

Green Infrastructure in Hampton Roads



July 2007

PEP07-10

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GREEN INFRASTRUCTURE IN HAMPTON ROADS

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ABSTRACT

Green infrastructure is a strategic approach to conservation planning that emphasizes interconnected networks of protected lands and intentional preservation of the broad range of ecological services provided by these lands and associated water bodies. This approach to conservation planning, when properly implemented, provides a highly cost-effective method of meeting multiple land use planning goals.

This report provides an overview of green infrastructure planning efforts underway in Hampton Roads and outlines a set of recommended future actions to move toward achievement of the benefits of this approach to regional open space planning. The Southern Watershed Area Management Program (SWAMP) was one of the first planning efforts in the State of Virginia to use a green infrastructure based approach to open space preservation, habitat protection and water quality protection. Building on the success of SWAMP, a similar analytic approach was applied to the remainder of the Hampton Roads Planning District to identify opportunities for a regional conservation network. This work lays the foundation for the development of a green infrastructure network for Hampton Roads. In addition to the description of the work underway in Hampton Roads, case studies that provide examples of the application of green infrastructure are included. Prince George's County, Maryland provides an excellent example of integration of green infrastructure planning with the development approval process. The Hampton Roads Joint Land Use Study and the Onslow Bight Conservation Forum are examples of the use of green infrastructure planning to deal with encroachment of development on military facilities. The Staten Island Bluebelt is an example of the integration of an open space network with stormwater management to achieve a highly cost effective solution. Finally, the Boston Emerald Necklace and the Minneapolis – St. Paul Municipal Park System provide two of the oldest examples of open space networks in the U.S.

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GREEN INFRASTRUCTURE IN HAMPTON ROADS

1.1 INTRODUCTION

Land use planning, at its best, is focused on providing healthy, high quality communities for the citizens of Hampton Roads. Well-planned communities are places where people want to live and where businesses want to locate. As scientific understanding of man's interaction with the environment has improved, the sophistication of land use planning has advanced significantly. Computer-based mapping tools and detailed satellite imagery combined with advances in landscape ecology have fostered the ability to plan open space networks that meet multiple land use planning objectives. These open space networks have the potential to save many high value natural attributes while simultaneously accommodating well-planned development. This approach to open space planning is known as "green infrastructure".

Green infrastructure is a strategic approach to conservation planning that emphasizes interconnected networks of protected lands and intentional preservation of the broad range of ecological services provided by these lands and associated water bodies. This approach to conservation planning, when properly implemented, provides a highly cost-effective method of meeting multiple land use planning goals. Green infrastructure can play an important role in the following areas:

- Meeting regulatory requirements: Hampton Roads communities face an increasingly stringent set of regulatory requirements for environmental management. In particular, improved management of non-point source water pollution will be required through several interlocking programs. Protection and enhancement of forested areas and wetlands, particularly within riparian corridors, can provide water quality protection and flood control services while reducing costs associated with design, implementation and long-term maintenance of engineered stormwater best management practices.
- Buffering Military Facilities from Encroachment: Encroachment of urban and suburban development on military facilities is an increasing concern in Hampton Roads. Green Infrastructure networks can be tailored to provide open space buffers around facilities that must be shielded due to safety, nuisance and security concerns.
- Provision of high quality communities: Quality communities are dependent on a reasonable balance of developed lands and areas that are maintained in a natural state. Citizen health and satisfaction are bolstered by protection of clean air, clean water and ample outdoor recreational opportunities. Quality communities are also business attractors, helping to ensure robust local economies.
- Support of Urban Growth Areas: Green Infrastructure is an excellent tool to support the identification and implementation of urban growth areas. Many communities are interested in concentrating new development in nodes to assist

in controlling service and infrastructure costs and protecting open space. Green Infrastructure provides a template for these decisions by differentiating lands suitable for development and those most suitable for preservation.

- Cost-effective solutions: Intact natural systems provide services that once removed must often be replaced at significant taxpayer expense. Environmental restoration efforts that attempt to repair damage after the fact are typically expensive and often only partly successful. Requiring the protection of green infrastructure when development takes place can reduce the extent and cost of engineered solutions that are required to minimize environmental impacts.
- Protection of significant natural resource base: Hampton Roads is home to several rare and unique habitat types. Protection of green infrastructure is a critically important facet of protecting these significant natural communities.
- Buffering and protection of working lands, minimization of nuisance situations: Fragmentation and encroachment by development are important factors in the loss of viable agricultural and silvicultural lands. Green infrastructure networks can both include and buffer working lands, helping to minimize fragmentation and nuisance situations.
- Opportunity for regional coordination on conservation planning: Green infrastructure networks provide a well reasoned template for regional planning efforts, particularly when analyzed in conjunction with traditional grey infrastructure systems such as transportation and utility networks.

The Conservation Fund defines green infrastructure as:

“...our Nation's natural life support system - an interconnected network of protected land and water that supports native species, maintains natural ecological processes, sustains air and water resources and contributes to the health and quality of life for America's communities and people”

Given the range of services provided by natural systems, it is entirely appropriate to think in terms of these systems as being “green infrastructure”. Just as traditional “grey infrastructure” systems are designed and financed to provide specific services, it is possible to preserve and restore natural systems to provide specific functions and benefits. Often times these functions and benefits are provided at relatively low cost by natural systems as compared to human built systems.

Green infrastructure is generally characterized as a “hub and spokes” network of protected lands. In this type of topography the hubs are protected land areas that encompass the highest quality and least fragmented ecological landscape attributes. The spokes are typically linear areas of protected lands that link the hubs together. This model provides important connectivity between habitat types that might otherwise become isolated “islands” in the landscape. In more urban environments, the opportunity for this type of structure may already be lost. In those situations, green

infrastructure can be biased more towards providing services and recreational opportunities for humans. In the urbanized sections of Hampton Roads, these opportunities include protection of smaller forested areas, creation of linear parks for multi-use trails and protection of riparian corridors for water quality protection and flood control.

1.2 REPORT CONTENT

This report provides an overview of green infrastructure planning efforts underway in Hampton Roads and outlines a set of recommended future actions to move toward achievement of the benefits of this approach to regional open space planning. The Southern Watershed Area Management Program (SWAMP) was one of the first planning efforts in the State of Virginia to use a green infrastructure based approach to open space preservation, habitat protection and water quality protection. Building on the success of SWAMP, a similar analytic approach was applied to the remainder of the Hampton Roads Planning District to identify opportunities for a regional conservation network. This work lays the foundation for the development of a green infrastructure network for Hampton Roads. In addition to the description of the work underway in Hampton Roads, case studies that provide examples of the application of green infrastructure are included. Prince George's County, Maryland provides an excellent example of integration of green infrastructure planning with the development approval process. The Hampton Roads Joint Land Use Study and the Onslow Bight Conservation Forum are examples of the use of green infrastructure planning to deal with encroachment of development on military facilities. The Staten Island Bluebelt is an example of the integration of an open space network with stormwater management to achieve a highly cost effective solution. Finally, the Boston Emerald Necklace and the Minneapolis – St. Paul Municipal Park System provide two of the oldest examples of open space networks in the U.S.

1.3 GREEN INFRASTRUCTURE INITIATIVES IN HAMPTON ROADS

The Southern Watershed Area Management Program (SWAMP) and the subsequent Hampton Road Conservation Corridor Study (HRCCS) both involved a green infrastructure based approach to conservation planning. The following sections provide a brief synopsis of those projects. Together these projects provide a foundation for green infrastructure based planning in Hampton Roads.

1.3.1 Southern Watershed Area Management Program

The Southern Watershed Area Management Program (SWAMP), developed by the cities of Chesapeake and Virginia Beach, in partnership with the Hampton Roads Planning District Commission and the Virginia Coastal Zone Management Program is intended to assist in the protection of natural resources, sensitive lands and water supplies in the headwaters of the Albemarle-Pamlico system. The project study area encompasses the watersheds of Back Bay, the Northwest River and the North Landing River in the cities of Chesapeake and Virginia Beach. The focus of the project has been the development and implementation of a collaborative watershed management program for the Southern Watershed Area. To this end a number of initiatives have

been pursued including the development of Strategic Plan for Agriculture, a Conservation Plan, analysis of the application of Conservation Design in the Southern Watershed and development of recommendations for a Rural Area Preservation Program.

1.3.1.1 The Conservation Corridor System

One of the major accomplishments of the Southern Watershed Area Management Program was the identification of a green infrastructure network in the Southern Watershed Area. During the time period when the network was under development the term “green infrastructure” was not yet in common use and the network was referred to as a “conservation corridor” system. The corridor system has proven to be a valuable planning tool for the cities of Chesapeake and Virginia Beach and the state and federal agencies working in the SWA. The corridor system has been utilized in comprehensive planning efforts, the creation of a Purchase of Development Rights program in Chesapeake, and is the target area for wetlands mitigation as outlined in the Multiple Benefits Conservation Program Memorandum of Agreement.

The Corridor System was developed through a partnership between the Virginia Department of Conservation and Recreation’s Natural Heritage program and the SWAMP Local Government Advisory Committee. A multiple benefits approach was used from the outset to identify a system that would contribute to water quality protection, natural resource protection and provide a framework for wetlands mitigation in the Southern Watershed Area. Figure 1 depicts both the corridor system and protected lands within and adjacent to the corridors. The system was designed to capitalize on the existing network of protected lands and highlight opportunities for connectivity. The corridor system provides a framework for the protection of the rich complement of Natural Heritage resources found in the Southern Watershed Area. A report developed by Natural Heritage entitled “Conservation Plan for the Southern Watershed Area” documents the natural resources of the SWA, the development of the corridor system and outlines a set of management recommendations.

