuel filters often (especially during first 2 weeks).
- In older vehicles (in most cases, pre-1994), biodiesel's solvent effects may corrode natural rubbers (especially true if you intend on using B100). Check with the vehicle manufacturer as well as your mechanic in order to determine if any natural rubber hoses or seals need replacing before filling up with a high blend of biodiesel (You are probably safe if using a blend below B20).

Where Can I Find More Information?

National Biodiesel Board
www.biodiesel.org
www.biodiesel.org/buyingbiodiesel/retailfuelingsites/default.htm

Virginia Clean Cities
www.hrccc.org/biodiesel.html

Biodiesel Handling and Use Guidelines
www.nrel.gov/vehiclesandfuels/npbf/pdfs/40555.pdf

Clean Cities Virginia

July 14, 2007

VIRGINIA

Virginia Clean Cities
Hampton Roads Coalition
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To: Sara Stamp
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A Biodiesel Endowment

The endowment fund approach is an excellent way to achieve the goal of preserving agriculture in the sensitive Dragon Run watershed. It offers many advantages, primary among them good economics and low risk:

- A variety of funding mechanisms will work, which allows wide latitude in securing grants, low-interest loans and other financial instruments from diverse sponsors and partners.

- Loaned contributions to the endowment would not be at risk because only the interest earned on capital would be expended to support agriculture. The capital investments could be returned to the contributors.

- Interest from the endowment would support a price equalization program to reduce or remove the price penalty that discourages more widespread acceptance and use of biodiesel and hinders development or expansion of an agriculture-based biofuels industry.

- Price equalization or biodiesel price reductions relative to the costs of petroleum diesel would encourage rapid acceptance of biodiesel blends by diverse users, including farmers, loggers, school bus fleets, retailers and other end users.

    - This increased use and acceptance of a renewable fuel made from soybeans grown in the Dragon Run watershed offers direct and indirect economic benefits to the region's farmers and other community members: Every dollar spent in

agriculture multiplies itself 2.3 times by circulating and re-circulating in the local economy. Each new job in agriculture increases regional employment by 1.5 FTE.[1]

A fast start to reach goals and demonstrate benefits

The endowment fund would jump-start the Dragon Run biodiesel program to more quickly achieve the goals and benefits that are described in the feasibility study completed in June.[2] The benefits, which are more fully explained in the cited study, include:

- Crop value increases for the soybean farmer that result from increased demand for beans to make soy oil, the favored feedstock for biodiesel production by the local plant, Virginia Biodiesel Refinery LLC in New Kent County.

- The direct and multiplied benefits to the regional economy from spending money on a locally produced renewable fuel that displaces an imported petroleum product. The petroleum diesel offers comparatively few regional economic benefits because a far greater portion of the local fuel dollar is sent out of the region, state and country.

- Branding, not the product, but the concept of selecting a local renewable fuel and tying this consumer choice to a specific and local benefit, perhaps using a tagline such as "Save the Dragon, buy biodiesel."

- Improved community resilience and self-sustainability in the event of petroleum shortages.

- Possible fuel price and availability advantages if petroleum-based fuels continue to increase in cost, or supplies become restricted and inconsistent.

1

[1] *Policy Issues in Rural Land Use*. Vol. 9, No. 2, Dec. 1996. Department of Agriculture, Resource and Managerial Economics: Cornell Cooperative Extension. 14 June 2006. <http://aem.cornell.edu/faculty_sites/nlb4/publications/pirlu/vol9n2.pdf>

[2] Task 2 Part One Dragon Run Biodiesel Feasibility Study.Contract No: C07-02-05 Dragon Run, Virginia Clean Cities for Middle Peninsula Planning District Commission, Dragon Run SAMP Economic Development. 18 May 2007.

How much biodiesel

Table 1[3] below presents a range of the potential amount of biodiesel that could be used in blends with motor fuel in the Dragon Run watershed. The table presents various scenarios using survey results and motor fuel biodiesel market penetration levels. Scenarios are labeled A-E on the left column. Scenario A, for example, was calculated on the basis that all diesel sold (based on survey results) contained a 2, 5, 10, and 20% blend of biodiesel. Highway diesel and off-road diesel scenario results are presented. Nearly 2.4 million gallons of #2 fuel oil is used for heating homes, businesses and institutions in the Dragon Run area. The additional sales potential for biodiesel blended into heating oil, known as "bio-heat," would be 120,000 gallons if the common B5 blend was selected. This amount is not reflected in Table 1.

Table 1 shows only the biodiesel component of blends. It excludes the petroleum portion.

A	All diesel sold contains	B2	B5	B10	B20
	Highway diesel (gallons)	96143.6	240359	480718	961436
	Off-road diesel (gallons)	42720	106800	213600	427200
B	5% of diesel sold contains	B2	B5	B10	B20
	Highway diesel (gallons)	4807.18	12017.95	24035.9	48071.8
	Off-road diesel (gallons)	2136	5340	10680	21360
C	10% diesel sold contains	B2	B5	B10	B20
	Highway diesel (gallons)	9614.36	24035.9	48071.8	96143.6
	Off-road diesel (gallons)	4272	10680	21360	42720
D	20% diesel sold contains	B2	B5	B10	B20
	Highway diesel (gallons)	19228.72	48071.8	96143.6	192287.2
	Off-road diesel (gallons)	9548	23870	47740	95480
E	50% diesel sold contains	B2	B5	B10	B20
	Highway diesel (gallons)	48071.8	120179.5	240359	480718
	Off-road diesel (gallons)	23870	59675	119350	238700

[3] Task 2 Part One Dragon Run Biodiesel Feasibility Study.Contract No: C07-02-05 Dragon Run, Virginia Clean Cities for Middle Peninsula Planning District Commission, Dragon Run SAMP Economic Development. 18 May 2007.

How many soybeans

The USDA National Agricultural Statistics Service reports that Essex, Gloucester, Middlesex, Mathews, King and Queen, and King William Counties collectively have 593 farms total, comprising 145,409 acres.[4] Looking at this farmland from a biomass perspective, or more specifically an oilseed perspective, soybean appears to be the primary oilseed crop grown in the Middle Peninsula area. The NASS reported 227 soybean farms with production of 1.44 million bushels.

