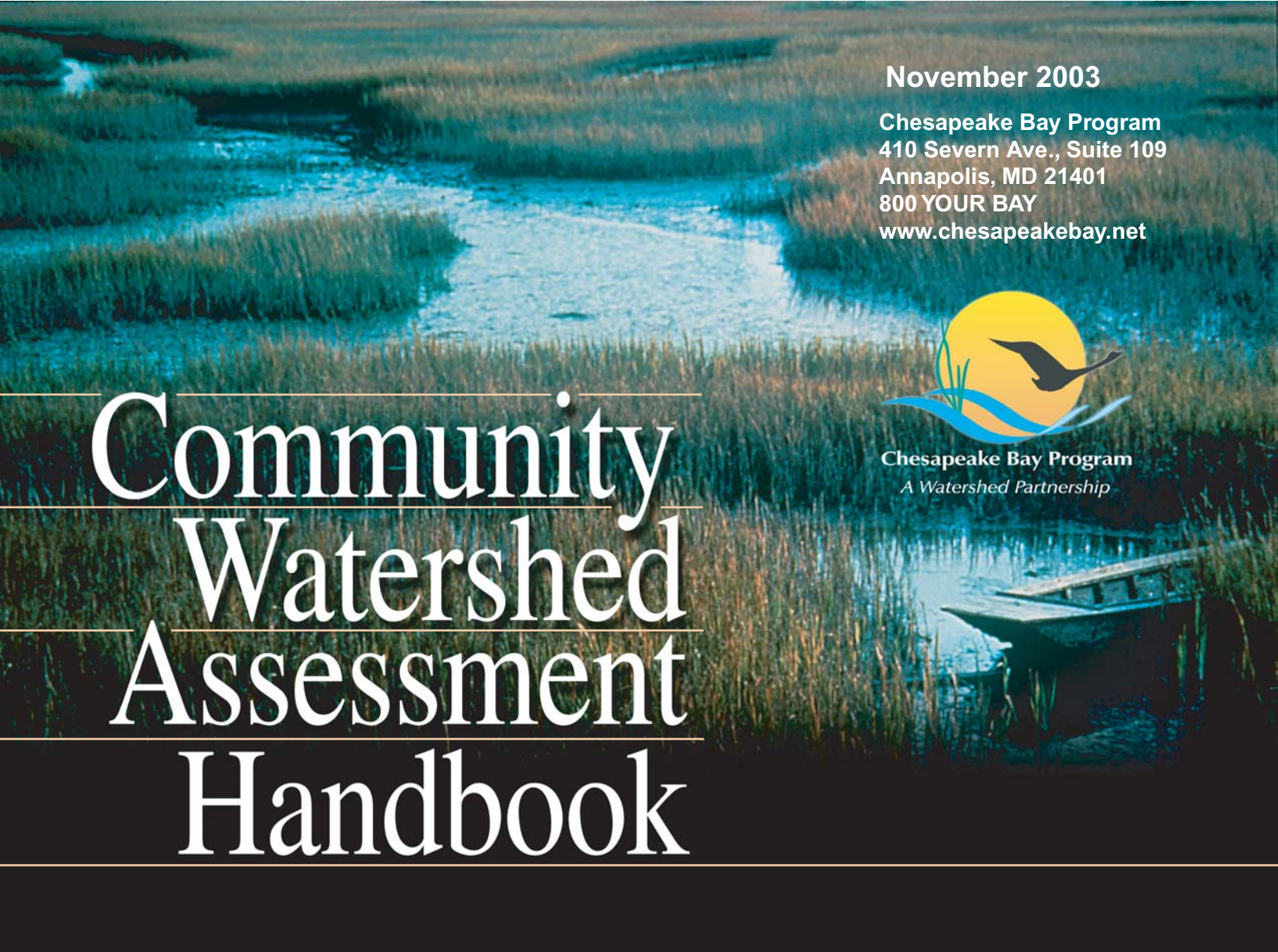

Community Watershed Assessment Handbook

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Chesapeake Bay Program
A Watershed Partnership

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FOREWORD

Recognizing the critical role of locally supported watershed management planning in the restoration of the Chesapeake Bay, Program partners involved in the *Chesapeake 2000* agreement have committed to the development of watershed management plans covering two-thirds of the Bay watershed. The agreement provides a series of actions to be taken by Bay Program partners that are intended to result in the improvement of Chesapeake Bay water quality and living resources. The Bay Program partners include the states of Maryland, Pennsylvania, and Virginia; the District of Columbia; the Chesapeake Bay Commission, a tri-state legislative body; the U.S. Environmental Protection Agency, representing the federal government; and participating advisory groups. For more information on the specific commitments in the agreement, visit the Chesapeake Bay Program web site (http://www.chesapeakebay.net/c2k.htm).

This *Community Watershed Assessment Handbook* was developed under the direction of the Chesapeake Bay Program's *Chesapeake 2000* Watershed Commitments (CWiC) Task Force which was created to address the *Chesapeake 2000* commitment to "work with local governments, community groups and watershed organizations to develop and implement locally supported watershed management plans in two-thirds of the Bay watershed." These watershed plans should "address the protection, conservation and restoration of stream corridors, riparian forest buffers and wetlands for the purposes of improving habitat and water quality, with collateral benefits for optimizing flow and water supply." The CWiC Task Force would like to acknowledge the following individuals and groups who significantly contributed to the development of this handbook:

- Jennifer Kozlowski, Environmental Management Fellow, Chesapeake Research Consortium, 645 Contees Wharf Rd., Edgewater, MD 21037
- The International City/County Management Association (ICMA) 777 N. Capitol Street, NE, Suite 500, Washington, DC 20002 in partial fulfillment of EPA grant CB-983432-01.

CHAPTER 1 Introduction

THE IMPORTANCE OF WATERSHED PLANNING

When water flows across the land during rainfall events, it carries fertilizers, loose soil, litter and other pollutants into streams and other surrounding water bodies. As a result, everything we do on the land affects the quality and quantity of our water resources and the natural systems that surround us. Therefore, the natural resources and the quality of life in our communities are directly affected—positively or negatively—by the way we plan for and manage the land we use.

Watershed management planning is a way to consider a wide range of environmental, economic, and social issues along with the community's vision for the future of the watershed under a single framework. Working within physical boundaries rather than political boundaries, the watershed management planning process provides opportunities to address water quality and habitat issues beyond the scope of single jurisdictions. It provides a means to ensure environmental protection, to support quality of life issues, and accommodates economic development using the watershed as the planning framework. Any kind of planning allows you to put a single action into the context of a larger vision—watershed management planning allows for that vision to include healthy natural resources and waterways.

Local governments and watershed associations play an essential role in restoring the Chesapeake Bay through the restoration and protection of local water bodies and habitat. Many local agencies have been engaged in watershed management planning for years. Because these entities have developed an understanding of the connection between land use and environmental health, watershed planning has become an integral part of comprehensive land use planning within their

jurisdictions. Localities in the Chesapeake Bay area have successfully conducted watershed management planning in areas such as the Anacostia watershed in the District of Columbia and watersheds in Montgomery County, Maryland; Lancaster County, Pennsylvania; and Fairfax County, Virginia. In these watersheds, protection, preservation, restoration and other land use decisions can now be made using technical and financial resources as efficiently and effectively as possible in order to improve water quality, habitat and the quality of life for all residents.

Watershed management planning is a process that involves many steps and should include a variety of stakeholders as well. Figure 1-1: *The Watershed Approach* depicts the basic elements of that process. Watershed groups often start at the top of the wheel by building public support and then move clockwise. A group is likely to travel around the wheel several times, with each cycle building upon the information and experience gained previously. The "spokes" connecting each step to the center illustrate that the process does not always move in one direction and that the steps are interrelated. Information gained at one step may lead the group to move to another step in the process. For example, information gained during the inventory step may lead the group back to seeking new stakeholders. The parts of the watershed planning process covered in this handbook are depicted as steps 1–3. The remaining steps would be addressed through the development of the actual watershed management plan.

WHY DO A WATERSHED ASSESSMENT?

A critical step in developing and implementing a watershed management plan is a comprehensive assessment of existing environmental conditions. Before a decision can be made about the best way to plan for and manage the important aspects of your watershed, you need to know what is there. A watershed assessment will help you identify potential problems or concerns in your watershed by assisting you in observing and evaluating how various land uses can affect the environmental and economic health of the watershed.

Assessment
A survey or inventory of natural and cultural resources within a watershed along with an analysis of how landscape and hydrologic systems function within the watershed.

All good watershed management plans are founded on watershed assessments. The more knowledge you have about the current and potential future conditions of your watershed, the better you will be able to plan to achieve the vision you have for the watershed.

Figure 1-1. The watershed approach.

(Reproduced from *A Guide to Developing Local Watershed Action Plans in Ohio.)*

WHAT IS THE PURPOSE OF THIS HANDBOOK?

The purpose of this handbook is to outline a basic process for assessing your community in order to develop a picture of current and future watershed conditions. The handbook describes a step-wise procedure for organizing a watershed assessment including a selection of questions to guide in the identification of concerns, in gathering appropriate information, and in analyzing information to ascertain possible causes for existing or potential problems. An extensive list of specific resources and references is provided to lead you through the collection of appropriate information. Resource management guidelines are also presented to serve as a measure for comparing the present watershed conditions with optimal conditions that you're striving to achieve through watershed management planning.

The Bottom Line

In essence, the watershed assessment is a description of both current conditions and functions of resources (the inventory of information) and the desired future condition (the "vision" for the watershed). This information provides a foundation for the development of a watershed plan that can prescribe activities needed to get from the current to future conditions.

Keep in mind that the more energy spent on the assessment, the better the watershed management plan will be. The assessment process not only brings together relevant information, it brings people together to begin to form a shared vision that will become critical in the development and implementation of a watershed management plan.

WHO IS THE AUDIENCE?

The primary audiences for this handbook are local governments, community organizations, and volunteer groups in the Chesapeake Bay watershed. The process outlined is intended to aid local governments and community organizations that are interested in addressing water quality and habitat concerns on a watershed scale. It also provides helpful information for organizations with limited technical and financial resources.

HANDBOOK OVERVIEW

THE ASSESSMENT PROCESS (Chapter 2)

The handbook outlines a simple and straightforward assessment process (see Figure 1-2: *Diagram of the Community Watershed Assessment Handbook*) beginning with organizing an assessment team and identifying concerns and issues, compiling data, and finally analyzing the information collected for use in developing strategies to address any problems revealed during the assessment.

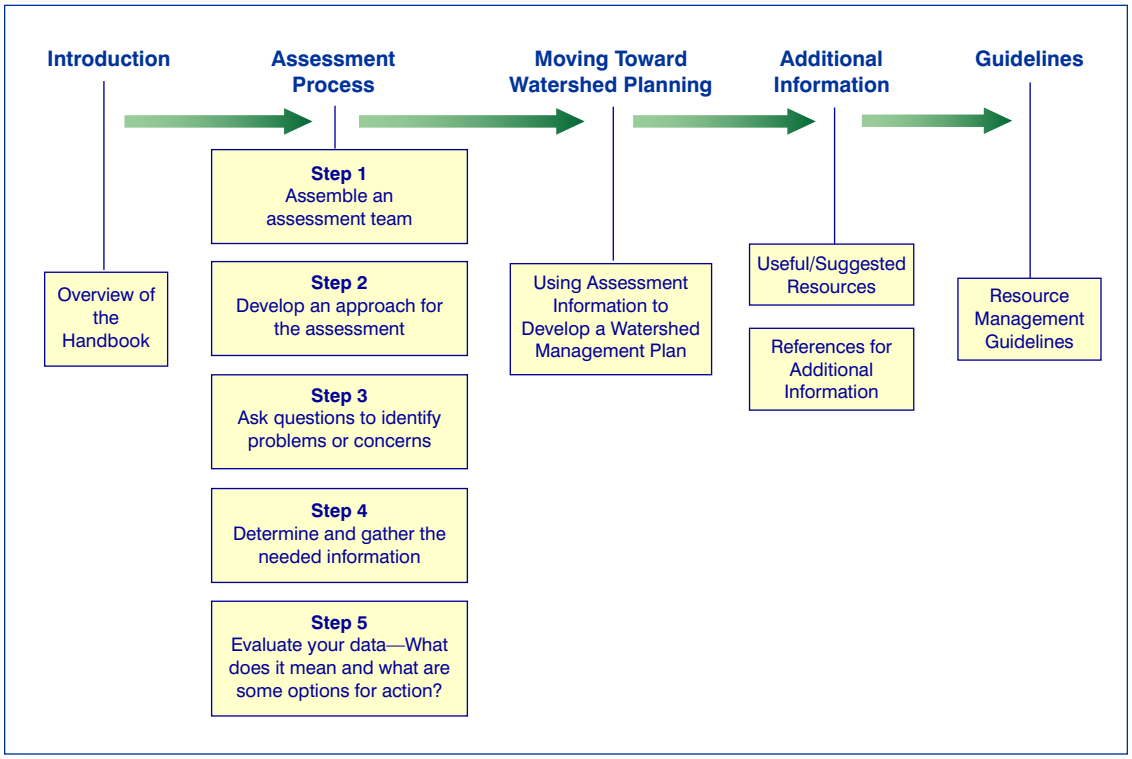

Figure 1-2. Diagram of the Community Watershed Assessment Handbook.

Not all of the issues presented in the handbook will apply to your watershed. The content and extent of your assessment will depend on the concerns and priorities within your community. It is important to determine what information you need to compile so that time and effort are not spent gathering information that is not needed or important. The assessment process described in this handbook will help you identify priorities and determine how to best evaluate your watershed.