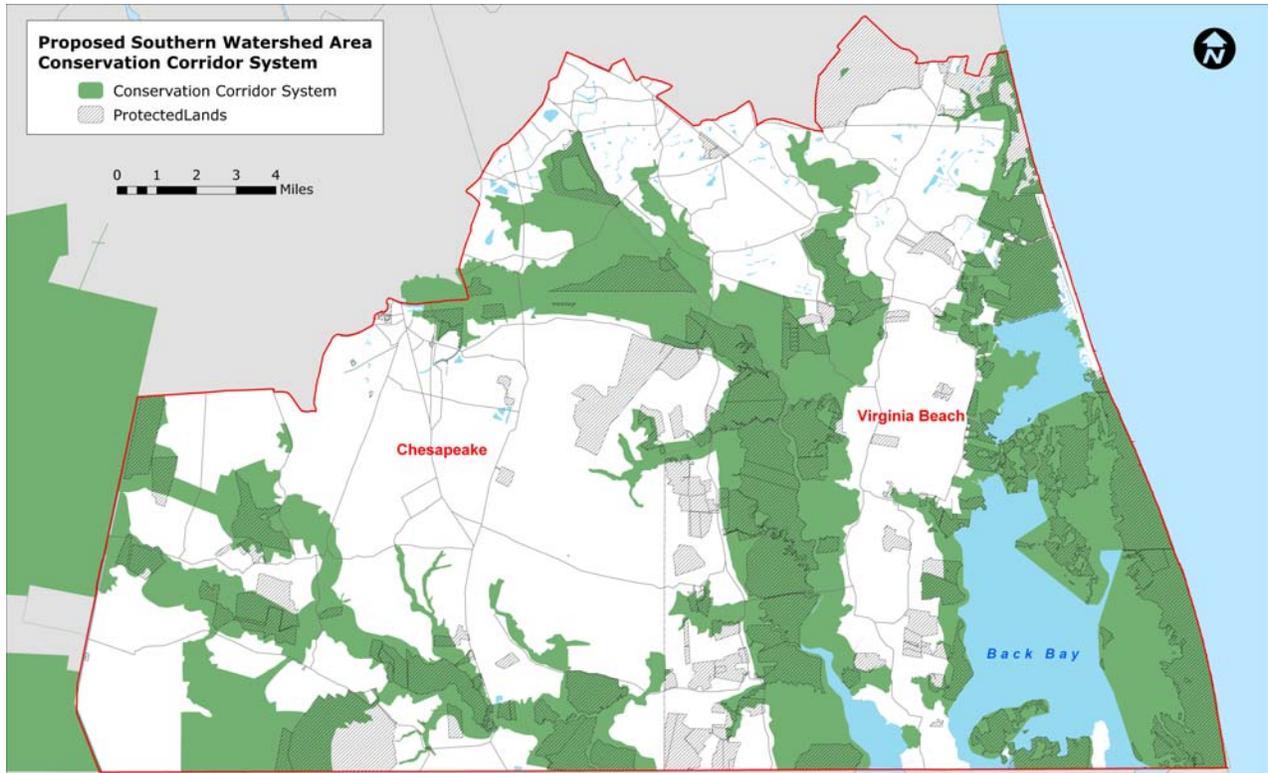


Figure 1: Southern Watershed Area Conservation Corridor System

1.3.1.2 The Multiple Benefits Conservation Plan Memorandum of Agreement

The Multiple Benefits Conservation Plan Memorandum of Agreement (MBCP MOA) was completed and signed by the Cities of Chesapeake and Virginia Beach, the HRPDC, the Virginia Departments of Conservation and Recreation, Environmental Quality, Game and Inland Fisheries, and Transportation, the Virginia Marine Resources Commission, the United States Army Corps of Engineers, Fish and Wildlife Service, Natural Resources Conservation Service and The Nature Conservancy in June of 2002.

The MOA is intended to encourage the achievement of multiple ecological benefits when sites are selected for wetlands restoration or preservation in the Southern Watershed Area. Benefits may include wetlands restoration and protection, water quality protection, wildlife habitat enhancement, storm water management, passive recreational opportunities and other benefits. The conservation corridor system depicted in Figure 1 is included in the MOA as the target search area for mitigation sites for wetlands impacts in the SWA. This approach provides a rational approach to organizing mitigation sites on the landscape to maximize their collective benefit.

Subsequent to the development of the MOA a set of guidelines for permit applicants in the Southern Watershed Area was developed to explain the Memorandum of Agreement. The guidelines explain the use of the conservation corridors in the selection of a multiple benefits mitigation site and provide information on the use of a watershed-based approach to wetlands mitigation.

1.3.2 Hampton Roads Conservation Corridor Study

The Hampton Roads Conservation Corridor Study is a valuable first step towards the establishment of a green infrastructure network for the entire Hampton Roads region. The HRCCS expands the identification of conservation corridors from the Southern Watershed Area to the remainder of the Planning District. The geographic information system analysis and the stakeholder involvement process employed in the development of the corridor study have resulted in the identification of priority areas for conservation and opportunities for linkage among those areas.

The HRPDC staff created a set of draft maps of the corridor system and then worked with various stakeholder groups to refine and enhance the maps. Natural resource professionals reviewed the maps and provided recommendations from a resource management perspective. Local government staff reviewed draft maps of the corridor system in an effort to maximize the utility of the network and to minimize conflict with each locality's future land use plans. The draft maps were edited and finalized based on the stakeholder input.

1.3.2.1 Focus on Riparian Areas

A primary goal of the analytic process was the use of GIS techniques and stakeholder input to identify areas that contribute to the protection of critical habitat and water quality when conserved or restored. The analytic process also included the identification of opportunities for connectivity between the proposed conservation areas. In Hampton Roads, these high value areas are often in and adjacent to riparian corridors. Riparian areas can be defined as the transitional areas between terrestrial and aquatic ecosystems. Riparian areas exist adjacent to streams, lakes, estuarine and marine shorelines. These areas provide opportunities for the achievement of multiple ecological benefits due to their inherently high biodiversity, prevalence of wetlands, and potential for water quality protection. In addition to the intrinsic habitat and water quality protection value, riparian areas are a focus of the HRCCS due to the opportunities they provide for creation of a linked corridor system. Urban development patterns, particularly in the older central city areas, have fragmented habitat to the extent that the riparian areas provide the best remaining opportunity for restoration of a linked corridor system.

1.3.2.2 Initial Model Development

One of the challenges of choosing the data layers to include in the HRCCS model was finding data that both encompassed the entire Hampton Roads region and was consistent in quality and scale across jurisdictional boundaries. Only four datasets met these criteria and were ultimately chosen for use in the modeling effort. The datasets selected were the National Wetlands Inventory (NWI), the National Land Cover Dataset (NLDC), the Virginia Conservation Lands Needs Assessment (VCLNA) Dataset and a riparian corridor layer developed specifically for this project. Other datasets of interest, such as flood zones and soils were not available digitally for the entire Hampton Roads Planning District at the time of the project.

A weighted overlay analysis in GIS was used to create the initial version of the corridor system for Hampton Roads. Weighted overlay analysis is a standard technique used with raster GIS data for determining the suitability of the landscape to meet the stated criteria. For this project, the VCLNA cores, NWI, NLCD, and riparian corridors were incorporated into the model to produce one final suitability dataset. The two major steps in the weighted overlay analysis process are ranking and weighting the data layers.

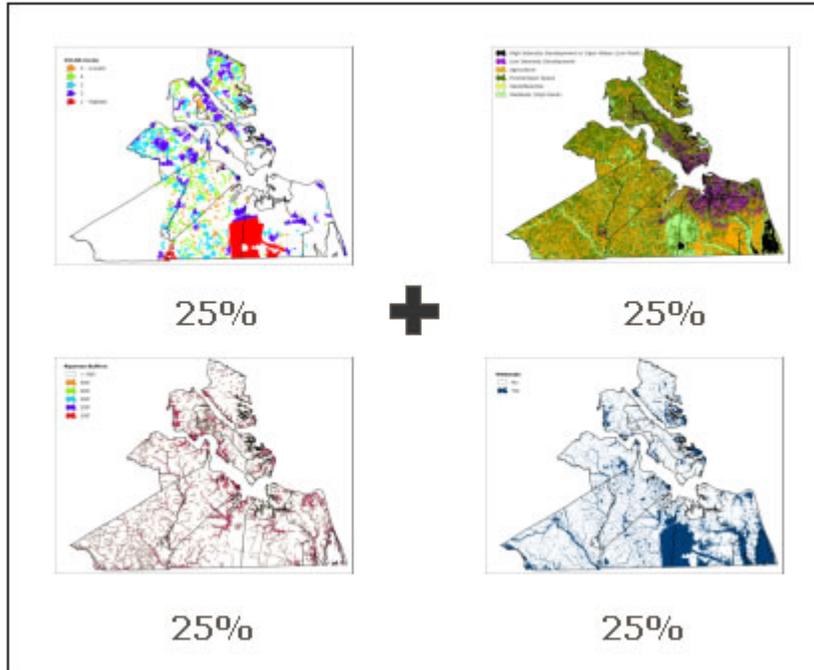


Figure 2: The four data layers used to generate the first version of the corridor map