Table 2.[5] USDA NASS Report Middle Peninsula farming statistics

Total Cropland (farms)	593
Total Cropland (acres)	145,409
Total Corn for grain (farms)	204
Total Corn for grain (acres)	53,662
Total Corn for grain (bushels)	3,138,137
Total soybean for grain (farms)	227
Total soybean for grain (acres)	62,146
Total soybean for grain (bushels)	1,436,714

Of the 145,409 acres of farmland in the Middle Peninsula, 115,808 are used for corn and soybeans, the main feedstocks for ethanol and biodiesel, respectively. The main buyers of soybeans in the Middle Peninsula are Purdue and Old Dominion Grain. There are some buyers of specialty food-grade soybeans.

The Essex County Extension Agent, Keith Balderson, said that the single-most important concern of soybean farmers in the Middle Peninsula, and anywhere, is anything to improve the price of soybeans (i.e. more demand). Soybeans are the only oilseed feedstock currently grown in the Middle Peninsula. However, Balderson discussed the ability to grow canola (Brassica napus L.) in the region. Test plots of canola were grown in Essex County in the early 1990s for at least 2 years, and Balderson remembers good yields.

Cost to equalize biodiesel and petroleum diesel

The next table illustrates the annual cost (highlighted in yellow) to equalize the biodiesel component of blends relative to the cost of the petroleum component, based on various scenarios.

[4] U.S. Dept of Agriculture. National Agricultural Statistics Service. Virginia Data – Crops. Year 2006-2007. http://www.nass.usda.gov/Census/Pull_Data_Census

[5] Task 2 Part One Dragon Run Biodiesel Feasibility Study.Contract No: C07-02-05 Dragon Run, Virginia Clean Cities for Middle Peninsula Planning District Commission, Dragon Run SAMP Economic Development. 18 May 2007.

The first three segments of the table illustrate the annual costs of subsidies ranging from 2 cents to 7 cents per gallon for blends ranging from 2 percent to 20 percent, assuming all potential gallons of diesel become biodiesel blends. The annual costs range from $3,720 to $130,200.

The bottom two table segments assume that a more realistic one-half of potential sales become blends of biodiesel and explore the costs of a 5-cent and 10-cent per gallon subsidy on the same range of blends. This yields annual costs ranging from $4,650 to $93,000.

The fourth row in each of the five sections indicates the amount of funds (highlighted in blue) that would be required to produce interest earnings equal to the subsidy amount above it, assuming that the entire principal amount was invested in 26-week US Treasury Bills carrying a 4.865 percent discount rate, the rate resulting from the July 16, 2007 auction of bills to be issued July 19, 2007 and mature on January 19, 2008. ($1,000 bill generates $49.20 annually at this rate.)

Table 3: Annual costs to equalize the biodiesel portion of 9.3 or 4.65 million blended gallons

9.3 million gallons	Diesel and #2 contains:	B2	B5	B10	B20
	B100 portion of blend	186,000	465,000	930,000	1,860,000
	Cost of 2-cent subsidy	$3,720	$9,300	$18,600	$37,200
	Endowment size	$76,000	$189,000	$378,000	$756,000
9.3 million gallons	Diesel and #2 contains:	B2	B5	B10	B20
	B100 portion of blend	186,000	465,000	930,000	1,860,000
	Cost of 5-cent subsidy	$9,300	$23,250	$46,500	$93,000
	Endowment size	$189,000	$473,000	$945,000	$1,890000
9.3 million gallons	Diesel and #2 contains:	B2	B5	B10	B20
	B100 portion of blend	186,000	465,000	930,000	1,860,000
	Cost of 7-cent subsidy	$13,020	$32,550	$65,100	$130,200
	Endowment size	$265,000	$662,000	$1,323,000	$2,646,000
4.65 million gallons	Diesel and #2 contains:	B2	B5	B10	B20
	B100 portion of blend	93,000	232,500	465,000	930,000
	Cost of 5-cent subsidy	$4,650	$11,625	$23,250	$46,500
	Endowment size	$95,000	$236,000	$473,000	$945,000
4.65 million gallons	Diesel and #2 contains:	B2	B5	B10	B20
	B100 portion of blend	93,000	232,500	465,000	930,000
	Cost of 10-cent subsidy	$9,300	$23,250	$46,500	$93,000
	Endowment size	$189,000	$473,000	$945,000	$1,890,000

A resolution implementing increased use and production of biodiesel

WHEREAS, the Dragon Run is a uniquely valuable and sensitive watershed located in the Middle Peninsula of Virginia in parts of Essex, King and Queen, Middlesex, and Gloucester Counties; and

WHEREAS, The Middle Peninsula Planning District Commission (MPPDC)'s Dragon Run Watershed Special Area Management Plan (SAMP) project's mission is to support and promote community-based efforts to preserve the cultural, historic and natural character of the Dragon Run, while protecting property rights and the traditional and current uses of agriculture, forestry and outdoor recreation; and

WHEREAS, two independent studies conducted for the SAMP indicate that one promising path to achieve Dragon Run preservation goals is to provide sustainable natural resource-based economic benefit to the watershed community centered around the use and production of biodiesel that is made from the oil extracted from soybeans grown by farmers in the watershed; and

WHEREAS, the use of biodiesel , an alternative, domestically produced non-petroleum fuel , increases the energy security of the United States while reducing the annual trade deficit; and

WHEREAS, the use of biodiesel reduces emissions of ozone-forming compounds and other compounds that have been shown to be toxic to human health; and

WHEREAS, Virginia Clean Cities is a locally based non-profit organization that is contracted by the MPPDC through the SAMP program to provide technical support and monitor biodiesel developments, activities and grant funding opportunities throughout the Commonwealth.