Do not be intimidated. Not all of the issues presented in the handbook will apply to your watershed. The content and extent of your assessment will depend on the concerns and priorities within your community.

The following is a brief description of the basic steps in the assessment process. Each step is discussed in more detail in Chapter 2: *The Assessment Process*.

STEP 1. Assemble the assessment team—Identify all interested parties in your community and determine which technical support agencies need to be involved in the watershed assessment.

STEP 2. Develop an approach for the assessment—The assessment team will develop a strategy for conducting the watershed assessment based on desired future conditions for the watershed and the resources available to perform the assessment.

STEP 3. Ask questions to identify problems or concerns—These questions will help you determine what the known and perceived problems are in your watershed and serve as a guide for the collection of relevant information.

STEP 4. Determine and gather the needed information—Based on the concerns revealed in Step 3, you will determine the information that is already available which needs to be gathered, determine whether there is any missing information, and collect new data to fill in those gaps. An extensive list of "tried and true" resources is provided in Chapter 4: *Additional Information* to assist you in data compilation.

STEP 5. Evaluate your data—What does it mean and what are some options for action?—Analyze and evaluate data to define conditions and issues within your watershed to aid in the development of specific preservation and restoration goals, and to ascertain which areas within your watershed are in need of immediate action. During the data evaluation, you will also be able to determine whether more study is needed for particular issues.

MOVING TOWARD WATERSHED MANAGEMENT PLANNING (Chapter 3)

Once your watershed assessment is complete, you are well on your way to developing a watershed management plan. Although this handbook does not provide direction on how to complete a plan, Chapter 3 sets the stage for you to begin thinking about how the issues you identified in previous chapters may be addressed through watershed management planning. Several excellent, easy to follow sources for developing a plan and finding financial and technical assistance are recommended in Chapter 4: *Additional Information*.

ADDITIONAL INFORMATION (Chapter 4)

Sources are provided for suggested resources and references to complete each aspect of the assessment process as well as for background information on the various related topics.

GUIDELINES FOR EVALUATING EXISTING CONDITIONS (Chapter 5)

The resource management guidelines presented in Chapter 5 provide a description of conditions against which you can compare the findings of your assessment. This evaluation will assist you in setting priorities as you develop your watershed management plan and strategy for action. These guidelines do not address every situation, but they do provide advice for those most often encountered. Recommended actions to remedy typical problems are also given. The guidelines and recommended actions are intended to serve as tools for selecting watershed management alternatives and setting priorities for future watershed planning.

CHAPTER 2 The Assessment Process

The assessment process described in this handbook is designed to lead you through a series of steps that will give you a better understanding of the problems and assets within your watershed. This will be accomplished by gathering existing information such as maps and photographs, planning and zoning documents, permits, and reports prepared by government agencies. The assessment may also involve collecting new information through interviews, field trips, or surveys. The type and amount of information gathered as well as the individuals and groups involved in the assessment process should be tailored to the specific concerns of the group, the characteristics of the watershed, and the technical tools and financial resources available.

Not all of the data and information sources mentioned absolutely need to be used to conduct an adequate assessment. The assessment should focus on the places and resources that make your watershed special. Time spent articulating a vision of the desired future for your watershed will be invaluable in focusing the scope of your assessment—what you are trying to accomplish and why it is important. Formulating a vision statement will help your community concentrate its energies and resources on achieving its identified shared goals.

In the same respect, establishing well-defined goals and objectives prior to launching the assessment will set the stage for action and describe what tasks will need to be carried out. Your group may find it help-

Vision
Summarizes the ideal future state that a community hopes to attain.

Goal
A description or definition of the desired change or outcome that the group wants to achieve.

Objectives
Describe how goals will be achieved through specific measurable tasks.

ful to begin by setting goals for the watershed as a whole, then develop separate goals and objectives for specific stages of the watershed management planning process including the watershed assessment, public involvement, and implementation of the watershed plan. Keep in mind that the development of goals and objectives is an iterative, or changing, process. Goals and objectives are often revised and updated to accommodate new information, accomplished actions, changing conditions, or increased resources or support. Some examples of typical vision statements with related goals and objectives are provided below in Figure 2-1: *Example Vision Statement and Goals* and Figure 2-2: *Sample Goal, Objectives and Actions With Programmatic Indicators* and in Appendix C: *Bowker Creek Watershed Management Plan*. More information on setting goals and objectives can be found in Chapter 4: *Additional Information*.

VISION STATEMENT

"Our vision for the Mullica River Watershed is a landscape that will remain largely pristine and protected, with high quality water, unique Pine Barrens and estuarine habitats and wildlife, and appropriate, sustainable and environmentally compatible development, agriculture and recreation."

GOALS

- The quality and quantity of our surface and ground water resources should be preserved, protected and enhanced through, among other things, the definition of reasonable water quality standards;
- The native biodiversity of our region should be preserved, protected, and enhanced;
- Agriculture, commercial, residential and recreational development in the watershed should be appropriate, sustainable, and environmentally compatible; and
- The unique identities, aesthetic values and cultural and social resources of the watershed communities should be maintained.

Figure 2-1. Example vision statement and goals.

from "Mullica River Watershed Planning Project", submitted to NJDEP January 2002 http://www.state.nj.us/pinelands/mullica/visionstatement.pdf or http://www.state.nj.us/pinelands/mullica/overview.htm)

GOAL
Protect or restore the riparian corridor in targeted high quality streams.

OBJECTIVES	ACTIONS	INDICATORS
Increase riparian corridor	• Local land trust solicits the donation of conservation easements from property owners along targeted streams.	• Number of acres donated
	• City and county park districts purchase land for a seven mile greenway along east side of river	• Miles purchased, donated, or deeded
Protect riparian corridor	• Watershed communities pass township or municipal ordinances requiring 150 ft. easements for any new construction in floodplain of targeted steams.	• Number resolutions or ordinances passed.
Restore riparian corridor in targeted areas	• Resource agencies work with streamside landowners to install five willow post revetments at high erosion points.	• Number of willow post projects completed
	• Install grass filter strips in 100 acres of critical headwaters farms.	• Number of acres grassed.

Figure 2-2. Sample goal, objectives and actions with programmatic indicators.
(From *A Guide to Developing Local Watershed Action Plans in Ohio*)

The assessment process also is not always initiated or followed exactly in the order that it is presented in this handbook. In some instances, members of an existing watershed organization will have an idea of current and potential problems but not enough information to decide how to address their concerns. In other cases, a small group of individuals concerned about a particular environmental issue in their community or watershed will decide that more information is needed to address certain concerns and then form an assessment team to gather information. Whichever the case, the key concept to keep in mind is that a comprehensive watershed assessment that identifies and prioritizes issues can only be accomplished through a broadly inclusive process.

STEP 1
ASSEMBLE AN ASSESSMENT TEAM

The key to a successful evaluation of your community's assets is the participation of a representative cross-section of the community to ensure that the information collected is complete and correct. Including as many individuals as possible with an interest in environmental decisions from the beginning of the process will increase the likelihood that the assessment and ultimate watershed management plan will have the support of all stakeholders.

The assessment team should include anyone with knowledge of the local resources and a desire to help. Success depends on involving a good mix of people and organizations to fill a number of diverse roles—such as leadership, laboror, or political liaison, and providing expertise in scientific, technical, education and public policy issues, and insight on local matters. Make sure that local landowners as well as individuals from the local development community are active participants in the assessment process. It is equally important to include technical specialists from state and regional agencies as advisers. The-following is a list of those people, agencies and organizations you should consider involving in your watershed assessment. All of these people will not need to participate in every aspect of the assessment, but should be involved or consulted at appropriate times throughout the process.

Non-governmental participants

Landowners and local residents
Environmental and conservation groups
Farm organizations
Civic organizations
Recreational groups (e.g., hiking, fishing)
School groups (students and teachers)
Builders/developers
Consulting engineers
Local businesses and industry
Media
Religious groups
Chambers of commerce

Federal agencies

U.S. Environmental Protection Agency
Federal Emergency Management Agency
USDA Natural Resources Conservation Service
U.S. Fish and Wildlife Service
U.S. Army Corps of Engineers
USDA Forest Service
National Park Service Rivers, Trails, and Conservation Assistance
National Oceanic and Atmospheric Administration Coastal Zone Management Program

State and local agencies

Departments of Natural Resources
Departments of the Environment
Soil and Water Conservation Districts
Public Works Departments
Planning/Zoning Boards
Flood Control Districts
Cooperative Extension Services
Resource, Conservation and Development Councils
Local decision makers
Parks and Recreation Departments
Departments of Health

STEP 2
DEVELOP AN APPROACH FOR THE ASSESSMENT

Once an assessment team is assembled, the team is responsible for developing direction and guidance to conduct the watershed assessment. A good approach will address any resource concerns within the context of desired future conditions for the community—in other words, your vision for what you want your watershed to be like in the future. As mentioned previously, a good place to start is by identifying broad goals for the watershed that can be refined as data is collected and evaluated. Answering the following questions will help you define the scope of work, focus your resources, and aid in the development of some initial assessment goals.

- Why are we doing this?
- What are the benefits to the watershed, citizens and stakeholders?
- How should we go about doing it?
- What is/are the desired outcome(s)?
- What are the boundaries of our watershed?
- What will it cost?
- Where and how will we obtain funding and/or assistance to complete the assessment?
- What are our technical and personnel resources?
- When will we begin and when will we finish?
- How will we ensure that the assessment process leads directly into planning implementation?

Once the general goals for the assessment have been established, you will want to define how the goals will be met through specific, measurable, time-oriented

tasks (assessment objectives). This will direct your approach to data collection. For example, if one of your goals is to preserve forests, you need to identify where your forests are and determine the condition of the forests. If a goal is to reduce the impact of stormwater runoff, you need to identify areas with and without stormwater management issues and identify sources of sediment and other nonpoint source pollutants. If a goal is to define the condition of local streams, you need to gather water quality information and you may want to organize a stream walk. Quite often the goals will need to be prioritized to direct the assessment approach.

The team should also identify ways to inform the wider public about the environmental assessment project and to solicit additional participation. Approaches can include newsletters and mailings to key landowners and local agency representatives, public meetings, posting notice of activities in prominent locations, or the creation of a web site describing your watershed efforts. Depending on the size of your team and the scope of the assessment work to be done, it may be advantageous to form smaller working groups to focus on specific parts of the inventory plan.

Watershed Work Assignments

The following elements should be defined for each assessment task or objective:

- The kind of information needed
- The availability of the information
- The format(s) of the information
- The level of detail needed
- Who will collect the information
- How and when the information will be collected.

A sample worksheet is provided in Appendix D.

It can not be overemphasized that the success of the assessment and ultimate plan for the watershed relies on the participation and support from a broad range of individuals, stakeholder groups, and specialists—each contributing different viewpoints and goals. A broadly inclusive process of this sort will provide more support for your outcomes, more innovative solutions for a wider variety of problems, and a more certain outcome of success. The key to a smooth and successful assessment is establishing effective communications between the community, the assessment team, and technical support specialists, and ensuring that each group understands the goals of the process.

STEP 3
ASK QUESTIONS TO IDENTIFY PROBLEM AREAS

Faced with analyzing a watershed, it's hard to know the types and amount of data you will need to develop strategies to support your goals. Before any data or other information is collected, you need to clearly identify issues and concerns that are specific to your watershed—ideally based on your previously identified vision, goals, and objectives. It is critical to determine what information needs to be compiled so that time and resources are not wasted on gathering unneeded or unimportant information.

Discussions with the various stakeholders you identified in Step 1 as being important to the assessment process should uncover the major issues in your watershed. You may also need to consult various technical experts to identify any habitat or other water resource concerns or conditions that are unique to your watershed. Throughout the issue identification stage, you may find it helpful to map the locations of problems and overall concerns or keep a list of how frequently an issue is mentioned by different groups and individuals. This will aid you in setting priorities for gathering information and in determining what the extent of the assessment should be.

A comprehensive, well-planned assessment of your watershed will provide you with the necessary knowledge of what your landscape looks like, how it functions relative to your goals, and the interactions between landscape and water. Knowing how land is used in your watershed can help you determine possible pollutant sources or problem areas. Directed questions for each topic presented in this section will guide the discovery or confirmation of any issues or problems with your water resources and any human or ecological features that may be present which positively or negatively affect the quality of your water resources. Answers to these questions will serve to focus the acquisition of data in the watershed assessment. It should be noted that these questions do not cover all possible issues, but represent the types of problems that many communities face.

Land and Water

The relationship between human activity on the land and living resources and water quality are irrefutable. If you have an idea about which types of activities are occurring on the land, you will have a better sense of the types of problems to look for in your watershed, and where to find them.

The following questions are organized according to major topics that are most often addressed in watershed management plans. The overall topics and questions presented may go beyond the scope of what you are considering for your assessment. This is done intentionally to make sure that you think about all possible issues. It does not imply, however, that all questions need to be answered, or that data will need to be collected in all cases. Again, the type and amount of information you will gather should ultimately be tailored to the characteristics of the watershed, the specific concerns of the group, and the financial resources available to your group.