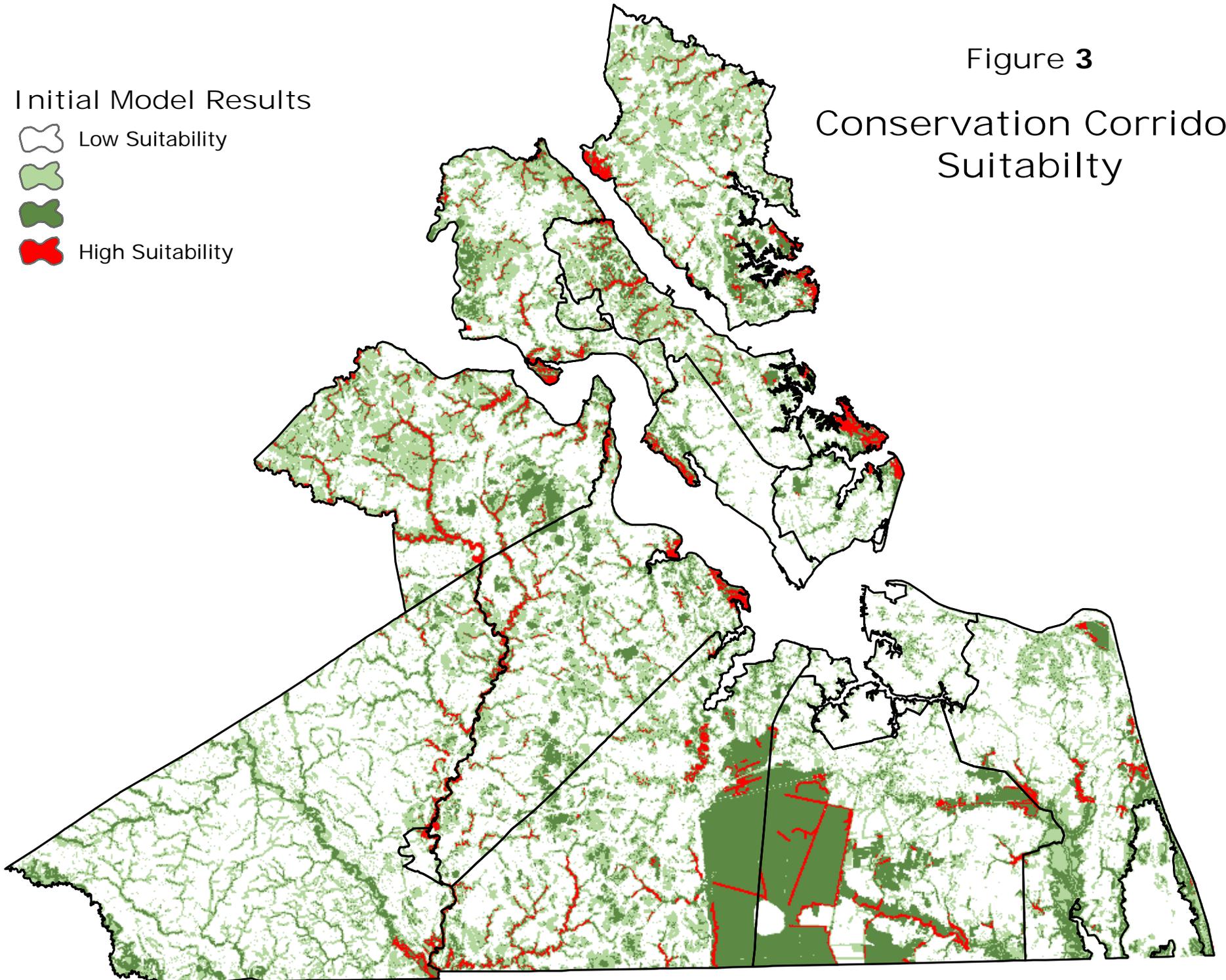
Figure 3 on the following page is the first version of the regional conservation corridor map. Areas of greatest suitability for inclusion in the corridor network are shown in the darker shade of green and in red.

Figure 3

Conservation Corridor Suitability

Initial Model Results

- Low Suitability
- Medium Suitability
- High Suitability



1.3.2.3 Stakeholder Involvement and Model Refinement

Multiple opportunities were provided for stakeholder review and comment as the conservation corridor system was developed. The HRPDC Joint Environmental Committee process was used throughout the project as a sounding board. A meeting with conservation specialists was used as a means of prioritizing data layers. Meetings with locality representatives provided an opportunity to discuss land use planning issues. Draft maps were circulated to the parks and recreation departments and planning departments of the region's localities for review and comment. The analytic process was refined and the draft maps edited based on the stakeholder input. The following sections provide additional detail on the stakeholder involvement process.

1.3.2.3.1 Natural Resource Agency Meeting

The Natural Resource Agency meeting held on September 19, 2005 provided an opportunity for professionals in the field of natural resource conservation to review and comment on the results of the GIS analysis from the initial model development. Representatives from the HRPDC, the Virginia Department of Conservation and Recreation, the Virginia Department of Transportation, the Virginia Department of Game and Inland Fisheries (VDGIF), the Virginia Institute of Marine Science (VIMS), the Virginia Dare Soil and Water Conservation District, the Virginia Beach Department of Agriculture and the Natural Resource Conservation Service (NRCS) participated in the meeting. The meeting included an overview of the project, general group discussion of the Corridor plan, a survey process to assist in ranking potential conservation areas and a wrap-up discussion. The survey process involved the Analytical Hierarchy Process (AHP), a quantitative method for ranking decision alternatives by developing a numerical score to rank each alternative. The score is based on how well each alternative meets the decision makers' criteria. The AHP method is used to gain consensus on how to weigh individual data layers against each other for the suitability analysis. The natural resources stakeholder group participated in an AHP exercise to rank the relative importance of various landscape attributes in protecting critical habitat and water quality. This information was used to further refine the corridor system to meet these natural resource management goals.

1.3.2.3.2 Local Government Staff Meetings

Two meetings with local government staff provided an opportunity for planning professionals to examine draft maps of the corridor system and provide input based on future land use plans of the local governments. A meeting for the Southside Hampton Roads localities was held on September 26, 2005 and a meeting for Peninsula localities was held on September 29, 2005. Topics discussed at the meetings included possible conflicts between the draft corridor system and future land use plans, opportunities for linkage of the corridor system across locality boundaries and possible linkage of the corridor system with existing or planned parks and open space features.

Based on this input several modifications were made to the Peninsula maps to highlight opportunities for linkages among the Peninsula localities. The Southside maps were edited to reflect new existing conservation areas. There was also a discussion about the future greenways planned in the City of Virginia Beach.

1.3.2.3.3 Joint Environmental Committee Meetings

The Hampton Roads Joint Environmental Committee process was used extensively for review and discussion of the conservation corridor system. A series of presentations was made to the committee on various facets of the corridor system and the methodology used to create it. The Joint Environmental Committee meets monthly and is comprised of representatives of local, state and federal agencies working on a broad range of regulatory and environmental programs in Hampton Roads

In preparation for the HRCCS a series of presentations to the Joint Environmental Committee was used to provide the group with background on other projects in Virginia that help to inform a green infrastructure for Hampton Roads. Presentations included the Virginia Conservation Lands Needs Assessment (VCLNA), the Virginia Comprehensive Wildlife Conservation Strategy, Blue Infrastructure mapping efforts and the Interactive Stream Assessment Resource (INSTAR). These presentations helped to provide a framework for subsequent discussions of the evolving HRCCS.

1.3.2.3.4 Other Opportunities for Review and Comment

The draft HRCCS maps and associated materials were distributed to the Parks and Recreation Departments and the Planning Directors of all of the Hampton Roads localities for review and comment. Based on this final round of reviews, additional modifications were made to the corridor system in the City of Chesapeake.

1.3.2.4 Development of the Opportunities for Connectivity Overlay

Once the modeling effort was complete an additional overlay for the final map was developed. The Opportunities for Connectivity data layer highlights areas where there are opportunities to create a linked network of green infrastructure (both protected and unprotected spaces) in Hampton Roads. Since the corridor system is primarily riparian-based, most of the suitable conservation areas are connected via streams. The boundaries of this corridor layer are generalized and should be interpreted at a regional scale only – not at a neighborhood level. This map is intended as a tool to aid the regional planning process and does not necessarily reflect the actual future land use plans of individual Hampton Roads localities.

Figure 4 The Hampton Roads Conservation Corridor Study

Legend

 Opportunities for Connectivity

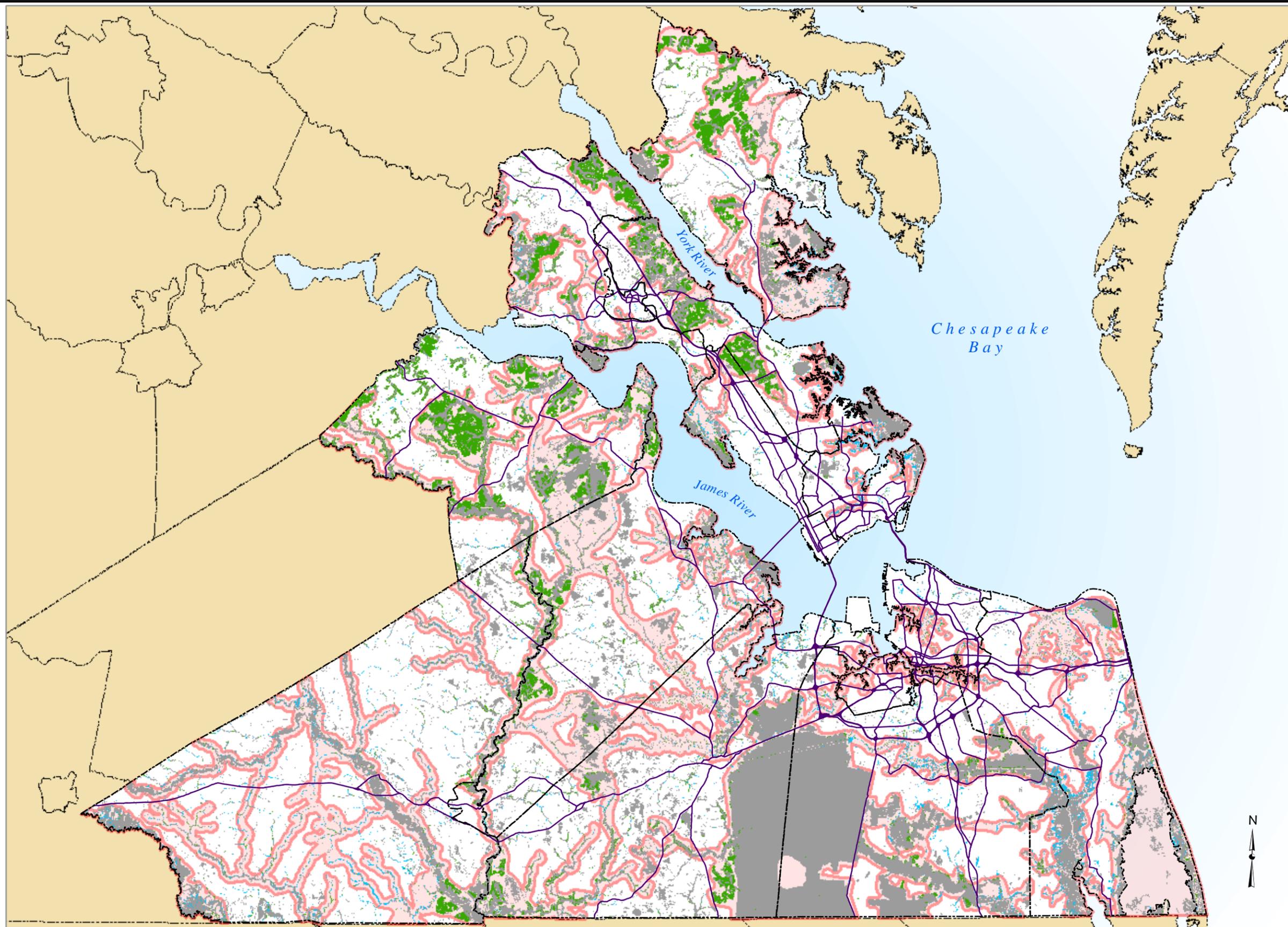
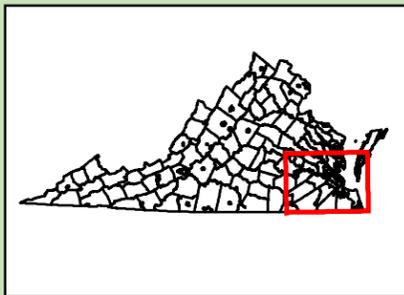
Suitability for Conservation

 Low suitability

 High suitability - WATER QUALITY

 High suitability - HABITAT

 High suitability - BOTH



Notes:

The Suitability for Conservation information identifies areas that are potentially most suitable for protection based on a wildlife habitat or water quality protection perspective. The suitability information was derived through weighted overlay analysis in GIS using the following data sources: National Land Cover Dataset, National Wetlands Inventory, riparian corridors, and the Virginia Land Conservation Needs Assessment habitat cores. The map was refined based on the input from natural resource experts in the Hampton Roads region.

The Opportunities for Connectivity information highlights areas where there are opportunities to create a linked network of green infrastructure in Hampton Roads. Protected and unprotected greenspaces can be linked to each other, as well as to existing recreational areas.

This map is intended as a tool to aid the regional planning process and does not necessarily reflect the actual future land use plans of individual Hampton Roads localities.



May 2006



1.3.2.5 Application of the Corridor System

The corridor system could be applied to meet a broad range of planning and environmental goals in the Hampton Roads region. The following sections provide an overview of possible application areas.

1.3.2.5.1 Regulatory Compliance

The corridor system could also be used as a component of compliance with a range of regulatory programs. In the Southern Watershed Area, a Memorandum of Agreement was developed among the local, state and federal agencies involved in wetlands regulation to use the corridor system as a tool in selecting sites for off-site compensation for wetlands impacts. This type of program could either be developed for other sub-areas in Hampton Roads or be expanded to a region-wide program. In addition, compliance with regulatory programs related to water quality protection such as the NPDES stormwater program and Total Maximum Daily Load (TMDL) requirements may be aided by the inclusion of a green infrastructure component. Two of the critical factors in managing non-point source pollution and municipal stormwater are the quantity and placement of impervious surface areas in a watershed. The HRCCS identifies important riparian corridor areas that if protected or reforested, address to some extent both of these concerns. Clearly the protection and enhancement of lands within the HRCCS will be, in most cases, only a subset of the efforts needed to meet TMDL goals. Floodplain management and flood hazard mitigation efforts will also benefit from the proper management of riparian corridors and other shoreline areas.

1.3.2.5.2 Conservation Goals

The HRCCS has the potential to be a valuable component of regional and local natural resource conservation programs. As discussed previously many of the areas identified in the corridor system have high intrinsic value for protecting critical habitat and water quality. The corridor system is rich in wetlands and forested areas and many opportunities are identified to protect or establish linkages between wetland and upland areas. Undeveloped riparian corridor areas in Hampton Roads are rich in biodiversity and have the potential if properly managed to provide both important habitat and help to manage non-point source water pollution. Maintenance of existing forested riparian buffers will help to filter stormwater runoff and can provide uptake of critically important nutrients, such as nitrogen and phosphorus. In addition, these forested areas help slow the transport of sediments and other particulate matter into receiving waters.

1.3.2.5.3 Parks, Recreation and Open Space Goals

Linkage of parks, trails and other recreation areas to the corridor network has the potential to buffer critical habitat areas from encroachment by new development. In addition, these areas can contribute to the management of non-point source water

pollution if impervious surface areas are kept to a minimum. Similarly the protection of agricultural areas adjacent to the corridor system can provide buffering of important habitat areas. Maintaining low intensity land uses adjacent to the corridor system will minimize the encroachment of new development on important habitat areas. The potential also exists to use the corridor system as a buffer between incompatible land uses such as agriculture and rural residential development. Finally the corridor system could be used as an organizational paradigm for a purchase of development rights program.

1.3.2.5.4 Other Planning Goals

Finally, a broad range of other planning programs may benefit from the inclusion of a green infrastructure component. When used in conjunction with other planning tools, green Infrastructure can assist in limiting encroachment of new development on military bases, support of urban growth areas, control of infrastructure and service provision cost and protection of drinking water supplies. To meet these diverse goals, green infrastructure can be used both as a tool to buffer critical resources and as an element of a future land use plan to differentiate between those areas identified for future development and those areas identified for conservation. In the case of control of infrastructure and service provision costs, green infrastructure could be used as an element of a growth management plan to concentrate new development in specific areas, thereby limiting the length of water and sewer pipes and the size of service provision areas for police and fire. In the case of protection of drinking water supplies, green infrastructure can be used to buffer the shorelines of reservoirs and water supply rivers. In the Southern Watershed the conservation corridor system has been used to identify areas that if protected from development would both limit encroachment on Naval Air Station Oceana and NALF Fentress and contribute to the integrity of the corridor system.

1.3.3 Green Infrastructure Workshops

The Hampton Roads Planning District Commission organized and hosted two workshops on green infrastructure topics in 2006. The workshops were intended to:

- Provide a forum for discussion of green infrastructure topics among professionals involved in the field,
- Provide an opportunity for education and involvement of local, regional and state agency staff involved in land use planning and natural resource management,
- Provide an opportunity for education and involvement of a broader stakeholder community including private non-profit groups and citizens, and
- Foster discussion on the future of green infrastructure in Hampton Roads.

The first workshop, held on May 25, 2006, focused on the broad range of green infrastructure projects underway in the mid-Atlantic region. Speakers from agencies working on green infrastructure projects at the local, regional, state and multi-state scales were invited to present information on their projects. The following is a brief synopsis of the presentations:

- Mr. Eric Walberg of the HRPDC provided a brief overview of the concept of green infrastructure,
- Mr. John Wolf of the National Park Service provided an overview of the Chesapeake Bay Program's Resource Lands Assessment project,
- Mr. Clay Bernick and Ms. Sandra Erdle presented information on the Southern Watershed Area Management Program (SWAMP),
- Mr. Eric Walberg and Ms. Sara Kidd presented information on the Hampton Roads Conservation Corridor Study (HRCCS)
- Mr. Wink Hastings of the National Park Service presented an overview and lessons learned from several GI efforts in the northern Chesapeake Bay watershed,
- State agency staff provided information on several green infrastructure efforts underway in Virginia:
 - Mr. Sam Hall, Virginia Department of Game and Inland Fisheries: Virginia Wildlife Action Plan
 - Mr. Joe Webber, Virginia Department of Conservation and Recreation: Virginia Conservation Lands Needs Assessment (VCLNA) expansion
 - Mr. John Davy, Virginia Department of Conservation and Recreation: Virginia Outdoors Plan
 - Ms. Joan Salvati, Virginia Department of Conservation and Recreation: Chesapeake Bay Preservation Act
 - Mr. Scott Lerberg, Virginia Coastal Zone Management Program: Coastal Geospatial and Educational Mapping System (GEMS)
- The workshop was closed with a panel discussion of state level efforts.

Response to the workshop was positive with many participants stating that they had benefited from the experience. It was obvious given the broad range of GI efforts underway that Virginia has reached an important juncture in this approach to conservation planning. As these efforts evolve it will be important to continue the discussion among local, regional, state and federal agencies involved in GI research, program development and implementation efforts.

The second workshop, held on September 14, 2006, focused on funding and implementation issues associated with green infrastructure. The second workshop was structured as follows:

- Mr. Eric Walberg with the HRPDC provided an overview of Green Infrastructure concepts and a description of the Hampton Roads Conservation Corridor Study.
- Mr. Dan Nees, Director of the University of Maryland Environmental Finance Center discussed several topics including the definition of green infrastructure, the role and structure of the financing process, the use of green infrastructure as a financing structure and characteristics of a successful financing strategy.
- Mr. David Carter with the Trust for Public Land presented information on the approach that TPL takes in advancing open space protection. A synopsis of land conservation ballot measures nationally and in Virginia highlighted the large number of successes for the period 1998 – 2005.
- Ms. Caren Schumacher with the Williamsburg Land Conservancy provided a detailed description of the organization and work of the Williamsburg Land Conservancy. The Conservancy currently protects 2,700 acres in the Historic Triangle Area.
- Ms. Tyla Matteson of the Hampton Land Conservancy provided a description of the start-up of the Hampton Land Conservancy.
- Ms. Emily Clifton of the Maryland National Capital Parks and Planning Commission presented an overview of the development of a Green Infrastructure Plan for Prince George's County in Maryland. The plan was developed with extensive community involvement and reflects the development goals of the County. The Plan has been integrated into the development approval process.
- Ms. Barbara Bodenstein with the Elizabeth River Project focused on restoration plans for Paradise Creek. The cornerstone of this work is the development of the Paradise Creek Nature Park.
- Mr. Gene Crabtree with the Natural Resources Conservation Service discussed a broad range of cost-share programs available to private landowners to support the restoration of wetlands and riparian buffers.
- Closing Discussion: A range of options for moving forward with the implementation of a green infrastructure network in Hampton Roads was discussed. Possible future actions include:
 - A follow-on meeting to continue the discussion of green infrastructure implementation in Hampton Roads,

- Use of the regional green infrastructure plan as a framework to obtain funding from Governor's open space initiative,
- Development of partnerships among various stakeholder groups to foster implementation of a regional open space network.

The two workshops provided a valuable educational experience and opportunities for information exchange among local government staff, state and federal agency staff and representatives from private non-profit agencies. In addition, the workshops helped to frame regional discussions on the role and implementation of green infrastructure in Hampton Roads and generated a great deal of enthusiasm for this approach to open space planning.

1.3.3.1 Important Themes that Emerged from the Workshops

Several important themes emerged from the workshops including the need for continued coordination among various levels of government working on different aspects of green infrastructure, the value of developing a long term financing strategy for green infrastructure implementation and the value of capitalizing on opportunities for the integration of green infrastructure implementation with the development approval process. These themes will help to inform future work both within Hampton Roads and at the state and multi-state levels.

Workshop One

Coordination and integration of the various state agency green infrastructure projects is critically important if the maximum benefit is to be derived from these efforts. One of the most promising aspects of green infrastructure is opportunity to use it as an organizational framework for open space planning, insuring the development of an open space network that achieves multiple benefits and is sustainable. These goals can only be realized through careful planning and integration of the various projects that are underway. Work currently underway at the state level includes the following:

- Virginia Department of Conservation and Recreation's Natural Heritage Program: The Virginia Conservation Lands Needs Assessment contains several different models including the Virginia Natural Landscape Assessment Model, a Cultural Model, a Vulnerability Model, a Forest Economics Model, an Agricultural Model, a Recreation Model and a Water Quality Model. These efforts are resulting in the development of several key elements of a statewide green infrastructure network for Virginia.
- Virginia Department of Conservation and Recreation's Outdoor Recreation Planning Program: The 2007 Virginia Outdoors Plan contains a chapter on green infrastructure. The chapter provides an overview of green infrastructure and a set of recommended actions including:
 - Revising the Code of Virginia to include green infrastructure planning objectives,

- Inclusion of green infrastructure in local comprehensive plans,
 - Establishment of a statewide task force to promote green infrastructure planning,
 - Regional and local governmental agencies should adopt and implement green infrastructure plans.
- Virginia Department of Game and Inland Fisheries: The Virginia Wildlife Action Plan, which includes analysis of problems facing species and habitats and recommendations to address the problems, provides a significant layer of information for inclusion in a statewide green infrastructure plan. In addition the Bird Conservation Program and Watchable Wildlife Program contribute important elements to a statewide green infrastructure network.
 - Virginia Coastal Zone Management Program: The Coastal GEMS system includes information on a variety of topics including “Blue Infrastructure” elements such as oyster reef location and fish sanctuaries.

A reasonable next step in the state level process is the development of a unified Green Infrastructure Plan for Virginia. The task force identified in the Open Space Plan recommendations could serve as a steering committee for this effort.

Integration of Multi-state, state, regional and local efforts is also important: The value of open space networks can be maximized through careful integration of analysis and planning taking place at different geographic scales. Continued communication and sharing of information among the Resource Lands Assessment at the Chesapeake Bay watershed level, the various Virginia state agency efforts and the Hampton Roads Conservation Corridor Study at the regional level will be needed to derive maximum benefit from these efforts. Hampton Roads is well positioned for that integration through the regional conservation corridor work.

Workshop Two

Key points from Workshop Two include the following:

- Development of a long-term finance plan for green infrastructure implementation is needed to maximize the cost savings available through green infrastructure planning.
 - Dan Nees focused on the notion of using green infrastructure as a financing structure.
 - He emphasized the difference between funding and financing. He defined funding as acquiring fiscal resources and financing as a discipline concerned with determining value and making decisions, an allocation process that includes acquiring, investing and managing fiscal resources. He identified the goal of financing as increasing return on investment.

- He presented three financing truths:
 - It is cheaper to protect than restore,
 - Taking action today is cheaper than taking action tomorrow,
 - Natural resource protection and restoration cannot be funded through grants.
- Return on investment in the public sector is improved through the reduction of costs.
- Integration of GI planning with the development approval process is a critically important element of implementation in a constrained fiscal environment.
 - Ms. Emily Clifton of the Maryland-National Capital Parks and Planning District Commission presented an overview of the Prince George's County, Maryland Green Infrastructure Plan. This is a powerful planning tool due to its integration with the County's General Plan and linkage with the development approval process.

Workshop Two provided many useful examples of elements that could be used to enhance green infrastructure implementation in Hampton Roads. The financing approach presented by Dan Nees addresses the need to maximize return on investment in protecting open space networks and the services that they provide. The Prince George's County example presented by Emily Clifton demonstrates the efficacy of integrating green infrastructure plan implementation with the development approval process. These two methods have the potential to advance the implementation of a green infrastructure in Hampton Roads.

1.4 RECOMMENDED FUTURE ACTIONS

The Southern Watershed Area Management Program, the Hampton Roads Conservation Corridor Study and the associated green infrastructure workshops provide the basis for future work on the development and implementation of a green infrastructure network in Hampton Roads. The green infrastructure workshops served as a forum for the discussion of existing initiatives and possible future directions in Hampton Roads. Following the workshops HRPDC staff has continued to work with local government staff through the Joint Environmental Committee and the Strategic Planning Committee. Based on those conversations the following implementation actions that have been identified as priorities:

- Development of a white paper on the integration of green infrastructure with the development approval process: This effort will involve analysis of the Prince George's County, Maryland Green Infrastructure Plan and associated ordinances. Prince George's County requires the dedication of open space that contributes to the County's green infrastructure network when land is subdivided. Opportunities to implement a similar program in Virginia will be identified.

- A workshop on the use of green infrastructure to buffer military facilities in Hampton Roads from encroachment by new development: The workshop will have a regional focus and will involve stakeholders from the military, local government, state government and other constituencies as needed. Examples of the application of this approach to dealing with encroachment in North Carolina and Florida will be used to spark discussion.
- Examination of the integration of green infrastructure with stormwater management through case studies from other communities will be collected and analyzed to provide examples of this evolving approach to stormwater management and the potential benefits of its application in Hampton Roads.

1.4.1 Development of a white paper on the integration of green infrastructure with the development approval process

Many communities in Hampton Roads require some form of open space protection when land is developed. This effort would involve the examination of opportunities for integration of requirements for green infrastructure protection when land is subdivided and/or developed. Such an approach would involve the adoption of a green infrastructure plan at the local level and integration of the plan with the development approval process. This approach has the advantage of guiding the dedication of open space so that the result is an integrated network of protected lands rather than a fragmented set of small areas of open space. The integrated network could include lands that contribute multiple benefits including opportunities for recreation, habitat protection, water quality protection and stormwater management. Comprehensive plans, future land use plans, zoning ordinances, subdivision ordinances and other elements of local government land use planning and regulation are critically important in determining the future land use patterns in Hampton Roads. The extent to which a regional green infrastructure network is implemented is therefore highly dependent on the extent to which it is a component of the local government planning process.

The following Prince George's County example demonstrates the effectiveness of linking green infrastructure planning with the development approval process.

CASE STUDY ONE: PRINCE GEORGE'S COUNTY, MARYLAND COUNTYWIDE GREEN INFRASTRUCTURE PROGRAM

Prince George's County in Maryland has one of the most comprehensive local green infrastructure programs in the United States. The goal for the program is to "Preserve, enhance, and/or restore an interconnected network of countywide significant environmental features that retain ecological functions, maintain or improve water quality and habitat, and support the desired development pattern of the General Plan." The Prince George's County Green Infrastructure Plan contains a countywide map of the green infrastructure network and chapters on the network, objectives and policies

and implementation strategies. The Green Infrastructure Plan is designed to integrate tightly with the County's General Plan and support the development patterns outlined in the General Plan. Protected lands are added to the network by a variety of means including land purchase, requirements for dedication of green infrastructure elements when land is developed, location of off-site mitigation for environmental impacts within the network and encouragement of voluntary conservation.

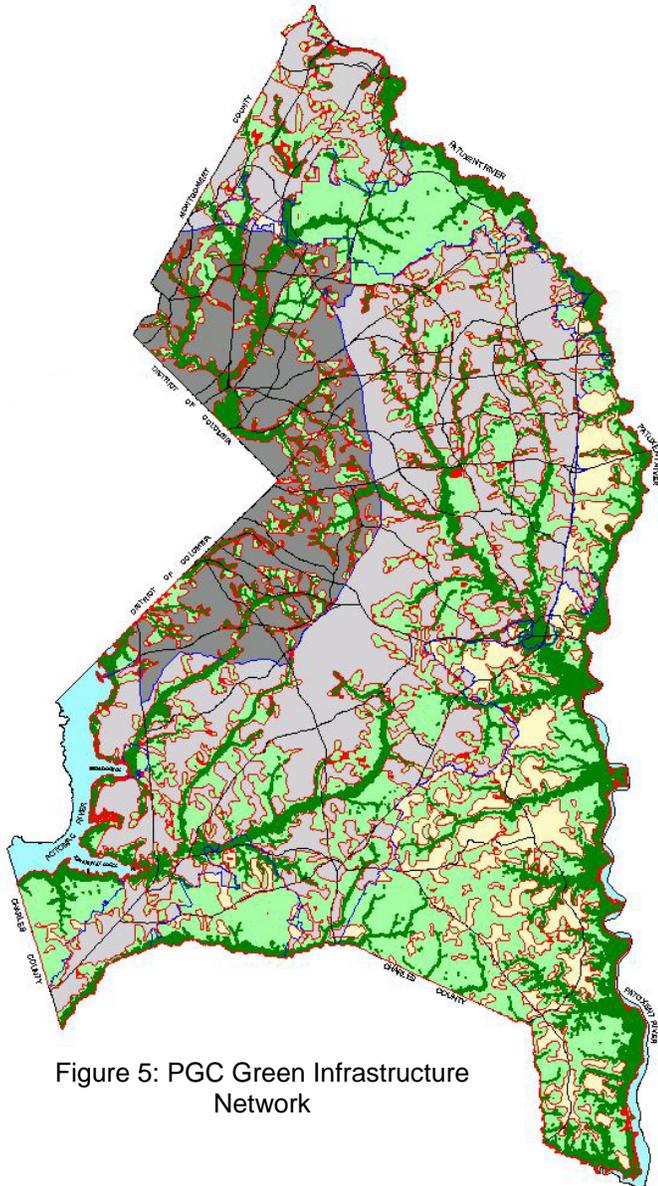


Figure 5: PGC Green Infrastructure Network

The Prince George's County Green Infrastructure Plan was developed through an extensive stakeholder process. The statewide Maryland Greenprint Program was used as a starting point for the process. A set of local objectives for the Green Infrastructure Plan was established for use in adapting the state level work to meet local needs. Of primary importance in the Plan is the improvement of water quality through the protection and enhancement of the green infrastructure network. Water quality objectives articulated in the Plan include improvement of the water quality in each major watershed to elevate the Benthic Index of Biological Integrity rating of the watershed by at least one category and improvement of the stream habitat in each major watershed to elevate the habitat rating of the watershed by at least one category.

The development review process plays an important role in implementing the green infrastructure plan. When land is subdivided the process must accommodate the green infrastructure network. County staff works with applicants through the development

review process to insure that required open space dedication supports the green infrastructure network.

This approach is much more effective than open space requirements that are not tied to an overarching plan. Often times open space requirements result in protection of “left over” land that has no particular conservation value. The process followed in Prince George’s County insures that each individual development project contributes to the integrity of the green infrastructure network. The following site plans illustrate this process. The first plan includes some open space that corresponds to the green infrastructure network, but other areas within the network are shown with roads and lots.



Figure 6: Site Plan Prior to Review

The second illustration shows the result of the development review process. The site plan has been reworked to provide a contiguous open space area that links to the green infrastructure network.



Figure 7: Site Plan After Review

The process of mitigation for environmental impacts is also used as an opportunity to protect and restore elements within the green infrastructure network. When off-site mitigation is required for forest impacts 100% of the mitigation occurs within the green infrastructure network. When off-site mitigation for wetland and stream impacts is required 100% of the mitigation projects will be targeted to areas identified in the countywide catalog of mitigation sites. The catalog of mitigation sites is to be developed subsequent to the Green Infrastructure Plan and will be designed to support the network.

1.4.2 Workshop on the use of green infrastructure to buffer military facilities in Hampton Roads from encroachment by new development

As the population of Hampton Roads continues to grow and new residential and commercial development expands, it is becoming increasingly difficult to avoid encroachment of development on established military facilities. This encroachment can lead to a variety of problems ranging from nuisance situations to safety concerns. Use of protected green space is one element of creating and maintaining land use patterns that both protect the ability of the military facilities to function and support a high quality of life for surrounding citizens.

The focus of the workshop will be identification of areas where overlap exists between the conservation corridor network and areas that the military would like to buffer from new development. This analysis will result in the identification of a subset of the corridor system that meets both conservation and encroachment prevention goals.

The following case studies of the Hampton Roads Joint Land Use Study (JLUS) and the Onslow Bight Conservation Forum illustrate the potential benefits of this type of planning effort.

CASE STUDY TWO: HAMPTON ROADS JOINT LAND USE STUDY

The cities of Chesapeake, Norfolk and Virginia Beach and the U.S. Navy partnered in a process facilitated by the Hampton Roads Planning District Commission to conduct the Hampton Roads Joint Land Use Study (JLUS). The study focused on encroachment issues associated with three airfields, NAS Oceana, NALF Fentress and Chambers Field. The study resulted in a set of recommended actions to address encroachment by new development.

One category of recommended actions involves purchase of lands surrounding Oceana and Fentress to buffer the facilities. The JLUS references the conservation corridor system developed through the Southern Watershed Area Management Program (SWAMP) as a tool for the identification of lands that if protected provide both the needed buffering and contribute to the vitality of natural resources in the area. The corridor system identifies lands that have the potential to provide multiple benefits including habitat protection, water quality protection and flood hazard mitigation. The conservation corridor system includes significant land area adjacent to the airfields. The Conservation Areas map on the following page depicts the corridor system and several categories of protected lands. Protection of the remaining lands in this section of the corridor system will both enhance the connectivity of the corridor system and benefit the military facilities. Several parties involved in the process, including the Navy, the Cities of Chesapeake and Virginia Beach and the HRPDC are currently attempting to obtain funding for protection of the identified lands.

CASE STUDY THREE: ONSLOW BIGHT CONSERVATION FORUM

The North Carolina Onslow Bight Conservation Forum (NCOBCF) was initiated in 2001 by Marine Corps Base Camp Lejeune and the Nature Conservancy in response to encroachment of development on the military base and habitat loss. Camp Lejeune and the surrounding Onslow Bight are located in the southeastern coastal plain of North Carolina. Camp Lejeune encompasses approximately 153,000 acres and is home to eight federally-listed threatened and endangered species. The Onslow Bight extends from Cape Lookout to Cape Fear, North Carolina. The landscape of Onslow Bight includes extensive saltwater marshes, wetlands and longleaf pine savannahs.

The Forum includes representatives from diverse set of stakeholders including:

- North Carolina Department of Environment and Natural Resources
- The Nature Conservancy
- U.S. Fish and Wildlife Service
- North Carolina Coastal Federation
- National Resources Conservation Service
- MCB Camp Lejeune
- MCAS Cherry Point
- Endangered Species Coalition
- North Carolina Wildlife Resources Commission
- North Carolina Coastal Land Trust
- North Carolina Department of Transportation

The mission statement for the Forum is as follows:

To provide for open discussion among the participants concerning the long-term conservation and enhancement of biological diversity and ecosystem sustainability throughout the Onslow Bight landscape compatible with the land use, conservation and management objectives of the participating organizations and agencies.

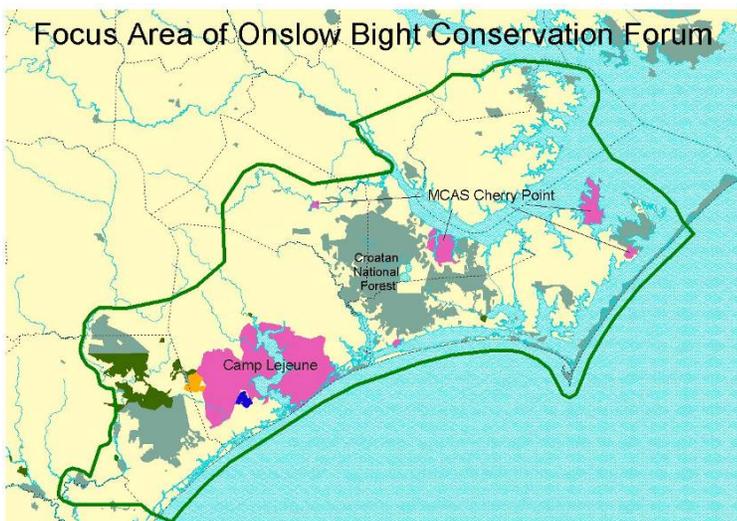


Figure 9: Onslow Bight Focus Area

The working relationship of the members of the Forum was formalized through the development of a Memorandum of Understanding between the parties. The Forum meets on a regular basis. The major initial accomplishment of the Forum was the purchase of 2,500 acres of land adjacent to Camp Lejeune's training ranges in October of 2002. This area was slated for residential development, a prospect that would have both exacerbated the encroachment problem and resulted the loss of a critical habitat

area. Subsequent to that effort the Forum has gone on to leverage approximately \$34 million in funding, protect over 37,000 acres of habitat and restored and conserved almost 6,000 acres.

A subcommittee of the Forum, titled the Onslow Bight Conservation Design Committee, is currently in the process of developing a Conservation Design Plan for Onslow Bight. The draft version of the Plan outlines the creation of a green infrastructure network for the region. The Plan will identify core areas, corridors and buffer areas. Implementation of the Plan will be coordinated with land use planning process at the state, regional and local levels. The Joint Land Use Study involving Onslow County and Camp Lejeune is cited as a model for this coordination.

1.4.3 Research on the Integration of Stormwater Management and Green Infrastructure

Increasingly stringent requirements for management of nonpoint source water pollution are placing financial burdens on Hampton Roads localities. One potentially cost effective approach involves the inclusion of green infrastructure elements in an overarching stormwater management program. Green infrastructure elements often have the advantage of lower initial cost and lower maintenance costs as compared to engineered solutions. BMPs such as detention ponds and constructed wetlands can be used in conjunction with protected natural systems to both control costs and improve protection of intact natural systems. This effort would involve research and the collection of case studies of the integration of stormwater management and green infrastructure.

The Staten Island Bluebelt provides an example of the cost effective integration of stormwater management and green infrastructure planning.

CASE STUDY FOUR: STATEN ISLAND BLUEBELT PROGRAM

The Staten Island Bluebelt Program utilizes a combination of green infrastructure and engineered best management practices (BMPs) to manage stormwater on Staten Island's south shore. The New York City Department of Environmental Protection (NYCDEP) is augmenting a system of streams, ponds and wetlands to address preexisting problems with localized flooding, degraded water quality and erosion. A land area in excess of 12,000 acres has been acquired in an effort to protect the last major stand of freshwater wetlands in New York City. Prior to this management effort this section of Staten Island was one of the last remaining areas of the city without adequate stormwater and sanitary drainage infrastructure.

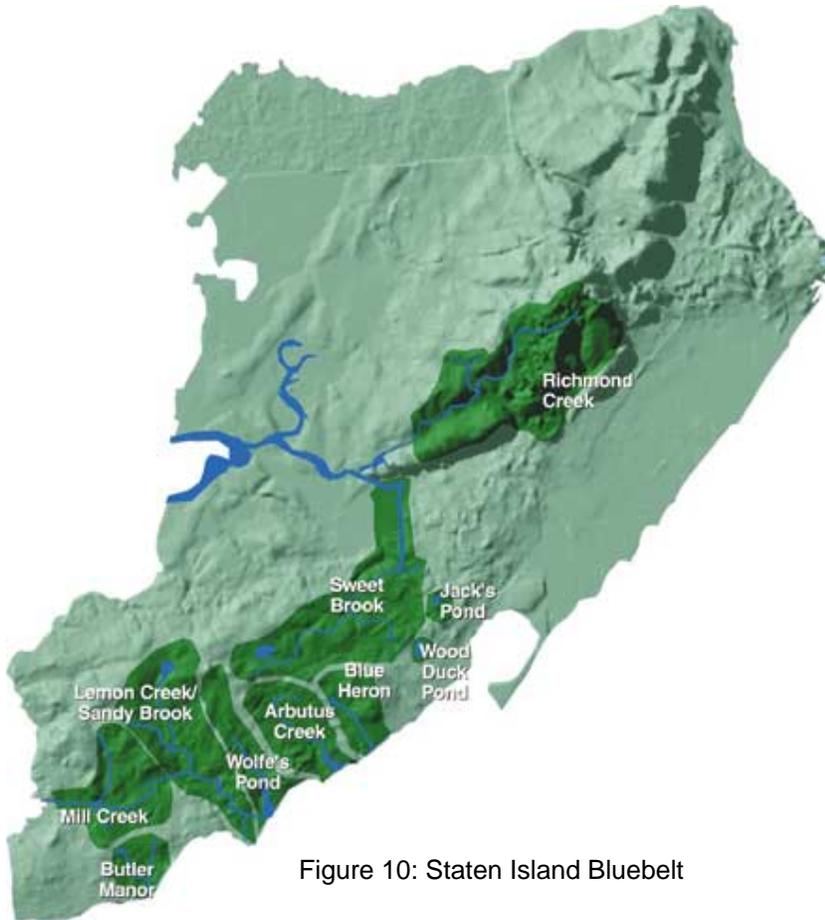


Figure 10: Staten Island Bluebelt

The engineered stormwater BMPs utilized in the Bluebelt Program interface the storm drain system and the natural drainage corridors. The BMPs both improve water quality and provide

temporary storage for stormwater to lessen the intensity of peak water flows during large storm events. Minimization of adverse impact on environmental systems is a primary design goal of the project.

The green infrastructure component of the project is a corridor of protected lands that include naturally occurring wetlands, lakes, ponds, streams and forested areas. This mixture of publicly and privately held lands are zoned as Designated Open Space (DOS). Development is not allowed within the DOS zone. A transfer of development rights program is used to protect the economic interests of the owners of the privately held land within the DOS zone.

This combination of protected lands and engineered stormwater BMPs provides multiple benefits by simultaneously addressing habitat protection, water quality protection, stormwater management and provision of green space as an element of urban design. New York City anticipates saving approximately fifty million dollars using this green infrastructure based approach as opposed to building an extensive network of subsurface storm sewer lines. This type of cost effective solution will become increasingly necessary as regulatory requirements for protection of water quality become increasingly intertwined with other planning concerns.



Figure 11: Preexisting Conditions



PHOTO: ANDREW GORDON PHOTOGRAPHY

Figure 12: Constructed wetlands

Several other lower priority items are also under discussion:

- Continued refinement of the regional conservation corridor network: work with individual localities to refine the network,
- Identification and selection of a sub areas within the regional conservation corridor network for implementation action: focus on those areas with multiple benefits and good agreement with local land use policy and planning,
- Examine development of a regional parks plan,
- Examine development of a regional agriculture and forestry protection plan,
- Continue efforts to ensure integration of the Hampton Roads Conservation Corridor network with state and multi-state level initiatives,
- Development of a long term financing strategy for green infrastructure in Hampton Roads,
- Continue public education efforts.

1.4.4 Continued Refinement of the Conservation Corridor Network

Stakeholder involvement was an important element of the HRCCS. However, given the time and fiscal restraints associated with the project it was not possible to perform an exhaustive stakeholder involvement process in each Hampton Roads locality. The goal of this task will be provision of the opportunity for each Hampton Roads locality to work with the HRPDC staff to refine the conservation corridor network to more fully meet the needs of the diverse stakeholder community present in each locality.

1.4.5 Identification and Selection of Priority Areas for Implementation

The HRCCS resulted in the identification of over 475,000 acres of land as significant in their ability to protect habitat and water quality. The associated conservation corridors, which provide opportunities for connectivity between the priority conservation lands, encompass 860,000 acres. Only 221,000 acres within the network are currently under some form of protection. An important next step in this process is the identification of sub areas within this network for protection. Sub areas could be selected based on a variety of factors including threat of development, prevention of encroachment, advancement of local planning goals and contribution to regulatory compliance. The result of this task would be an overlay to the conservation corridor map that depicts the priority areas.

1.4.6 Examine the Development of a Regional Parks Plan

One potentially viable element of a regional green infrastructure plan is the development of a regional parks plan. A regional parks plan could both include and add to the conservation corridor network. This type of plan would emphasize recreational uses as they would integrate with the identified conservation lands. Benefits of this approach include identification of opportunities for a regional trail network and opportunities for shared regional facilities.

The Boston Emerald Necklace and Twin Cities Park System provide examples of two of the oldest and most successful regional open space planning efforts. The following case study provides a brief introduction to these projects.

CASE STUDY FIVE: BOSTON EMERALD NECKLACE AND THE MINNEAPOLIS-ST. PAUL PARK SYSTEM



Figure 13: Arnold Arboretum in the Boston Emerald Necklace

The Boston Emerald Necklace and the Minneapolis - St. Paul Municipal Park System are two of the earliest examples of planned open space networks in the United States. Landscape architect Fredrick Law Olmsted designed the Boston Emerald Necklace in 1887 to link together a series of parks. The resulting network of parks and parkways includes the Boston Public Garden, the Boston Common, Commonwealth Avenue, the

Back Bay Fens, the Riverway, Olmsted Park, Jamaica Park, Arnold Arboretum and Franklin Park. The parks in the network feature a broad range of amenities including a botanical garden, public art, citizen vegetable and flower gardens, a zoo, a golf course and hiking and biking trails. In addition, the network provides wildlife habitat, enhances stormwater management and flood control.

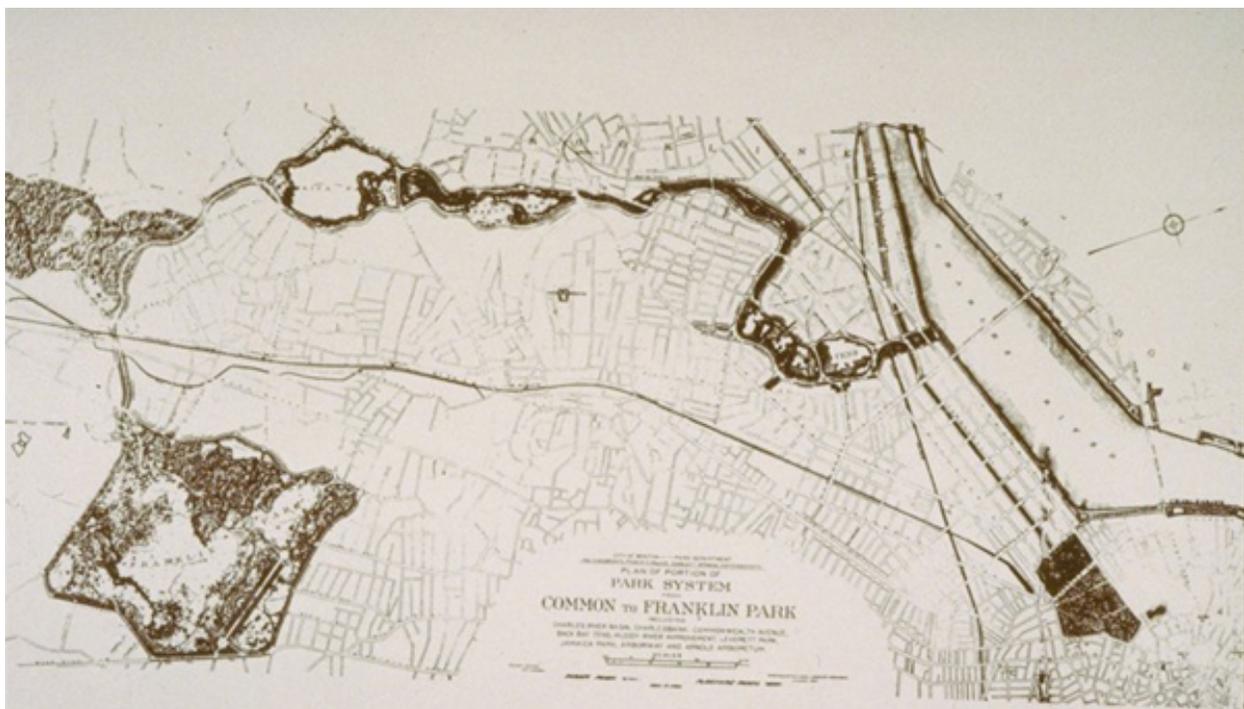


Figure 14: Fredrick Law Olmsted's drawing of the Boston Emerald Necklace

The Minneapolis – St. Paul Municipal Park System, planned by landscape architect Horace Cleveland in the 1890's, includes 6,400 acres and fifty-eight miles of parkways in Minneapolis and 4,207 acres and forty-six miles of parkways in St. Paul. This network incorporates buffers around the cities lakes and natural areas along the Mississippi River. The Minneapolis portion of the park system is designed so that all homes in the city are within six blocks of green space.

In an effort to improve the connectivity and environmental value of the park system the Metro Greenways Program has been established. Goals for the program include protection, restoration and reconnection of a region-wide network of natural areas and open spaces to provide a broad range of public benefits. A recent ecological assessment by Minnesota's Department of Natural Resources (DNR) determined that approximately 280,000 acres of high quality terrestrial and wetland habitat remain in the Twin Cities region. Roughly 100,000 acres of this habitat is not publicly owned or protected. As part of the analytic process a map of the surveyed habitat areas has been developed. The map also includes an overlay of potential connections around the areas of high biological diversity.

Implementation actions include the allocation of \$9.3 million in state funds to 29 protection and 16 restoration projects during the period of 1998-2004. Approximately 2,500 acres have been protected and 600 acres have been restored through this program. Projects range in scale from a two acres demonstration site along the Midtown Greenway in central Minneapolis to the acquisition of two 60 acres parcels needed to complete a 2,800 acres greenway adjacent to the St. Croix River.

1.4.7 Examine the Development of a Regional Agriculture and Forestry Protection Plan

Analysis of opportunities to buffer and protect working lands was not included in the HRCCS. Opportunities exist to use the conservation corridor network to buffer working lands from encroachment from new development. Just as military facilities may suffer a diminishment in their ability to perform their mission when faced with encroachment, working lands lose their viability when fragmented and surrounded by new development. Multiple problems arise including nuisance complaints from new residents, loss of ability to move farm machinery due to increased traffic on rural roads and loss of business and service infrastructure needed to support agricultural and forestal operations. Development of a regional agriculture and forestry protection plan would be dependent on additional GIS analysis to identify areas to be protected, ranking of areas based on threat from development and identification of areas with opportunity for both buffering and achieving conservation goals.

1.4.8 Integration with Other Green Infrastructure Efforts

The State of Virginia is currently in the initial stages of establishing a statewide green infrastructure system. The inclusion of the VCLNA data in the development of the HRCCS insures that a strong linkage exists to the evolving statewide effort. HRPDC staff will continue to work with state staff to insure compatibility with the statewide network. The Chesapeake Bay Program developed the Resource Lands Assessment (RLA), a green infrastructure network that extends across the entire Chesapeake Bay watershed. HRPDC staff is currently involved in discussions with the Chesapeake Bay program staff to provide feedback from the HRCCS to the Bay watershed wide effort. HRPDC staff is also involved in discussions with the Albemarle-Pamlico National Estuary Program (APNEP) and individual North Carolina localities on opportunities of linking the system with localities in North Carolina.

The Nature Conservancy has been very active in Hampton Roads, particularly in the Southern Watershed Area. Lands have been purchased in the North Landing River and Northwest River watersheds. In addition, TNC recently announced an agreement with International Paper and the Conservation Fund to acquire 218,000 acres across 10 states. This purchase includes more than 20,000 acres in Sussex, Surry, Isle of Wight and Southampton counties in Virginia and in Northampton and Hertford counties in North Carolina. The tracts purchased in Virginia overlap the lands identified in the HRCCS, mainly along the Nottoway, Meherrin, and Blackwater Rivers in Southampton County. This purchase adds significantly to the protection of riparian corridor lands in Hampton Roads.

1.4.9 Development of a Long Term Financing Strategy for Green Infrastructure in Hampton Roads

This item would involve analysis of financing plans in use in other communities to support long-term investment in open space networks and development of a set of recommendations for Hampton Roads.

1.4.10 Continuation of Public Education Efforts

A video titled Make the Connection: Green Infrastructure for the Future of Hampton Roads was produced as part of the Conservation Corridor project. The video provides an illustrated introduction to the basics of green infrastructure and a brief overview of SWAMP and the HRCCS. The video has been distributed to all Hampton Roads localities and is available for broadcast on public access cable channels and other outlets. The City of Virginia Beach is using the video in conjunction with its Green Ribbon Commission by broadcasting it both on their public access cable channel and making it available for viewing on the cities web site.

1.5 CONCLUSIONS

Green Infrastructure planning and implementation can make a meaningful contribution to the quality of communities in Hampton Roads while simultaneously providing a cost effective component of complying with regulatory requirements for water quality protection and stormwater management. HRPDC staff will continue to work with local government staff and other stakeholders to move from planning to implementation of green infrastructure network in Hampton Roads. Three priority projects, identified through consultation with local government staff, will be pursued first. Those projects are development of a white paper on the integration of green infrastructure with the development approval process, a workshop on the use of green infrastructure to buffer military facilities in Hampton Roads from encroachment by new development and the examination of the integration of green infrastructure with stormwater management through a set of case studies.

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- Figure 1: SWAMP Conservation Corridor System: HRPDC
- Figure 2: Data Layers in the First Version of Regional Corridor System: HRPDC
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- Figure 8: Hampton Roads Joint Land Use Study Natural Resources Map: EDAW. Final Hampton Roads Joint Land Use Study. April 2005.
- Figure 9: Onslow Bight Conservation Forum Focus Areas: Rogers, Richard. "Partnerships in Conservation: North Carolina's Military Bases". <www.nga.org/cda/files/0409MilitaryBreifRogers.ppt>
- Figure 10: Staten Island Bluebelt Map: Vokral, John, Dana Gumb, Robert D. Smith, and Sandeep Mehrotra. "Staten Island Bluebelt: A Natural Solution to Environmental Problems" Stormwater Journal web site: <http://www.forester.net/sw_0106_staten.html>
- Figure 11: Preexisting Stormwater Management Conditions on Staten Island: Vokral, John, Dana Gumb, Robert D. Smith, and Sandeep Mehrotra. "Staten Island Bluebelt: A Natural Solution to Environmental Problems" Stormwater Journal web site: <http://www.forester.net/sw_0106_staten.html>
- Figure 12: Constructed Wetlands adjacent to Staten Island Bluebelt: Vokral, John, Dana Gumb, Robert D. Smith, and Sandeep Mehrotra. "Staten Island Bluebelt: A Natural Solution to Environmental Problems" Stormwater Journal web site: <http://www.forester.net/sw_0106_staten.html>
- Figure 13: Photo of Arnold Arboretum in the Boston Emerald Necklace: The Emerald Necklace Conservancy. <<http://www.emeraldnecklace.org/index.cgi?page=arboretum>>
- Figure 14: Drawing of Boston Emerald Necklace: The Emerald Necklace Conservancy. <<http://www.emeraldnecklace.org/index.cgi?page=necklace>>