NOW THEREFORE, BE IT RESOLVED that the _____ directs the division superintendent, staff, teachers and other appropriate personnel to learn more about the advantages of biodiesel and to support and encourage the use of biodiesel blends in school buses and other diesel-powered vehicles and equipment; and

BE IT FURTHER RESOLVED to amend– if necessary – the process used to procure fuel to enable the purchase of biodiesel blends and to seek an agreement – if necessary – from the county that will permit the School Division rather than the county to receive payments from a biodiesel buy-down fund; and

BE IT FURTHER RESOLVED to adopt a voluntary schedule to convert to a minimum blend of B5 (5 percent biodiesel mixed with 95 percent petroleum diesel) as soon as possible, but no later than April of 2008, and to gradually increase this blend level up to a B20 blend as soon as practical, but no later than April of 2009; and

BE IT FUTHER RESOLVED to educate other potential users in the community and encourage watershed -wide support for and promotion of biodiesel blends as a way to reduce the use of imported petroleum fuel and to support a strong local soybean market; and

BE IT FURTHER RESOLVED to direct the Division Superintendent to appoint one or more representatives to participate in the Dragon Run Biodiesel Partnership and support to the extent practical the Dragon Run Biodiesel Partnership Action Plan; and

BE IT FURTHER RESOLVED to use the technical support offered by the SAMP until September 2008 and other free resources and technical assistance offered by Virginia Clean Cities to help further these goals.

ADOPTED by the _____, of Virginia, this _____ day of _____, 2007.

Dragon Run Biodiesel Partnership Agreement and Action Plan

We, the undersigned, agree that there is a need for community-based efforts to preserve the cultural, historic and natural character of the Dragon Run, while protecting property rights and the traditional and current uses of agriculture, forestry and outdoor recreation; and

We agree that a promising path to achieve this preservation goal is to foster sustainable natural resource-based economic benefit to the watershed community centered around the use and production of biodiesel , a clean renewable fuel that is made from oil extracted from soybeans produced in the Dragon Run Watershed; and

We agree to actively participate in the Dragon Run Biodiesel Partnership and to support the Biodiesel Action Plan. Elements of the Action Plan are presented in detail in supporting documents that are cited and excerpted in the appendix. Action Plan items are summarized here:

- **Clean School Bus USA Biodiesel buy-down program**

A Middle Peninsula Clean School Bus grant proposal has been selected by EPA for funding. The proposal includes a cost-equalization fund to encourage school districts to use biodiesel blends to reduce diesel exhaust emissions from school buses. The grant budget includes a maximum of $20,000 to "buy down" the differential cost of biodiesel (up to $0.01 per percent of biodiesel in the blend) so that a school district can elect to use blends of the cleaner, domestically produced alternative fuel in school buses without paying a premium over the cost of petroleum diesel. (See Appendix A for a more detailed summary and hyperlink to a web-accessible version of the complete document.)

- **Dragon Run Rural Economic Development buy-down program**

The Middle Peninsula Planning District Commission has contracted with Virginia Clean Cities to develop a proposal to create a similar buy-down program to extend the biodiesel cost-equalization opportunity to other users of diesel, including additional government agencies, commercial fleet operators with central fueling, such as farmers and other small businesses, and private vehicle owners who purchase fuel from retail stations. A USDA no-interest loan and private donations are some of the intended sources of funds for this initiative, which will function like an endowment or trust fund. (See Appendix B for a more detailed summary and a hyperlink to a web-accessible version of the complete document.)

- **Biodiesel cost control by varying blend levels**

Buy-downs and other subsidies are valuable tools to jump-start and grow a strong local biodiesel industry, but they have limited sustainability. A long-term commitment to biodiesel blends can be maintained without cost-equalization programs, however, simply by varying the biodiesel blend up or down to accommodate changes in the price differential between biodiesel and petroleum diesel. (See Appendix C for an example of how varying the blend can sustain use of biodiesel for just pennies even when the differential cost is large.)

- **Biodiesel Education and marketing programs**

In order for biodiesel to have a significant, lasting and favorable impact on preservation of the Dragon Run, support for the use of biodiesel will have to extend throughout the supply chain from producer to end users, and across the spectrum of users from large government fleets to single private cars and trucks. (See Appendix D for a summary of discussions about biodiesel educational, marketing and promotional opportunities. See Appendix E for the Clean School Bus USA project work plan and timeline. The complete documents are web accessible from links provided in the appendices.)

Partner Signature: _____Date:_____

Partner title or name of organization: _____

Appendix A: Summary – Clean School Bus project.
Complete document available at http://www.hrccc.org/dragonrun.html

Virginia Middle Peninsula Clean School Bus USA 2007-2008

A project to promote healthful air by reducing school bus diesel exhaust emissions

Applicant: Hampton Roads Clean Cities Corporation
DBA Virginia Clean Cities

Partners: Dragon Run Steering Committee
Gloucester County Schools
King & Queen County Schools
Kingmor Supply
Mathews County Schools
Middlesex County Schools
Phillips Energy
Virginia Biodiesel Refinery LLC
Virginia Clean Cities
Virginia Department of Environmental Quality
Virginia Division of Energy

CFDA title: Clean School Bus USA
CFDA Number: 66.036
Funding Opportunity: EPA-R3APD-07-02
Region 3 Clean School Bus USA
Project Manager: Virginia Clean Cities and
Hampton Roads Clean Cities Coalition
Al Christopher & Chelsea Jenkins
al.christopher@hrccc.org
cjenkins@hrccc.org
804-436-3867 Al
757-256-8528 Chelsea
Project Period: Dec 1, 2007 to Nov. 30, 2009
Project Cost: $213,624

Statement of Work

a. Air Quality Description of the Area Served by the Project

Support for clean school bus initiatives in Virginia's Middle Peninsula responds to a desire for environmental justice in economically challenged communities which suffer disproportionately from poor air quality effects. Many of these counties and the surrounding areas are home to large non-white populations. In fact, current asthma prevalence rates are higher among multiracial and black adults than any other race or ethnicity in Virginia and the U.S.[1].

Improvement to the quality of air breathed by the sensitive population of children who are most exposed to school bus diesel exhaust emissions will be the primary benefit of this project. Lengthened exposure by riders to exhaust fumes both on and off the bus is the inevitable result of the rural nature and elongated geography of Virginia's Middle Peninsula and the spread-out shapes of several of the county-sized school districts. Four of the six district counties have a long and narrow shape, which makes it difficult to avoid lengthy bus routes. Several of the jurisdictions are forced by geography or economics to combine students from two or even three school divisions – elementary, middle and high school – on the same bus route, up to 2 ½ hours roundtrip daily.

The region's ambient air quality also will benefit from the project. Gloucester, the southern-most portion of Middle Peninsula, is included in the Hampton Roads metropolitan area, one of three areas in Virginia that historically have suffered from poor air quality and received an "F" in the American Lung Association's 2007 State of the Air Report (see *Appendix D*). The western portion of Middle Peninsula – King William and King & Queen – is adjacent to Richmond, a second area of historically poor air quality. Essex, the northern-most school district in Middle Peninsula, is only 50 miles south of the Northern Virginia non-attainment area, one of the nation's worst air-quality regions (see *Appendix E)*. Gloucester County is part of the Hampton Roads 8-hour ozone standard maintenance area. Hampton Roads and Gloucester County just this month were redesignated to attainment for the 8-hour ozone standard and are operating under a maintenance plan to ensure that air quality remains healthful. The American Lung Association's State of the Air report 2007 pointed out that the Mid-Atlantic region continues to carry the highest air pollution burden in the nation. The most burdened major cities include the Washington-Baltimore-Northern Virginia areas, ranked 12th worst for both ozone and short-term particle exposure, and 21st for year-round exposure to particles.[2]

b. Project Description

The objective is to promote healthful air, especially for student riders, by reducing diesel exhaust emissions from school buses in Virginia's Middle Peninsula through:

1. Installation of exhaust after treatment devices
2. Use of biodiesel blends and, possibly, a propane demonstration
3. Idle reduction through driver training
4. Early replacement of old buses with cleaner new ones
5. Leveraging outcomes with three complementary grants and news coverage

1. Installation of exhaust after treatment devices is linked to use of biodiesel blends

The front-engine International DT 466 Type C school bus is by far the dominant type operated in Middle Peninsula. All but two of the 115-bus Gloucester fleet, for example, is an International chassis and all but

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[1] Asthma in Virginia: A Comprehensive Data Report, 2006. Virginia Department of Health, p 10.
[2] State of the Air: 2007. American Lung Association. Accessed June 17, 2007 online: ttp://lungaction.org/reports/SOTA07_stateozone.html?geo_area_id=51

a handful of those use the DT 466 engine. The nine exceptions are 1990-1993 models powered by a variant of the 466 engine, the DT 360 motor.

The project has budgeted $70,000 for the retrofit of up to 100 buses with a diesel oxidation catalyst (DOC), to take place during calendar year 2008, within nine months of the Dec. 1, 2007 project start date. Virginia Clean Cities now is providing monitoring and reporting assistance to the Virginia Department of Environmental Quality (DEQ) in the oversight of a neighboring school bus DOC project funded under a federal Supplemental Environmental Project (SEP).

2. Use of biodiesel blends and, possibly, a propane demonstration

Middle Peninsula school districts that receive funding for DOCs and districts that do not elect to install DOCs will be encouraged to use biodiesel blends to further reduce diesel exhaust emissions. Biodiesel use will be encouraged through education and a biodiesel "buy down" program.

The project budget includes a maximum of $20,000 to "buy down" the differential cost of biodiesel (up to $0.01 per percent of biodiesel in the blend) so that a school district can elect to use blends of the cleaner, domestically produced alternative fuel without paying a premium over the cost of petroleum diesel.

Clean Cities will work with the state's only distributor of a propane-powered school bus to seek a school district partner within Middle Peninsula to purchase and demonstrate the vehicle, which is required by the Virginia Department of Education before sales in the Commonwealth can commence. The project's $32,000 budget item for new a new bus will be earmarked until June 2008 for a propane bus. In the event the propane bus demonstration cannot go forward or no school district wishes to purchase a propane bus, this budget line item will become available for a modern diesel bus.

3. Idle reduction

The project budget includes $3,130 to develop materials and conduct a workshop on idle reduction strategies. Several Middle Peninsula school districts have idle reduction programs or policies in place. Virginia Clean Cities will survey these existing programs and catalogue other idle reduction best practices that might be adaptable to Middle Peninsula. Idle reduction technologies also will be explored for potential application, presented at the workshop and included in workshop materials. Virginia Clean Cities will provide EPA's idle-reduction video to each school district to assist in driver training. This training will be provided in concert with fuel quality and biodiesel preparedness workshops that will take place in 2008.

4. Early bus replacement

The project budget includes $32,000 to pay up to 45 percent of the cost of one early replacement bus with the lowest available emissions and latest emissions controls. This fund will be earmarked for a propane powered bus and held in reserve until June 1, 2008 to allow time to determine whether a Middle Peninsula school district will participate in a possible propane bus demonstration. If there is no propane demonstration, the earmarked funds will go back into the pool for an early replacement bus with the lowest available emissions and latest emissions controls.

5. Leveraging outcomes with three complementary grants and news coverage

Virginia Clean Cities manages three additional projects that complement this proposal and offer opportunities to leverage materials and intellectual resources to improve and extend outcomes for all of the projects and extend the impacts of federal dollars used in this project and the others:

- The Dragon Run Biodiesel project affects all of the Middle Peninsula counties and encompasses portions of the land area of four of the six counties. This federally-financed initiative is exploring ways in which increased use and possible small-scale production of biodiesel could provide economic value to farmers and other landowners and, therefore, help to preserve current and

historic agrarian and sylvan land uses to buffer a unique and sensitive watershed that is protected by a Special Area Management Plan.

- A Biofuels preparedness and fuel quality workshop series funded by the Commonwealth of Virginia and the National Biodiesel Foundation will produce quick guides and internet-accessible resources for fleets, distributors, retailers and users of biodiesel and other biofuels. The workshops and the quick guides will be made available to Middle Peninsula school districts and will be an essential part of a program to introduce biodiesel to new users.
- The Commonwealth and the Virginia Soybean Association funded the Biodiesel Retail Infrastructure and Marquee Fleet project, which includes money for biofuels education and cleaning tanks in preparation for the introduction of biodiesel blends, a standard protocol to be observed by school districts. The Gloucester School district recently was awarded funds to clean several diesel tanks.

- **News media and outreach:** Since a variety of methods are proposed to reduce school bus emissions, there will be multiple opportunities for local news media coverage. Virginia Clean Cities will coordinator at least one media event each to showcase DOC benefits, propane bus deployment (ribbon cutting), idle reduction and use of biodiesel blends. Regular announcements also will be developed and disseminated through Virginia Clean Cities bi-monthly electronic newsletter to a large network of stakeholders located throughout Virginia and the nation.

Appendix B: Summary of recommendations from "Biodiesel and Sustainable Economic Development in Dragon Run Watershed," a March 2007 feasibility study. Complete document available at http://www.hrccc.org/dragonrun.html.

1.) Trust Fund to equalize cost of biodiesel

A trust fund finance mechanism could be created to buy down cost of biodiesel relative to cost of petroleum for farmers. This proposal was offered by Sara Stamp. It could take many forms, but the underlying premise is to secure a source of funds to generate interest income that could be used to provide economic benefit to Dragon Run farmers in the form of more competitive biodiesel prices. Biodiesel typically costs about the same or slightly more than conventional petroleum diesel, but there are times when the differential cost can be unfavorably high for biodiesel.

2.) EPA Clean School Bus Grant

The Clean School Bus USA grant program offers financial support to reduce unhealthy exhaust emissions from school buses. The current round of proposals is due no later than June 26, 2007. Consultant recommends that consultant and stakeholders assemble a grant proposal for one or more school districts in Dragon Run. The EPA Clean School Bus program encourages emissions reductions practices including: use of biodiesel, addition of after-market particulate traps and diesel oxidation catalysts, repowering school buses with cleaner engines and bus replacement. The program also accepts proposals that would use grant funds to equalize the cost of alternative fuels like biodiesel with conventional petroleum fuels to encourage wider use of the cleaner alternatives to reduce emissions.

3.) Hybrid Co-operative

Buyer and Producer Co-ops have been parts of successful programs to develop the biodiesel market in many areas of the country. Consultant recommends a hybrid co-operative approach that partners a retailer, fuel distributor, Virginia Biodiesel Refinery LLC and end users of biodiesel blends. This mechanism is less costly in capital equipment because no small tanks and pumps would be supplied or purchased, which typically is the case for user co-operatives. It would reduce the chance of poor quality issues that can result when inexperienced users store, handle and dispense biodiesel blends, especially during cold weather. Economic risk would be widely spread and the key risk takers also would have the opportunity to reap economic rewards in exchange for their risk. It should be possible to design a hybrid biodiesel co-op that could take great advantage of the type of marketing discussed next:

4.) Branding the Idea (not the product)

The difficulty of creating a direct economic benefit to farmers and a possible indirect approach employing the concept of "Branding" the act of purchasing biodiesel as an idea was presented by consultant and described here:

On the matters of a refinery partnership and direct benefit to farmers: The owners and managers of Virginia Biodiesel Refinery LLC in the town of Eltham in New Kent County have indicated that they will be active Dragon Run partners and help out in any way.

The refinery has a self interest in any effort to encourage greater use of biodiesel. But a direct link and direct benefit going the other way --- from refinery to farmer – is much harder to find or create. The refinery does not buy soybeans from farmers. It buys refined soybean oil from Perdue, which produces the oil from soybeans grown in Dragon Run and elsewhere. (Another part of a later feasibility study proposes to take a look at whether soybeans or another potential feedstock such as Canola could be crushed locally to produce oil, but it is not now known whether that might be practical.)

An indirect linkage exists now: Demand for biodiesel results in demand for soybean oil. Demand for soybean oil results in demand for soybeans, which results in higher revenues for farmers who grow soybeans. Therefore, farmers should work to increase demand for biodiesel by using it and encouraging others to use it. The analogy often used to describe this indirect economic link is "a rising tide raises all ships." One could apply this indirect link to any soybean region, whether or not it has a biodiesel refinery. The presence of a nearby refinery in New Kent County offers advantages of biodiesel supply security and lower transportation costs.

Other linkages and connections might be more important than the refinery-farmer link. Farmers who grow or could grow soybeans have a fairly clear but still indirect financial stake in any effort to encourage greater use of biodiesel. The many other potential users and supporters of biodiesel who live and work in Dragon Run also have stakes, but it is harder to put an economic value on the benefits they could derive from greater use of biodiesel. What is the value of cleaner air and water? What is the value of a rural and native resource-based lifestyle? How much is energy diversification, resource sustainability and increased domestic energy security worth?

In order to communicate the linkages between biodiesel and Dragon Run preservation, one path to consider is to "brand" the use of biodiesel (the concept not the actual product) in a way that associates the use of biodiesel with the preservation of Dragon Run and all that that means in terms of keeping more open space, fostering a more vital farm economy, preserving a rural lifestyle, sustainable use of native natural resources, cleaner air, domestic sustainable and renewable fuel production, etc. This approach might make it easier to reduce a complex linkage to a simple idea to communicate, which could make the project easier to replicate in other regions and possibly easier to implement here. The hard part is getting the message down to a simple concept to make the

“brand” catch on and “catchy.” “Dragon Power” could become a branding tag line to help get across the message that there is a linkage between the use of biodiesel and preserving Dragon Run.

“Dragon Power” or something like that phase could be the tag line or basis for a simple marketing campaign that promotes the benefits of using biodiesel. Other parts of the message could work off of the tag line. A tag line incorporating the concept – It’s good to use Dragon Power -- could be incorporated into just about everything associated with the Dragon Run project: stationary used in newsletters, posters distributed to partners, decals and other point-of-sale materials used by biodiesel retailers.

Appendix C: Cost control by varying the blend of biodiesel

Price calculator for biodiesel blends				
	B2	B5	B10	B20
gallons:	100	100	100	100
petro gals:	98	95	90	80
bio gals:	2	5	10	20
petro price:	2.000	2.000	2.000	2.000
petro total:	196.00	190.00	180.00	160.00
bio price:	2.300	2.300	2.300	2.300
bio total:	4.60	11.50	23.00	46.00
total cost	200.60	201.50	203.00	206.00
avg price gal:	2.006	2.015	2.030	2.060
fed tax	0.244	0.244	0.244	0.244
va tax	0.160	0.160	0.160	0.160
total with tax	2.410	2.419	2.434	2.464

enter cost of petroleum diesel:	$ 2.00
enter cost of B100 used to blend:	$ 2.30
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differential cost of B10 in example:	$ 0.030
differential cost of B20 in example:	$ 0.060

The differential cost of biodiesel blends compared to petroleum can be managed by adjusting the blend level up or down

Appendix D: Education and marketing section, Feasibility Study, Part One. (Complete document available at http://www.hrccc.org/dragonrun.html.)

VII. Outlets for Continued Education of Stakeholders, Partners, and End Users

Use existing networks

- Local parks & recreation
- Chambers of Commerce
- RC&D councils
- School board monthly meetings

Use marquee school bus fleets and other opportunities to generate news coverage

- Issue press releases and alert the news media of photo opportunities

Create a newsletter or contribute to existing company communications

- Update stakeholders on progress
- Outline how new stakeholders can get involved
- Create a database of contacts

Bring Dragon Run into local events, festivals, meetings in the area

- Dragon Run Day
- Gloucester Daffodil Festival
- West Point Crab Festival
- Mathews Markets Days
- Urbanna Oyster Festival
- Other annual events and meetings

Appendix E: Clean School Bus USA timeline (Complete document available at http://www.hrccc.org/dragonrun.html.)

Timeline for work plan assumes Dec. 1, 2007 project start date	
work task description	date/frequency
General kick-off meeting to discuss broad components of project and begin planning to coordinate DOC order and biodiesel buy-down	January
Biodiesel preparedness meeting, coordination of tank cleaning, review and update biodiesel buy-down and other issues	february
Idle reduction strategy meeting, review DOC order, biodiesel buy-down and other issues	march
Propane-powered school bus meeting, review of biodiesel preparedness, DOC order, biodiesel buy-down and other issues	April
Early bus replacement meeting, review of biodiesel preparedness, DOC order progress, biodiesel buy-down and other issues	May
School bus garage personnel install DOCs	June-July
Early replacement school bus order is placed	April-May
Follow-up meeting to monitor progress and troubleshoot issues	July
Follow-up meeting to monitor progress and troubleshoot issues	September
Press event/press release for biodiesl, DOCs, biodiesel, new bus	As appropriate
VCC reports on outputs achieved and outcomes documented to EPA	quarterly
Additional and special reporting as may be needed	As appropriate
VCC final report to EPA	TBD
Note: It is expected that this project can be completed within one year. A two-year grant cycle has been proposed, however, in case of unexpected delays in the purchase of DOCs and the unpredictable nature of the proposed propane bus demonstration, which would be a first in the state. Reporting on progress and documentation of outputs and outcomes will continue for one, two, or more years, according to the wishes of EPA.	

Biodiesel in Dragon Run: Roadmap to Preservation

Virginia Coastal Zone
MANAGEMENT PROGRAM

Clean Cities
Virginia

Dragon Run
WATERSHED

NOAA
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
U.S. DEPARTMENT OF COMMERCE

This work was funded by the Virginia Coastal Zone Management Program at the Department of Environmental Quality through Grant # NA06NOS4190241 Task 95 of the National Oceanic and Atmospheric Administration, Office of Ocean and Coastal Resource Management, under the Coastal Zone Management Act of 1972, as amended.
The views expressed are those of the author(s) and do not necessarily reflect the views of NOAA or any of its subagencies.

Virginia Clean Cities & Hampton Roads Clean Cities Coalition

<u>AMERICAN</u> ENERGY FOR TRANSPORTATION

www.hrccc.org

Clean Cities

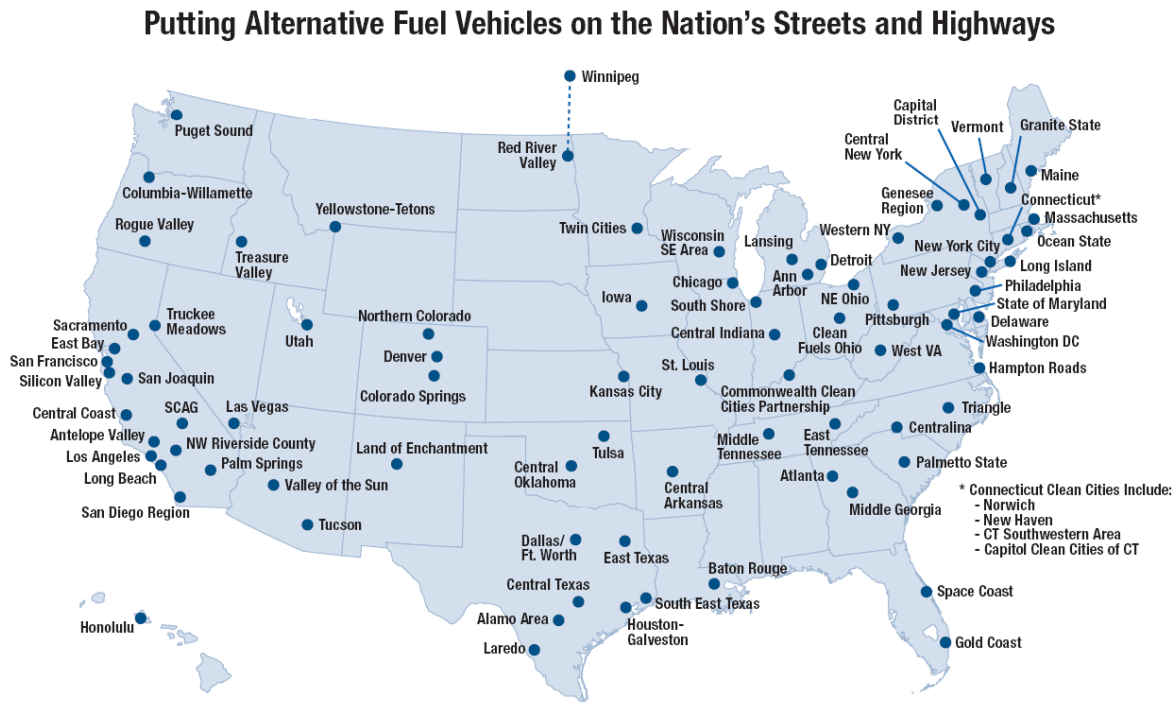
National US DoE voluntary program to promote energy independence in transportation

90 Coalitions nationwide

One designated Coalition in Virginia (Hampton Roads)

Statewide effort ongoing

DoE Website:
http://www.eere.energy.gov/cleancities/
Virginia Clean Cities:
http://www.hrccc.org



Dragon Run: Why is it Worth Preserving?

- One of Chesapeake Bay watershed's most pristine waterways
- Encompasses extensive & unspoiled swamp forest and woodland communities
- Mainly undeveloped, almost entirely privately owned, encompasses 140 miles of rural landscape – mostly forests, farms, & wetlands
- Forestry & farming large economic drivers
- Plays a significant role in Middle Peninsula's culture and identity
- Name frequently borrowed by local enterprises & establishments
- 14 rare species & 5 rare natural communities are found in the watershed
- *Unique opportunity for proactively preserving the Dragon for future generations that safeguards both natural resources and traditional uses of the land & water, including the property rights of landowners*

MPPDC & HRCCC

Dragon Run Watershed Special Area Management Plan (SAMP) – The purpose of a SAMP is to protect significant coastal resources when all levels of government are committed to a collaborative planning process to produce enforceable policies. The Dragon Run SAMP project's mission is to support and promote community-based efforts to preserve the cultural, historic and natural character of the Dragon Run, while preserving property rights and the traditional uses within the watershed.

Opportunities for Sustainable Natural Resource-Based Development in the Dragon Run Watershed ("Yellow Wood Study") – As part of the Dragon Run SAMP, the Yellow Wood study was conducted in October 2005 in order to identify and explore economic development activities and opportunities that sustain traditional land uses while enhancing the natural resource base or at least minimizing adverse impacts.

Biodiesel in Dragon Run: Roadmap to Preservation **–** HRCCC was contracted by the MPPDC to continue further exploration of biodiesel market viability and present recommendations based on survey summaries and stakeholder interest detailing potential to fulfill the goal to provide sustainable natural resource-based economic benefit to the watershed community centered around the use and production of biodiesel as a cleaner, healthier, domestic alternative to fossil fuel.

Two studies indicate biodiesel use as way to preserve Dragon & provide economic value…

The Yellow Wood Study: "Opportunities for Sustainable Natural Resource-Based Development in the Dragon Run Watershed"

Overall purpose:

• Identify and explore economic development activities and opportunities that sustain traditional land uses while enhancing the natural resource base or at least minimizing adverse impacts.

• Seven areas were selected for further exploration, including biodiesel utilization (and production) for municipal vehicles. The Yellow Wood study found biodiesel utilization to be an example of enterprise that fits within the overall goal of sustainable natural resource-based economic development for the Watershed, whether carried out within the public or private sectors.

Link to access study: http://www.mppdc.com/dragon/index.shtml

Two studies indicate biodiesel use as way to preserve Dragon & provide economic value…

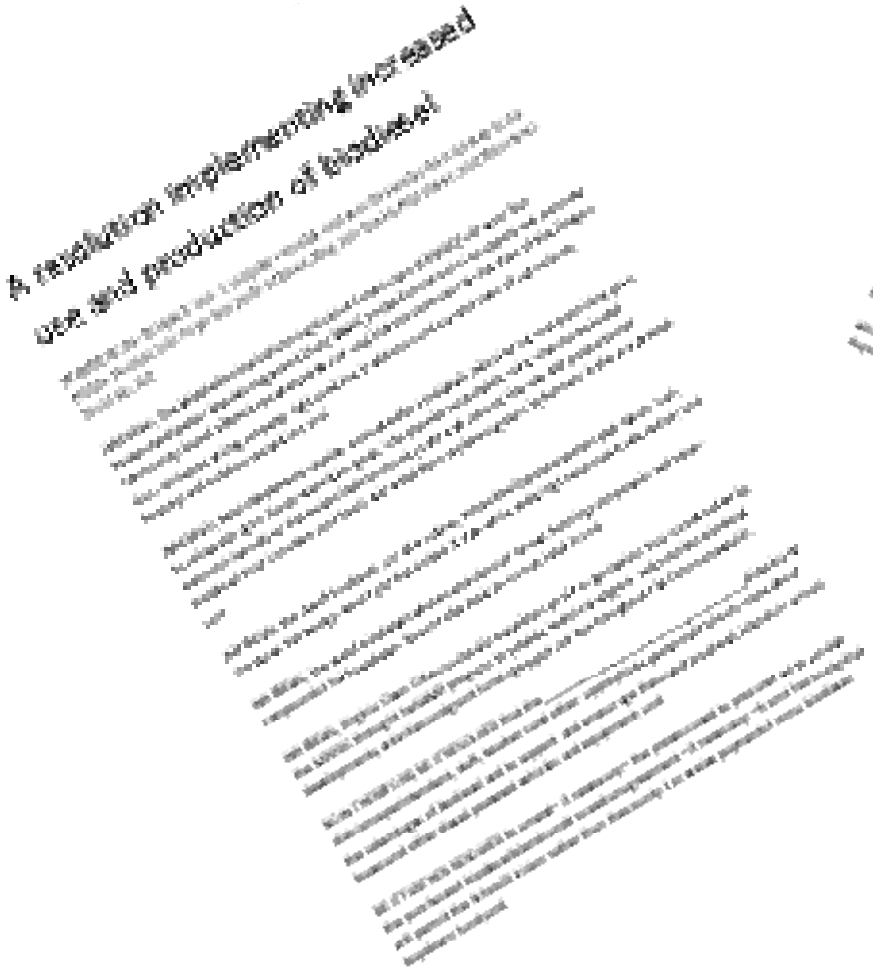
Biodiesel and Sustainable Economic Development in the Dragon Run Watershed

Explores the feasibility of biodiesel consumption and production as tools for natural resource-based economic development and preservation of existing land uses

The analysis: 1) presents arguments for how biodiesel use and/or production could provide benefit to the Middle Peninsula and Dragon Run Watershed areas; 2) refines the roles of strategic partners; 3) attempts to characterize and quantify potential capacity, will and market for biodiesel end users, including local governments, school bus and other diesel-powered equipment, farmers, and commercial fleets; 4) assesses factors impacting biodiesel market penetration; 5) examines cooperative approaches to traditional fuel retail sales; and 6) examines next steps and presents recommendations.

Link to access study: http://www.hrccc.org/biodiesel/dragonrunbiodiesel.html

A resolution implementing increased use & production of biodiesel



Schools not asked to commit cash financial resources now or later, unless they decide to do so on voluntary basis

Partnership Agreement spells out in greater detail four save-the-Dragon prongs:

1. Clean School Bus USA grant program – exhaust treatment devices and biodiesel "buy-down" program

2. Private "buy-down" endowment to give other fleets same chance

3. Cost control by blend variation when subsidies are gone

4. Education and marketing to convince entire community to "save the dragon"

CSBUSA – Biodiesel Buy-down and emissions control devices (DOC)

A Middle Peninsula Clean School Bus grant proposal has been selected by EPA for funding. The proposal includes a cost-equalization fund to encourage school districts to use biodiesel blends to reduce diesel exhaust emissions from school buses. The grant budget includes a maximum of $20,000 to "buy down" the differential cost of biodiesel (up to $0.01 per percent of biodiesel in the blend) so that a school district can elect to use blends of the cleaner, domestically produced alternative fuel in school buses without paying a premium over the cost of petroleum diesel.

Will move slowly on biodiesel to make sure all comfortable and well educated about protocol, know use low blends in cold weather, etc.

Private Endowment

To give other fleets same chance

The Middle Peninsula Planning District Commission has contracted with Hampton Roads Clean Cities Coalition to develop a proposal to create a similar buy-down program to extend the biodiesel cost-equalization opportunity to other users of diesel, including additional government agencies, commercial fleet operators with central fueling, such as farmers and other small businesses, and private vehicle owners who purchase fuel from retail stations. A USDA no-interest loan and private donations are some of the intended sources of funds for this initiative, which will function like an endowment or trust fund.

Cost Control

By blend variation when subsidies are gone

Price calculator for biodiesel blends				
	B2	B5	B10	B20
gallons:	100	100	100	100
petro gals:	98	95	90	80
bio gals:	2	5	10	20
petro price:	2.000	2.000	2.000	2.000
petro total:	196.00	190.00	180.00	160.00
bio price:	2.300	2.300	2.300	2.300
bio total:	4.60	11.50	23.00	46.00
total cost	200.60	201.50	203.00	206.00
avg price gal:	2.006	2.015	2.030	2.060
fed tax	0.244	0.244	0.244	0.244
va tax	0.160	0.160	0.160	0.160
total with tax	2.410	2.419	2.434	2.464

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The differential cost of biodiesel blends compared to petroleum can be managed by adjusting the blend level up or down

Education and marketing to convince entire community to “Save the Dragon”

In order for biodiesel to have a significant, lasting and favorable impact on preservation of the Dragon Run, support for the use of biodiesel will have to extend throughout the supply chain from producer to end users, and across the spectrum of users from large government fleets to single private cars and trucks.

CSBUSA non-federal match from schools is all in-kind, requiring no extra funds:

Example: Shop labor to install pollution control equipment on older buses is the school matching contribution

Existing & Potential Partners

Fuel distributors
Biodiesel refinery
MPPDC
HRCCC
VA DEQ
EPA
News media
Farmers
DRSC
Private fleets (i.e. Bay Transit)
Fuel retailers, others?)

Dragon Run Biodiesel Project Webpage

http://www.hrccc.org/biodiesel/dragonrunbiodiesel.html

The following documents are posted to the Dragon Run Biodiesel Project webpage:

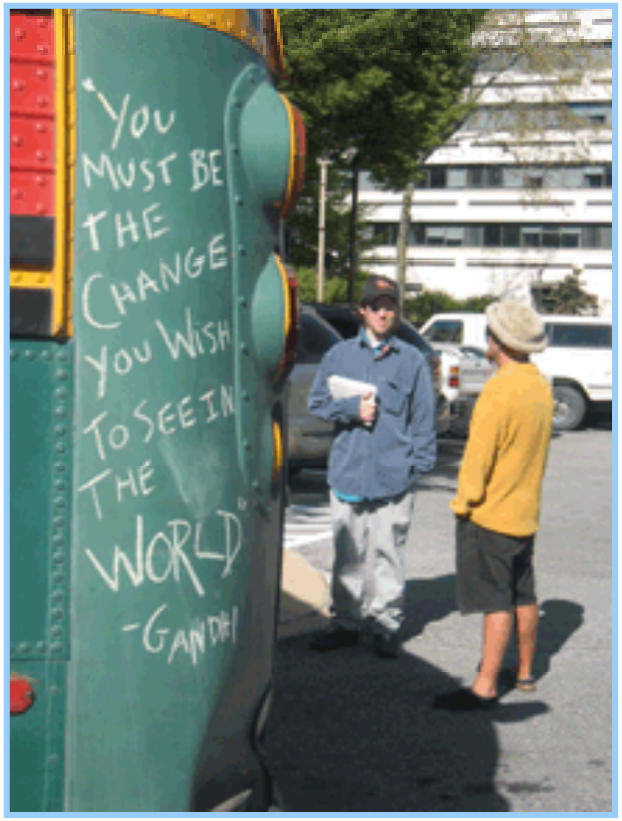
- Dragon Run SAMP
- Yellow Wood Study
- Biodiesel pre-feasibility study and concept development
- March 2007 feasibility study by HRCCC – "Biodiesel and Sustainable Economic Development in the Dragon Run Watershed"
- Biodiesel market metrics in Dragon Run – How large could it grow?
- Other HRCCC feasibility study (Appendix D in action plan ??? Huh, this is edu & marketing stuff)
- Elected Board Resolution encouraging biodiesel use and production
- Partnership agreement and action plan (includes 5 appendices: summary of CSBUSA project & timeline, summary of recommendations from March 2007 feasibility study, controlling costs by varying biodiesel blend, biodiesel education & marketing opportunities)
- CSBUSA workplan with budget
- This PowerPoint
- Biodiesel Quick Guides and other general biodiesel resources

U.S. Department of Energy
Energy Efficiency and Renewable Energy

Clean Cities

Clean Cities Virginia

Middle Peninsula Planning District Commission



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