WATER QUALITY AND QUANTITY

What are the permitted and recreational water uses within the watershed? Consider the uses from the following list:

Water supply
Industry
Recreation/swimming
Mining
Treated wastewater returned to streams/rivers
Power plants
Irrigation
Fishing
Reservoirs

- Are the above uses supplied by surface water or groundwater?
- What land uses, discharges, or other conditions are within the watershed that can affect water uses?
- Are there other water uses or plans for increased use in the future?
- Are any plant or animal communities present in the watershed that are dependent on high-quality water, such as brook trout or other indicator species?
- Have water recharge areas been mapped for the public water supply wells and private wells?
- Is there a protection plan or program in place for the surface water and groundwater public drinking water supplies?
- Have special protection areas such as wetlands, groundwater recharge areas, or sensitive streams been identified within the watershed?
- Are there uses that are currently not permitted because of poor water quality, or are there goals for new uses that are contingent on improved water quality?
- Have the streams or water bodies been designated as impaired, and are there total maximum daily loads (TMDLs) written for those water bodies?
- Are any water uses restricted or not feasible due to quantity and flow issues?

- What are the load reductions needed for non-point nutrient and sediment sources for your watershed?

LAND USE

Because water runs over and through the land that you live on before it gets to streams, lakes, and rivers, the decisions you make regarding how your land is used directly affect the quality of your waters. The amount of land consumed by houses, roads, or commercial development also impacts wildlife habitat. Separate decisions made related to the development of individual shopping centers or residential communities may themselves seem insignificant. But the cumulative impacts of multiple unplanned or poorly planned actions may have significant affects on water quality, habitat and even the cost of living in that area. Below are a few questions to get you started on determining your land uses and their impacts:

- What are the past and current land uses, including residential, commercial, industrial and agricultural uses?
- How is land in the watershed zoned for future land uses?
- Are there any areas that you wish to ensure are protected?
- Are any of these priority areas likely to be impacted by future development or other future uses?
- Have urban or agricultural best management practices been installed and maintained (e.g., stormwater management practices)?
- Where are future subdivisions proposed?
- Where are new roads and utilities proposed?
- Are there areas of known failing septic systems or older communities with a high probability of septic failures in the future?

NATURAL RESOURCES AND HABITATS

Information will be needed in order to determine if there are any problems in your watershed relating to natural resources and habitats. The following topics and questions can help you in identify the natural resources and habitats in your watershed and recognize areas that may need protection or restoration:

Forests

- What forested areas are considered biologically diverse or high quality habitat?
- Are there any old growth forests in the watershed?
- Are there any large blocks of forests not crossed by roads, and if so, where are they located in your watershed?
- Do forested corridors connect any blocks of uninterrupted forest?
- Are there saplings in the understory (besides pine and holly)?
- Do you notice an overabundance of gypsy moth larvae or is there evidence of other known pests or pathogens that may be cause abnormal defoliation or tree death?
- Have any interior dwelling species been identified in the forest habitat (e.g., wood thrush or other neotropical songbirds)?
- Is the forest large enough to support interior dwelling species?
- Is there evidence of damage in forested areas from off-road vehicles (e.g., erosion, trees removed, built trails, gullies etc.)?

Wetlands

- Where are the wetlands in your watershed?
- What land uses are adjacent to wetlands?
- Have the wetlands been filled in, drained, or dredged?
- Has water been diverted from the wetlands?
- Are the wetlands being mowed?
- Is there a single plant species dominating the wetlands? If so, what is it?

Streams/stream corridors

Riparian buffers

- Are there areas where there are no forested buffers on either or both sides of the stream?
- Where there are riparian buffers, are they at least 35 feet in width, preferably 100 feet on each side of the stream?
- Are the riparian buffers composed of a mix of native plant species?
- Are the trees in forested buffers primarily deciduous trees, evergreens, or a mix?

Erosion

- Are stream banks eroding or slumping?
- Is sediment entering the stream from construction sites?
- Have stream channels been widened or deepened?

Fish barriers

- Are there physical or chemical barriers to the migration of fish or other aquatic life (e.g., dams or culverts)?

Litter

- Have litter, leaves, yard clippings, or other debris been dumped around or in your streams?

Point source pollution

- Are there discharges through pipes into any streams in your watershed?
- Do you observe foaming or discoloration of the stream water near a discharge pipe (i.e., gray or brown water)?
- Have there been any measurable changes in water temperature downstream of a discharge?

Mining impacts

- Are there any streams in your watershed where stream bed and/or water in the stream channel is a rusty orange color?
- Is there evidence of erosion or rock/sediment slides into streams near active or abandoned mine operations?
- Is there evidence of sediment discharge or deposition downstream of mining activities?
- Have wetlands been drained or streams moved/straightened to accommodate mining activities?

Nonnative species

- Does a single plant or animal species dominate any aquatic or terrestrial habitat of the stream corridor? If so, what is it?

Lakes and ponds

- What are the allowed uses for the lake (fishing, swimming, water supply)?
- Are the allowed uses limited because of water quality?
- Does the water appear unusually cloudy or muddy?
- Has a green or brown cloudy layer (algae) been observed in the water or a slimy green scum on the surface of the water?
- Can any unusual odors be detected?
- Has a recent fish kill occurred in any lake or pond?
- Is the water level unusually low?

Coastal/shoreline

- Is there evidence of erosion along any coastal or shoreline areas?
- Have there been any recent beach closures?
- Are marinas taking part in a clean marina program?
- Are there areas designated as protected coastal habitat?
- Is there a depletion of SAV (submerged aquatic vegetation)?
- Have any coastline areas been hardened (structures built to protect the beach)?
- Are any coastal or shoreline areas which are abnormally shallow due to sedimentation?

After you've thought about the previous topical questions, you may want to consider the following additional questions to further clarify the scope of your watershed assessment:

- What are the specific problems with any resources of concern, such as loss (and future loss) of habitat, degradation of air or water quality, or an unnatural fluctuation in water quantity or water temperature?
- How much data is needed for particular issues to adequately explain the condition of the watershed to others?
- Should data be sampled from a few key points in the watershed, or is a full, detailed inventory of the watershed necessary?
- What environmental indicators (i.e., sensitive species) can be used to establish whether a problem exists and to determine the extent or severity of any identified problems?

STEP 4
DETERMINE AND GATHER NEEDED INFORMATION

As soon as important issues in your watershed have been acknowledged based on the group's overall goals for the watershed and once those questions from Step 3 that you want or need to answer have been idenitified, you are ready to start gathering information. Keep in mind that there should be a logical purpose for all information you intend to obtain and you should have a clear sense of what the ultimate use will be for all data gathered—otherwise you run the risk of drowning yourself with too much information.

There are generally two tiers in assembling assessment data. The first is to gather existing data. This is information that is readily available in the form of maps, photographs or other published material and which can be obtained on the internet or by contacting local or state government agencies, universities, or other watershed and community groups. The second tier involves collecting new

Maps

Maps are a key component to a watershed assessment-they provide a means of spatially relating a variety of data and a foundation from which management and planning decisions are made. Much of the information that is collected during the assessment can be shown on a map or a series of maps, including wetlands, parks, wildlife areas, landfills, problem areas in streams, rare plants and animals, and drinking water supplies. Displaying this information on maps is a good way to help you visualize and understand what is happening in your watershed and to direct your focus on potential problems.

Many types of maps are available, including road maps, U.S. Geological Survey (USGS) topographic quad maps, soil maps, aerial photos, and satellite imagery. The extent of your study area will help determine the scale of mapping that will be needed. Large-scale maps such as 1:200 scale (1 inch = 200 feet) geographic information system (GIS) topographic maps or enlarged 7.5-minute USGS quadrangle maps with a scale of 1:24,000 show hills and valleys, vegetation, streams and rivers, buildings, roads, bridges, pipelines and transmission lines, municipal boundaries, and other features.

Additional resources can be added or overlaid through the use of GIS. (GIS is a computerized system designed to support the compiling, storing, retrieving, and analyzing of spatially related data and is a great tool for integrating information and displaying a wide variety of data on a map.) EPA's Green Communities Web site (http://www.epa.gov/greenkit/mapping.htm) provides an overview of some mapping resources that are readily available, including USGS topographic maps, county and state highway maps, national wetlands inventory maps, county soils surveys, county and local natural areas inventories maps, aerial photography, and land use mapping. Many state agencies provide access to a wide variety of data to the public that can also be used for the creation of maps.

information through direct observation utilizing physical surveys or through biological and water quality monitoring. The two tiers can be carried out either sequentially or simultaneously and can be performed by the same or different teams depending on the approach that is best for your group. However, gathering existing information first is recommended to save time and money so that limited resources can be more sensibly applied to fill in data gaps.

COLLECTING EXISTING DATA

Many assessments have already been conducted at local, state, and federal levels and volumes of data are available for your reference. You are fortunate to be in the Chesapeake Bay basin because much of this information has already been compiled for your use. A good place to begin investigating the environmental condition of your watershed is the Chesapeake Bay Program's "Watershed Profiles" (http://www.chesapeakebay.net/wshed.htm). This internet application assembles numerous maps, charts and information that will give you a general idea of the conditions, resources and problems in your watershed.

While a basic overview of your watershed can be obtained through Watershed Profiles, local sources should be the initial contact for acquiring information that is specific to your watershed and that is detailed enough for your use. Local government agencies, established watershed associations, and even area colleges or universities are good places to start. In fact, local comprehensive plans and land use plans provide an excellent foundation for identifying existing and proposed land use conditions. If a comprehensive plan exists for your community, you should determine whether the overall goals for your watershed have been or could be addressed in the plan.

State and federal agencies also have a wide variety of useful information that can fill in where local information is lacking. Government documents that are available to the public (federal, state, and local) can be an important source of information for many different areas of the assessment, such as, landfills, superfund sites, and permitted discharges. Accessing this information can be as easy as asking for information over the phone, making an appointment to visit an office to look at reports, or requesting information by mail. Table 2-1: *Data Types and Sources* provides an overview of the numerous sources where you can access different types of data. Much of this information is now available on agency websites as well, and many relevant web addresses are provided in Chapter 4: *Additional Information* and Appendix A: *Contact Information*.

Here are a few additional tips to consider to facilitate your compilation of watershed information:

- Maintain worksheets for recording data, and update maps with any data that can be shown on a map (see sidebar). A worksheet sample can be found in Appendix D: *Watershed Work Assignments Worksheet*.
- Designate someone to compile and organize all data, worksheets, and maps into notebooks, binders, or appropriate files.
- Reevaluate data throughout the collection process in order to keep track of what information still needs to be gathered.

Geographic Information Systems

Specialized computer programs are often utilized to facilitate the viewing, storing, manipulating, and analyzing of watershed data. Such programs are commonly referred to as Geographic Information Systems (GIS) and are designed to organize and graphically represent any data that have spatial attribute information such as street addresses, zip codes, county names, or longitude/latitude coordinates. Data on land cover, slope, wetlands, population, roads, and streams are a few examples of the types of information that are available and can be freely downloaded from a variety of public data clearinghouses. The GeoSpatial One-Stop Initiative (http://www.geodata.gov/) and the Geography Network (http://www.geographynetwork.com/) are two such clearing-houses that provide data at a small, subwatershed scale so as to be useful for local watershed assessments. Additional data can be accessed from State natural resource, environment, and planning agencies as well.

Coupled with good information, GIS are powerful tools for watershed assessment. They can be used to overlay many layers of information representing numerous aspects of watershed conditions, enabling the user to locate areas with multiple attributes such as agricultural lands on steep slopes or forests in the floodplain. GIS programs can also be used to analyze information to derive measures of forest fragmentation, impervious surfaces, and nutrient loads. These derived data sets can then be ranked, weighted, and combined to prioritize areas for watershed protection and restoration.

A variety of commercial GIS software is available to facilitate your data compilation and analyses. The Environmental Systems Research Institute produces some of the most popular GIS software (e.g., ArcView , ArcInfo , and ArcGIS) and these products can be obtained at a discount to qualifying conservation organizations. Anyone is capable of mastering GIS, but as with all software, learning GIS requires a significant investment of time. Given the cost and time needed to acquire and learn GIS, some colleges, uni-versities, and non-profit organizations offer free or subsidized courses in using GIS and some also provide analytical support to watershed groups.

Table 2-1. Data types and sources.

Data Sources	Data Types																								
	Watershed Maps	Topography	Hydrology	Water Flow	Water Quality Assessment Reports	Source Water Quality and Quantity	Discharge Permits	Soils	Urban Runoff	Agricultural Runoff	Land Uses	Wetlands	Floodplain	Forest Cover	Riparian Buffers	Historical Uses	Future Land Use	Land Ownership	Easements	Zoning	County Comprehensive Plans	Agricultural Statistics	Habitat	Biological Data	Threatened or Endangered Species	Aquatic Vegetation
Natural Resources Conservation Service								X		X		X							X				X	X		
Chesapeake Bay Program	X	X							X	X	X	X		X									X	X	X	X
State Environmental or Natural Resource Agencies				X	X	X	X		X		X	X	X													
State and U.S. Fish and Wildlife Service												X			X								X	X	X	
Local or Regional Soil & Water Conservation Districts and Cooperative Extensions	X	X	X					X		X	X	X			X							X				
County or City Planning Department	X	X	X	X				X			X	X	X	X	X	X	X	X	X	X	X					
State and U.S. Agricultural Departments										X	X											X				
U.S. Geological Survey, state Geologic Surveys	X	X	X	X		X					X															
Historical Society and Land Trusts											X					X			X							
State Department of Forestry or U.S. Forest Service														X	X											
Local water and sewer utilities				X		X																				
Local Department of Engineering			X						X				X													
State Flood Control District			X										X													
U.S. Environmental Protection Agency					X	X	X																			

COLLECTING NEW DATA

Once you've assembled available data relevant to the community's initial issues and concerns, you may discover that some of your information is incomplete. The team must then determine what additional information is needed to sufficiently evaluate any resources of concern. Collecting new data can range from a simple windshield survey to extensive water quality or biological monitoring. Protocols are available for numerous procedures to help you acquire new data.

One methodology that is commonly employed is a physical survey of the watershed or stream corridor. Streams are often referred to as a barometer for the condition or health of a watershed. As such, stream walks are frequently conducted to identify specific problems and assets in a watershed which can then be documented on maps. Impacts of land uses and changes in land cover are directly reflected in the stability of a stream and in the quality of aquatic and terrestrial habitat of the stream corridor. Conditions such as bank erosion, pipe outfalls, channelization, lack of buffers, or sedimentation can be attributed to specific land uses or known water quality violations. Each of these conditions will be readily observable to you in a stream walk.

A number of straightforward, easy to follow methods for conducting a stream walk have been developed by various organizations. Guides published by groups such as the Izaak Walton League, Maryland Save Our Streams, the Maryland Department of Natural Resources, and the Virginia Citizen Water Quality Monitoring Program include descriptions of field procedures and protocols for recording and evaluating data. References for the various methodologies are provided in Chapter 4: *Additional Information* and you are encouraged to review and use the one that is most suitable to your needs and resources.

Water quality sampling is another commonly utilized methodology for acquiring important information on the state of the watershed. The

Gaining Access to Privately Owned Land

Before stepping foot on the property that is to be assessed, you must receive permission from the landowner. Write a letter to the landowner asking for permission to be on the land and explain the need for the visit. Include a description of the project, a contact person, and a list of those who will be on the team. Attach a permission form for the landowner to sign and return. An example of a permission letter can be found in the Maryland Stream Corridor Assessment (http://www.dnr.state.md.us/streams/stream_corridor.html)

level of sophistication can range from using a field test kit to sending samples to a certified laboratory. Prior to choosing a water quality monitoring technique, you should refer to your initial goals and objectives to rationalize the ultimate use of the information. If the data collected is intended to provide an indication of potential problem areas, then a simple field test kit can be cost-effective for identifying problems. In addition, it's a good way to educate and involve community members. On the other hand, if a precise analysis of water quality is needed, then more extensive sample collection and analysis may be appropriate. Keep in mind that a more thorough water quality investigation can be quite expensive depending on the number of samples collected and the parameters analyzed. References for recommended water quality testing and monitoring methodologies are also provided in Chapter 4: *Additional Information*.

Biological surveys of aquatic life (fish and aquatic insects), birds, amphibians, reptiles, and mammals can also provide important insight as to the condition of stream corridors and the watershed as a whole. The presence or absence of particular indicator organisms in the stream or adjacent land can be directly correlated to land use activities in the watershed. Again, numerous methods have been developed by various organizations for conducting biological surveys and references for these resources can be found in Chapter 4: *Additional Information*.

If you have not already consulted with your state environmental agencies, it is a good idea to talk to agency representatives who are currently assisting other local groups in collecting watershed information. They can provide useful and time saving information on state-preferred assessment and monitoring methods. Contact information for state agencies is provided in Appendix A of this handbook.

STEP 5
EVALUATE YOUR DATA: WHAT DOES IT MEAN AND WHAT ARE SOME OPTIONS FOR ACTION?

Now that you've finished your watershed assessment, you are faced with the task of determining what to do with the plethora of information you've accumulated. There are countless ways to evaluate your data. The interrelationships among the information on the topics you investigated will need to be examined in order to define the conditions and issues within the watershed. This type of analysis, which involves the integration of information about separate topics in order to discover processes or interactions, is referred to as synthesis. A more detailed

explanation of synthesis is provided in the text box on this page. It is recommended that you use a watershed-wide approach to assess the effect of land uses and land cover on water quality. If various assessment tasks were delegated to different subgroups, you'll want to bring them all together to work as a unified group in attempting to fit all the pieces into a clear picture of the watershed.

Throughout the data analysis, you should periodically refer back to the broad goals identified by the assessment team at the beginning of the assessment process and determine whether the data collected will provide enough information to address those goals. If additional data gaps are revealed during the evaluation step, the missing information should be either collected or flagged for further study.

Synthesis

Watershed analysis calls for developing an understanding of the many processes and interactions occurring within a watershed. Information gathered during a watershed assessment is typically organized into separate distinct topics—such as soils, forests, land use, etc. This information needs to be integrated in order to discover processes and interactions occurring between the categories. This is where synthesis comes into play. Simply stated, synthesis is the act of discovering a relationship or previously unrecognized connection between two or more pieces of information—a connection between roads and water quality, for example.

A watershed analysis generally begins with a pool of information representing different subject matter from different sources, at different scales and levels of detail. The assessment team must first compile and sort through raw material (data, maps, reports, etc.). Information can be sorted in many ways—chronologically, geographically, categorically—and every arrangement will reveal some relationships but conceal others. The information then needs to be distilled and synthesized. The discovery of relationships between critical pieces of information can be impossible with too much data. So, the information within each topic or category needs to be condensed and summarized. There is no formula for the distillation process—it occurs within the human brain and is accomplished through careful consideration of the intended use for the information.

It is often helpful for teams responsible for different aspects of the analysis to begin with raw material (data, maps, etc.), and proceed to compile, organize and analyze the data to end up with a particular product (write-up, map, table, etc.). The distilled information can then be transferred to a base map for collective consideration by team members. Using the visually distilled information, the team members can begin the process of detecting dominant relationships, interactions, and connections between subjects within the watershed. Those dominant relationships that occur across significant portions of the landscape will be the focus of directing restoration and protection efforts for the community's action plan.

In general, a good overall approach for your data evaluation should begin by identifying the assets or good conditions in the watershed that are in need of protection. Next you will want to identify problem areas. This can be easily accomplished by comparing proposed land use changes with the areas you've targeted for preservation. Any potential problems should then be evaluated in relation to existing land uses. This will help you focus your efforts towards areas reliant on immediate attention for protection or restoration.

There are numerous specific techniques for evaluating your data. One of the most common and easiest ways to quickly identify the interaction of land uses and land cover with water quality and habitat conditions is by using map overlays. This is most often done with a computerized mapping software package called a geographic information system (GIS) (refer to the text box on page 19 for more information on the use of GIS for watershed assessments). If you don't have access to GIS, base maps (topographic or road maps) or aerial photographs can be overlaid with clear acetate maps of other data sets such as land use or other planning maps. It may also be helpful to use a variety of acetate overheads that can be projected on a screen so the assessment team as a group can discuss the implications of the data sets, consider potential sources of problems, or ask questions requiring the acquisition of more data.

Visualize Your Data

Displaying as much information as possible about your watershed on a map will enable you to see the overall picture of what you know about the current state of the watershed. It will also help you recognize the work needed to reach your desired future vision of the watershed.

You can also take a more analytical approach for data analysis and begin by asking a series of questions about the various topics you've investigated (i.e., land use, stream corridors, etc.).

- What do we know about the issue or part of the landscape that seems to be problematic?
- What do we know that is positive and needs to be protected?
- Do we have enough information to make a decision about what needs to change?
- If not, what is missing and where can we get the needed information?
- Who can help bring about the needed change?
- What is the priority for the issue—emergency, serious, minor?

Answers to these questions will give you a general sense for areas of concern and set the stage for developing a strategy for addressing them.

Once you've identified potential or existing problems, areas of concern, and areas in need of protection, one way to further analyze your information is to develop a scoring process for rating the condition of smaller subsets of the watershed. These subwatersheds can be assigned numerical scores according to the number and severity of water quality and habitat problems found. The resulting scores allow the team to divide the subwatersheds into categories such as those needing restoration, those needing preservation, and those needing further study. The subwatersheds can then be given a priority ranking for each category, which will serve as the basis for an action plan to address the problems or issues.

Another technique for examining data to determine or clarify interactions or processes in your watershed is the use of a system to rank specific types of problems encountered. Simply stated, the process requires you to assign a rating of 1–3 for whatever parameters are important to you such as habitat value, severity, correctability, access or potential cost. Consideration should always be given to correcting problems at the source and not just the observed problem. For example, stream erosion could be the result of inadequate stormwater management from a residential development upstream or from livestock having direct access to the stream. In both cases, the source of the problem needs correction in addition to considering the stabilization of the stream itself. This technique is rather subjective and is dependent on how different individuals perceive different problems. However, working together as a team, and with a little bit of experience, the process can be worthwhile. After problems are ranked, you should be able to develop individual project proposals and seek funding to address the source of problems. Preservation sites can also be identified and targeted for easement or other preservation programs.

Whatever process you choose to follow for your data analysis, it will take considerable time and cooperation among all parties involved to discuss the data and to make decisions about next steps. In order to examine all possible relationships between land use and habitat or water quality conditions, numerous different data combinations will need to be considered. (Refer to the textbox on page 24 for more information on data Synthesis.) Everyone involved in the data evaluation brings a different perspective to the discussion. It is important to keep an open mind and respect all opinions and interpretations and make objective decisions about problems, possible causes, and in thinking about effective solutions.

Also keep in mind that local or regional experts from government environmental agencies will often provide assistance in your data evaluation and can offer suggestions to help resolve any specific issues that may surface. These experts can be very valuable in helping you to identify or verify actual sources of problems using sound analytical techniques.

CHAPTER 3 Moving Toward Watershed Management Planning

After having completed the community watershed assessment, your team should have a good sense of the condition and impacts affecting your watershed. By examining the results of your data evaluation you should be able to identify of the following:

- Specific preservation and restoration goals
- Regulatory changes or needs to support the goals
- Areas in need of immediate preservation or restoration action

In moving from the designation of goals based on data evaluation to developing a plan for managing your watershed, the group will want to begin thinking of all possible alternatives for addressing its concerns and bringing about desired changes. The resources management guidelines that are presented in Chapter 5: *Guidelines for Evaluating Existing Conditions* provide a foundation for comparing existing and/or anticipated future conditions with the desired vision for the future of the watershed. The recommended actions for those guidelines that are relevant to the vision for the watershed represent some possible actions you may choose to initiate in order to reach the goals for your watershed.

There are a number of excellent watershed management planning resources available that will guide you through the process of developing a strategy to reach your goals and to determine those actions that should receive priority treatment. A listing of some guidebooks can be found at the beginning of Chapter 4: *Additional Information*. You are strongly encouraged to utilize whichever resource(s) best fits the situation in your watershed in order to steer the transformation of information gathered during the watershed assessment

into an all-inclusive management plan. The watershed management plan will serve as a guide to help you bring about the changes needed for achieving your vision for the future of the watershed.

You should also consider consulting state environmental protection and/or natural resources agencies to find out about the many technical, financial, and management resources offered through state watershed programs. Coordinating and partnering with state and local governments will allow you to take advantage of the invaluable assistance they can provide.

Contact information for the various state agencies in the Chesapeake Bay region are listed in Appendix A: *Contact Information*.

CHAPTER 4 Additional Information

WATERSHED ASSESSMENT MANUALS

These watershed assessment manuals are excellent resources and a good starting place to find comprehensive information on all aspects of the watershed management planning process in a single manual.

WATERSHED INVENTORY WORKBOOK FOR INDIANA

The Watershed Inventory Workbook is designed to help watershed partnerships determine the sources of potential water quality concerns in their communities. This assessment tool provides straightforward, easy to understand background information on the various assessment issues, and simple questions and guidance for gathering appropriate information to help watershed partnership volunteers understand the watershed and begin to define any potential problems. The use of numerous visuals, including example maps, tables and worksheets with typical sample entries, make this workbook an excellent, easy to use resource to for any watershed group. (Purdue Extension, March 2002)
Available on the web at:
http://www.ecn.purdue.edu/SafeWater/watershed/inventoryf.pdf

OREGON WATERSHED ASSESSMENT MANUAL

This comprehensive manual provides clear and simple guidance on conducting a watershed assessment to help communities determine which features and processes in the watershed are working well and which are not. The process

includes steps for identifying issues, examining the history of the watershed, describing its features, and evaluating various resources within the watershed. Each chapter provides guidance on evaluating watershed conditions. The assessment concludes with a report or record of the assessment that contains the information needed to develop action plans and monitoring strategies for protecting and improving fish habitat and water quality. (Oregon Watershed Enhancement Board, July 1999)
Available on the web at:
http://www.oweb.state.or.us/publications/index.shtml

CONDUCTING A WATERSHED SURVEY

This document will equip a community group to perform a watershed survey and make a record of its history and geography, land and water uses, and potential and actual pollution sources. Simple instructions are provided for reading a topographic map, marking a watershed's boundaries, and observing and evaluating the effects of land development. You will also gain an understanding of city planning, zoning, municipal waste treatment, and environmental practices that lessen the impact of urban growth and development. (West Virginia Department of Environmental Protection, Save Our Streams Program.)
Available on the web at:
http://www.amrivers.org/docs/ConductSurveyFinal.pdf

VISIONING, GOALS AND OBJECTIVES

The Vision Thing: Tools to Get It in Focus—This manual, developed for a workshop at a community planning conference, explores the process of visioning as a method to build consensus among broad-based community participants for the purpose of developing comprehensive and long range plans based on the community's aspirations. The handbook 1) defines what a vision is, 2) reviews general principles that contribute to successful visioning, and 3) outlines the basic elements of a visioning process. (American Communities Partnership)
Available on the web at: http://www.acp-planning.com/

The Community Visioning and Strategic Planning Handbook—This handbook describes a framework and design for communities to engage in a visioning process. It provides information on community participation, community profiling, developing action plans, and implementing solutions.
(National Civic League, 3rd printing, 2000)
Available on the web at:
http://www.ncl.org/publications/descriptions/community_visioning.html

A Guide to Community Visioning: Hands-On Information for Local Communities—The *Guide to Community Visioning* provides a layperson's introduction to the community visioning process. It discusses the phenomenon of rapid change and how visioning can help local communities manage change in planning for the long-term future. It offers a detailed description of the Oregon Model of community visioning, a simple, four-step process pioneered in Oregon, and shares the visioning success stories of four distinctly different Oregon communities. (American Planning Association, 1993, revised 1998)
Available on the web at:
http://www.communityvisioning.com/aguidetocommunityvisioning/

Community Tool Box: Decision Making Tools—This toolkit is a compilation of tried and true methods that can help people work together to protect, enhance, or restore the special places in their communities. Tools for decision making include consensus building, defining issues, vision creating, and goal and priority setting. (National Park Service, Rivers Trails and Conservation Assistance Program)
Available on the web at:
http://www.nps.gov/phso/rtcatoolbox/dec_goalsetting.htm

STAKEHOLDER INVOLVEMENT

Creating Effective Groups to Address pressing Local Problems: A Resource Guide for Watershed Councils in the Pacific Northwest—This guide is a compilation of suggested resources to support the process of conflict resolution within community forums. It also includes information on dealing with anger and perspectives on power. (Washington State University, $4.00)
Available on the web at:
http://cru84.cahe.wsu.edu/cgi-bin/pubs/EB1930.html

Building Local Partnerships—Provides suggestions for who should be included in partnerships, potential contributions for participants, stages for developing

successful partnerships, building a common purpose, establishing goals, encouraging participation and tips for identifying and overcoming obstacles. (Conservation Information Technology Center's *Know Your Watersheds* series)
Available on the web at:
http://www.ctic.purdue.edu/KYW/Brochures/BuildingLocal.html

Community Tool Box: Organization Tools—This toolkit is a compilation of tried and true methods that can help people work together to protect, enhance, or restore the special places in their communities. Techniques for various aspects of community and stakeholder involvement are presented, including partnerships, various types of gatherings, and a number of facilitation and outreach methods. (National Park Service, Rivers Trails and Conservation Assistance Program)
Available on the web at:
http://www.nps.gov/phso/rtcatoolbox/org_partnerships.htm

MAPPING

Chesapeake Bay Program: Watershed Profiles—This internet resource assembles maps, charts and information that portray the environmental condition of Chesapeake Bay watersheds. The applications operate at a variety of scales from the entire 64,000 square mile Chesapeake Bay watershed to small tributary watersheds. (Chesapeake Bay Program)
Available on the web at: http://www.chesapeakebay.net/wshed.htm

EPA Green Communities—This website presents a multitude of information on mapping as a key component of a complete watershed inventory. Included are links to specific sources of information and web-based mapping tools.
Available on the web at: http://www.epa.gov/greenkit/mapping.htm

Mapping information is also available through each of the Chesapeake Bay partner jurisdictions. For more information visit their websites:

Pennsylvania DEP GIS: http://www.dep.state.pa.us/external_gis/gis_home.htm

Maryland State Geographic Information Committee: www.msgic.state.md.us

Virginia Geographic Information Network: http://www.vgin.state.va.us/

District of Columbia DOH Watershed Protection Division:
http://dchealth.dc.gov/watersheds

New York DEC mapping: http://www.dec.state.ny.us/website/map/index.html

West Virginia GIS Technical Center: http://wvgis.wvu.edu/

Delaware DataMil http://www.datamil.udel.edu/nationalmappilot/
or Delaware Geological Data Committee
http://www.state.de.us/planning/coord/dgdc/index.htm

WATERSHED BASICS

The following resources provide general background information on natural resources, landscape, and various process elements of watersheds.

Abandoned Mine Reclamation Clearinghouse—A great web-based resource that is easy to navigate and presents clear and simple background and practical information on Watershed Basics, Water Quality Monitoring (biological, physical and chemical components), and Watershed Assessment (focusing on Abandoned Mine Drainage).
Available on the web at:
http://www.amrclearinghouse.org/Sub/WATERSHEDbasics/

Conservation Information Technology Center's *Know Your Watershed* series—The Center's Watershed Management Starter Kit consists of eight clear, simple, and concise guide booklets intended to serve as a jump-start to beginning a successful locally-led watershed management planning partnership. The series is based on information that experienced watershed coordinators "wished they'd have known before they started". (Conservation Information Technology Center)
Available on the web at:
http://www.ctic.purdue.edu/KYW/

Why Watersheds?—This slide show provides excellent background information on watershed basics and why planning at the watershed level is important. The Center has also developed a variety of technical tools and resources for all aspects of watershed protection encompassing watershed planning, watershed restoration, storm water management, watershed research, better site design, education and outreach and watershed training. (Center for Watershed Protection)
The slideshow can be viewed online at:
http://www.cwp.org/whats_a_watershed.htm

EPA Watershed Information Network—A web-based roadmap to information and services for protecting and restoring water resources. Information provided includes state water quality information, EPA's Watershed Initiative, and an online "Watershed Academy" which offers a variety of self-paced training modules that represent a basic and broad introduction to the watershed management field. (U.S. Environmental Protection Agency)
Available on the web at: http://www.epa.gov/win/

WATER QUALITY/QUANTITY

The following resources provide general background information on water quality and quantity issues as well as links to guides and web-based resources for gathering existing information and/or assessing the condition of water resources in your watershed.

GENERAL INFORMATION

Chesapeake Bay Program—The Chesapeake Bay Program web site provides a multitude of useful water quality information including general background information, links to relevant publications, water quality status and trends throughout the Bay region, and access to several types of related water quality data.
Available on the web at: http://www.chesapeakebay.net/wquality.htm

Classroom of the Future—This web-based module presents clear, simple background info on all aspects of chemical, physical and biological assessment components of a water quality assessment.
Available on the web at:
http://www.cotf.edu/ete/modules/waterq3/WQassess1.html

Watershed Assessment, Tracking and Environmental Results (WATERS)—This web-based resource combines integrated water quality information from various EPA Office of Water programs by linking it to the national surface water network to describe the water bodies of the United States. Locations and associated information on designated use of a water body, water quality monitoring stations, assessments of water quality, causes and sources of impaired waters can be accessed from an interactive map.
Available on the web at: www.epa.gov/waters

Water Quality Interpretation Manual—This manual explains the importance of seven basic water quality parameters that are commonly used in many monitoring programs. Intended for teachers and other citizens as an educational resource the manual is arranged in a manner that is very clear and concise for those being introduced to the topic of water quality. (Pennsylvania DCNR, available through the Schuylkill Center for Environmental Education, $10)
Available on the web at:
www.schuylkillcenter.org or call: (215) 482-7300

EPA's Safe Drinking Water Standards—The U.S. EPA sets standards for approximately 90 contaminants in drinking water. These standards, along with each contaminant's likely source and health effects, and detailed information on specific contaminants are available on the web at:
http://www.epa.gov/safewater/hfacts.html

Pollution and/or Health Advisories—Current pollution and healtth advisories are available through city or county public health departments or the National Pollution Response Center at 1-800-424-8802

Water Quality Assessment Reports—USGS scientists collect and interpret data about water chemistry, hydrology, land use, stream habitat, and aquatic life in most of the major river basins and aquifers in nearly all 50 states. Data and reports can be accessed on the USGS National Water Quality Assessment program (NAWQA) web site at: http://water.usgs.gov/nawqa/

NPDES Permits—Information on existing and proposed NPDES permits is available through State water pollution control agencies and USEPA Region III for the District of Columbia.

Pennsylvania:
http://www.dep.state.pa.us/dep/depute/watermgt/wqp/forms/forms

Maryland: http://www.mde.state.md.us/Water/index.asp

Virginia: http://www.deq.state.va.us/permits/water.html

District of Columbia: http://cfpub.epa.gov/npdes/doctype.cfm?sort=name&program_id=45&document_type_id=8

New York: http://www.dec.state.ny.us/website/dow/mainpage.htm

West Virginia: http://www.dep.state.wv.us/item.cfm?ssid=11&ss1id=604

Delaware: http://www.dnrec.state.de.us/water2000/sections/surfwater/dwrsurfwat.htm

Local water and sewer utilities (including water and sewer plans and combined sewer overflows)—Contact city, county or town public works departments or departments of the environment directly.

Additional state-specific water-related information is available through state environmental or natural resource agencies. For more information visit them on the web at:

Pennsylvania:http://www.dep.state.pa.us/dep/deputate/watermgt/Wqp/WQStandards/wqstandards.html

Maryland: http://www.mde.state.md.us/Programs/WaterPrograms/Water_Supply/index.asp or http://www.dnr.state.md.us/bay/monitoring/index.html

Virginia: http://www.deq.state.va.us/water/reports.htm

District of Columbia: http://dchealth.dc.gov/services/administration_offices/environmental/services2/water_division/services.shtm

New York: http://www.dec.state.ny.us/website/dow/

West Virginia: http://www.dep.state.wv.us/item.cfm?ssid=11&ss1id=192

Delaware: http://www.dnrec.state.de.us/dnrec2000/WaterQuality.asp or http://www.dnrec.state.de.us/water2000/

GROUNDWATER AND DRINKING WATER

The Groundwater Foundation—This web site provides comprehensive information on numerous groundwater topics as well as guides for groundwater assessments and programs for community groundwater protection.
Visit them on the web at: http://www.groundwater.org/GWBasics/gwbasics.htm

Groundwater & Surface Water: Understanding the Interaction—A guide intended for watershed partnerships which presents a clear and simple explanation of groundwater basics, including groundwater and surface water interactions, watershed boundaries, aquifers and recharge, and threats to groundwater as well as potential management approaches. (Conservation Information Technology Center's *Know Your Watersheds* series)
Available on the web at:
http://www.ctic.purdue.edu/KYW/Brochures/GroundSurface.html

US EPA Office of Groundwater and Drinking Water—This web site provides a compilation of groundwater-related information ranging from general background information on drinking water and protecting groundwater, to drinking water standards, contaminants, regulations, and guidance, as well as links for existing data and databases.
Visit the site at: http://www.epa.gov/safewater/

Consumer Confidence Reports—The U.S. Environmental Protection Agency requires water suppliers to provide annual drinking water quality reports to the general public. These consumer confidence reports are available on EPA's local drinking water information web page, which offers links to many Internet-accessible water quality reports as well as other specific information about local drinking water supplies and state drinking water and source water protection programs.
Visit the website at: http://www.epa.gov/safewater/ccr/ccrfact.html

Home*A*Syst: An Environmental Risk-Assessment Guide for the Home—This handbook is comprised of eleven chapters to help you learn about, investigate and take action on environmental health risks in and around your home. Each chapter provides in-depth information and comprehensive checklists to help evaluate your risk.
Available on the web at: http://www.uwex.edu/homeasyst/

USGS Ground Water Information Pages—These web pages are designed to provide useful information about ground-water resources of the Nation, including online data and water resource information by state, various assessment techniques, and related publications.
Visit the web pages at: http://water.usgs.gov/ogw/

The Karst Waters Institute—The Karst Waters Institute works to improve the fundamental understanding of karst water systems through sound scientific research and the education of professionals and the public. This website provides access to a national karst library and data base, information on hydrogeology, biology, mapping and methodology for groundwater monitoring in karst terrain, and links to other useful karst links.
Visit them on the web at: http://www.karstwaters.org/

A Procedure to Estimate the Response of Aquatic Systems to Changes in Phosphorus and Nitrogen Inputs—This procedural manual provides simple guidance to estimate waterbody sensitivity to nutrients. Useable by field conservationists, partners, and landowners with little prior educational background, it incorporates educational material that will raise the awareness and knowledge level of field conservationists. Management recommendations by type of waterbody are provided along with general recommendations for subsequent analysis. (Natural Resources Conservation Service. 1999. A Procedure to Estimate the Response of Aquatic systems to Changes in Phosphorus and Nitrogen Inputs. NRCS National Water and Climate Center, Portland, OR.)

Maryland Department of the Environment Water Supply Program—This website provides state-specific information on groundwater and drinking water, including applicable permits and chemical contaminants.
Visit them on the web at: http://www.mde.state.md.us/Water/index.asp

Virginia Ground Water Protection Steering Committee—This site includes information on protecting and managing groundwater in Virginia as well as links to other useful sites.
Visit them on the web at: http://www.deq.state.va.us/gwpsc/

District of Columbia Groundwater Protection Program—This website provides regulations, up-to-date physical and chemical data, and other information pertaining to the underground waters of the District.
Visit the website at: http://dchealth.dc.gov/services/administration_offices/environmental/services2/water_division/report.shtm

LAND USE

The following resources provide general background information on land cover and land use issues as well as links to guides and web-based resources for gathering existing information and/or predicting future land use in your watershed.

GENERAL

Green Communities Toolkit—This U.S. EPA web-based toolkit provides information and resources to identify past and present land use patterns, how development has occurred, and the policies that are in place to control and guide future land use decisions (http://www.epa.gov/greenkit/historic.htm). The site

also provides tools for mapping existing and predicted future land use to get a picture of current land use patterns and projected land uses.
Access the toolkit on the web at: (http://www.epa.gov/greenkit/2toollan.htm).

National Land Cover Dataset (NLCD)—The U.S. Geological Survey (USGS), in cooperation with the U.S. Environmental Protection Agency, has produced a nationwide land cover dataset based on 1992 Landsat imagery and supplemental data. The NLCD is a component of the USGS Land Cover Characterization Program and contains 21 categories of land cover information suitable for a variety of State and regional applications, including landscape analysis, land management, and modeling nutrient and pesticide runoff.
Available on the web at:
http://mac.usgs.gov/mac/isb/pubs/factsheets/fs10800.html

Land Cover Characterization Program—This USGS-led program addresses national and international requirements for land cover characterization and data management. The program websiteprovides state-of-the-art multiscale land cover characteristics data bases for use by scientists, resource managers, planners, and educators. The Program also serves as a central facility for access and information on land cover data.
Visit them on the web at: http://landcover.usgs.gov/index.html

The 2000 Maryland Storm Water Design Manual, Vols. I & II.—A comprehensive manual of storm water management guidance for Maryland, including a background section on impacts of storm water runoff, BMP options and criteria and selection guidelines. Information is also available on Maryland's performance standards, construction specifications, testing requirements, and innovative site planning. (Maryland Department of the Environment, 2000)
Available on the web at:
http://www.mde.state.md.us/programs/waterprograms/sedimentandstormwater/stormwater_design/index.asp

Maryland State Geographic Information Committee—Provides public access to numerous types of geospatial data that is available from various Maryland State government agencies. The website includes a technology toolbox, a clearinghouse of all metadata produced by state and local government agencies in Maryland (including data for the entire Chesapeake Bay basin), a link to Maryland's Environmental Resources & Land Information Network (MERLIN), and numerous related publications.
Visit them on the web at: http://www.msgic.state.md.us/

Citizen's Guide to Planning and Zoning in Virginia—This practical how-to booklet is intended to help users better understand the planning process and play an active role in local land use decisions. The guide provides answers to frequently asked questions, lists helpful resources, and allows readers to "grade" their local community on growth and sprawl issues. (Chesapeake Bay Foundation Virginia Office, $10)
Available on the web at:
http://www.cbf.org/site/PageServer?pagename=resources_pubs_index
Or call: (804) 780-1392

District of Columbia Planning and Design Information Technology Division—This newly created division of the Office of Planning supports land use planning activities with Geographic Information System (GIS) analysis, computer-aided design (CAD), graphic design, and information technology development. In addition, the division is expanding its roles as the state data center for the US Census and as a leader in the Washington Geographic Information Systems Consortium.
View information on the web at:
http://planning.dc.gov/divisions/planning_design/index.shtm

MODELING APPLICATIONS FOR EFFECTS FROM VARIOUS LAND USES

Place Matters Tools—A dynamic database website that is a useful resource for communities (their professional planners, pubic agencies, and concerned citizens) to identify tools and processes for better community design and decision making, including tools for local and regional planning utilizing low impact and environmentally sensitive approaches.
View the toolkit at: http://www.placematterstools.org

L-THIA (Long-Term Hydrologic Impact Assessment)—This modeling application enables users to estimate changes in surface runoff, recharge and non-point source pollution resulting from proposed land use changes. (Purdue Department of Agricultural and Biological Engineering)
Available on the web at: http://www.ecn.purdue.edu/runoff/lthia/lthia_index.htm

ECASE (Engaging Citizens as Stewards of Ecosystems)—A predictive model of land use change on natural resources to assist with local decisions. (Purdue Department of Forestry and Natural Resources)
Available on the web at: http://www.fnr.purdue.edu/ECASE/ecase.html

CITYgreen—A powerful GIS application for land-use planning and policy-making. The software conducts complex statistical analyses of ecosystem services and creates easy-to-understand maps and reports. CITYgreen calculates dollar benefits based on your specific site conditions, and analyzes stormwater runoff, air quality, summer energy savings, carbon storage, and tree growth. CITYgreen combines photographs and field data to create a detailed inventory and benefits analysis of vegetation at a neighborhood scale.
Available on the web at:
http://www.americanforests.org/productsandpubs/citygreen/

The Impervious Cover Model– A simple classification system that allows a community to predict current and future stream quality based on the assessment of impervious cover in the surrounding watershed. (Center for Watershed Protection)
Available on the web at: http://www.stormwatercenter.net/
(Select the Monitoring and Assessment link)

The Simple Method—This model allows storm water runoff pollutant loads to be calculated with a minimum need for data collection. The Simple Method estimates pollutant loads for chemical constituents as a product of annual runoff and pollutant concentrations. (Center for Watershed Protection)
Available on the web at: http://www.stormwatercenter.net/
(Select the Monitoring and Assessment link).

NATURAL RESOURCES AND HABITATS

The following resources provide general background information and links to guides and web-based resources for gathering existing information and/or assessing the various natural resources and habitat issues that you may encounter in your watershed.

FORESTS

Chesapeake Bay Program: Habitats—The Chesapeake Bay Program "habitats" web site provides a variety of information on forest habitats including general background information, links to relevant publications, and status and trends of forests throughout the Bay region.
Visit the website at: http://www.chesapeakebay.net/habitats.htm

American Forests—The American Forests website provides information and resource links for topics such as why trees are important, climate change impacts, urban forests, tree planting tips and methods, and forest ecosystem management. Visit the website at: http://www.americanforests.org/

Center for Urban Forest Research—The Center for Urban Forest Research produces a wide variety of urban forestry research product including fact sheets, tree guides, and technical reports which are available to public managers, urban planners, city foresters, landscape designers, arborists, and other interested parties. A number of computer models that can be used to make informed decisions regarding urban forest management are available as well. ECOSMART is a tool that can be used to help landowners plan for better energy efficiency, water conservation, and fire safety. STRATUM (Street Tree Resource Analysis Tool for Urban forest Managers) is an easy to use, computer-based program that enables any community to assess their street tree resource's structure, function, value, and management needs. STRATUM functions as a resource management tool to assist managers in decision-making, policy development and priority setting. Access these resources on the web at: http://www/wcufre.ucdavis.edu

TreeLink—A web-based resource that provides general background information, scientific information, and networking opportunities for people working in urban and community forestry. For the researcher, the arborist, the community group leader, and the volunteer—the purpose is to inform, educate, and inspire. Available on the web at: http://www.treelink.org/

USDA Forest Service, National Forest Health Monitoring Program—A national monitoring program designed to determine the status, changes, and trends in indicators of forest condition. The FHM program provides useable data, field guides and monitoring methodologies and develops analytical approaches to address forest health issues that affect the sustainability of forest ecosystems. Visit them on the web at: http://www.na.fs.fed.us/spfo/fhm/

Additional state-specific information is available through state environmental or natural resource agencies. Find them on the web at:

Pennsylvania DCNR Bureau of Forestry: http://www.dcnr.state.pa.us/forestry

Maryland DNR Forest Service: http://www.dnr.state.md.us/forests/

Virginia Department of Forestry: http://www.vdof.org/

District of Columbia Urban Forestry Administration: http://www.ddot.dc.gov/ufa/index.shtm

New York State DEC, Division of Lands and Forests:
http://www.dec.state.ny.us/website/dlf/

West Virginia Division of Forestry: http://www.wvforestry.com

Delaware Forest Service: http://www.state.de.us/deptagri/forestry/index.htm

WETLANDS

Chesapeake Bay Program: Wetlands—The Chesapeake Bay Program Wetlands Habitats web site provides general information on types and functions of wetlands and links to many wetland-related tools and resources including the publications, "Protecting Wetlands: Tools for Local Governments in the Chesapeake Bay Region", and "Protecting Wetlands II: Technical and Financial Assistance Programs for Local governments in the Chesapeake Bay Region".
Available on the web at: http://www.chesapeakebay.net/habitats.htm

U.S. EPA Office of Wetlands, Oceans, and Watersheds—The U.S. EPA Wetlands website provides a wealth of wetlands-related information, including background information on wetlands and watersheds, resource protection and restoration, monitoring and assessing water quality, training opportunities, citizen action options, laws and regulations, guidance and scientific documents and other publications.
Visit the website at: http://www.epa.gov/OWOW/wetlands/

National Wetlands Inventory Home Page—The National Wetlands Inventory (NWI) produces and provides information on the characteristics, extent, and status of the Nation's wetlands and deepwater habitats. In addition to status and trends reports, the NWIC website provides manuals, plant and hydric soils lists, field guides, posters, resource maps, atlases, state reports, and numerous articles published in professional journals. (US Fish and Wildlife Service)
Visit the website at: http://wetlands.fws.gov/

Wetlands—This manual provides thorough information on wetlands of North America, a background on wetlands law and protection, wetlands management, wetland creation and restoration for habitat replacement and water pollution control. (Mitsch, William J. and James G. Gosselink. 2002. 3rd Edition, John Wiley & Sons Canada, Ltd.)

U.S. EPA Biological Assessment of Wetlands Workgroup (BAWWG)—The BAWWG website provides a wealth of information on methods and programs to evaluate the biological integrity of wetlands. Notable tools to assist wetland bioassessment practitioners include introductory fact sheets, interactive databases, modules for evaluating wetland condition, and comprehensive literature search mechanisms.
Visit the website at: http://www.epa.gov/owow/wetlands/bawwg/

U.S. EPA Methods for Evaluating Wetland Condition—This guide for suggested procedures to perform a rapid and inexpensive assessment of land use around a given wetland will help you to quickly and easily identify wetlands that are at risk from nutrient and/or sediment inputs. (Land Use Characterization for Nutrient and Sediment Risk Assessment, March 2002)
Available on the web at:
http://www.epa.gov/waterscience/criteria/wetlands/17LandUse.pdf

U.S. EPA Five Star Restoration Program—This restoration program was established so the U.S. Environmental Protection Agency (EPA) can work with its partners for education through community-based wetlands restoration projects in watersheds across the U.S. The program provides challenge grants, technical support, and opportunities for information exchange to enable community-based restoration projects.
Visit the website at: http://www.epa.gov/owow/wetlands/restore/5star/

National Wetlands Research Center (NWRC)—The NWRC is a source and clearinghouse for information about the ecology and values of wetlands and for managing and restoring wetland habitats and associated plant and animal communities. The NWRC website presents a wealth of information on wetland habitats through a compilation of journal articles, databases, synthesis reports, and maps. The NWRC provides technical assistance, training, and information/library services as well.
Visit them on the web at: www.nwrc.usgs.gov

Wetland Science Institute—A USDA Resource clearinghouse that provides field soil hydrology indicators, training materials, wetland plant guides and more.
Find the clearinghouse on the web at: http://www.pwrc.usgs.gov/wli/wetdel.htm

Additional state-specific information is available through state environmental or natural resource agencies. For more information visit them on the web at:

Pennsylvania DEP Waterways, Wetlands and Erosion Control: http://www.dep.state.pa.us/dep/deputate/watermgt/wc/subjects/wwec/general/wetlands/wetlands.htm

Maryland MDE Wetlands and Waterways Program: http://www.mde.state.md.us/wetlands/index.html

Virginia DEQ Wetlands Program: http://www.deq.state.va.us/wetlands/

Virginia Marine Resources Commission—Wetlands Mitigation and Compensation Policy: http://www.mrc.state.va.us/fr390.htm

District of Columbia Bureau of Environmental Quality, Water Quality Division: http://dchealth.dc.gov/services/administration_offices/environmental/services2/water_division/index.shtm

New York DEC Freshwater Wetlands Program: http://www.dec.state.ny.us/website/dfwmr/habitat/fwwprog.htm,

New York DEC Marine Habitat Protection (tidal wetlands): http://www.dec.state.ny.us/website/dfwmr/marine/mhabitat.htm

West Virginia DEP Division of Water and Waste Management: http://www.dep.state.wv.us/item.cfm?ssid=11&ss1id=155

Delaware DNREC Division of Water Resources: http://www.dnrec.state.de.us/dnrec2000/Wetlands.asp or http://www.dnrec.state.de.us/water2000/Sections/Wetlands/DWRWetlands.htm

STREAMS/STREAM ASSESSMENTS

Stream Corridor Assessment Methodology– A survey tool that environmental managers can use to quickly identify a variety of environmental problems within a watershed's stream network. The stream corridor assessment is intended to provide an easy, rapid method for examining an entire drainage network so future monitoring, management and or conservation efforts can be better targeted. (Maryland Department of Natural Resources, Sep. 2001, Kenneth T. Yetman) Available at:
http://dnrweb.dnr.state.md.us/download/bays/streams/surveyprotocols2.pdf

Stream Visual Assessment Protocol (SVAP)—Provides a simple procedure to evaluate the condition of a stream based on visual characteristics. It is designed for use by landowners and conservationists in the field. The protocol provides an overall assessment of the condition of the stream and riparian ecosystems, identifies opportunities to enhance biological value, and conveys information on how streams function and the importance of protecting or restoring stream and riparian areas. The assessment can be completed in 15 to 20 minutes and no prior training in biology or hydrology is required. (Natural Resources Conservation Service, National Water and Climate Center, Portland, OR 1998 NWCC-TN-99-1)
Available on the web at: http://www.wcc.nrcs.usda.gov/wqam/wqam-docs.html

The Streams Systems Technology Center—The Stream Systems Technology Center, or "STREAM TEAM", is a national technical center chartered to improve knowledge of stream systems and watershed hydrology, develop operational tools and technology, provide training and technical support, and coordinate the development of needed technology to secure favorable conditions of water flows. (US Forest Service)
Visit them on the web at: http://www.stream.fs.fed.us/

The Rapid Stream Assessment Technique (RSAT)—This stream assessment technique was developed to guide watershed managers through a simple, rapid reconnaissance-level assessment of stream quality conditions in order to identify stream restoration needs. (Center for Watershed Protection)
Available on the web at: http://www.cwp.org/tools_assessment.htm

Rapid Bioassessment Protocols– The Rapid Bioassessment Protocols are a series of methodologies developed by the U.S. Environmental Protection Agency for assessing water quality, habitat, and biology in streams and rivers. (U.S. EPA)
Available on the web at: http://www.epa.gov/owow/monitoring/rbp/

Stream Corridor Restoration: Principles, Processes, and Practices—This highly detailed and informative technical manual for resource managers and others in stream corridor restoration was created by a multi-disciplinary scientist and engineer team from numerous federal agencies. The document explains stream restoration theory and techniques, stream corridor structure and processes, and describes how to develop a stream corridor restoration plan. (U.S. Department of Agriculture Natural Resources Conservation Service)
Available on the web at: http://www.usda.gov/stream_restoration/strmotln.htm

Maryland Streams: Take A Closer—This manual describes the physical processes affecting the appearance and behavior of streams for use in integrating the understanding of physical processes into natural resources management planning and effective stream conservation. Different stream types, characteristics and functions are illustrated using examples of streams from across the state. (Maryland Department of Natural Resources, Watershed Restoration Division)
Available on the web at:
http://www.dnr.state.md.us/streams/pubs/md_streams_wrd.pdf

Maryland's Guidelines to Waterway Construction—The Maryland Waterway Construction Guidelines provide a set of recommended details for approaches frequently encountered during the stabilization, modification, or rehabilitation of urbanized or previously channelized streams and rivers. Technical design options are presented for various stream stabilization practices and other projects as well as limitations of common restoration and stabilization practices. (Maryland Department of the Environment)
Available on the web at:
http://www.mde.state.md.us/Programs/WaterPrograms/Wetlands_Waterways/documents_information/guide.asp

Stream Reach Inventory and Channel Stability Evaluation: A Watershed Management Procedure—This guide describes procedures for measuring and evaluating the resistive capacity of mountain stream channels relative to the detachment of bed and bank materials. (Pfankuch, 1978 USDA Forest Service, Northern Region)

Biological Indicator Organisms—Keys for commonly found pollution sensitive, intermediate, and intolerant macroinvertebrate indicator species and a link to Kentucky's Biological Stream Assessment and monitoring procedures.
Available on the web at: http://www.state.ky.us/nrepc/water/bioindpg.htm

RIPARIAN BUFFERS

Chesapeake Bay Program: Forest Buffers—The Chesapeake Bay Program Riparian Forest Buffer web site provides a variety of information on riparian forest buffers including general background information, links to relevant publications, and status and trends of forests throughout the Bay region.
Visit the website at: http://www.chesapeakebay.net/forestbuff.htm

Connecticut River Joint Commissions—The commission created ten straightforward and easy to understand fact sheets on numerous topics related to riparian buffers, including general background information, field assessments, forested buffers, urban buffers, buffers on agricultural land, guidance for communities. Available on the web at: http://www.crjc.org/riparianbuffers.htm

A Guide for Establishing and Maintaining Riparian Forest Buffers– This handbook provides professional land managers and planners with the latest information on the functions, design, establishment, and management of riparian forest buffers. It uses the three-zone buffer management concept as a guideline for buffer establishment. (Chesapeake Bay Program)
Available on the web at:
http://www.chesapeakebay.net/pubs/subcommittee/nsc/forest/handbook.htm

Riparian Forest Buffers: Function and Design for Protection and Enhancement of Water Resources—A very thorough, easy to understand web-based presentation of information on the importance and benefits of streamside buffers, problems associated with the absence of or improperly functioning buffers (nutrients, sediments), and guidelines for managing or establishing streamside buffers. (USDA Northeastern Area Natural Resources Fact Sheet, NA-PR-07-91)
Available on the web at:
http://www.na.fs.fed.us/spfo/pubs/n_resource/riparianforests/

Pennsylvania Stream ReLeaf Forest Buffer Toolkit—This toolkit provides individuals, local organizations and government agencies with the latest information on how to plan for, design, establish and maintain streamside forest buffers. It is intended particularly for groups that rely on volunteers who may not have a technical knowledge of trees or stream ecosystems and need guidance on how to go about a stream-side planting project.
Available on the web at:
http://www.dep.state.pa.us/dep/deputate/watermgt/Wc/Subjects/StreamReLeaf.htm

The Maryland Riparian Buffer Systems Manual—This manual is a compilation of resource information presented at a series of two-day workshop on riparian buffer systems (1997-8) including stream assessment, groundwater hydrology, nutrient cycling, plant and animal communities, and riparian restoration. (Maryland Cooperative Extension)
Available on the web at: http://www.riparianbuffers.umd.edu/manual.html

Maryland Department of Natural Resources Forest Service—This website provides background information on the functions and benefits of a streamside forest as well as guidelines for establishing a streamside forested buffer.
Available on the web at:
http://www.dnr.state.md.us/forests/publications/buffers.html

Virginia Riparian Buffer Initiative and Plan—The Virginia Department of Forestry's Riparian Buffer Initiative website provides useful background information on the purpose and benefits of riparian buffers as well as case studies for buffer management projects, GIS data, information on the buffer planting tax credit program, tree planting guides and links for other useful websites and resources.
Visit the website at: http://www.dof.state.va.us/rfb/index.shtm

EROSION

The occurrence and location of any stream bank erosion in your watershed will be revealed while conducting a stream assessment. The following references provide general information on causes and implications of stream bank erosion and methods for predicting future erosion.

Streambank Erosion Fact Sheet—This factsheet provides a general overview of common causes, prevention and repair techniques for stream erosion, as well as bioengineering practices to reinforce and stabilize eroding stream banks.
Available on the web at:
http://www.bae.ncsu.edu/programs/extension/wqg/sri/erosion5.PDF

Understanding, Living with, and Controlling Shoreline Erosion—This 97 page book contains information on understanding the impacts of shoreline erosion, selecting methods for preventing erosion, and eight basic steps to plan and implement an erosion control project. The guidebook was developed from a Northern Michigan perspective, although it is applicable to inland lake and stream situations throughout the northeastern U.S.
Available on the web at: http://www.watershedcouncil.org/shore.htm

Bank Erodibility Hazard Index– A practical method for predicting streambank erosion rates and examples of its implementation. (Rosgen, 1996)
Available on the web at:
http://www.wildlandhydrology.com/assets/Streambank_erosion_paper.pdf

Streambank Erosion: Measuring Bank Loss—A "quick and dirty" streambank survey method that provides quick numbers for comparing the potential tons of soil loss between various eroding banks. Field sheets are included to calculate the tons of sediment loss and soil contribution to the receiving river each year. Available on the web at: http://www.boquetriver.org/adopteros.html

Stream Channel Reference Sites: An illustrative Guide to Field Techniques—This guide presents a step by step explanation of field data collection techniques for understanding stream channel morphology. (USDA Forest Service Rocky Mountain Forest and Range Experiment Station, Fort Collins, CO General Technical Report RM-245, 1994)
Available on the web at: http://www.fs.fed.us/rm/main/pubs/order.html

Erosion and Sediment Control Program in Maryland—(Maryland Department of the Environment, Nonpoint Source Program) This program serves as the official guide for erosion and sediment control principles, methods, and practices in Maryland. Information povided includes: applicable laws and regulations; minimum criteria for effective erosion and sediment control practices; training and certification programs; requirements for ordinances; criteria for plan submittal, review, and approval; and procedures for inspection and enforcement for sediment and erosion control practices.
Visit the website at: http://www.mde.state.md.us/programs/waterprograms/sedimentandstormwater/home/erosion_sediment.asp

District of Columbia Erosion and Sediment Control Program—This Watershed Protection Division program manages land disturbing activities to prevent accelerated soil erosion and sediment deposition in the Potomac and Anacostia Rivers and their tributaries. The Branch develops and implements programs in storm water management, erosion and sediment control, and flooodplain management. Visit the website at: http://dchealth.dc.gov/services/administration_offices/environmental/watershed/sstsb.shtm

FISH BARRIERS

The occurrence and location of any barriers to fish passage in your watershed will be revealed while conducting a stream assessment. The following references provide general information on types of stream and river blockages, their effects on fish and aquatic species, and methods and case studies for dam removal and construction of fish passage structures.

US Fish & Wildlife Service—http://fisheries.fws.gov/FWSMA/fishpass.htm

Chesapeake Bay Program—http://www.chesapeakebay.net/fishpass.htm

Dam Removal Success Stories: Restoring Rivers through Selective Removal of Dams that Don't Make Sense (American Rivers, 1999) http://www.american-rivers.org/damremovaltoolkit/successstoriesreport.htm

PA Fish & Boat Commission Migratory Fish Passage on the Susquehanna River
http://www.fish.state.pa.us

MD Department of Natural Resources: Fish Passage Program
http://www.dnr.state.md.us/streams/freshwater_fisheries.html

VA Department of Game and Inland Fisheries Anadromous Fish Restoration Program http://www.dgif.state.va.us/fishing/shad/

DC Fisheries Management Program http://dchealth.dc.gov/services/administration_offices/environmental/services2/fisheries_wildlife/aquatic_wildlife.shtm

INVASIVE SPECIES

The presence and location of any aquatic or terrestrial invasive or nuisance species in your watershed are often reported by citizen or other environmental or academic groups and may also be revealed while conducting a stream assessment. The following references and resources provide general background information, implications, and methods for control or removal of invasive species.

Smithsonian Environmental Research Center Marine Invasions Research Program—The Smithsonian Environmental Research Center (SERC) is a leading national and international center for research on non-native species invasions in coastal ecosystems. Their web site provides links to research and information related to aquatic and coastal invasive species and a national Ballast Information Clearinghouse.
Visit their website at: http://invasions.si.edu/

Invasivespecies.gov—This website is a clearinghouse for federal and state activities and programs concerning invasive species. Information presented includes impacts of various invasive species, the Federal government's response,

species profiles and geographic information for select invasive organisms, and links to databases, educational resources and agencies and organizations dealing with invasive species issues.
Visit their website at: http://www.invasivespecies.gov

Plant Invaders of Mid-Atlantic Natural Areas– This guidebook presents homeowners with information and photos on highly invasive plants affecting aquatic and terrestrial natural areas in the Mid-Atlantic and offers suggestions for native alternative plants. (U.S. Fish & Wildlife Service Chesapeake Bay Field Office)
Available on the web at: http://www.nps.gov/plants/alien/pubs/midatlantic/

National Sea Grant College: Nonindigenous Species Program (SGNIS)—The SGNIS site is a national information center that contains a comprehensive collection of research publications and education materials produced by Sea Grant programs and other research institutions across the country on zebra mussels and other aquatic nuisance species. Visit the website at:: http://www.sgnis.org

Additional state-specific information on Invasive species is available on the following websites:

Pennsylvania National Diversity Inventory:
http://www.dcnr.state.pa.us/forestry/pndi/pndiweb.htm

Maryland DNR Invasive & Exotic Species:
http://www.dnr.state.md.us/wildlife/invintro.html

Virginia DCR Invasive Alien Plants:
http://www.dcr.state.va.us/dnh/invinfo.htm

Invasive Plant Council of New York State: http://www.ipcnys.org/

West Virginia Native Plant Society Invasive Species:
http://www.wvnps.org/invasivesstate.html

Delaware Invasive Species Council: http://www.udel.edu/DISC/

MINING IMPACTS

The occurrence and location of any adverse impacts due to surface mining activities or operations in your watershed are often reported by citizen or other environmental groups or agencies and may also be revealed while conducting a stream assessment. The following references and resources provide general background information, maps, and federal and state laws, regulations and programs for various mining-related activities.

The Office of Surface Mining—This website is a one-stop information resource for all matters of surface mining and reclamation in the United States. Topics covered include background information and maps, applicable laws and regulations, clean streams programs, grant information, and links to other resources and specific state and regional mining related information.
(U.S. Department of the Interior)
Visit the website at: http://www.osmre.gov/osm.htm

National Association of Abandoned Mine Land Programs—The association serves as a forum to address current issues, discuss common problems, and share new technologies regarding the reclamation of abandoned mine lands. Information is provided on state and federal reclamation programs, hazards associated with abandoned mine lands, updates on congressional and other federal actions, funding opportunities, and links to other mining related resources.
Find program information on the web at: http://www.onenet.net/~naamlp/

Pennsylvania Bureau of Mining and Reclamation—This website presents the latest information on regualtions and permits for mining activities in Pennsylvania. Numerous mining-related fact sheets, web links, and information on the various mining programs in Pennsylvania are available as well.
Visit the website at:
http://www.dep.state.pa.us/dep/deputate/minres/bmr/bmrhome.htm

Maryland Department of the Environment's Mining Program—This website provides maps of coal reserves in Maryland and offers information on relevant mining regualtions, permitting requirements, and reclamation and revitalization programs for abandoned mine lands.
Visit the website at::
http://www.mde.state.md.us/Programs/WaterPrograms/MiningInMaryland/home/index.asp

Virginia Department of Mines, Minerals and Energy—This website provides maps and a wealth of data on Virginia's geology, laws and regulations for mining activities, and guidelines for reclamation of mined lands.
Visit the website at: http://mme.state.va.us

LAKES AND PONDS

The following guides and manuals provide general background information on lakes and pond systems, guidelines for gathering existing information and/or assessing lakes and ponds, and suggestions for management options.

Lake and Pond Management Guidebook—This guidebook contains ideas and projects for small-scale lake and pond improvements including step-by-step practical, low-cost solutions to a wide range of lake management problems. Includes shoreline buffers, fisheries management, reducing nuisance algal growth, controlling exotic aquatic plants, and more. (Lewis Publishers, December 2002)

Lakewalk Manual: A Guidebook for Citizen Participation—This manual provides citizens a useful tool for assessing and protecting their lakes. The manual and companion worksheet offers an organized means for citizens to learn about lakes and to collect observed information and data. (EPA 910/B-95-007, published by EPA Region 10)
Available on the web at: http://www.epa.gov/owow/lakes/ordrdocs.html

Reflecting on Lakes: A Guide for Watershed Partnerships—This simple guide helps community groups understand the characteristics and processes that take place within a lake and its associated watershed. Procedures are described for assessing the condition of the lake and for developing a protection plan using a watershed approach. (Conservation Technology Information Center)
Available on the web at:
http://www.ctic.purdue.edu/KYW/Brochures/ReflectingLakes.html

COASTAL AREAS

The following resources provide general background information and links to guides and web-based resources for gathering existing information and/or assessing and managing coastal areas within your watershed.

A Citizen's Guide to Coastal Watershed Surveys—A free publication created by the Maine Department of Environmental Protection that provides simple and straightforward guidance for citizen groups to perform a coastal watershed survey.
Available on the web at: http://www.ume.maine.edu/ssteward/resources.htm

National Estuary Program—U.S. EPA's National Estuary Program website provides background information on the importance and threats to the nations estuaries and other coastal habitats, the effects of pollution on water quality in estuaries, management guidelines and links to state comprehensive conservation and management plans. Visit the website at: http://www.epa.gov/owow/estuaries/

State-specific information is available through the following state coastal management programs:

Pennsylvania Coastal Zone Management Program:
http://www.dep.state.pa.us/river/czmp.htm

Maryland's Coastal Program: http://www.dnr.state.md.us/bay/czm/

Virginia Shoreline Erosion Advisory Service:
http://www.dcr.state.va.us/sw/seas.htm, or http://www.mrc.state.va.us

Virginia Coastal Program: http://www.deq.state.va.us/coastal/

New York State Division of Coastal Resources:
http://www.dos.state.ny.us/cstl/cstlwww.html

Delaware DNREC Coastal Management Programs:
http://www.dnrec.state.de.us/dnrec2000/Divisions/Soil/dcmp/index.htm or
http://www.dnrec.state.de.us/development/CZA/CZAhome.htm

MONITORING

The following resources provide general information on training, methodologies, and tips for the development of citizen-led volunteer water quality and quantity monitoring programs.

The National Directory of Volunteer Environmental Monitoring Programs—A nationwide directory compiled by the U.S. EPA that lists existing groups that have monitoring programs and provides technical information about the methodology utilized for the various kinds of monitoring taking place.
Visit the directory on the web at:
http://yosemite.epa.gov/water/volmon.nsf/Home?OpenForm

National Environmental Methods Index—A free web-based clearinghouse of environmental monitoring methods. The database contains method summaries of chemical and biological field protocols for regulatory and non-regulatory water quality analyses. The site also allows monitoring data to be shared among agencies and organizations.
Available on the web at: http://www.nemi.gov

The Audubon Naturalist Society—Offers water quality courses throughout Maryland and Virginia which are designed to increase water quality awareness, understanding, and action.
Information is available on the web at:
http://www.audubonnaturalist.org/forum_wq.htm

U.S. EPA Volunteer Monitoring Program—Provides guidance for initiating a volunteer water quality monitoring program beginning with recommendions for suggested elements of a holistic, comprehensive monitoring program that serves all water quality management needs and addresses all water body types. Information on monitoring methods and support available through EPA is available as well.
Visit the Program's website at: http://www.epa.gov/owow/monitoring/volunteer/

I**zaak Walton League, Stream Study—**The Stream Study is based on material developed by the Save Our Streams Program of the Isaak Walton League of America. A methodology for determining the water quality of a stream based on the collection and identification of stream-bottom macroinvertebrates was developed based on the Stream Study.

Visit the Izaak Walton League Programs on the web at:
http://www.people.virginia.edu/percent7Esosiwla/Streamstudy/StreamStudyHomePage/StreamStudy.HTML or http://www.iwla.org/sos/

National Handbook of Water Quality Monitoring—This handbook provides information on how to design a monitoring system to observe changes in chemical water quality associated with agricultural sources of nonpoint pollution. Part one was published in 1996 and covers how to design a monitoring system. Part two is under development and will cover the analysis of data from monitoring. (Natural Resources Conservation Service. 1996. National Handbook of Water Quality Monitoring. 450-vi-NHWQM. National Water and Climate Center, Portland, OR)
Available on the web at:
http://www.ulct.org/bountiful/water/waterResource/wqm1.pdf

Additional state-specific information on water monitoring programs is available through state environmental or natural resource agencies. Visit their websites at:

Pennsylvania Citizen's Volunteer Monitoring Program—An informational clearinghouse for all services that are available to volunteer monitors, including fact sheets, guidance for developing a water monitoring program, a directory of citizen's monitoring groups, and more.
Visit the website at:
http://www.dep.state.pa.us/dep/deputate/watermgt/WC/subjects/cvmp.htm

Maryland Stream Waders—A volunteer stream sampling program sponsored by Maryland Department of Natural Resources. Volunteers participate in a one day training session and then spend about two more days during the March-April sampling window collecting aquatic invertebrate samples from stream beds. The samples are sent to DNR for "bug identification" and analysis. Program information is available on the web at:
http://www.dnr.state.md.us/streams/mbss/mbss_volun.html

Maryland Save Our Streams—Educates and encourages citizen volunteers and community organizations to clean, monitor, and protect Maryland's waterways. Visit the Save Our Streams Program at:
http://www.saveourstreams.org/

Virginia Citizen Water Quality Monitoring Program and Citizens for Water Quality—A cooperative program among the Virginia Department of Environmental Quality, Virginia Department of Conservation and Recreation, Virginia Save Our Streams and Alliance for the Chesapeake Bay. Information is provided on technical assistance, training, workshops, methods manuals, and financial assistance (when funds are available). Program information is available on the following websites: http://www.deq.state.va.us/cmonitor/, http://www.sosva.com/, www.AllianceChesBay.org

District of Columbia Department of Health Water Quality Division: http://dchealth.dc.gov/services/administration_offices/environmental/services2/water_division/index.shtm

New York DEC Bureau of Watershed Assessment and Research: http://www.dec.state.ny.us/website/dow/bwar.htm

West Virginia Save Our Streams: http://www.wvwrc.org/monitoring.htm

Delaware River Keeper Network: Provides information on the Delaware River Keeper Water Quality Monitoring Program, datasheets, and workshop, training, and technical assistance information. Visit the website at: http://www.delawareriverkeeper.org/monitoring.html

Delaware Nature Society Stream Watch: http://www.delawarenaturesociety.org/nrc/SW/nrc-streamwatch.htm

WATERSHED / COMMUNITY PLANNING

These watershed management and community planning handbooks are excellent resources to guide you through the watershed management planning process.

Watershed Action Guide for Indiana—This guide was developed to fill the need for technical information and practical instruction for developing a watershed management plan in Indiana. It discusses how to build the group, how to set attainable goals, how to conduct a watershed inventory, and where to look for specific types of information. (Indiana Department of Environmental Management)
Available on the web at: http://www.state.in.us/idem/owm

A Guide to Developing Local Watershed Action Plans in Ohio—This guide is designed to assist citizens, citizen organizations, businesses and local governmental agencies start planning and implementing watershed projects. The Guide describes how to: find the information and resources needed to create and implement a local watershed action plan; address multiple causes of water quality and habitat degradation in a watershed; and involve stakeholders from both inside and outside of government in a process for developing integrated solutions and prioritizing problems. (Ohio EPA)
Available on the web at: http://www.epa.state.oh.us/dsw/nps/guide.html

Community Culture and the Environment: A Guide to Understanding a Sense of Place—This guide explores the concepts of community and culture and provides tools for identifying, assessing, and working cooperatively within the social dynamics and local values connected to environmental protection. The tools presented will help you define your community, identify stakeholders, enhance education and outreach, build partnerships, reach consensus, identify resources, plan and set goals, and integrate local realities with ecological issues. (EPA publication No. 842-B-01-003)
Available on the web at: http://www.epa.gov/ecocommunity/tools/community.pdf or call 1-800-490-9198.

Watershed Stewardship: A Learning Guide—A comprehensive, practical watershed enhancement educational curriculum intended to help residents and volunteers be good stewards of their watershed. The manual teaches people how to work together as a group, understand and enhance watershed ecosystems and connect resource management to watershed ecosystems. (Oregon State University Extension Service $42)
Available on the web at: http://eesc.orst.edu/agcomwebfile/edmat/EESC4.pdf

Putting Together a Watershed Management Plan—This booklet provides an overview of three stages for putting together a watershed plan, beginning with a series of critical questions to determine whether the group is ready to initiate the planning process. (Conservation Information Technology Center's *Know Your Watersheds* series)
Available on the web at:
http://www.ctic.purdue.edu/KYW/Brochures/PutTogether.html

Watershed Project Management Guide—This book outlines a four-step process for developing a watershed management plan. The guide provides tools, approaches and information that can be used in watershed management plan development and highlights how to implement the management plan and evaluate its effectiveness. (CRC Press, August, 2002, $119)

The Do-It-Yourself Local Site Planning Roundtable Kit—This kit contains all information and materials you needed to initiate a local better site planning roundtable in your community. Included are two ready-to-view slideshow presentations on CD-ROM, materials and instructions to guide workshop participants through a site planning exercise, documentation of the benefits of better site design, and electronic copies of all of the agendas, invitation letters, and other correspondence you'll need to get the roundtable process started. (Center for Watershed Protection)
Ordering information is avaliable on the web at: http://www.cwp.org/index.html

Virginia Guide to Local Watershed Management Planning—This guide to watershed management planning is intended to provide guidance and consistency to ongoing and future watershed planning efforts in Virginia localities. The guidebook begins with recommending a review of existing planning efforts, suggests a framework for institutional and regulatory responsibility, then urges the establishment of implementation strategies and benchmarks for measuring success. (VA Dept. of Conservation and Recreation) To order call: (877) 42 WATER

PennSCAPEs—PennSCAPEs is a richly illustrated web-based program for neighborhood planning and design that specifically focuses on increasing people's awareness and understanding about how to create walkable neighborhoods. PennSCAPEs is intended to serve as a provocative educational and empowerment tool for elected officials, developers and citizens to learn about and create community design strategies that promote smart growth and healthy lifestyles. PennSCAPEs is also a policy tool for municipal staff and professionals to utilize model ordinances related to neighborhood design and development. The intent is to give municipalities the flexibility to adopt an entire neighborhood code or portions of the code, depending on the local context.
Available on the web at: http://www.pennscapes.psu.edu/pennscapes/default.htm

OUTREACH

The following internet sites and resource references provide information and links to guides and manuals for conducting community outreach and for developing a watershed outreach strategy.

EPA Nonpoint Source Outreach Toolbox—This web-based toolbox offers strategies and sample materials geared toward changing personal behaviors to prevent nonpoint source pollution. Included are a "how-to" guide for launching a local nonpoint source outreach campaign and sample materials and templates to be used and tailored to community's local problems.
Visit the website at: http://www.epa.gov/owow/nps/outreach.html

Getting in Step: A Guide to Effective Outreach in Your Watershed—This guide presents a step-by-step approach and provides countless useful tools for developing and implementing an effective watershed outreach plan. The three part organization of the guidebook provides the overall framework for developing and implementing an outreach plan, tips and examples for developing outreach materials, and tips for working with the news media (manual and video versions available). (US EPA, 1998)
Available on the web at: http://www.epa.gov/owow/watershed/outreach/documents/getnstep.pdf

Getting in Step: Engaging and Involving Stakeholders in Your Watershed—This guide provides the tools needed to effectively identify, engage, and involve stakeholders throughout a watershed to restore and maintain healthy environmental conditions. Key concepts highlighted in the guide include aspects such as forming a stakeholder group, dealing with conflict and hidden agendas, and making decisions using a consensus-based approach. (US EPA, 2003)
Available on the web at: www.epa.gov/owow/watershed/outreach/documents

A Step-by-Step Guide to Conducting a Social Profile for Watershed Planning —A workbook and website provide individuals and watershed committees with a general overview of the importance of social issues to the watershed planning process and also offer detailed guidance on how to assess these issues in individual watersheds. (University of Illinois Department of Natural Resources and Environmental Sciences)
Available on the web at: http://www.watershedplanning.uiuc.edu/

CHAPTER 5 Guidelines for Evaluating Existing Conditions

To assist you with evaluating existing conditions in your watershed, a compilation of resource management guidelines outlining preferred conditions for a variety of land uses is provided in the next section. These guidelines were created by the Chesapeake Bay Program to address the *Chesapeake 2000* agreement committment that each jurisdiction will develop aquatic health guidelines to ensure the health of stream corridors. The guidelines are intended to fulfill multiple purposes. First, they provide a "vision" for ideal conditions in your watershed. As such, they serve as a baseline for comparing existing conditions with the desired future condition for your watershed and can be used to help your group formulate a comprehensive watershed management plan. They can additionally function as a tool for measuring the success of the implementation of the watershed management plan.

Once your group has distilled and evaluated the data gathered during your watershed assessment, any current and potential problems as well as the likely reasons for those problems should be apparent. The location of areas that need to be protected or preserved will also be evident. