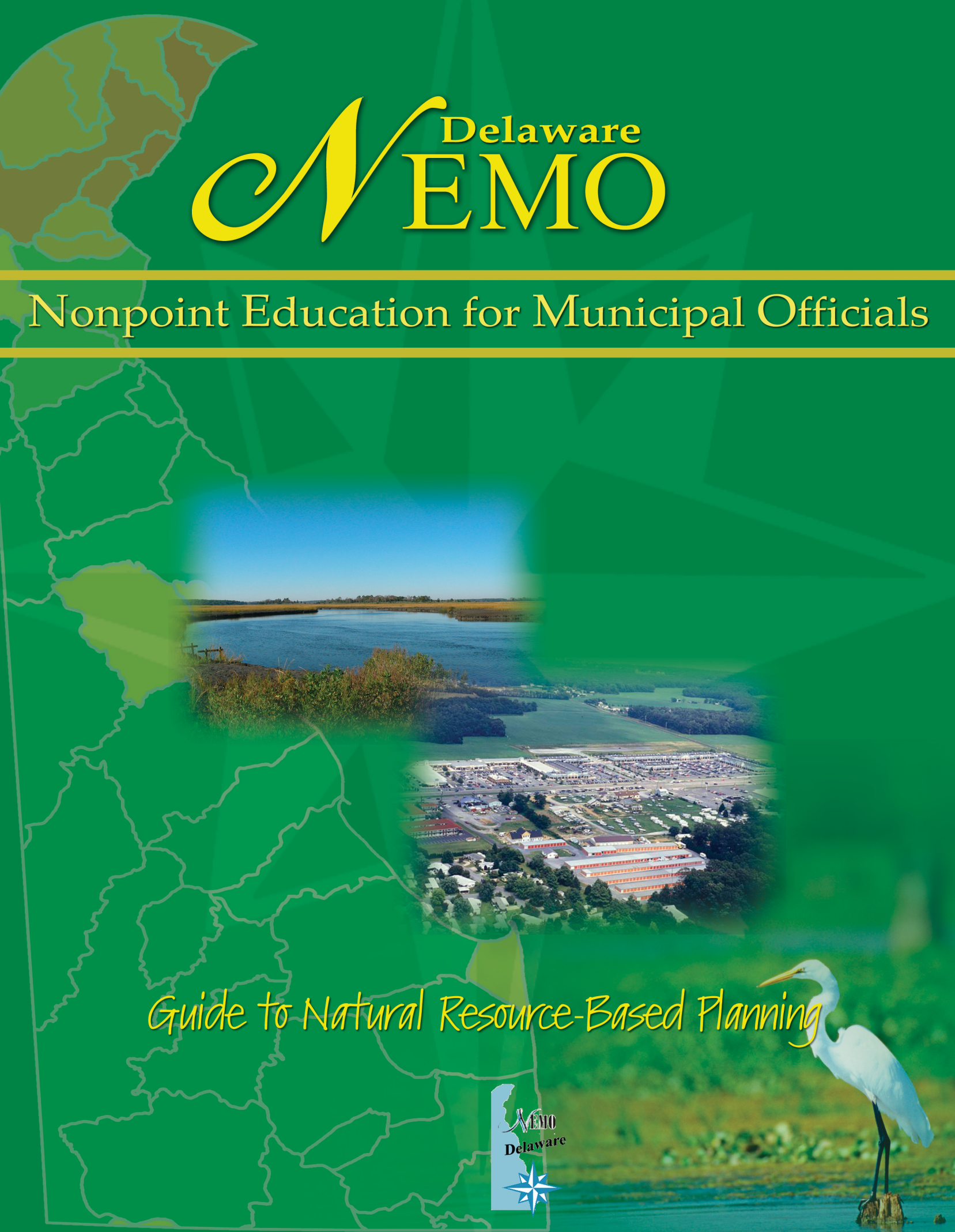
Delaware NEMO

Nonpoint Education for Municipal Officials



Guide to Natural Resource-Based Planning

Delaware NEMO

Guide to Natural Resource-Based Planning

A product of the Delaware NEMO Program

Prepared by
Delaware Sea Grant College Program
Newark and Lewes, DE
2005

Sea Grant
University of Delaware

This project was funded, in part, through a grant from the Delaware Coastal Programs with funding from the NOAA Office of Ocean and Coastal Resource Management, under Grant No. NA03NOS4190078, and by NOAA Office of Sea Grant, Department of Commerce under Grant No. NA050AR4171041, and the Delaware Sea Grant College Program. Publication No. DEL-SG-10-05.

This manual was produced with the support of a grant from the Delaware Coastal Programs to the University of Delaware Sea Grant Marine Advisory Service. The Delaware NEMO Steering Committee, comprised of local government, state agency, nonprofit organization, and university partners, was formed to guide the development and production of this manual. The Steering Committee members include the following individuals and organizations.

Delaware NEMO Steering Committee

Delaware State Agencies

Delaware Department of Transportation (DelDOT)
Delaware Department of Natural Resources and Environmental Control (DNREC)

Ann Marie Townshend — Office of State Planning Coordination
Michael B. Mahaffie — Office of State Planning Coordination
Marianne Walch — DelDOT, Stormwater Quality Program
Randall V. Cole — DelDOT, Stormwater Quality Program
Kathy E. Bunting Howarth — DNREC, Watershed Assessment
Lyle A. Jones — DNREC, Watershed Assessment
Beth L. Krumrine — DNREC, Sediment and Stormwater Program
Paul W. Evans — DNREC, Sediment and Stormwater Program
Susan E. Love — DNREC, Delaware Coastal Programs
Kimberly B. Cole — DNREC, Delaware Coastal Programs
Michael K. Brown — DNREC, Nonpoint Source Pollution Program
Robert R. Palmer — DNREC, Nonpoint Source Pollution Program
John M. Kennel — DNREC, Div. Water Resources, Management Section
Kevin Coyle — DNREC, Office of the Secretary

Local Government

Kathy Roth — Town of Ocean View
Richard Kautz — Sussex County Planning and Zoning Commission
George O. Haggerty — New Castle County, Department of Land Use

Nonprofit Organizations

Edward A. Lewandowski — Center for Inland Bays
Sara L. Wozniak — Appoquinimink River Association

University of Delaware

Nicole M. Minni — Institute for Public Administration, Water Resources Agency
Martha B. Corrozi — Institute for Public Administration, Water Resources Agency
Gerald J. Kauffman — Institute for Public Administration, Water Resources Agency
Martin W. Wollaston — Institute for Public Administration, Water Resources Agency
William A. McGowan — Delaware Cooperative Extension
Jennifer Gilbert — College of Agriculture and Natural Resources
Joseph G. Farrell — Sea Grant Marine Advisory Service

Acknowledgements

This manual was a team effort. Steering Committee members volunteered to write, revise, or recruit collaborators to address key planning issues that affect natural resources.

Introduction
Joseph G. Farrell, University of Delaware Sea Grant Marine Advisory Service

Chapter 1 — Natural Resource-Based Planning
Nicole M. Minni and Lori Schnick, University of Delaware, Institute for Public Administration, Water Resources Agency (IPA-WRA)

Chapter 2 — Impervious Cover
Martha B. Corrozi, with contributions from Gerald J. Kauffman and Kevin J. Vonck, University of Delaware, IPA-WRA

Chapter 3 — Maintaining Riparian Areas and Wetlands
Jennifer Gilbert, University of Delaware College of Agriculture and Natural Resources

Chapter 4 — Planning For and Managing Open Space and Natural Areas
Beth L. Krumrine and Paul W. Evans, Delaware Department of Natural Resources and Environmental Control (DNREC), Sediment and Stormwater Program, and Susan E. Love, DNREC, Delaware Coastal Programs

Chapter 5 — Managing Stormwater
Beth Krumrine and Paul Evans, DNREC, Sediment and Stormwater Program, and Marianne Walch, Ph.D, Delaware Department of Trasportation, Stormwater Quality Program

Chapter 6 — Source Water Protection
Martha B. Corrozi, University of Delaware IPA-WRA, and Sara Wozniak, Appoquinimink River Association, with contributions from Martin W. Wollaston, Gerald J. Kauffman, and Kevin J. Vonck, University of Delaware IPA-WRA

Chapter 7 — The State's Role in Sustainable Development
Ann Marie Townshend, Office of State Planning Coordination

Chapter 8 — Resources for Writing Ordinances that Protect Natural Resources
Ann Marie Townshend, Office of State Planning Coordination

Appendix A — Conducting a Natural Resource Assessment: An Example
Nicole M. Minni and Lori Schnick, University of Delaware IPA-WRA.

Special thanks to the following individuals:

Cover design— Amy M. Wood, MidFin Multimedia
Technical editing — Andrea Kreiner, A. Kreiner Company
Proofreading — Beth Chajes, University of Delaware, Marine Public Education Office
Production — Pam Donnelly, University of Delaware, Marine Public Education Office
Overall support — Rita L. Baty, University of Delaware, Sea Grant Marine Advisory Service
Grant Liaison — Kimberly B. Cole, DNREC, Delaware Coastal Programs

This project was funded, in part, through a grant from the Delaware Coastal Programs with funding from the NOAA Office of Ocean and Coastal Resource Management, under Grant No. NA03NOS4190078, and by NOAA Office of Sea Grant, Department of Commerce under Grant No. NA050AR4171041, and the Delaware Sea Grant College Program. Publication No. DEL-SG-10-05.

The Delaware NEMO Program is a charter member of the National NEMO Network. Special thanks to University of Connecticut NEMO Program and National NEMO Network Hub for their unwavering guidance and support and to the Minnesota Northland NEMO Program for permission to adapt their resource material.

Thanks to all,
Joseph G. Farrell, Delaware NEMO Coordinator and Managing Editor

Introduction

Introduction*

This publication — ***NEMO Guide to Natural Resource-Based Planning*** — is intended to provide an overview of principles and practices to guide local planning commissions and councils as they weigh the decisions of what to preserve and where to develop.

During the last decade, Delaware experienced high rates of growth in all three counties, with major growth occurring in coastal Sussex County, southern New Castle County, and the Dover area. According to the Delaware Population Consortium, the state as a whole grew 18 percent, while Sussex County grew 38 percent. Current trends, including an increasing U.S. population, strong consumer demand for coastal properties, low taxes, and a steady economy, indicate that the population and the number of homes and businesses in Delaware will likely continue to expand, with another 16 percent growth expected between 2005 and 2020. How this growth will occur — and how to minimize undesirable consequences on our natural resources and community character — is the subject of this manual.

In the countryside, residential developments are springing up adjacent to wetlands, at the headwaters of streams, and along coastal bays. In beach communities, “mega-houses” with footprints that approach their lot dimensions are replacing modest cottages. Wide roads are replacing country lanes to accommodate the increase in vehicles. From a natural resource perspective, this type of development can destroy natural habitat, contribute to surface and groundwater pollution, and increase impervious surface areas, which leads to increased stormwater runoff. The cumulative impact of this growth contributes to the disruption of our landscape, the degradation of the state’s water quality, and a reduction in biodiversity, as well as a loss of local community character.

While federal and state natural resource statutes and regulations provide some measure of protection, it has been much more difficult to regulate the diffuse nature of nonpoint pollution, or polluted runoff, than it is to regulate what comes out the end of a pipe. In fact, the most pressing water quality problems facing our streams, bays, and coastal ocean are largely nonpoint pollutants — including nutrients, bacteria, and suspended solids — that run off rooftops, roads, lawns, and farms. Municipalities and towns have the ability to improve water quality and natural resources through land-use ordinances and decisions.

As a local elected official or planner, you are in a position to help direct growth where and how it is most appropriate. The NEMO message is that natural resources and community character can be protected while accommodating compatible growth.

NEMO, the acronym for Nonpoint Education for Municipal Officials, derives its name from its emphasis on educating local decision makers — those community members who serve on county or municipal boards, commissions, and councils — about nonpoint source pollution and how the land-use decisions you make affect water quality and other natural resources. NEMO is first and foremost an educational program. It is targeted specifically at local land-use decision makers. Its goal is to give you the knowledge and

*The introduction is based on “NEMO Strategies” in *NEMO Project Fact Sheet 4: Strategies for Coping With Polluted Runoff,* by Chester Arnold, 2002.

understanding that will allow you to make better decisions about development, while minimizing the impact on water and other natural resources. Its message is, "Good planning is the key to charting a community's future course."

The guiding principles of natural resource protection can be organized in a four-tiered approach, which can be summarized as plan, minimize, mitigate, and maintain. The purpose of this manual is to offer tools and approaches to help you plan your community with an eye on protecting those natural resources — particularly water resources — that your community cherishes. The approach is simple and straightforward:

1. Plan Development Based on Your Community's Natural Resources

While the acronym "BMPs" generally refers to "best management practices," a compelling alternative definition is "better and more planning." *Pollution prevention through good planning is usually the least expensive and most effective way to protect natural resources.* Knowing where your special places and natural resources are will help you determine how to guide development to the most suitable places. Conducting a natural resource inventory, if one has not already been done, is a critical first step. Chapter 1 — Natural Resource-Based Planning and Appendix A will guide you through this process and provide you with links to much of the data that is currently available.

Conducting a resource inventory is also a great way to learn more about your community's resources. Identifying important natural resources and setting protection priorities provides a framework within which the impacts of a proposed or existing development can be evaluated. Formal inclusion of these priorities in municipal or county plans or procedures is important. Developing broad resource protection strategies, to be applied at either the municipal or watershed level, can be an effective approach to protecting areas adjacent to water resources. An example of such a strategy is the creation of a riparian buffer zone (see Chapter 3).

An example of a planning tool that has become widely used as an indicator of water quality degradation is *impervious land cover analysis.* Impervious cover refers to surfaces that do not absorb water, such as paved roads, parking lots, driveways, sidewalks, and rooftops. Studies have shown a direct relationship between the percent of impervious cover and the degree of water quality damage in the watershed. This tool is useful to consider at the site level; the more impervious cover, the greater the need to minimize and mitigate the potential impact of increased stormwater flow off the site (see Chapter 2).

2. Minimize Impacts Through Site Design

The site design stage offers the best chance for local officials, architects, and builders to work together to reduce polluted runoff from a site. Evaluate site plans with an eye toward minimizing both impervious areas and disruption of natural drainage and vegetation. Cluster development and conservation design — which reduce the total areas of paved surfaces and increase open space — should be considered. Designs which reduce grading and filling and retain natural features and hydrology should be encouraged. In addition to protecting water resources, these designs can be aesthetically pleasing and less costly.

In Delaware, larger development projects are also required to submit a proposed plan to the Office of State Planning Coordination through the PLUS process (Preliminary Land Use Service). The PLUS process involves reviews by all applicable state agencies at the start of the land development process, adding value and knowledge to the process local governments use to make land-use decisions. The purpose of PLUS is threefold:

- To identify and mitigate potential impacts of development which may affect areas beyond local boundaries;
- To fully integrate state and local land-use plans; and
- To bring state agency staff together with developers and local officials early in the process.

See Chapter 7 for a more detailed explanation of PLUS.

3. Mitigate Unavoidable Impacts by Using Best Management Practices

Best management practices (BMPs) include a whole range of methods designed to prevent, reduce, or treat stormwater runoff and to mitigate other impacts of development. BMPs can be very effective at reducing development impacts. Choosing the correct BMP is often highly specific to the site. Things to be considered in selecting what mitigation method is most appropriate include the natural features of the site and the management structure of the property. For example, a flat, dry field would require different stormwater management than a site with a steep slope bordering a stream. The management structure of the property can play into the decision of what mitigation method is most appropriate; a BMP that requires regular and potentially expensive maintenance may not be the best alternative over the long run if the property is to be managed by a homeowners' association or small municipality.

Enforcement (ensuring that BMPs are built as designed) and *education* (raising community awareness about why and how BMPs work) are the key pieces that will ensure that the BMPS perform their mitigation functions as intended well into the future.

4. Maintain Existing Best Management Practices

The last step in the process is one that is often overlooked. Without a commitment to maintenance, even the best BMPs will lose their effectiveness over time. Whether it's a riparian buffer, open space, a stormwater management pond, or the latest in green technology, there should be an up-front plan on how it will be maintained, who will maintain it, and how it will be paid for. The review and approval of a maintenance plan should be part of a local land-use approval process.

Using This Guide

The chapters in this manual present the issue being addressed, provide a short explanation of why it is important to address it, present the relevant BMPs, and discuss some of the tradeoffs involved. An important part of each chapter is a list of questions for you to ask either yourselves or the developer as you devise land-use ordinances or review proposed projects. The chapters also provide a list of resources, which can provide additional information or assistance. The chapters are structured as follows:

- Chapter 1 — Natural Resource-Based Planning
- Chapter 2 — Impervious Cover
- Chapter 3 — Maintaining Riparian Areas and Wetlands
- Chapter 4 — Planning for and Managing Open Space and Natural Areas
- Chapter 5 — Managing Stormwater
- Chapter 6 — Source Water Protection
- Chapter 7 — The State's Role in Sustainable Development
- Chapter 8 — Resources for Writing Ordinances that Protect Natural Resources

This manual is not intended to make you an expert, but by being able to ask the right questions at the appropriate stage of the planning process, you have the greatest potential to influence the developer, minimize the environmental impact of the proposed development, and maintain the quality of life within your community.

1. Natural Resource-Based Planning

Natural Resource-Based Planning*

Planning, when done well, is among the most powerful tools available to communities. A solid plan, based on good natural resource information, guides rational land-use decisions, and allows the community to consider innovative tools for resource protection with fewer chances for legal challenges to their planning authority. The plan also sends a clear message about what the community values and wishes to preserve, and if well crafted, results in few surprises to developers, local officials, or residents.

The Importance and Benefits of Natural Resource-Based Planning

Natural resource-based planning is a process that puts the community's natural resource base at the forefront. By identifying natural resources at the beginning of the planning process, your community can determine where development is most appropriate. This way, communities can avoid the unintended consequences of the typical planning process, such as open space becoming the "leftover" pieces, water resources being degraded, and community character being compromised.

A good comprehensive plan is not a "wish list" of local concerns — it's a rational list of actions based on accurate information about your community. Inventories and assessments are a key step in the planning process because they will help guide the discussion about where development or other land uses should occur and what natural resources should be protected or restored.

A natural resource inventory (NRI) is the information collected to identify the location and character of natural resources.

A natural resource assessment (NRA) is an analysis of the NRI to aid in decision-making and management efforts.

An NRI is simply a collection of data represented by descriptive maps. It can include anything from a simple hand-drawn map to comprehensive, geographic information system-based, land-cover maps. Once an NRI is completed, the information collected can then be used to conduct an NRA to investigate local natural resource issues.

Identify Natural Resource Issues of Importance to Your Community

Traditional municipal planning starts with areas "suitable for development" based on factors such as proximity to roads, utilities, and other infrastructure. It is common for the whole community to be designated "suitable" with different uses/densities allowed in

*This chapter is adapted for Delaware from segments of *A Quick Guide to Using Natural Resource Information,* produced by the Minnesota Department of Natural Resources and the Dakota County Soil and Water Conservation District, 2004.

particular areas. Natural resources are not factored into the plan, unless they are barriers to development (for example, wetlands or steep slopes).

Alternatively, natural resource-based planning starts with a community's natural resource base and works "backward" to identify development potential. The foundation of the natural resource-based plan is a natural resources inventory, which tells the community what it has to work with. Because not all natural resources can be protected, they must be prioritized based on the community's values and goals. The community then develops plans and regulations that guide development to areas most suited for it, minimizing impacts to priority natural resources through the location, design, and engineering of new development.

Natural resource-based planning truly places the community in the driver's seat regarding its future. Of course, community involvement at all phases is a key part of the natural resource-based planning process to ensure your planning investment has good support.

The first step in natural resource-based planning is to identify the natural resource issues that are important to your community. One way to involve your community is to assemble a work group from the community. This group should consist of, and if possible be led by, members of the local commissions as well as interested community groups and local experts.

Conduct a Natural Resource Inventory

After identifying the natural resources that are important to your community, the next step is to conduct a natural resource inventory, which forms the foundation of the natural resource-based plan. The natural resource inventory (NRI) is a summary in map form of a municipality's open-space lands, water resources, natural areas, and protected corridors. From this inventory, you can start to identify areas of your town that are suitable for development or areas that are best preserved. This prioritization can provide the basis for your open-space plan and comprehensive plan, which in turn can be folded into other site- or regional-level plans.

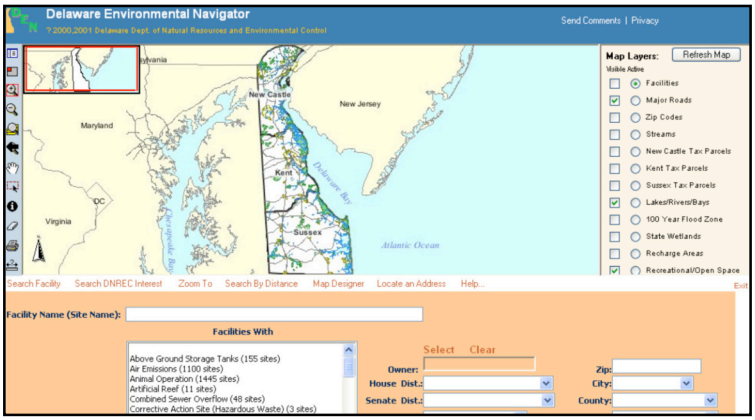
Next, determine the boundaries of your inventory. The inventory can focus anywhere from the municipal boundary, your growth and annexation areas, or to a slightly larger surrounding area, such as the watershed area. The determination of the study area should be dependent on the overall goals of your community.

Once you have assembled your work group and determined your study area, you are ready to start assembling the maps and other information that will comprise the NRI. Map information can either be printed "hard-copy" maps, transparent overlays, or digital maps.

A natural resource inventory (NRI) is collected information (data) that identifies the location and character of natural resources. These data can be presented in two types of map forms, either hand-drawn or digital within a geographic information system. A geographic information system (GIS) is computer-based mapping software that allows the user to overlay data in order to identify and prioritize natural resource protection and management. If your municipality does not currently have GIS, there is a free GIS data viewer available for download at *www.esri.com/software/arcexplorer/index.html.*

If you have completed your municipal comprehensive plan, you may find some of these maps and possibly the data for your maps as part of your plan. It is important, at this point, to prioritize your collection process and to organize your data according to your goals. To begin your inventory you should start with the following:

A. Base map
B. Land use/cover
C. Water resources
D. Unique and fragile lands
E. Committed open space



In Delaware, we have several sources for digital mapping data. Please refer to the references section of this chapter for this information. The Delaware Department of Natural Resources and Environmental Control (DNREC) maintains GIS datasets for a variety of natural resources. These data can be viewed on DNREC's internet mapping service, called the Environmental Navigator, *www.dnrec.state.de.us/DNRECeis/,* as shown in the graphic to the right. Other data can come from satellites and aircraft in the form of remotely sensed information.

The state of Delaware currently has aerial photography for the years 1992, 1997, and 2002, which is available for viewing and printing from the Delaware Data Mapping and Integration Laboratory (DataMIL). The Delaware DataMIL contains Delaware's most up-to-date "framework" datasets. These datasets are boundaries, water features, transportation, elevation, surface cover, and reference data (e.g., geographic names). The web site is *datamil.delaware.gov*. You can view, search, extract data, and create maps from this web site. These tools enable you to start your inventory.

The Delaware DataMIL: *datamil.delaware.gov/*

A. The Base Map will include the 2002 aerial photography, roads, and your municipal boundary. These initial data layers will provide a means for you to delineate the boundaries of your study area. Your study area could be your municipal boundary, a surrounding buffer, potential growth and annexation areas, or your local watershed boundary. The base map will orient your study area to other geographical features such as forest cover and streams, for example, so it is important to include surrounding information.

B. Land Use/Cover is an important data layer that helps define the development patterns of your community and provides areas of focus for land-use planning efforts. The land use/cover data layer in Delaware has been created from the aerial photography mentioned above for the years 1992, 1997, and 2002, depicting what is on the ground. An example of what would be represented in the land use/cover dataset would be residential

or commercial areas, forests, wetlands, and water. If you have completed your comprehensive plan, an existing land-use map should be included that has the land-use coded by parcel, providing more detail. This data layer will also display water and agricultural areas. In a GIS, these individual categories can be queried to determine not only where these resources are located, but how much area is consumed by these resources. This will help you begin focusing your efforts in resource protection and economic development.

C. Water Resources are vital to biodiversity and the long-term environmental health of your community. There are a number of water resource layers available from the Delaware Geological Survey (DGS) and the United States Geological Survey (USGS) as well as DNREC. Watershed boundaries are one of them. The watershed is the area that drains into a particular water body. Watershed boundaries can be created at several scales. There are four major basins in Delaware: Piedmont, Chesapeake Bay, Delaware Estuary, and Inland Bays. The sub-basins comprise these major basins, and the smallest catchments that comprise the sub-basins average 5–10 square miles. Surface water can be shown using the streams and water-body layer available from the Delaware DataMIL. These data can be used to accomplish the overall goal of managing nonpoint source pollution and maintaining and improving water quality.

D. Unique and Fragile Lands delineate areas in your community that provide habitat for unique plants and animals. DNREC's Division of Fish and Wildlife has identified these sensitive habitats where species are listed as threatened, endangered, or of special concern. The identification of the most unique and fragile lands in your town will help you with the prioritization of lands during the open-space planning process. This prioritized list will help to focus the lands targeted for open-space acquisition.

E. Committed Open Space is land that is protected from development by public and private ownership or easements. The committed open-space information from DNREC gives the state, municipal, and private lands. This is another data layer that can benefit from the input of local experts, particularly from your local land trust. Knowing where the committed open space is in your community is key in planning for future recreation and open-space needs. With this knowledge, you can start to create connections between preserved land and prevent fragmentation of natural resources by directing development to appropriate areas.

Conduct a Natural Resource Assessment

The next step is the analysis phase. There is a definite difference between compiling database information and maps for your town and the analysis of that information. The natural resource assessment is a separate activity from the inventory and usually involves the manipulation of the data in order to answer questions you or your group have about your town. The first step in your NRA is to create a checklist of the analyses that should be conducted. This checklist will be based upon the goals of your municipality or issues your municipality is facing. The list may include imperviousness, forest cover and quality, flooding, wetlands, waterways, lakes, water quality, habitat and habitat corridors, endangered species, etc.

An NRA can range from a simple visual analysis to detect land-use patterns on a map to a complex water runoff model (generally requires a GIS). A visual NRA is a qualitative

approach that works well with a hand-drawn NRI, but can also be used with a GIS-based NRI. The overlay approach of viewing natural resources, whether it is with mylar overlays or with a GIS, will open up a dialog of questions regarding these areas in your municipality.

In Appendix A, the town of Milton will be used as an example to take a look at a proposed development and perform an assessment of the natural resources that are within the proposed parcels.

What Are the Important Questions to Ask?

- At what scale was the data created? *When overlaying data with mylar or transparencies, all the data should be printed at the same scale.*
- Who is charged with maintaining the dataset?
- How often is the data updated?
- What is the best method for obtaining the most resent dataset?

For More Information

There are numerous resources for more information related to data within Delaware. The following web sites are either internet mapping sites (IMS), where one can interact with the map, or a resource for gathering data related to your particular needs.

- The Delaware Department of Natural Resources and Environmental Control (DNREC) web site, the Environmental Navigator (DEN), provides many types of information collected by DNREC such as permitted facilities, enforcement actions, and environmental monitoring. *www.dnrec.state.de.us/DNRECeis/*
- Through the Delaware DataMIL's Map Production Lab, Delaware citizens can create maps and download GIS framework data of any location in Delaware. Data layers that are available for viewing, printing, and download off the DataMIL can be found at *www.datamil.udel.edu/home.asp?main=onlinedata&toc=tocdata.*
- On New Castle County's E Parcel Viewer, one can view zoning and parcel data; locate environmental features such as waterways, forests, and water resource protection areas; and find nearby schools, parks, and libraries. *dmz-arcims02.co.new-castle.de.us/website/nccparcelmap2/viewer.htm*
- Kent County's web site allows the viewer to access land-use information down to the parcel level, including zoning, acreage, building permit, property location, building type, year built, and land-use application information. *www.co.kent.de.us/Departments/Planning/GIS/index.htm*

- Sussex County's web site allows the viewer to access zoning, parcel information, school district boundaries, flood zones, and tax ditches. With this site you can make a map of your neighborhood, city, or even the county and choose what elements you would like to include.
  www.sussexcounty.net/departments/mapaddress/index.cfm

- Thompson Mapping's *(www.smartmap.com)* web sites that are listed below allow the viewer to access a wealth of information for land-use planners, technicians, utility companies, managers, and others from the Delaware Department of Agriculture, the city of New Castle, three municipalities in Kent County, as well as Kent County's web site listed earlier.

  - Delaware Department of Agriculture — *www.smartmap.com/dda/*
  - City of New Castle — *www.smartmap.com/newcastle/*
  - Kent County municipalities of Milford, Smyrna, and Dover — *www.smartmap.com/kc_mun*

- The University of Delaware's Institute for Public Administration Water Resources Agency provides comprehensive instruction on source water protection in Delaware through its *Source Water Protection Guidance Manual for the Local Governments of Delaware,* "A Toolbox for Protection of Public Drinking Water Supplies in Delaware."
  www.wr.udel.edu/swaphome/phase2/SWPguidancemanual.html

- Soil data availability varies throughout the state of Delaware. SSURGO soils data will be posted when available at the University of Delaware Spatial Analysis Lab.
  www.udel.edu/FREC/spatlab/soils/

For questions about data, contact the data steward (owner) of the dataset under source information on the maps provided. For questions regarding the DNREC Environmental Navigator, contact the agency directly.

References

1. State of Minnesota, Department of Natural Resources, 2004. *A Quick Guide to Using Natural Resource Information.*
2. Delaware DataMIL, *datamil.delaware.gov/*
3. Delaware Department of Natural Resources and Environmental Control (DNREC) Environmental Navigator, *www.dnrec.state.de.us/DNRECeis/*
4. Delaware Division of Fish and Wildlife, *www.dnrec.state.de.us/fw/*
5. ESRI's ArcExplorer Java Edition,
   www.esri.com/software/arcexplorer/download.html

2. Impervious Cover

Impervious Cover

Impervious cover is any surface in the landscape that cannot effectively absorb or infiltrate rainfall. This includes driveways, roads, parking lots, rooftops, and sidewalks. When natural landscapes are intact, rainfall is absorbed into the soil and vegetation. These mediums naturally slow down, spread out, and soak up precipitation and runoff. Water percolating into the soil becomes a stable supply of groundwater, and the runoff is naturally filtered of impurities before it reaches creeks, streams, rivers, and bays.

Excess impervious cover creates a landscape that cannot absorb or infiltrate rainfall.

As areas become more developed, the amount of impervious cover increases, and natural filter systems are no longer in place to intercept the runoff. This has serious implications for water quality and flood control. Typical pollutants in runoff from impervious areas include pesticides, oil, litter, fertilizers, sediment, salt, and bacteria. A growing body of scientific literature has shown that groundwater recharge, stream base flow, and water quality measurably change and can decrease as impervious cover increases. Studies have shown a direct relationship between the intensity of development, as indicated by the amount of impervious surface, and the degree of damage in a watershed.

The Implications of Impervious Cover

Water bodies become degraded as the percentage of impervious cover in a watershed increases. Hydrologically, this means reduced volumes of water to recharge base flows and increased runoff from rains, increasing peak flows. These two things, respectively, exacerbate drought and flooding impacts. According to the National Weather Service, major floods can develop from as little as 2.2 inches of rain over a six-hour period in northern Delaware, one-third less precipitation than is needed to trigger the same degree of flooding in less-developed parts of the state. Center for Watershed Protection studies indicate that the size of one-hundred-year floods (or floods that have a one percent chance of occurring in any given year) can potentially double in watersheds with impervious cover levels greater than 20–30 precent.[1]

The other impacts on water quality include chemical, physical, and biological degradation. Chemically, an increased presence of bacteria, nutrients, pathogens, and sediment in receiving waters can limit the viability of drinking water and recreational activities. Physically, decreases in stream bank stability, the amount of large woody debris, and channel roughness consequently lower the quality of habitat available for biologic species. Biologically, species diversity declines, biological interactions are altered, and pollution-tolerant organisms become more prevalent.

Based on research in Delaware and elsewhere, streams can show signs of degradation and can be considered stressed in watersheds where the impervious coverage exceeds

10–15 percent. Impervious cover can be an important and measurable indicator of stream water quality and watershed health. Therefore, it is important to understand the typical percentage of impervious surface associated with various urban and suburban land uses. Table 1 illustrates the typical impervious surface coverage for land uses common in Delaware and other states.

Additional impervious area, in the form of roads, is needed to link dispersed communities together.

Most developed land uses exceed the threshold of 10–15 percent impervious cover, which defines a healthy watershed or stream system. It may initially appear from Table 1 that dispersed development would be desirable; that building homes on lots of one or two acres with scattered commercial areas (the "sprawl scenario") would result in the lowest percentage of impervious surface coverage. However, on a regional or watershed level, greater overall water supply and quality protection is achieved through more concentrated development. Under the sprawl scenario, development is spread over a much broader area, and additional impervious area in the form of roads would be needed to link the dispersed houses and communities together. University of Delaware Water Resources Agency research estimates that roadways are typically 50 percent impervious cover, including the median and rights of way. Therefore, dispersed development can result in a significant increase in the total impervious cover in the watershed. Concentrated development results in greater protection for the overall watershed, as a much larger percentage of the watershed is left in its natural condition, preserving water supply and quality. In addition, such centralized development can be directed away from sensitive areas, such as stream banks, to minimize the negative impact on water quality.

Table 1. Typical Percent Impervious Coverage of Land Uses in Delaware

Land Use	% Impervious Cover
Commercial and business district	85%
Industrial	72%
Residential district with 1/8 acre or less lot size (town houses)	65%
1/4 acre lot size	38%
1/3 acre lot size	30%
1/2 acre lot size	25%
1 acre lot size	20%
2 acre lot size	12%

Sources: University of Delaware, Water Resources Agency, 1998; USDA, Soil Conservation Service, TR-55, 1983.

As land-use decision makers are evaluating development projects, it is important that they understand the connection between land use and impervious cover percentages and their impact on water bodies. A decision maker can minimize the percentage of impervious cover and its impact through informed and educated decision making. Being aware of the implications of high percentages of impervious cover in a concentrated area and taking steps to reduce and mitigate it accordingly is a key tool in reducing the negative impacts of impervious cover.

Good Practices for Local Governments

The best management practices (BMPs) for impervious cover address watershed zoning based on impervious cover thresholds, innovative planning approaches, new development, and retrofitting existing development.

Plan

Watershed management and impervious cover thresholds are tools available to assist planners with wise land-use decisions to protect water supplies. Watershed zoning based on impervious cover thresholds is a measurable and scientifically defensible technique to protect stream water quantity and quality in watersheds. Watersheds provide the natural boundaries to guide the land planning decisions that affect stream water quality; after all, watersheds know no political boundaries. By employing these concepts in the county and municipal zoning codes, growth can be concentrated into those areas with existing development and infrastructure and away from the undeveloped watersheds. Proposals are under way to modify the New Castle County Zoning Code to incorporate these watershed-based impervious cover thresholds in the Christina Basin of Delaware.

For stream health and groundwater recharge, it is essential to consider the effect of impervious surfaces on groundwater recharge areas. In order to maximize the amount of groundwater recharge, planning tools and BMPs can be used to minimize the impact of impervious cover on the natural environment by effectively reducing the volume of runoff leaving a site, maintaining the volume of natural recharge, and preventing the discharge of pollutants into the groundwater system. Chapter 6 — Source Water Protection contains information on land-use tools, sediment and stormwater controls, suburban/urban BMPs, and nonregulatory approaches that can be used to maximize groundwater recharge.

Using cluster development to direct impervious cover away from natural resource areas can be an effective planning tool to protect water resources. Cluster development concentrates development and impervious cover rather than dispersing it throughout a site while maintaining designated open-space areas. Cluster development uses a variety of planning and design tools to enable development while minimizing the impacts of the impervious surfaces on water supply and quality. The open-space areas preserve natural resources while maximizing the overland flow of the runoff. This provides infiltration, which results in slowing, holding, and treating the water running off the impervious areas on the site. In order to realize these types of developments, local officials need to incorporate appropriate language into local ordinances and

comprehensive land-use plans (see Chapter 8 — Resources for Writing Ordinances that Protect Natural Resources). These types of development balance the economic needs of a community while preserving open space and protecting local water resources.

The best management practices and planning techniques described above do not completely eliminate the negative impacts of impervious cover, but as natural areas are continually developed, these techniques should be considered by local land-use planners, decision makers, and developers.

Minimize

Local governments can encourage, assist, or require builders to minimize impervious surfaces. Techniques that can be used to minimize impervious cover include, but are not limited to, reducing the scale of the size of streets, setbacks, parking spaces, lot sizes, driveways, and sidewalks. Creative grading and drainage techniques can be used in order to reduce stormwater runoff and encourage infiltration. Existing subdivision codes, zoning regulations, parking and street standards, and various other regulations may impede some of these impervious cover minimizing techniques. It would be prudent to review these regulations to remove these impediments where appropriate.

Mitigate

Forms of stormwater management, such as green technology, wet ponds, dry ponds, and manufactured BMP devices, are frequently used to mitigate the impacts of impervious surfaces in existing and new developments. Choosing which technique to apply to a specific site is dependent upon the amount of runoff that needs to be intercepted, the lot size, the permeability of the soils, and several other site-specific factors. A more detailed discussion of stormwater management techniques is included in Chapter 5 – Managing Stormwater.

A rain barrel, used to collect runoff from the impervious roof.

Maintain

There are many developed areas that cannot use the plan, minimize, or mitigate strategies to reduce impervious cover. In these areas, it is important to maintain the existing impervious cover in a way that encourages the flow of the runoff through the stormwater system and reduces the pollutant loads in that runoff. There are a variety of stormwater BMPs that can be used to promote flow through the system while providing stormwater treatment for trash, litter, coarse sediment, oil, and other debris before the runoff proceeds through the system. For example, street sweeping seeks to remove the buildup of pollutants that have been deposited along the street or curb, using a vacuum-assisted sweeper truck. Additional tools include catch basin inserts, oil/grit separators, hydrodynamic structures, and a variety of proprietary tools. In addition to these BMP tools, maintaining existing BMPs that mitigate impervious cover impacts, such as wet

ponds, dry ponds, and manufactured BMP devices, according to the appropriate maintenance standards is essential to their proper functioning and role in reducing impervious cover impacts. If these stormwater BMP tools are employed and proper maintenance occurs, the impacts of the existing impervious cover runoff can be reduced.

Tradeoffs

Ignoring the negative impacts of increased impervious cover can lead to economic disaster and social difficulties. There are several examples of this in the past few years in northern Delaware, where near-record flooding incidents have resulted in devastation for homeowners and infrastructure. Heavy rains and flash floods have submerged low-lying areas, washed out roads, and swept away bridges. In September 2004, 149 of 159 homes in the Glenville community of northern Delaware became uninhabitable. Homes in the nearby Yorklyn and Hockessin areas were also damaged and uninhabitable. This is a result of increased runoff rates and peak discharge rates (as well as development in the floodplains). The increased impervious surfaces in this area, in addition to flawed planning, have created a situation where the runoff can no longer be absorbed, which, combined with increased peak discharges, results in severe and numerous flooding events. In instances such as this, the area may be in need of federal disaster assistance as well as state and local aid. This will cost the local, county, state, and federal governments, as well as insurance companies, large amounts of money while displacing residents and damaging the community character. Circumstances such as these demonstrate the need to proactively reduce the amount of impervious cover.

The up-front costs of reducing impervious cover through BMP implementation and specific planning techniques can be high, but not necessarily. In some cases, reducing impervious cover and utilizing these thresholds for watershed management can also save money. Roads, sidewalks, and other infrastructure can account for over half the cost of a subdivision. For example, if a 32-foot-wide roadway were narrowed to 30 feet, the savings would be up to $100 per linear foot or up to $528,000 per mile. Reducing the imperviousness of new development not only benefits the environmental health of streams, the economy, and the local community, but it also results in economic savings for the development.[3,4]

Without the use of BMPs, innovative planning techniques, watershed zoning based on impervious cover, and other tools, the negative impacts of impervious cover will become far worse than they are today. In order to protect our communities and water bodies, when possible, it is most beneficial and cost-effective to work to reduce impervious cover thresholds through zoning ordinances and prior to developing sites rather than working to reduce impervious cover impacts after the fact on existing development.

For Further Information

There are numerous resources that provide more information related to the impacts of impervious cover and how to mitigate its impact on the community and local streams. The following web sites are just a few of the resources that contain information about impervious cover:

The Center for Watershed Protection provides local governments and watershed organizations with the technical tools for protecting our streams, lakes and rivers. The center has developed a multidisciplinary strategy for watershed protection that encompasses watershed planning, watershed restoration, stormwater management, watershed research, better site design, education and outreach, and watershed training.
www.cwp.org

The Delaware Department of Natural Resources and Environmental Control (DNREC) Sediment and Stormwater Program can provide assistance in finding information pertaining to impervious cover.
www.dnrec.state.de.us/DNREC2000/Divisions/Soil/Stormwater/StormWater.htm

The Stormwater Manager's Resource Center (SMRC) provides technical assistance to local governments and stormwater practitioners on stormwater management issues. Created and maintained by the Center for Watershed Protection, the SMRC has everything you need to know about stormwater in a single site.
www.stormwatercenter.net/

The University of Delaware's Institute for Public Administration, Water Resources Agency (IPA-WRA) provides technical assistance for water resources and watershed policy to governments in Delaware and the Delaware Valley.
www.wr.udel.edu

Questions to Ask During the Development Process

- Have the impervious surfaces been minimized?
- Have pervious alternatives been considered?
- What efforts will be taken to minimize site disturbance and soil compaction?
- Are the impervious surfaces located appropriately in relation to the natural resource assessment?
- Are the impervious surfaces located appropriately with respect to groundwater infiltration and recharge areas?
- Have the BMPs that have previously been installed to reduce the impacts of impervious cover been maintained?

References

1. Center for Watershed Protection. March 2003. *Impacts of Impervious Cover on Aquatic Systems*. Watershed Protection Research Monograph No. 1. Ellicott City, Maryland.

2. CH2M-Hill. 1993. *Costs of Providing Government Services to Alternative Residential Patterns.* Committee on Population Growth and Development, USEPA Chesapeake Bay Program. Annapolis, MD. 168 pp.

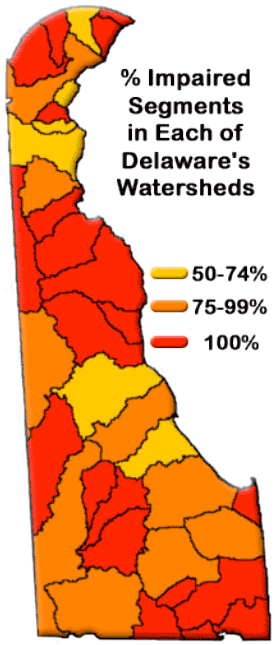
3. Schueler, T. 1997. Comparative Pollutant Removal Capability of Urban BMPs: A Reanalysis. *Watershed Protection Techniques.* 2(4): 515-520.

4. Schueler, T. 1994. Use of Cluster Development to Protect Watersheds. *Watershed Protection Techniques.* 1(3): 137-140.

3. Maintaining Riparian Areas & Wetlands

Maintaining Riparian Areas and Wetlands

Riparian areas are the lands along the banks of our rivers, lakes, and tidal waters. Many riparian areas not only border surface waters, but they are often adjacent to or actually include wetland areas, too. Delaware has 132,000 acres of freshwater wetlands and almost 90,000 acres of tidal wetlands. Wetlands are one of the most productive environments and provide a host of benefits, including filtering pollutants from the water, providing protection from flooding, and providing critical habitat for many species of plants and animals. Wetlands can hold large quantities of water, releasing it gradually while recharging groundwater. The soils and plants within wetlands are very effective at removing pollutants from runoff and groundwaters. Over the past 40 years, 40,000 acres of wetlands have been lost in Delaware.[1]



From *Delaware's Pollution Control Strategy,* DNREC 2000.

More than 90 percent of Delaware's waterways are considered impaired. The state's list of impaired waters includes 377 bodies of water that suffer from 11 different impairments, the most common of which are pathogens and nutrients (nitrogen and phosphorus). Most of these impairments come from nonpoint sources.[2] Increased runoff during storm events due to impervious cover in urban and suburban areas is one of the primary causes of nonpoint source pollution. Stormwater runoff can contain nutrients, hydrocarbons, pathogens, and toxic metals.

Forests play an important role as a buffer to our waterways. However, over the past 20 years Delaware has lost more than 20,000 acres of forest land. Those acres adjacent to water bodies are of particular concern for their pollution filtering capabilities.

The Importance and Benefits of Buffers

Riparian buffers perform a number of important functions:

- Slowing the velocity of stormwater runoff. The vegetation in buffers slows water flow, increasing the amount of time it takes runoff to reach surface waters. This extra time allows for more water to infiltrate through soil, more particulate matter in runoff to settle out, more opportunity for plants to take up water and nutrients, and less erosion.

- Filtering stormwater pollutants. Plants effectively remove contaminants from runoff through nutrient uptake and soil filtration. For areas where nutrients in runoff are of particular concern, deep-rooting

Types of Buffers

Riparian Buffers
Natural riparian buffers are areas of wooded land adjacent to water resources, which act as a transition zone between uplands and aquatic habitat. Riparian buffers as a BMP are made up of three zones: a hardwood forest, a mixed forest, and a vegetated filter strip (grass area).

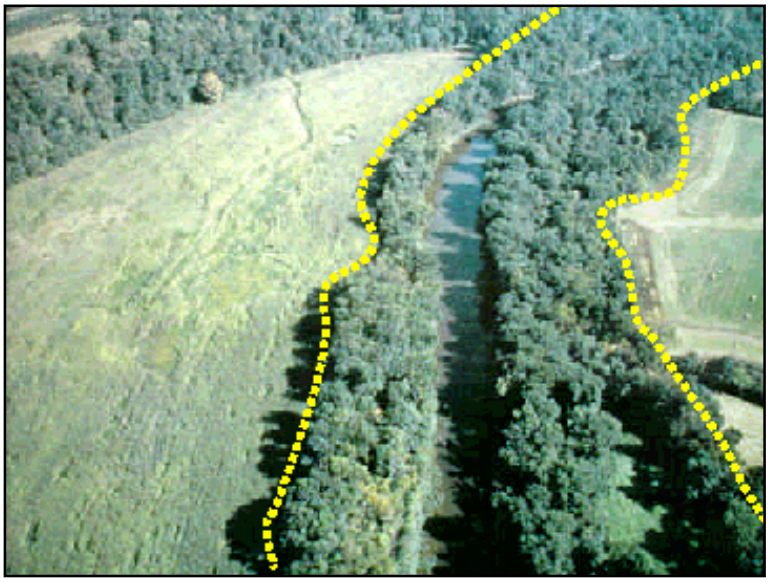
Vegetated Filter Strips
These areas can be the third zone of a riparian buffer or they can stand alone. For adequate pollution prevention, widths from 35 to 300 feet may be needed, depending on the site characteristics and the pollutants of concern.

grasses and woody plants are effective groundwater denitrifiers (they utilize the nitrogen, removing it from the groundwater), and trees remove large quantities of phosphorus from soil and water.

- Shading surface water. Buffers provide shade for narrow stream segments during the summer heat, helping to maintain a safe water temperature range for aquatic life.

- Bank stabilization. The deep root systems of trees and shrubs provide soil stabilization.

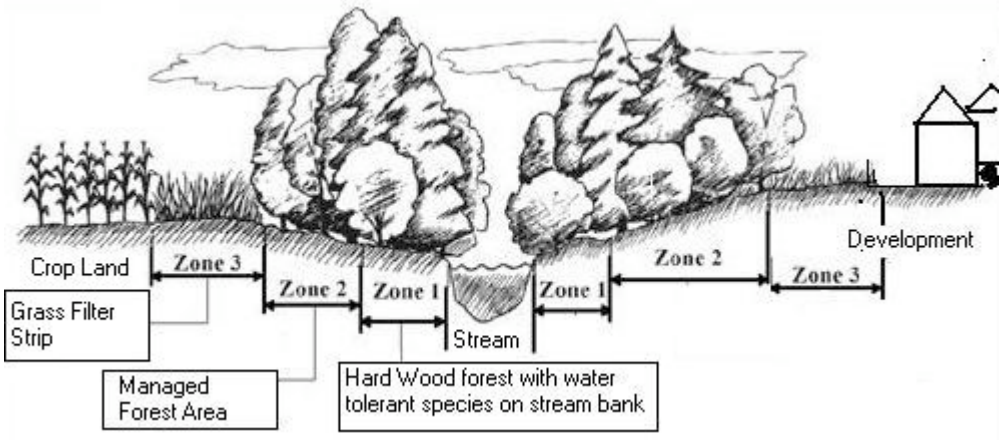
- Habitat. Buffers provide excellent habitat for many different species. Within buffers there is food, shelter, and close proximity to water. Debris from streamside buffers provides organic matter for the aquatic food chain.



Natural riparian buffers are areas of wooded land adjacent to water resources.

- Habitat connectivity. Riparian corridors can connect diverse habitat types, from tidal wetlands to interiors of upland forests and perhaps across the peninsula to tidal wetlands again, allowing animals to move along them and utilize much larger habitats.

- Recreational opportunities. Riparian buffers increase the scenic quality of the landscape. They are wonderful for hiking, biking, bird-watching, and other outdoor activities.



Three-Zone Riparian Buffer, adapted from *USDA NRCS Riparian Forest Buffer Conservation Practice Job Sheet 391.*

Buffers don't act alone. For riparian buffers to function properly, it is advisable to keep impervious cover to a minimum and, if at all possible, separate impervious areas with infiltration opportunities such as rain gardens or grassed swales. When construction starts, minimize lot disturbance and damage to existing buffers. Protective riparian buffers are just one part of low-impact development, and for optimal function they should be used in concert with other BMPs highlighted in this manual.

Good Practices for Local Governments

Plan and Minimize

When reviewing new development proposals, consider that the less that is disturbed during construction, the less you will have to fix afterwards. Existing riparian areas should be maintained. Some planning questions include the following: How wet is the soil on-site? Is it safe to build there without adding fill, a practice that alters the hydrology of the site and reduces the effectiveness of wetlands and riparian buffers? Does the site contain a wetland that should be protected? How can buffers be utilized within this project?

When revegetating a stream bank to create a new riparian buffer, choose native plant communities, which are naturally adapted to the local conditions and require little maintenance. Construction vehicles should be kept out of riparian areas to reduce chances of soil compaction.

A three-zone riparian buffer is more effective at pollution reduction than a simple grass filter strip, but site characteristics might sway you to one option over the other. Additionally, the following site characteristics may lead to increased buffer widths needed for water pollution prevention:

- Steep slopes
- High sediment loads
- Dense soils (from tillage or compaction)
- Altered hydrology on-site such as concentrated flows or subsurface drains

Mitigate and Maintain

Trees and their associated plant communities in Zone 1 of a riparian buffer are the first line of defense to protect water and should not be disturbed. Recreation should be discouraged from this area, and access to the water should be guided to specific points. Woody debris should not be removed from this portion of the buffer, and only the stability of selected water access points needs to be maintained.

Zone 2 is the forested area where trails for recreation activities can be located. This area can also be managed to provide forest products if desired. If no harvesting is to occur in this area, woody debris should be left in place.

Did You Know?

Not all runoff is appropriate for buffers.

Concentrated overland flow (flow out of a gutter, pipe, or in a channel) can cross a 50-foot buffer in 1 minute, too fast for any water treatment to occur.

Sheet flow (dispersed surface flow) is desirable for buffers, where flow takes up to 20 minutes to cross a 50-foot buffer. When designing a riparian area, it is important to ensure that no concentrated flow is directed at the buffer and that sheet flow can occur.

Natural obstructions to flow — vegetation, woody debris, rocks, etc. — within the buffer are good at decreasing flow velocity and should be left in place. Avoid paving trails; keeping impervious areas out of the buffer should be a priority.

The final zone furthest away from the water body is Zone 3, comprised of grasses and sometimes shrubs. This area is mowed infrequently, potentially once every three years to keep down encroachment of invasive species. If uses other than trails, such as a picnic area, are planned for Zone 3, mowing should occur no more than two to three times a growing season. It is important to plan who is responsible for the mowing before the project is under way.

What to Plant?[3]

Streamside Trees	Zone1 and 2 Trees	Zone 1 and 2 Shrubs	Zone 3
silver maple	American beech	arrowwood	warm or cool season grasses
black willow	bald cypress	bayberry	switchgrass - primary
eastern cottonwood	basswood	elderberry	indiangrass
green ash	butternut hickory	maple-leaf viburnum	big/little bluestem
sycamore	sweetgum	red chokeberry	wildflowers
	white ash	spicebush	black-eyed susan
	red maple	swamp azalea	purple or grey-headed coneflower
	tulip polar	winterberry	clover and other legumes

For more potential riparian plants go to *www.agnr.umd.edu/MCE/Publications/Publication.cfm?ID=13&cat=N*

What not to plant

For a list of plants not native to Delaware go to *www.dnrec.state.de.us/fw/nonnative_plants03.pdf*

Tradeoffs

Developer and Property Owners

Costs:

- Technical surveys and reports
- Buffer delineation
- Loss of developable land
- Buffer restoration
- Buffer protection during construction

Benefits:

- Increased property values
- Low-maintenance stormwater management
- Stream bank stabilization and control
- Increased diversity of wildlife
- Increased recreational opportunities

Local Government

Costs:

- Staff training
- Staff time
- Public education efforts
- Technical assistance to developers and land owners

Benefits:

- Increased property values
- Low-maintenance stormwater management
- Stream bank stabilization and erosion control
- Reduction in flood damage
- Groundwater recharge
- Preservation of wildlife habitat
- Increased recreational opportunities
- Preservation of drinking water quality

Questions to Ask During the Development Process

- Where are the well heads, excellent recharge areas, wetlands, streams, waters, flood plains, and other resources such as slopes that need to have natural buffers for protection?

- Are riparian buffers a good fit to meet Total Maximum Daily Loads (TMDLs) or protect sensitive water bodies in your watershed?

- Are there existing buffers on the site that can be maintained, or are new buffers being constructed?

- If new buffers are being constructed, what is the appropriate size and vegetation type for the proposed project? (Note: The same project on two different sites may benefit from different buffers. This is where it is important to know about soil type, depth to groundwater, type of water body the project borders, etc.)

- Are the buffers within the property lines or are they part of the community open space?

- How do you intend to educate homeowners about their role in maintaining the buffer?

- With the knowledge that all management practices need to be maintained, how will buffer maintenance be scheduled and budgeted for?

- Do you want to provide a healthy environment to your constituents in a way that costs a minimum of tax dollars to institute and administer and provides environmental benefits permanently?

For Further Information

A simple Google search on “riparian buffer” will turn up a wealth of information. Some very useful sites are listed below:

Designing Buffers

www.agnr.umd.edu/MCE/Publications/Publication.cfm?ID=13&cat=N
This is a good reference because information provided is relevant to Delaware.

Incorporating Buffers Into Development Plans

www.crjc.org/buffers/Guidance for Communities.pdf
This is a guideline for town planners on how to incorporate riparian buffers into future development plans. Though it is for the Connecticut River and not specifically for Delaware, it is still a very good resource.

State Government Site

www.dnrec.state.de.us/dnrec2000/divisions/soil/dcmp/riparian.htm
Information on Delaware’s Riparian Buffer Initiative links to a riparian buffer brochure and riparian buffer workshop summary that took place in 2000. There is also contact information for the DNREC personnel in charge of the Riparian Buffer Initiative Program.

Federal Government Site

www.nps.gov/cue/programs/aquaticecology/stream_restoration_course/cd/references/tech_notes/RiparianBuffer.pdf
This is the Natural Resources Conservation Service (NRCS) definition of a riparian buffer. There is information on what can be expected from riparian buffers and what maintenance is needed.

References

1. DNREC(a). Delaware’s Pollution Control Strategy. DNREC Online, *www.dnrec.state.de.us/water2000/Sections/Watershed/ws/impaired.htm* Data retrieved March 1, 2003.

2. DNREC(b). Wetlands. DNREC Online, *www.dnrec.state.de.us/dnrec2000/Divisions/Water/Wetlands.htm* Data retrieved March 1, 2003.

3. Tjaden, R. L. and G. M. Weber. 1999. *FS-725 Riparian Forest Buffer Design, Establishment, and Maintenance.* University of Maryland College of Agriculture and Natural Resources Extension Services. *www.agnr.umd.edu/MCE/Publications/Publication.cfm?ID=13&cat=N*

4. Planning & Managing Open Space

Planning for and Managing Open Space and Natural Areas

Increasingly, development proposals in Delaware include large amounts of open space and natural areas. While open space is important as a community amenity and for resource protection, management of these areas can be challenging and expensive. This chapter will define open space, explain its importance, and provide guidelines for locating and managing open space.

Open space is land set aside during the development process. Land is commonly set aside for recreation and stormwater management purposes, but can also be set aside for natural resource protection, preservation of cultural and historic resources, preservation of scenic vistas, and many other reasons. Land set aside for recreation is commonly referred to as "active open space," while land set aside for most other purposes is referred to as "passive open space." Passive open space often includes stream buffers, forested areas, floodplains, wetlands, areas of steep slopes, and other areas that are inappropriate for development or are of conservation concern.

Due to new techniques for residential development design and increasing environmental restrictions, development proposals are including large acreages of open space. Long-term management and maintenance of these areas sometimes are the responsibility of the municipality, but most are managed by homeowners' associations or maintenance corporations who have limited financial and technical resources to address this challenge. Mowing costs alone for some developments run in the tens of thousands of dollars per year.

Benefits of Open Space

Water quality protection and flood prevention. Wetlands and vegetated stream buffers retain flood waters and reduce the amount of pollutants entering streams. Groundwater supplies are replenished in places where water soaks into the soil and reenters aquifers.

Wildlife and native plant habitat. Natural areas set aside as community open space provide important habitat for native plants and animals. Large wooded tracts are particularly important to native species, including many types of songbirds and woodpeckers, salamanders, and native orchids. Large meadow areas are also needed to support many native birds, including bobwhite quail, eastern meadowlarks, and grasshopper sparrows.

Forest Fragmentation

The US Forest Service estimates that Delaware lost ***more than 20,000 acres*** of forest land between 1986 and 1999. Large tracts of forest, those 25 acres or larger, are becoming increasingly rare in Delaware. It is well known that trees help clean the air and water and provide shade and habitat for wildlife. But as large forests become smaller, their value decreases, particularly for wildlife. As large tracts of forest are cut, the forest "edge" normally increases. Forest edge provides habitat for deer, squirrels, rabbits, and many common bird species but is also susceptible to invasion by aggressive plant species that take over and greatly reduce the forest quality. Many of Delaware's rare and endangered species of plants, birds, and animals depend on forest "interior," generally the area of forest 300 feet or more from the edge, where invasive species cannot reach and dense vegetation provides the special conditions needed for breeding and foraging.

Forest fragmentation occurs when large, unbroken areas of forest are split into separate, smaller parcels of forest habitat, reducing "interior" forest and increasing forest "edge." Development activities that require the clearing of trees and building of roads, stormwater management facilities, and houses can drastically impact forest quality and habitat by increasing forest edge.

Air quality improvement. Wooded open spaces absorb carbon dioxide and pollutants from the atmosphere and provide shade, reducing air pollution levels and cooling the air.

Recreational opportunities. Active open space provides obvious recreational benefits. Natural areas set aside as passive open space provide opportunities for hiking, fishing, and bird-watching. For children, wooded areas and streams are natural playgrounds that encourage physical activity and imagination.

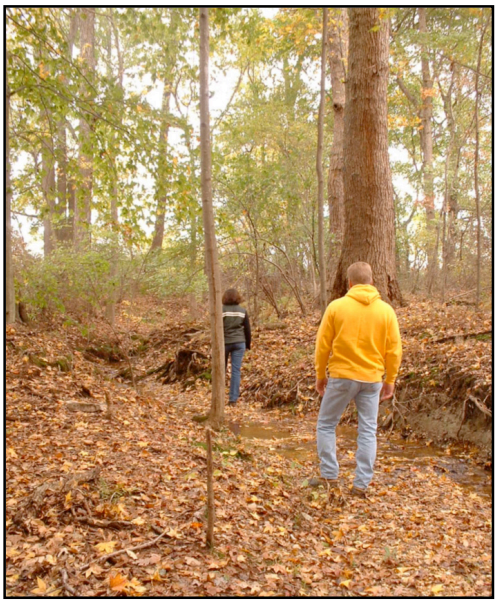
Sense of place. Open spaces help define the character of a region and contribute to the residents' sense of belonging.

Social benefits. Both active and passive open spaces provide areas for neighbors to meet and interact, strengthening community ties.

Increased home values. Extensive open spaces and forests increase property values and marketability because they enhance appearance and provide recreational opportunities.

Health benefits. Studies have shown that wooded areas and trees help contribute to an overall feeling of well-being and serenity. They also can contribute to physical well-being by providing opportunities for walking and jogging in a natural setting.

Screening and noise reduction. Wooded areas and trees provide screening from adjacent land uses and may reflect and absorb sound energy.



This mature forest was preserved as part of community open space in New Castle County and is popular with residents for walking and jogging.

Locating Open Space and Natural Areas within a Development Plan

A natural resource assessment should be the first step of the design process for a new development project. This inventory will show areas of the parcel where special resources exist, where development constraints are located, and where development is most appropriate.

From this, areas protected from development activities by federal and state regulations and local land-use ordinances should be clearly delineated. For example, federal and state regulations prohibit disturbance to tidal wetlands without permits, and federal regulations require that land within a certain radius of a bald eagle nest remains undisturbed. Local land-use ordinances might prohibit construction within floodplains or within a stream buffer zone. These areas are clearly off-limits to development activities.

To the extent possible, natural and cultural resources on a development site, whether protected by ordinance or not, should be conserved. However, it is not always possible to conserve every resource and meet the housing goals of the region or the economic requirements for development. The following guidelines should be considered when determining the location and extent of passive open space on a parcel:

- Maximize areas of contiguous forest. Lot lines should be drawn to avoid fragmenting forest blocks.

- Preserve high-quality habitats, such as mature forests and Delmarva Bays, prioritizing their preservation over lower-quality habitat.

- Adequate riparian buffers of no less than 100 feet from water bodies and wetlands should be maintained or installed. In many cases, 300 feet or more is recommended for purposes of providing adequate wildlife habitat.

- Use “green technologies” for stormwater management that utilize the natural contours and features of the landscape to direct and infiltrate runoff (see Chapter 5 — Managing Stormwater for more information on green technologies).

- Minimize areas of turf grass. Seek opportunities for meadow or forest restoration.

- Meet regional needs for recreation such as hiking and bird-watching as identified in the Statewide Comprehensive Outdoor Recreation Plan.

- Ensure that the goals of the municipality’s comprehensive plan are being met.

This development design maximized lots with wooded backyards, but in doing so, significantly fragmented the forest, limiting its value for wildlife.

Designation of active open space should consider the needs of the residents of the new development and the region as a whole. For example, tot-lots containing play equipment for young children may be more appropriate than basketball courts in new neighborhoods that target first-time homebuyers. Active open space should be centrally located and easily visible. Active open space that backs to backyards should be avoided, as should large areas of turf grass with no dedicated purpose as these areas are costly to maintain and not well used.

Managing Open Space

The work is not over once active and passive open spaces have been designated on the final site plan! While open space is a community and regional asset and provides many environmental, economic, cultural, and social benefits, many municipalities and homeowners' organizations are surprised by maintenance responsibilities and costs.

To reduce costs, many county and municipal governments have delegated the responsibility for managing community recreation areas, natural areas, and stormwater management facilities to a homeowners' association or maintenance association. While this puts management decisions in the hands of those who most use and benefit from the open space, homeowners' organizations rely on funding from residents that can be difficult to collect. In addition, the turnover rate of board members is usually high. This results in poor understanding of open-space management options and management decisions that have been made previously. To combat this, municipalities can

- Take an active role in community open-space management by accepting maintenance responsibilities of community open space or designating a staff member to assist homeowners' associations with making decisions and managing open space.

- Ensure that long-term maintenance costs are reduced by minimizing turf grass and maximizing low-maintenance open spaces like forest and meadows.

- Require that developers establish open-space maintenance plans that specify management techniques, stormwater maintenance schedules, mowing schedules, invasive species control, etc.

- Establish a long-term, stable funding mechanism.

Each type of open-space land use has benefits and drawbacks. Turf grass is necessary in areas with high foot traffic, like playgrounds and soccer fields. Most people are accustomed to and like the look of traditional lawn; however, maintenance is extremely expensive and can increase nonpoint source pollution if fertilizer and herbicides are applied. In addition, turf grass has little environmental or habitat value. Replacing turf grass with warm or cool season grasses that require mowing only once or twice a year saves money, provides great habitat for birds, and can increase water quality by filtering pollutants. Unfortunately, it has limits for active recreation. In addition, many people are unaccustomed to tall grasses and may have concerns. Mature forest normally requires virtually no maintenance and has wide acceptance by residents. However, occasional maintenance should include invasive plant species control and trail maintenance, if trails are provided.

Conservation Easements

A conservation easement protects the natural, scenic, and historic value of a property by restricting some of the uses of that property. Terms of the easement will vary from site to site. Typically, though, for residential developments, a conservation easement would restrict cutting trees or building structures within a forest but would allow hiking trails, a dock for fishing, etc.

Conservation easements are "held" by a third party who agrees to enforce the restrictions. In Delaware, conservation easements can be held by the Department of Natural Resources and Environmental Control, the Department of Agriculture, or nonprofit organizations such as the Sussex County Land Trust. Conservation easements benefit both the landowner and the holder of the easement. Obtaining the easement helps fulfill the conservation goals of state and nonprofit agencies, while easing the burden of maintenance on the property owner.

Natural areas conserved on-site as passive open space should be deed restricted to prevent future development and infringement by homeowners. Placing permanent markers or signs on the edge of these areas is highly recommended to remind residents that it is a community area. When possible, these areas should be placed into a permanent conservation easement.

Good Practices for Local Governments

Plan

- Create a town open-space plan, showing areas important for conservation, environmental protection, and town identity. Solicit public opinion and make the plan widely available.
- Require that development proposals include a natural resource assessment.
- Adopt ordinances that require conservation of priority natural resources.
- Adopt ordinances that encourage use of natural landscaping and provide outreach to communities and developers.

Minimize

- Ensure that long-term maintenance costs are reduced by minimizing turf grass and maximizing low-maintenance open spaces like forest and meadows.
- Locate passive open space within and adjacent to natural resource areas.
- Ensure no less than 100 feet of forested buffer zone around water bodies and wetlands.

Mitigate

- Minimize forest fragmentation and “edge effects” by reducing lot sizes and pulling lots and infrastructure out of forested areas.
- If 100-foot forested buffers do not exist, designate adequate open space and revegetate.

Maintain

- Take an active role in community open-space management and establish a long-term, stable funding mechanism.
- Require that developers establish open-space maintenance plans that specify management techniques, stormwater maintenance schedules, mowing schedules, invasive species control, etc.
- Require conservation easements or deed restrictions for natural areas in designated open space.

Community open-space area in traditional turf grass as compared to open space managed as a meadow.

Questions to Ask During the Development Process

- What are the natural and cultural resources on-site? Are they of regional or local importance or a component of a natural corridor?
- What are the recreational goals of the development, town, and region? Can they be met, in part, by the proposal?
- Has preservation of existing natural and cultural resources been maximized? Has use of turf grass been minimized?
- Are open-space areas connected within the parcel? Are they connected to open spaces adjacent to the parcel?
- Is forest fragmentation minimized?
- What are the long-term costs of open-space maintenance and who will be responsible?
- Will the passive open space be placed into a conservation easement?
- What will the deed restrictions be on natural areas, recreation areas, and stormwater facilities?

Technical and Financial Assistance for Managing Open Space

Technical and financial assistance is available from the following organizations:

Delaware Department of Agriculture, Urban and Community Forestry Program provides technical assistance and funding for publicly owned forests and assists developers, planners,

and engineers with tree preservation efforts during the development process. *www.state.de.us/deptagri/forestry/conser.shtml* (302) 698-4500

DNREC Division of Soil and Water Conservation, Sediment and Stormwater Program manages stormwater through permitting, education, and technical assistance. *www.dnrec.state.de.us/DNREC2000/Divisions/Soil/Stormwater/StormWater.htm* (302) 739-9921

DNREC Division of Soil and Water Conservation, Delaware Coastal Programs administers a grant program for natural resources planning and management projects specifically aimed at municipalities. *www.dnrec.state.de.us/dnrec2000/Divisions/Soil/dcmp/index.htm* (302) 739-9283

DNREC Division of Fish and Wildlife, Landowner Incentive Program provides technical assistance funding for habitat restoration projects that protect rare and endangered species. *www.dnrec.state.de.us/fw/landowner/delip.htm* (302) 653-2880

DNREC Division of Fish and Wildlife, Natural Heritage Program maintains a database of rare and endangered species in Delaware and will review site plans and provide conservation recommendations. *www.dnrec.state.de.us/nhp* (302) 653-2880

DNREC Division of Parks and Recreation, Planning Preservation and Development Section administers grants programs for park development and will hold conservation easements on high-priority natural resource lands. *www.destateparks.com/know/division/index.htm* (302) 739-9235

County Conservation Districts provide technical help and cost sharing for restoration projects. Sussex County, (302) 856-3990; Kent County, (302) 741-2600; New Castle County, (302) 832-3100

For Further Information

The State of Delaware Statewide Comprehensive Outdoor Recreation Plan (SCORP) contains extensive information about Delaware residents' recreational needs and desires by region. Available on-line at *www.destateparks.com/SCORP/SCORP_2-2-04.pdf.*

Five Simple Steps to Maintaining and Enhancing Community Open Space and Stormwater Management Areas. Delaware Department of Natural Resources and Environmental Control. September 2004. Sediment and Stormwater Program. Dover, Delaware. 39 pp.

Conservation Subdivisions: A Better Way to Protect Water Quality, Retain Wildlife, and Preserve Rural Character. Nonpoint Education for Municipal Officials. NEMO Project Fact Sheet 9. Available on-line at *nemo.uconn.edu/publications/fact_sheets/nemo_fact_sheet_9_s.pdf.*

Carving Up the Landscape: Habitat Fragmentation and What to Do About It. Nonpoint Education for Municipal Officials. NEMO Project Fact Sheet 10. Available on-line at *nemo.uconn.edu/publications/fact_sheets/nemo_fact_sheet_10_s.pdf.*

5. Managing Stormwater

Managing Stormwater

Land use in the United States has dramatically changed in the past 25 years. As natural areas are developed and turned into parking lots, driveways, and houses, more impervious surfaces are created, generating increased amounts of polluted runoff. This increased volume of runoff enters streams at a much faster rate than previously. In a natural setting, rain falls on vegetation and is either captured by plants or infiltrated into the soil. In a developed community, stormwater runoff can cause flooding that is known to scour streambanks and cause erosion. The water that runs over lawns, ball fields, roofs, parking lots, and golf courses collects and deposits pollutants such as oil, sediment, fertilizers, trash, debris, and chemicals into nearby waterways. Managing stormwater to prevent pollution and flooding is a key aspect of most development projects.*

Stormwater runoff contains pollutants

Polluted runoff harms wildlife

Excess runoff causes flooding

The Importance of Stormwater Management

Stormwater management is the science of managing stormwater runoff to prevent adverse impacts on the environment. The main goal is to manage water quantity in addition to protecting water quality. For development in the last 20 to 30 years, the construction of stormwater management ponds (or basins) on the site has been the preferred stormwater management practice. Initially, the focus was on managing the rate of runoff from a development to prevent flooding and erosion. More recently, ponds were modified to address water quality issues in addition to quantity concerns. The concept is simple: convey stormwater runoff to a containment area where nonpoint source pollutants, such as sediment, can settle out. Clean water can then be slowly released into the nearest waterway. These facilities were typically one of three types: wet ponds, infiltration basins, and dry ponds. Recently, another category of stormwater management facilities has become widely used. They are collectively referred to as “green technology” and address water quality through more natural means such as infiltration.

*The Delaware Sediment and Stormwater Regulations require that all land-disturbing activities greater than 5,000 square feet in area are carried out according to an approved plan.

Stormwater Management Practices

Wet Ponds

Wet ponds, also called stormwater ponds or retention ponds, typically look just like an ordinary pond, with the exception that they are specifically designed to manage stormwater and have a fairly standardized design. Wet ponds contain a permanent pool of water that is a minimum of three feet deep. The outlet structure of a wet pond is above the surface of the water, ensuring that the pond stays full. Stormwater discharges from the pond only when the water level rises over the outlet as a result of runoff from a rainstorm. In addition to managing water quantity issues, wet ponds also improve water quality. Prolonged storage of stormwater allows sediment to settle out, improving the quality of the discharged runoff. Eventually, the water level in the pond goes back to where it was before the storm.

Infiltration Basins

Infiltration basins are designed so that stormwater eventually soaks into the ground, imitating natural conditions and recharging groundwater supplies. In addition to recharging groundwater, infiltration basins also trap pollutants, making them a highly valued stormwater management tool. Site conditions must be right in order for infiltration basins to work properly. For example, a high water table or soils with high clay content will prevent runoff from sufficiently infiltrating through the soil. It is a requirement that infiltration basins be dry within 48 hours after a storm.

Dry Ponds

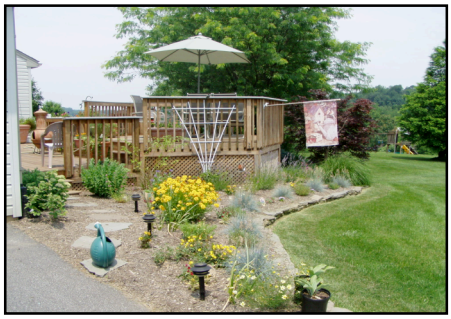
Dry ponds, or dry detention ponds, are containment areas for stormwater runoff that remain dry except after rainstorms, when runoff is conveyed to them. An outlet structure is built into dry ponds to allow stormwater runoff from a recent storm to drain slowly into a nearby stream or waterway. It operates similarly to a bathtub with a partially blocked drain. When water is flowing into it, the tub continues to fill up, even though some water is getting out through the drain. Dry ponds are designed so that all of the water has drained after about 48 hours. During dry periods, the facility usually looks like a depressed area with grass growing on the bottom and side slopes. Dry ponds are designed to manage water quantity only, and their water quality benefits are minimal. Dry ponds are not a preferred best management practice in the state of Delaware because of this reason.

Green Technology and Low-Impact Development

Scientists and engineers are currently designing and promoting new stormwater management techniques called “green technology” best management practices. They are proven to mimic natural processes, require less maintenance, and enhance local property values. Green technology BMPs are typically incorporated into the landscaping, so most people don’t even realize when they see them. Green technology BMPs are designed to address water quality. In many instances they must be used in combination with more traditional practices, such as ponds, to prevent flooding and erosion. The term “low-impact development” is a type of development that incorporates several components of green technology BMPs.

Bioretention Cells

First developed by the Prince George's County, Maryland, Department of Environmental Resources, bioretention is a BMP that uses plants and soils to remove pollutants and allow recharge of groundwater by water infiltration. Although it has the appearance of a landscaped island, it is designed to temporarily store and treat stormwater runoff.



Rain Gardens

Rain gardens are a type of bioretention cell that is commonly used by homeowners to promote the absorption of rooftop rainwater into the ground. Rain barrels can also be used to collect rainwater from rooftops. This water can then later be used to water plants during a dry period.

Filter Strips and Riparian Buffers

Filter strips are vegetated areas set aside to absorb water. Similarly, riparian buffers are strips of vegetation planted along a stream or waterway. This vegetation filters pollutants from the water before it enters into the water body. Both are effective at absorbing stormwater and filtering pollutants.

Bioswales/Biofiltration

These shallow impoundments are designed to infiltrate runoff into the soil and recharge groundwater. They also remove pollutants from the stormwater as it is conveyed downstream.

Porous Pavement and Pavers

Using either porous pavement or paving stones is one alternative to using concrete where large quantities of water runs off instead of infiltrating into the ground. This type of infiltration practice can be used in parking lots, roads, sidewalks, and other paved areas. Note that porous pavement systems are not suitable for all applications. Since porous pavement only works in low-traffic areas, it is a useful tool for residential driveways and streets and commercial parking areas.

Manufactured BMP Devices

With ongoing research, new BMPs are constantly emerging. In addition to the BMPs described above, a number of different types of manufactured treatment devices are available for postconstruction stormwater management. Manufactured or proprietary technologies can be classified into several broad categories:

- Hydrodynamic separator systems (such as Vortechs, Stormceptor, Baysaver)
- Filtration systems, including in-line filtration systems (such as sand filters and StormFilter) and a large variety of catch basin inserts
- Sediment containment devices such as baffle boxes
- Stormwater underground storage tanks
- Fabricated underground piping systems
- Porous pavement materials

With a growing number of manufactured products emerging for stormwater quality management, selecting devices that are appropriate for particular development situations can be challenging. Although some of the newer devices have been relatively untested, some information about these devices, their costs and maintenance requirements, and how best to use them can be found on manufacturers' web sites and in BMP manuals such as those listed in the reference section of this chapter.

Good Practices for Local Governments

Plan

- Require the identification of critical natural resources on a site prior to laying out the proposed development. This will aid in designing a stormwater management system that takes advantage of the natural features of the site and minimizes stormwater management facility construction.

- Strongly encourage the protection of riparian buffers and wetlands.

- Look at total watershed drainage patterns, not just those at the project site. Encourage the development of hydrologic and hydraulic (referred to as H & H) models for individual watersheds. These models help to identify what discharges could be tolerated from a specific area within a watershed without causing downstream flooding.

- Encourage designers to perform a downstream analysis to ensure that the receiving waterway can accept drainage from a development site without causing flooding or stream bank erosion.

- Inform owners of proposed development parcels that a sediment and stormwater plan must be approved prior to construction for all land-disturbing activities greater than 5,000 square feet in area. The approval process can take time, so it needs to be built into any development schedule.

- Provide stormwater easements or drainage right-of-ways when the proposed subdivision is crossed by a watercourse or drainage way.

Minimize

- Promote designs that disconnect impervious surfaces and channel runoff to vegetated and other porous areas.
- Encourage on-site infiltration of water rather than diversion by impervious roads, parking areas, and drainage structures. Diverted stormwater alters the natural hydrologic cycle, discourages groundwater recharge, and generates increased runoff and flooding.
- Development should retain the natural landscape by minimizing grading and disturbance of existing vegetation. Encourage stormwater management systems that utilize existing vegetation and natural drainage patterns.
- Promote the use of green technology stormwater management BMPs.
- Permit shared and porous paved driveways and sidewalks.
- Drainage from roads, parking lots, and roofs should be carried on the surface in shallow, gently sloping swales. Swales regulate velocity, minimize erosion, filter runoff, and maximize percolation. Also, stormwater should be carried as sheet drainage, diffused over large surfaces as opposed to concentrated drainage directed to curbs, storm sewers, or ditches.

Mitigate

- Where pipes are used, encourage perforated over closed pipes to allow leaching or filtration.
- Educate citizens regarding environmentally friendly landscaping and lawn care.
- Educate residents concerning pollution prevention practices such as not dumping oil, trash, debris, or grass clippings into storm drains, swales, and ponds.

Maintain

- Encourage long-term maintenance of stormwater management BMPs.

Tradeoffs

Stormwater management is essential in order to prevent flooding, minimize erosion, and meet water quality standards required by law. Although not designed to address problems associated with catastrophic storms, the BMPs discussed above have proven to be effective for the more common rainfall events. These practices have drastically reduced the pollutants entering our streams and ponds from developing areas. Stormwater management techniques for new construction must continue to evolve in an effort to improve performance. Neglecting water

quality and quantity problems in areas of the state that were developed prior to any stormwater management regulations will also result in a failure to meet national standards.

The long-term benefit of addressing stormwater from new and existing development greatly outweighs the initial cost. There will be a decrease in overall dredging and disposal costs due to reduced sedimentation, less frequent stream channel repairs, reduced flood damage and repair costs; decreased drinking water treatment costs, improved waterway aesthetics, increased tourism and tourist dollars, and potentially positive impacts to the commercial fishing and shellfishing industries.

Questions to Ask During the Development Process

- Does this proposed development minimize disturbance of the identified natural resources?
  Overall disturbance should be minimized in order to lessen the impact on the environment.

- Has there been an attempt to incorporate green technology BMPs into the stormwater management plan?
  Green technology BMPs should also be used whenever possible to lessen the impact on the environment.

- What are the impacts upstream and downstream of the site?
  It is crucial to consider this question when developing a site. For example, drainage patterns may change which can negatively impact an adjacent landowner.

- Is there an approved sediment and stormwater plan for every soil-disturbing activity greater than 5,000 square feet (not including agricultural land management)?
  Every land-disturbing activity over 5,000 square feet must have an approved sediment and stormwater plan. These plans must be submitted to the DNREC-approved delegated agency, specified by location:
    - *Kent County — Kent Conservation District*
    - *Sussex County — Sussex Conservation District*
    - *New Castle County (varies by location)*
        - *City of Newark — within city limits*
        - *City of Wilmington — within city limits*
        - *Town of Middletown — within town limits*
        - *New Castle Department of Land Use — all unincorporated areas of New Castle County*
        - *New Castle Conservation District — all incorporated areas of New Castle County (except city of Newark, city of Wilmington, and town of Middletown).*

  These plans are then reviewed by engineers who ensure that they are built to the proper capacity and built safely.

- Is there an entity (e.g., a homeowners' association) in place to deal with stormwater management issues and future facility maintenance?

  Because it is the property owner's responsibility to maintain stormwater management facilities on that land, a homeowners' association would be responsible for any publicly owned land within a development, including stormwater ponds. The collection of dues is crucial, not only to maintain open space, but also to maintain stormwater management facilities.

- Have you considered the differing maintenance needs/costs for different types of stormwater facilities?

  Different types of facilities require varying degrees of funding and maintenance. For further information on maintenance costs, please contact the DNREC Sediment and Stormwater Program at (302) 739-9921 to obtain your free guide, Five Simple Steps to Maintaining and Enhancing Community Open Space and Stormwater Management Areas.

For Further Information

Center for Watershed Protection, Stormwater Manager's Resource Center

www.stormwatercenter.net/

Delaware Department of Natural Resources and Environmental Control

Five Simple Steps to Maintaining and Enhancing Community Open Space and Stormwater Management Areas. September 2004. Sediment and Stormwater Program. Dover, Delaware. 39 pp.

Green Technology: The Delaware Urban Runoff Management Approach.

Nonpoint Education for Municipal Officials

Factsheet 4: Strategies for Coping with Polluted Runoff
nemo.uconn.edu/publications/index.htm#factsheets

Technical Paper 1: Addressing Imperviousness in Plans, Site Design and Land Use Regulations *nemo.uconn.edu/publications/index.htm#factsheets*

Twin Cities Metropolitan Council

Urban Small Sites Best Management Practice (BMP) Manual. 2001. (Includes detailed information on 40 BMPs that are aimed at managing stormwater pollution for small urban sites. The goal of the manual is to support the principles of accommodating growth while preserving the environment.)
www.metrocouncil.org/environment/Watershed/BMP/manual.htm

New Castle County Department of Land Use

Water Management Code Background White Papers. 2004.

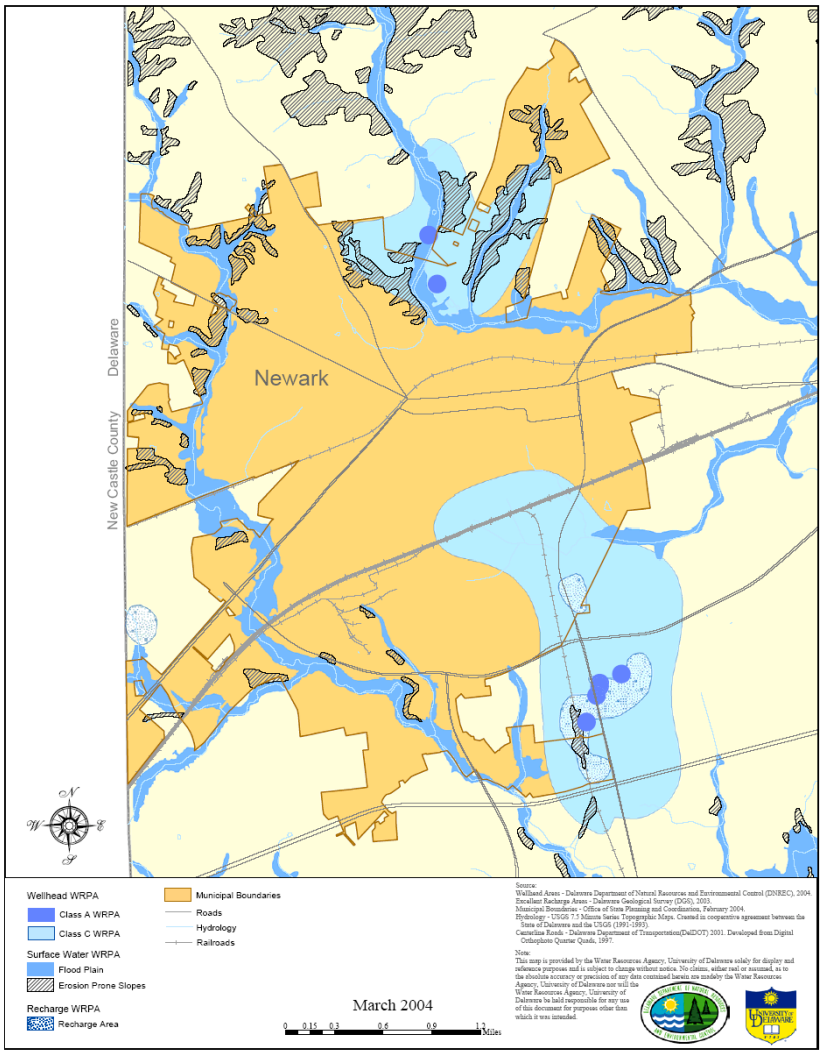
U. S. Environmental Protection Agency Web Site

Post-construction Stormwater Management in New Development and Redevelopment.
cfpub1.epa.gov/npdes/stormwater/menuofbmps/post.cfm

6. Source Water Protection

Source Water Protection*

The protection of source water resources (ground and surface water supplies used for drinking and food production) is critical to the economic and environmental health of Delaware and its citizens. Delaware has a finite, albeit renewable, supply of freshwater and as such, protection of public drinking water supplies becomes extremely critical as use increases. Delaware's Source Water Protection Law requires county governments and municipalities with year-round populations of 2,000 or more to develop maps delineating source water assessment areas including surface water, wellhead protection, and excellent groundwater recharge areas. An example of a water resource protection area map is shown at right.



City of Newark Water Resource Protection Area Map

The Source Water Protection Law also requires these governments to create regulations governing the use of land within those critical areas as part of the 2007 updates to their comprehensive land-use plans. While it is mandatory for these groups to regulate the use of land within source water protection areas, **all** local governments and private landowners have a responsibility to assure water quantity and quality is protected and available for future use.

Importance and Benefits of Source Water Protection

From a public health, environmental quality, economic development, public finance, and quality of life perspective, there are few things more important for local governments to ensure for their residents than source water protection. Threats to the quality and quantity of our drinking water sources are increasing, and potential pollution isn't easy to target. Today, our largest threat to drinking water no longer flows from a pipe but comes from materials found on the land such as fertilizer, septic tanks, and animal waste that is carried to our source water supplies by rainwater or snowmelt. From short-term disease outbreaks linked to contaminated drinking water to

*This chapter is taken from segments of the *Source Water Protection Guidance Manual for the Local Governments of Delaware,* "A Toolbox for Protection of Public Drinking Water Supplies in Delaware," written by the University of Delaware, Institute for Public Administration, Water Resources Agency in concert with DNREC.

restrictions on water use during drought periods, we can no longer take our drinking water for granted. Technology alone cannot ensure that our water supplies will meet our need for clean drinking water.

Good Practices For Local Governments

Due to the increasing threat to source water supplies from materials on the land, the following best management practices (BMPs) are a critical tool to protect these resources. Source water protection BMPs minimize the impact of land-use changes and other human activity on the natural environment by effectively reducing the volume of runoff leaving a site, maintaining the volume of natural recharge, and preventing the discharge of pollutants into the source water system.

Land-use tools, such as zoning ordinances and building codes, are often the most effective way to protect surface and groundwater sources. These tools provide flexibility to economically develop land parcels in environmentally sensitive ways given the unique opportunities and constraints of each property.

Zoning ordinances

Local governments can use a variety of alternative zoning tools in a zoning ordinance to protect surface and groundwater sources. These tools are usually implemented through the ordinance, but some may require state enabling legislation. Examples of zoning tools include the following:

Buffer and setback zoning designates linear or circular areas of land along the edges of streams, rivers, or reservoirs upstream of community water supply intakes. This tool is an important protection mechanism since land-use restrictions in the zones reduce the adverse impacts of surface water runoff on drinking water sources.

Cluster development provides options for grouping units in a portion of the total development area. This tool is implemented through cluster zoning and planned unit developments that maintain the overall density of land parcels, but provide flexibility where development occurs and what lands are left in more natural conditions.

Critical area zoning can protect highly vulnerable portions of the source water protection area. This type of zoning imposes restrictions or prohibitions and requires review standards for developments in water supply watersheds, areas with steep slopes, floodplains, wellhead protection zones, significant groundwater recharge areas, and similar sensitive areas.

Density or impervious cover standards protect water quality by limiting the impervious cover or concentration of facilities or activities generating or handling contaminants.

Impact fees collect money from new development applicants based on a formula that calculates impacts on natural resources and local infrastructure caused by development. The fee structure is typically codified within the zoning ordinance. The local government applies the fees to offset the impacts on water quality.

Overlay districts place additional zoning restrictions on top of underlying zoning. Land uses in overlay districts must then conform to the restrictions set for both zones. This approach can be

used to identify and set additional protective measures such as impervious cover thresholds for water supply watersheds, wellhead protection areas, floodplains, wetlands, and significant groundwater recharge areas.

Performance-based zoning uses an impact assessment approach to determine the limitations of the ability of the land to handle proposed development and/or to set design standards to be met by the potential land uses. Proposed developments must meet stipulated restrictions or standards. The regulations can be based on sewage capacity, acceptable volume of surface water runoff, or other relevant factors established for the area in which they wish to locate.

Building Codes

Building codes such as the following can also be used as tools to protect source water:

Building permit limitations are quotas on the number of permits issued in a specified time period or within a specified geographic area to limit the type, timing, distribution, or total amount of new construction.

Excavation, grading, and seeding codes regulate the amount and quality of surface runoff that leaves a site during and after construction.

Impervious surface codes control the proportion of a building site that can be covered by nonporous roads, roofs, parking lots, driveways, sidewalks, and other pavements without capturing and/or treating the runoff.

Porous pavement codes require the use of specific materials such as permeable asphalt, concrete, and crushed stone or gravel; open-celled pavers (such as concrete or plastic grids with voids that are filled with topsoil and seeded or filled with porous aggregate); grass; paving stones; and wood mulch. These materials can be used for street pavements, driveways, parking lots, sidewalks, bike and footpaths, pedestrian plazas, and courts where appropriate to increase the capture, infiltration, and treatment of runoff through the underlying soil.

On-site wastewater systems/septic system codes provide means to treat wastewater from larger lots in rural areas in an environmentally friendly way. Based on a review of nitrogen loading literature, the University of Delaware Water Resource Agency recommends that septic systems be permitted in Delaware source water resource protection areas provided the following conditions are met:

1) The minimum gross residential lot density is 2 acres per dwelling.
2) The minimum soil permeability is 0.5 inch per hour.
3) The depth from the ground surface to the seasonal high groundwater table is more than 5 feet.

Phased development codes regulate the timing of land-disturbing activities on a building site. This protection measure requires that construction be completed to a stage where exposed land is stabilized before another section of the site is placed under construction.

Underground storage tank codes do not permit underground storage tanks containing petroleum products or any hazardous substance in a certain quantity in designated source water protection areas.

It is important to note that nonregulatory approaches are also important in protecting drinking water sources. Pollution prevention, restoration of contaminated sites, acquisition of important parcels of land or interest in that land, water conservation and reuse, public education, and emergency planning all help to ensure that local water sources provide safe drinking water. Nonregulatory measures also provide opportunities for improving quality of life and involving citizens in meaningful activities that better their communities.

Tradeoffs

Although source water assessment and protection programs can be very costly, the consequences of inaction, including public health, environmental, and economic impacts, are far worse. Local implementation of a source water assessment and protection program can help prevent contaminated public drinking water supplies and costly solutions throughout the state.

The examples in the box demonstrate the enormous public expense, the public health threat, and the environmental impact of addressing contamination through technological solutions after contamination has occurred rather than preventing contamination through a source water assessment and protection program. The threats to public drinking water supplies can be significantly decreased if a source water assessment and protection program is implemented in a community.

Costs of Contaminated Drinking Water Sources

In 2000 Artesian Water Company's Llangollen Wellfield was contaminated with bis (2-chloroethyl) ether (BCEE). BCEE is a chemical used to make pesticides, deodorants, and other products and is most likely a human carcinogen. BCEE contamination has public health, environmental, and economic impacts on the community. In order to correct the problem, Artesian installed a $1-million carbon filtration system to remove all of the organic contaminants, including BCEE, and restored two million-gallon-per-day wells in the Llangollen Wellfield. Artesian was forced to implement a costly solution to the BCEE contamination in order to protect the public drinking water supply.

In 2004, the city of Newark began operation of a treatment plant for its South Wellfield drinking water source. This $3-million treatment facility was built to remove the high levels of iron and manganese present in the water from this source. However, this wellfield is also located adjacent to an industrial park. Testing has found elevated levels of organic compounds in the raw water of a well adjacent to Newark's South Wellfield. Therefore, the city also had to construct an additional treatment unit to remove organic compounds at an additional cost of over $500,000.

These costs, plus additional expenses, could have been avoided if a source water assessment and protection program had been in place to prohibit industrial uses from locating in close proximity to the established wellfields.

Threats to our drinking water are increasing from both point and nonpoint sources of pollution. Technology alone cannot prevent these threats. The source water assessment and protection program is designed to complement the traditional water treatment approach by adding another layer of protection to ensure safe drinking water supplies. In order to ensure that the community water supply remains safe, targeting the most significant pollution sources and preventing the need for corrective action in a fair and equitable manner is necessary.

Important Questions to Ask

- What areas in my jurisdiction need to be protected?
- Why are the areas vulnerable?
- What are the sources of possible contamination?
- What does our current town legislation say in regard to source water protection?
- What changes to current town legislation are needed to protect our source water supplies?
- What type of public education is necessary for my residents to understand the need for source water protection?
- What government and nongovernment groups could be possible partners on source water protection practices?
- What are the funding sources available to us?

For Further Information

University of Delaware Institute for Public Administration Water Resources Agency
Source Water Protection Guidance Manual for the Local Governments of Delaware, "A Toolbox for Protection of Public Drinking Water Supplies in Delaware." Provides comprehensive instruction on source water protection in Delaware.

Department of Natural Resources and Environmental Control, Ground Water Protection Branch can provide information on the Source Water Protection Program and regulations. (302) 739-4793

Source Water Protection: A Guidebook for Local Governments. Kundell, J. E., and T. A. DeMeo. 2000. National Association of Counties, Conference of Southern County Associations, Georgia Water Management Campaign, in cooperation with the Carl Vinson Institute of Government.

7. The State's Role in Sustainable Development

The State's Role in Sustainable Development

In Delaware, as in most other states, local land-use authority is delegated to county and municipal governments. However, land-use decisions are not just a local matter. The effects of land-use decisions are felt by all Delawareans, both fiscally and in the livability of our state.

Delaware provides many services and almost all of the infrastructure throughout the state government. The state provides social services, prisons, the largest police force, approximately 70 percent of school funding, 50 percent of library construction funding, and 60 percent of paramedic funding. The cost of providing these services is greatly impacted by the patterns of land use in the state. The state is also charged with protecting the quality of air, land, and water resources, which are all greatly impacted by the patterns of land use.

The patterns of land use that have occurred in recent decades have put a strain on Delaware's resources, both fiscal and natural. In recent years, state policies have attempted to direct growth in order to more effectively manage taxpayers' dollars and to protect Delaware's agricultural and natural resources.

What You Need to Know About TMDLs and Pollution Control Strategies

What are TMDLs and Pollution Control Strategies, and why are they important?

You will often hear the term "TMDL" in water-pollution discussions, because many of the actions we take to reduce pollution are based on this scientific measurement. TMDL stands for Total Maximum Daily Load, which is the maximum daily amount of a pollutant that a body of water can absorb without violating water quality standards. A nonscientific definition for TMDL could be "pollution limit." TMDLs are required under section 303(d) of the federal Clean Water Act, which requires states to identify and prioritize water bodies unable to meet or maintain applicable water quality standards for pollutants of concern. This list is known as the state's 303(d) List.

Pollutants of concern in Delaware waters are often chemicals, such as nitrogen and phosphorus from fertilizer runoff, but TMDLs could also be set for such other pollutants as bacteria, sediments, or even heat — anything that can adversely affect a waterway's natural health. Pollutants can come from specific "point" sources, such as sewage treatment plants, or from "nonpoint" sources, such as runoff from lawns, farms, parking lots, and golf courses.

TMDLs are established for much of the state, but all of Delaware's impaired waters must have a TMDL by the end of 2007. A Pollution Control Strategy, or PCS, is a plan to achieve the pollutant reductions required in the TMDL. It is a plan that primarily addresses nonpoint sources of pollutants. The plans will contain both voluntary and regulatory actions.

Why do I need to know about TMDLs and PCSs?

Everything we do impacts water quality — from government policy decisions on development and agriculture, to how we treat and landscape our homes and what we put down our drains. Everyone who works, plays, resides, or does business in an impaired watershed is or will be impacted by a TMDL and a PCS.

As a local policy maker, it becomes important for you to take water quality impacts into consideration before making policy decisions. Once a TMDL is in place, land-use decisions will need to consider water quality impacts locally and cumulatively within the watershed. Guidance or mandates may be created by the PCS. In order to meet TMDLs, we need to consider and change the way we do things on the land in our state.

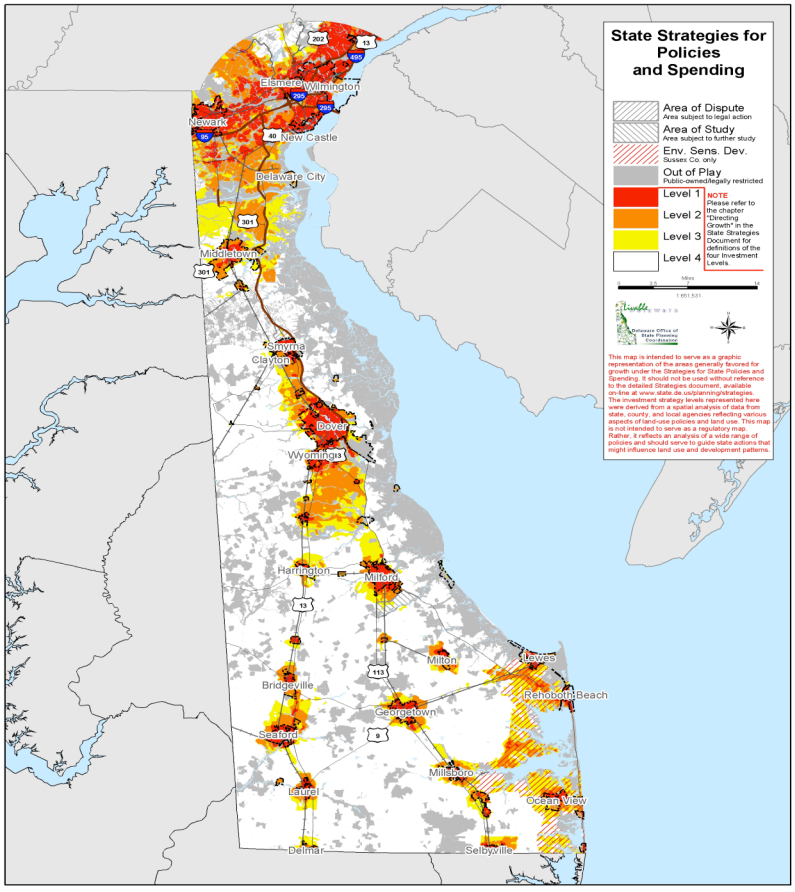
Strategies for State Policies and Spending

The Strategies for State Policies and Spending have been the centerpiece of the state's efforts to direct growth. First approved by the Cabinet Committee on State Planning Issues in 1999 and updated in 2004, these strategies direct how state investments will be made relevant to growth and preservation.

The 2004 update of the strategies document shows four "investment levels" that detail how state policies and investments will be used either to support development or to discourage development and support preservation. The following is a brief description of each investment level; a small version of the map is provided below. For detailed information on the Strategies for State Policies and Spending, including an interactive version of the map, visit *www.state.de.us/planning*.

- **Investment Level 1** — These are most often municipal areas which are the traditional hubs of development (shown in red on the map below). Density in these areas is typically higher than in outlying areas. A variety of transportation options are often available, including public transportation and bicycle and pedestrian systems. In these areas, state policies support investment in infrastructure, such as transportation, water, and wastewater; development and redevelopment activities; and open space investments for urban parks, recreational areas, waterfronts, and greenways. The state encourages mixed uses with a variety of transportation options to reduce reliance on cars for travel.

- **Investment Level 2** — These are the less developed areas within municipalities or unincorporated developments (shown in orange on the map below). They are often rapidly growing areas with opportunities for infill development. Similar to Level 1, state policies in these areas support investment in infrastructure, development and redevelopment activities, protection of critical waterways, and open-space investments for urban and suburban parks and greenways. The state encourages mixed uses with a variety of transportation options to reduce reliance on cars for travel.



- **Investment Level 3** — These are areas with "leap

frog" development that is discontinuous from existing infrastructure or areas designated in municipal and county comprehensive plans as long-term growth (shown in yellow on the map). In some cases, they reflect areas that would be otherwise suitable for growth, but have environmental constraints on or around the site. State policies in these areas provide for limited infrastructure investments that are logical extensions of existing infrastructure. The proper phasing, timing, and design of growth is important in these areas. State policies encourage protection of critical waterways, establishment of greenways, and providing a transition between Level 3 and Level 4 (rural) areas.

- **Investment Level 4** — These areas include rural areas, areas where counties and municipalities have not planned for growth, and areas with sensitive natural resources (shown in white on the map). State policies in these areas support preservation of natural and agricultural resources. State infrastructure investments will be limited to investments necessary to protect public health, safety, and welfare.

In addition to directing state investments, the Strategies for State Policies and Spending are used as a guide for reviewing local comprehensive plans and development proposals through the Preliminary Land Use Service (PLUS) process.

Preliminary Land Use Service (PLUS)

The PLUS process went into effect in February 2004, changing the way that the state reviews land-use proposals. The new PLUS process replaces the former Land Use Planning Act.* It gives state agencies an opportunity to review development proposals early in the development process, providing opportunities for natural resource protection, among other things. Being early in the process allows developers to incorporate changes based on comments made by state agencies before too much money has been invested in a particular design.

The PLUS process changes the state agencies' voice in land use. Previously, state agencies reviewed projects late in the land-use process. Therefore, comments came to the local agency when the local jurisdiction's role was to approve or deny a project. Under the new process, developers and local governments receive the concerns of state agencies early in the process when changes can be made to accommodate concerns. This allows for more informed decisions to be made. In some cases, the governing body can choose to apply conditions to a proposal based on the state comments.

In many cases, the expertise on issues such as natural resources, traffic, cultural resources, and other areas resides in the state agencies. Comments shared through the PLUS process often make developers aware of natural resource constraints on a project site, such as the presence of wetlands, wellhead protection areas, excellent recharge areas, and rare or endangered species. Comments also provide recommendations for protection of natural features, such as riparian buffers, tree preservation and mitigation, and impervious cover thresholds. Local government staff, planning commissions, and elected bodies rely on this expertise. The PLUS process puts this expertise at the front of the process.

*The PLUS process is detailed in 29 Del. Code Ch. 92.

Important Questions to Ask

- In which strategy level is the land-use proposal located?

- If the proposal is located within Investment Level 3 or 4, and otherwise within a growth area, are there specific natural resources or environmental constraints on the parcel that need protection?

The following are questions and answers that municipal officials might have about the PLUS process:

- *What projects need to go through PLUS review?*

  The thresholds for PLUS review are set in Title 29, Chapter 92; however, local jurisdictions with certified comprehensive plans can sign a memorandum of understanding (MOU) with the Office of State Planning Coordination to change the thresholds based on the local jurisdiction's needs. According to Title 29, Chapter 92, the following projects are subject to PLUS review:

  (1) Major residential subdivisions with internal road networks and more than 50 units, excluding previously recorded residential subdivisions of any size which have not been sunsetted.

  (2) Any nonresidential subdivision involving structures or buildings with a total floor area exceeding 50,000 square feet, excluding any previously approved and recorded nonresidential subdivision regardless of floor area size, or any site plan review involving structures or buildings with a total floor area exceeding 50,000 square feet, excluding any previously approved and recorded nonresidential site plan review regardless of floor area size.

  (3) Rezonings, conditional uses, site plan reviews, and/or subdivisions within environmentally sensitive areas, as identified within any local jurisdiction's comprehensive plan as certified under 29 Del. Code § 9103.

  (4) Annexations inconsistent with the local jurisdiction's comprehensive plan as certified under 29 Del. Code § 9103.

  (5) Applications for rezoning if not in compliance with the local jurisdiction's comprehensive plan as certified under 29 Del. Code § 9103.

  (6) Any other project which is required to be referred to the state for pre-application review by local jurisdiction regulations.

  (7) Any local land-use regulation, ordinance, or requirement referred to the Office of State Planning Coordination by a local jurisdiction for the purpose of providing the jurisdiction with advisory comments. The land-use regulations, ordinances, or requirements that are to be referred to the Office of State Planning Coordination may be specified in a jurisdiction's memorandum of understanding.

  (8) County and municipal comprehensive plans as required by Titles 9 and 22.

- *When should the project go through the PLUS process?*

  The project should be reviewed through PLUS prior to formal application to the municipal or county government.

- *Do local jurisdictions have to provide written correspondence on each land-use decision?*

  Yes, local jurisdictions have to notify the Office of State Planning Coordination. This allows the state to more closely track land-use changes and help state agencies improve the services they provide to local jurisdictions based on land-use change.

- *Who submits the PLUS application to the Office of State Planning Coordination?*

  The landowner or developer applying to the local jurisdiction is responsible for submitting the PLUS application to the Office of State Planning Coordination. However, each jurisdiction can specify the procedures by which applicants must abide in that jurisdiction.

For Further Information

Office of State Planning Coordination
www.state.de.us/planning
(302) 739-3090

8. Resources for Writing Ordinances

Resources for Writing Ordinances that Protect Natural Resources

Many important natural resource issues have been detailed in the preceding chapters – impervious cover, protection of groundwater resources, riparian buffers, open space, stormwater runoff, identifying and protecting natural resources – which municipalities have an important role in addressing. Municipal and county governments have authority over local land use, and natural resource protection relies on sound land-use policies. The actions that a municipal government takes, either through management of municipal facilities and infrastructure (parks, sewer systems, roads) or through implementing effective land-use controls (zoning, subdivision, street standards) can make all the difference in protecting and even enhancing, the quality of the natural environment within and surrounding its borders.

Because most of Delaware's municipalities are small, they often do not have environmental expertise on their staffs to develop and implement complex ordinances that protect natural resources. For this reason, environmental standards and requirements need to be simple, clear, and easy to administer.

The purpose of this chapter is to provide resources for municipalities who want to incorporate natural resource protection into their ordinances. These resources include model ordinances, books and publications, and technical assistance.

Importance of Municipal Regulation

Because state policies encourage development in and around municipalities and because municipalities offer many of the services that developers, home buyers, and businesses seek, it is important that municipalities have a strong role in planning for the protection of natural resources within their boundaries. These ordinances must balance protection of resources with the appropriate densities associated with developing within municipalities. Generally, planning practice dictates that higher densities are appropriate within municipal urban contexts. This allows for more efficient service delivery, and it reduces the effect of low-density development spread across a larger area.

Best Management Practices

The best management practices relating to local ordinances have been detailed in previous chapters, including the following examples:

- Minimum open-space requirements that provide for both active and passive/natural open space
- Riparian/wetland buffer protection
- Tree preservation/mitigation
- Cluster development/conservation design on sensitive sites
- Preservation of water resource protection areas
- Natural landscaping
- Protecting rare and endangered species habitat
- Allowing or encouraging pervious alternatives to impervious cover

Tradeoffs

Providing adequate regulation to protect natural resources can be a challenge for municipalities, which have traditionally been and continue to be locations for more dense, intense development. However, these two interests need not be mutually exclusive. It is important, when developing ordinances to protect natural resources, to be cognizant of the urban environment and the appropriateness of certain regulations in an urban context. In many cases, regulations that may be appropriate in a more suburban or rural setting may not be appropriate within a municipality.

Resources Available to Assist Local Governments

Model Ordinances

- The American Planning Association has developed *Growing Smart Legislative Guidebook: Model Statutes for Planning and the Management of Change,* 2002 edition (Stuart Meck, FAICP, general editor). This publication includes model legislation and ordinances to help implement smart growth initiatives. "Chapter 8: Local Land Development Regulation" and "Chapter 9: Special Environmental and Land Development Regulation and Land Use Incentives" include some model ordinances that might help municipalities protect natural resources. The guidebook is available at *www.planning.org.*

- The Environmental Protection Agency has model ordinances for protecting water resources available on its web site at *www.epa.gov/owow/nps/ordinance/.*

Code and Ordinance Review

- The Center for Watershed Protection published *Better Site Design: A Handbook for Changing Development Rules in Your Community* in 1998. This handbook discusses 22 principles of better site design and includes a "Code and Ordinance Worksheet" to help local governments evaluate ordinances, codes, and standards that shape development. The worksheet will help compare local development rules with the model development principles. It addresses such items as street standards, parking requirements, open-space management, buffers, and other development requirements that have an impact on watershed health. The worksheet and other publications about watershed protection are available at the Center for Watershed Protection's web site at *www.cwp.org/pubs_download.htm.*

Technical Assistance

- The Delaware Forest Service's Urban and Community Forestry Program has two full-time foresters who assist cities, towns, and communities with the management and care of their urban forestry resources. They can assist with developing tree ordinances, management plans for publicly owned forests (such as city or county parks, street trees, etc.), and inventories of and maintenance schedules for these trees. Their staff also works with developers, planners, and engineers to help educate these individuals on methods of preserving trees during the development process. Grants through the program can assist with tree planting and management

and community planning. For more information, contact the Delaware Forest Service at (302) 698-4500.

Other Resources and Publications

- *Conserving Wooded Areas in Developing Communities: Best Management Practices in Minnesota,* 2000. *files.dnr.state.mn.us/forestry/urban/bmps.pdf*

- *Nature Friendly Ordinances,* by James M. McElfish, Jr., Environmental Law Institute, 2004.

- *Better Models for Development in Delaware,* Office of State Planning Coordination, 2004.

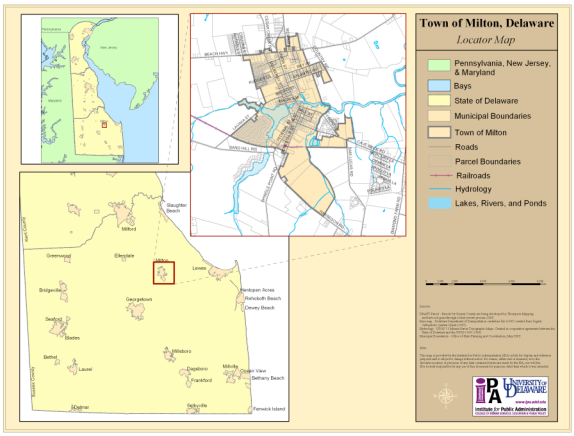
9. Appendix A

Appendix A:
Conducting a Natural Resource Assessment — An Example

The Inventory

The following example describes the process a town might go through in order to conduct a natural resource assessment (NRA). Before you can do an NRA, you need to conduct an inventory of what you have. A natural resource inventory (NRI) is a summary in map form of a municipality's open-space lands, water resources, natural areas, and protected corridors. The town of Milton will be used to demonstrate how to collect data for a natural resource inventory.

Figure 1. Locator Map of the Town of Milton



Data for your natural resource inventory can be collected over the internet and down-loaded into your GIS. Another option would be to download the data and place it within the free ESRI GIS software viewer called ArcExplorer Java Edition. Where GIS is not available, the data can be printed out from the internet onto transparencies (make sure they are at the same scale), which can be overlayed on top of one another. For the example below we have placed the collected data into ArcGIS. With these data, a municipality can start determining areas that are suitable to develop and areas that are best preserved by conducting a natural resource assessment (refer back to Chapter 1).

The maps used in the NRI will display the natural resources within the town of Milton and identify areas that will influence natural resource management, preservation, and protection. The five maps listed below are a good start in identifying the natural resources in and around the town of Milton.

A. Base Map

The town base map will be where you determine your study area to be. Your study area can be at the municipal level or at a watershed level. The base map will include the framework layers from the Delaware DataMIL, *datamil.delaware.gov*. When you go to the DataMIL web site, click on the "MAPPING" text link on the left hand side, then click on the "Enter Map Production Laboratory" text. This will open the Internet Mapping Site for Delaware Framework Data. All of the following data layers are available for viewing, printing, and downloading through the Delaware DataMIL. Only the digital ortho-photography cannot be downloaded from the internet, so it is recommended that your municipality print this data layer out as a paper map. The layers for your base map should include

- Municipal boundaries;
- Transportation, roads, and railroads;
- Hydrography, lines and areas; and
- 2002 aerial imagery.

Figure 2. Source Information

Municipal Boundaries — Delaware Office of State Planning Coordination

Transportation — Road network and railroads, DelDOT Centerline File

Hydrography — USGS/EPA

Geographic Names — USGS, Geographic Names Information System (GNIS)

2002 OrthoImagery — Detailed aerial photos, 2002 OrthoImagery Project

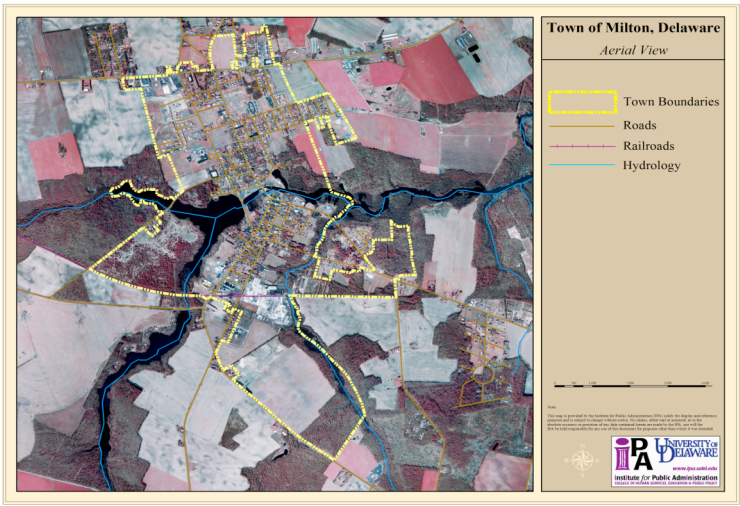


Figure 2. Base Map of the Town of Milton

B. Land Use/Land Cover

Land use/land cover is an important data layer that helps you define the development patterns of your community and provide areas of focus for land-use planning efforts. The land use/land cover data layer in Delaware has been created from digital orthophotography for the years 1992, 1997, and 2002, depicting what is actually on the ground. It is also available on the DataMIL. If you have completed your comprehensive plan, an existing land-use map will be included, with the land use coded by parcel. Examples of the two types of land-use data are shown in Figure 3.

It is recommended that, if you do not have a GIS, you print this data layer out on a transparency. It is important to make sure when you are printing data from the DataMIL that you use the same scale throughout.

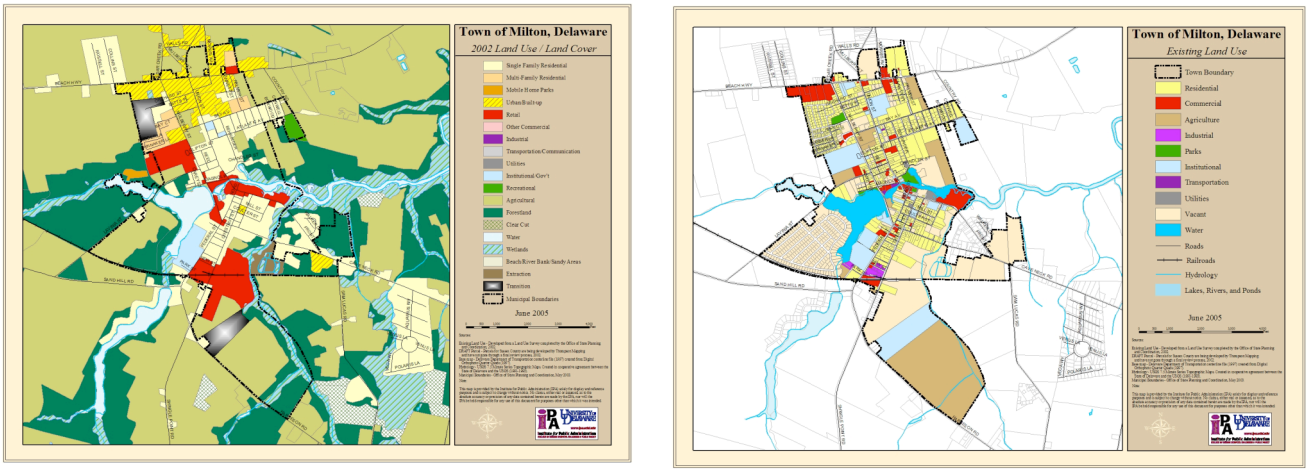


Figure 3. Land-Use Maps of the Town of Milton

Figure 3. Source Information

Left: Land Use / Land Cover — 2002 land use and land cover dataset for the state of Delaware based on the 1997 land-use data of the state and 2002 false color infrared digital orthophotography at a scale of 1:2400. The work was performed by EarthData International of Maryland, LLC, for the Delaware Spatial Data Implementation Team (I-Team).

Right: Existing Land Use — Land use coded by parcel for the town of Milton's comprehensive plan, 2003.

C. Water Resources Map

This map represents a municipality's surface and subsurface water. If your municipality has completed its comprehensive plan, these data may be included in the environmental features map. Well data is unavailable at this time over the internet. Water resource areas that will be included within this map (and their data sources) are as follows:

- Lakes, ponds, and rivers — *found on DataMIL*
- Wetlands — *found within the land use/land cover dataset also on the DataMIL*
- Groundwater recharge areas — *environmental features map in your comprehensive plan*
- Watershed boundaries — *found on DataMIL*
- FEMA Q3 flood plains — *environmental features map in your comprehensive plan, your county's web site, or FEMA's web site, www.fema.gov/.*

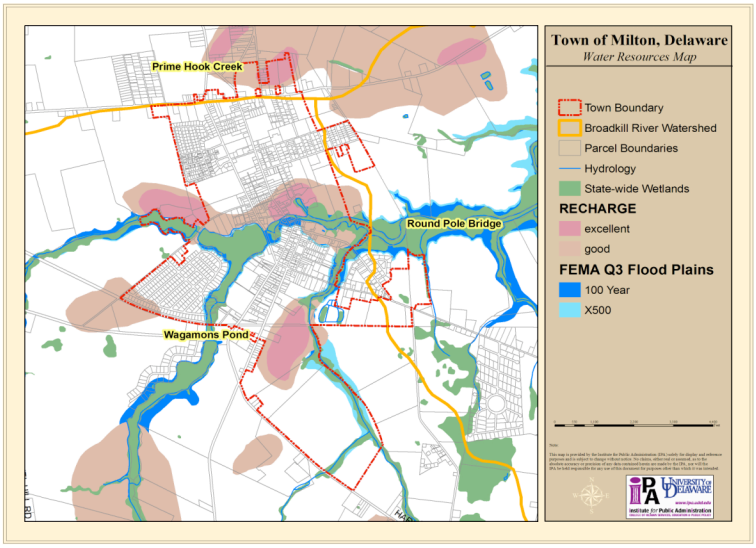


Figure 4. Source Information

Hydrography — USGS 7.5 Minute Series Topographic Maps. Created in cooperative agreement between the state of Delaware and the USGS (1991–1993) and EPA.

Wetlands — Department of Natural Resources & Environmental Control (DNREC), Statewide Wetlands Mapping Project (SWMP), 2000.

Watersheds — DNREC, 1998.

Groundwater Recharge Areas — Delaware Geological Survey, 2002.

Flood Plains — Federal Emergency Management Agency (FEMA).

Figure 4. Water Resources Map of the Town of Milton

D. Unique and Fragile Lands

This map represents areas in your community that provide habitat for unique plants and animals. The DNREC Division of Fish and Wildlife has identified these sensitive habitats where species are listed as threatened, endangered, or of special concern. The identification of the most unique and fragile lands in your town will help you with the prioritization of lands during the open-space planning process. This prioritized list will help to focus the lands targeted for open space acquisition. Due to the sensitivity of these areas, a map is not included within this appendix.

E. Committed Open Space

An outdoor recreation inventory, created by the DNREC Division of Parks and Recreation, can be found through the Environmental Navigator web site, *www.dnrec.state.de.us/DNRECeis/.* Data layers for this map consist of the following:

- State parks
- Federal parks
- Private conservation
- State forests
- State historic parks
- State reserves
- State fish and wildlife areas
- County parks
- Municipal parks
- Private doughnuts
- Agricultural easements
- Schools

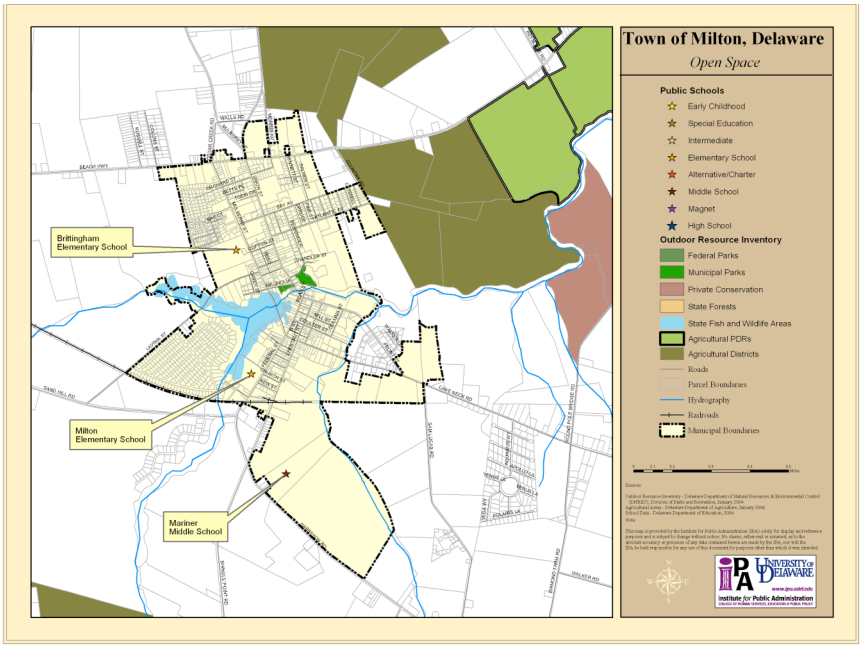


Figure 5. Source Information

Outdoor Resource Inventory — *Department of Natural Resources and Environmental Control (DNREC),* Division of Parks and Recreation, January 2004.

Agricultural Easements — *Delaware Department of Agriculture,* June 2004.

School Data — *Delaware Department of Education,* October 2004.

Figure 5. Open Space Map of the Town of Milton

Other data that is important for your inventory that could be collected at a later time would be the following:

- Land ownership by parcel
- SSURGO soil classification from NRCS
- Drainage basins with direction of flow
- Areas with limitations for development
- Productive wildlife habitat
- Proposed cultural resource protection areas
    - Sites of archeological or historical importance
    - Areas that define community character

The Assessment

Below is an example of a proposed development and how a municipality would work through the data collected in their inventory to assess potential impacts on some key natural resources. The town of Milton will continue to be used as the example.

The Issue

For purposes of illustration, a new residential development has been proposed in the southeast section of Milton indicated by the arrow in Figure 6.

The 139-acre parcel within the Milton town boundary is presently agricultural, but is zoned for residential use. Lot sizes for single-family residences typically are 0.25 to 1 acre, with each parcel comprising about 20 percent impervious cover.

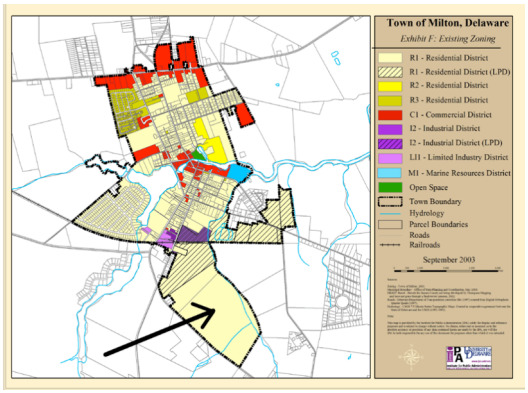


Figure 6. A new development is proposed on a large parcel zoned Low-Density Residential.

State Natural Resource Goals

The town of Milton has decided that one of its natural resource goals is to protect its water resources. Milton's drinking water is derived from groundwater, and fishing is a popular recreation in the community. Some areas of the town have experienced flooding during heavy rainfall episodes. The main goals of the town are to reduce pollutants, maintain a healthy stream habitat, increase recharge to groundwater, and decrease flooding. A natural resource assessment will be conducted to guide Milton in planning this and other developments in a manner that will help protect water resources.

Milton's natural resource goals could include the following:

- Reducing pollutant loads, which helps to maintain healthy drinking water, groundwater, and fish populations. Runoff washing over debris-laden impervious surfaces can cause stormwater pollution, which infiltrates into groundwater and into stream channels.
- Reducing the amount of impervious cover and maintaining forested riparian zones, which helps to reduce the amount of pollution that will be picked up in stormwater runoff.
- Maintaining groundwater recharge, which is essential for adequate water supplies in aquifers and adequate base flows in streams.
- Keeping recharge areas free of impervious cover, so that the water infiltration that is necessary for proper recharge can occur.
- Maintaining open space and pervious cover, which reduces the potential for flooding.
- Balancing development with the protection of natural resources such as wetlands and forests, which helps to reduce the intensity of stream flooding.
- Creating and maintaining a viable stream habitat, which is necessary for stream health and allows fish and other aquatic life to survive.
- Maintaining a healthy stream habitat, which will increase the economic and recreational value of the town.

Assemble Data Layers

The next step in the natural resource assessment is to determine what data layers will be needed to perform the analysis. The planning group will select the layers from data described in the natural resources inventory (see Chapter 1) that pertain to the natural resource goals. In this example GIS is not being used, so the layers of data will be downloaded from an internet mapping site and printed on the paper of choice.

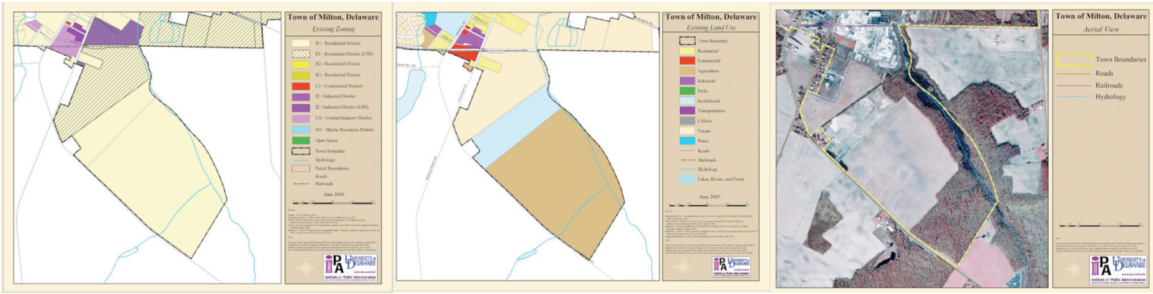


Figure 7. Base maps that include zoning, land use, and aerial photography of the town of Milton can be printed on plain white paper.

GIS layers that depict floodplains, wetlands, excellent and good recharge areas, and parcels will be printed onto clear film. The clear film layers can be overlaid onto the base maps in Figure 7, so that land uses beneath and within water resources can be assessed. The overlays will allow the town to analyze the land uses that are affecting water resources and where future development might be placed to limit harmful effects of development on water supplies. Multiple transparencies can be overlayed simultaneously to view two or three layers at one time over the base maps.

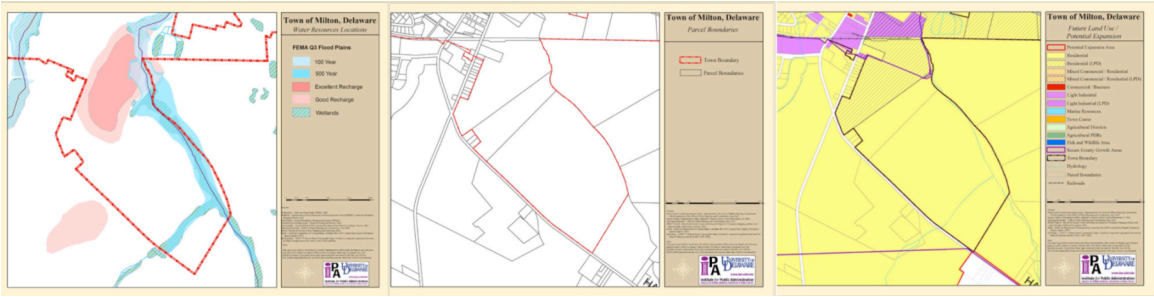


Figure 8. Water resource locations, parcels, and future town boundaries and land use are printed on clear film and are overlaid onto base maps shown in Figure 7. This method is useful for natural resource assessment when GIS is not available.

Conduct Your Assessment

In this analysis, floodplains will be used to simulate the riparian zone that could be created with GIS, if GIS were being used. It is good practice to maintain healthy riparian areas with trees and shrubbery, to act as a filter to storm runoff as well as protecting against flooding (Chapter 3). Land use within the riparian zone ideally would be limited to forest, but since development is necessary, best management practices can be used to limit the impacts of impervious surfaces. The floodplain and recharge layers were printed on clear film in order to view the zoning and land-use features within these critical resource areas. Planners can determine if the proposed development layout will place impervious surfaces within the riparian area. In Figure 9 below, the map image depicts recharge areas and floodplains overlying zoning data. The map shows the parcel in question contains both floodplains and recharge areas within it.

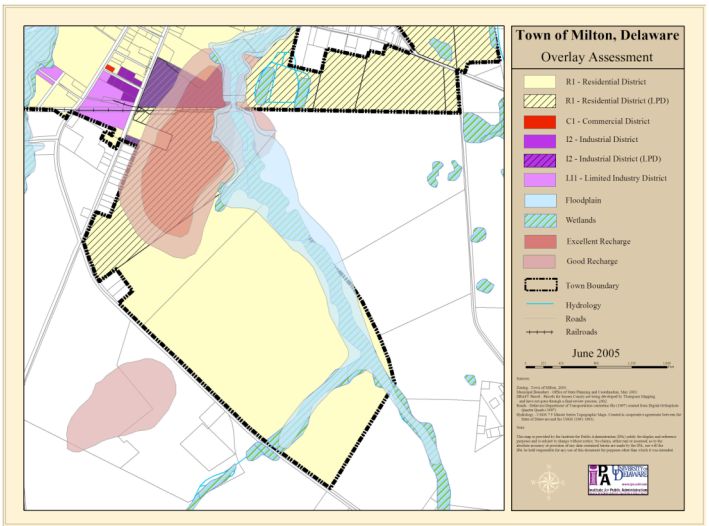


Figure 9. Clear film layers depicting floodplains and recharge areas can be laid atop zoning to identify critical areas that might require development best management practices to meet natural resource goals as listed above.

This sort of simple assessment allows town planners to visualize what development best management practices could be applied to best protect water resources. Perhaps town planners will decide that the actual development could be set back from the stream and clustered, leaving the floodplain and recharge areas as open space. This not only would protect the floodplain, but also would allow growth of a forested riparian area as well as a peaceful park area. If this is the case, the planner might opt for a different development plan, one that will create open space within the riparian buffer and cluster houses away from the stream channel. If GIS were to be used, a 100-foot buffer could be created around the stream channel to be used as the riparian zone data layer. Computer-aided design (CAD) drawings can be imported to the GIS to get a feel for varying development scenarios, in order to determine which would best protect the stream system.

10. Appendix B

Appendix B:
Contact Information & Related Organizations

Department of Natural Resources & Environmental Control

Division of Soil and Water Conservation, Delaware Coastal Programs

Delaware Coastal Programs manages coastal resources through a variety of research, permit, grant, and technical assistance programs. Funding and technical assistance is available to county and municipal governments through the Delaware Coastal Programs' Natural Resource Management grant program.

Contact: Susan Love
Resource Planner
Phone: (302) 739-9283
E-mail: susan.love@state.de.us

Kimberly Cole
Environmental Scientist
Phone: (302) 739-9283
E-mail: kimberly.cole@state.de.us

Division of Soil and Water Conservation, Nonpoint Source Program

The Delaware Nonpoint Source Program administers a competitive grant made possible through Section 319 of the Clean Water Act. The grant provides funding for projects designed to reduce nonpoint source (NPS) pollution in Delaware. NPS pollution may be defined as any pollution that originates from a diffuse source (such as an open field or a road) and is transported to surface or groundwaters through leaching or runoff. Reduction of NPS pollution may often be achieved through incorporation of specific best management practices (BMPs) into project work plans. All projects must include matching funding from a nonfederal source totaling at least 40 percent of the overall project cost.

In addition to funding projects that achieve reductions in NPS pollution, the Delaware NPS Program is committed to addressing the issue through educational programs, publications, and partnerships with other organizations working to reduce NPS pollution in Delaware.

Contact: Bob Palmer
Program Manager
Phone: (302) 739-9922
E-mail: Robert.Palmer@state.de.us

Division of Soil and Water Conservation, Sediment and Stormwater Program

The DNREC Sediment and Stormwater Program regulates construction activities in order to minimize the amount of sediment flowing into our waterways. This program also provides both technical assistance and educational opportunities on various subjects relating to stormwater management.

Contact: Beth Krumrine
Environmental Scientist
Phone: (302) 739-9921
E-mail: beth.krumrine@state.de.us

Paul Evans
Program Manager
Phone: (302) 739-9921
E-mail: paul.evans@state.de.us

Division of Water Resources

The division manages and protects water resources through various regulatory programs and by providing technical assistance, laboratory services, and educational services. The division works with everything from water quality to water quantity, from wastewater to source water, from wetlands to surface and groundwater quality, and from industrial to municipal point source dischargers.

Contact: Kathy Bunting-Howarth
Principal Planner
DWR-Office of the Director
Phone: (302) 739-9949
E-mail: katherine.howarth@state.de.us

Delaware Office of State Planning Coordination

The Office of State Planning Coordination (OSPC) represents the collective state agencies on land-use issues. The OSPC is responsible for developing the Strategies for State Policies and Spending, administering the PLUS process, and providing technical and financial assistance to local governments for comprehensive plan development and implementation.

Contact: Constance C. Holland, AICP
Director
E-mail: connie.holland@state.de.us

Herb Inden
New Castle County Circuit Rider Planner
E-mail: herb.inden@state.de.us

David Edgell, AICP
Kent County Circuit Rider Planner
E-mail: david.edgell@state.de.us

Bryan Hall
Sussex County Circuit Rider Planner
E-mail: bryan.hall@state.de.us

Michael Mahaffie
GIS Coordinator
E-mail: mike.mahaffie@state.de.us

Dorothy Morris
PLUS Coordinator
E-mail: dorothy.morris@state.de.us

540 S. Dupont Highway, Suite 7
Dover, DE 19901
Phone: (302) 739-3090
Web site: *www.state.de.us/planning*

Delaware Department of Transportation (DelDOT), NPDES Section

DelDOT's National Pollutant Discharge Elimination System (NPDES) Section works with nonprofit and government agencies managing multiple programs to reduce pollutants from entering the storm sewer system. These programs include mapping the DelDOT-owned storm sewer system, monitoring water quality from outfalls and stormwater BMPs, developing pollution and spill prevention plans, and public education and outreach.

Contact: Randy Cole
NPDES Program Manager
Phone: (302) 760-2194
E-mail: Randy.Cole@state.de.us

University of Delaware

Institute for Public Administration, Water Resources Agency (IPA-WRA)

Provides regional water resources planning and watershed policy assistance to state and local governments in Delaware and the Delaware River Basin through its education, public service, and research roles at the university.

Contact: IPA-WRA
DGS Annex
Academy Street
University of Delaware
Newark, DE 19716
Phone: (302) 831-8971
Fax: (302) 831-4934
Web site: *www.wr.udel.edu*

Delaware Water Resources Center (DWRC)

The DWRC has three primary goals: to support research that will provide solutions to Delaware's priority water problems; to promote the training and education of future water scientists, engineers, and policy makers; and to disseminate research results to water managers and the public. DWRC's efforts focus on exploring new ideas that address water problems or expand insights into water related phenomena.

Contact: Dr. J. Thomas Sims
Director
113 Townsend Hall
University of Delaware
Newark, DE 19716-2103
Phone: (302) 831-6757
E-mail: jtsims@udel.edu
Web site: *ag.udel.edu/dwrc*/

Delaware Cooperative Extension

Cooperative Extension connects the public with university knowledge, research, and resources to address youth, family, community, and agricultural needs.

Contact: Bill McGowan
Extension Agent, Community Development
16684 County Seat Highway
Georgetown, DE 19947
Phone: (302) 856-7303
Fax: (302) 856-1845
E-mail: billmcg@udel.edu

Sea Grant Marine Advisory Service (MAS)

MAS provides research-based information to the public in support of coastal stewardship, science education, economic development, and public safety. Program specialties include coastal community development, watershed education, coastal hazards, tourism, marine business and transportation, fisheries and aquaculture, seafood technology, and marine education.

Contact: Joe Farrell
Delaware NEMO Coordinator & Marine Resource Management Specialist
University of Delaware
College of Marine Studies
700 Pilottown Road
Lewes, DE 19958
Phone: (302) 645-4250
E-mail: jfarrell@udel.edu
Web sites: *www.ocean.udel.edu* or
nemo.udel.edu

Appoquinimink River Association

The Appoquinimink River Association works with municipalities to preserve, protect, and enhance the rivers and related natural resources of the Appoquinimink region (which includes Middletown, Odessa, and Townsend, Delaware) through public education, reforestation projects, stormwater retrofits, stream restoration, and much more.

Contact: Sara L. Wozniak
Executive Director
P.O. Box 341
Middletown, DE 19709
Phone: (302) 382-0335
E-mail: sara.wozniak@state.de.us
Web site: *www.RiverAssoc.org*

The Center for the Inland Bays

The Center for the Inland Bays is a nonprofit organization dedicated to the wise use and enhancement of Delaware's Inland Bays and their associated watersheds. The goals of the Center for the Inland Bays are as follows:

1. To sponsor and support educational activities, restoration efforts, and land acquisition programs that lead to the present and future preservation and enhancement of the Inland Bays watershed.
2. To build, maintain, and foster the partnership among the general public; the private sector; and local, state, and federal governments, which is essential for establishing and sustaining policy, programs, and the political will to preserve and restore the resources of the Inland Bays watershed.
3. To serve as a neutral forum where Inland Bays watershed issues may be analyzed and considered for the purposes of providing responsible officials and the public with a basis for making informed decisions concerning the management of the resources of the Inland Bays watershed.

Contact: Edward A. Lewandowski
Executive Director
16529 Coastal Highway
Lewes, DE 19958
Phone: (302) 645-7325
Fax: (302) 645-5765
E-mail: director@inlandbays.org
Web site: *www.inlandbays.org*

In addition to the above programs, the following organizations conduct watershed education programs in communities throughout Delaware. See their Web sites for listings of contacts and services.

Brandywine Conservancy
www.brandywineconservancy.org/

Brandywine Valley Association
www.brandywinewatershed.org/

Center for Watershed Protection
www.stormwatercenter.net/

Chesapeake Bay Program
www.chesapeakebay.net/index.cfm

Coalition for Natural Stream Valleys, Inc.
www.uwin.siu.edu/dir_directory/orgs/US/data/Coalition_for_Natural_Stream_Valleys%2C_Inc..html

Delaware Center for Horticulture
www.dehort.org/

Delaware Nature Society
www.delawarenaturesociety.org/

Delaware River Keeper Network
www.delawareriverkeeper.org/

Friends of White Clay Creek State Park
www.whiteclayfriends.org/

Nanticoke Watershed Alliance
www.nanticokeriver.org/

Partnership for the Delaware Estuary, Inc.
www.delawareestuary.org

Red Clay Valley Association
www.redclayvalley.org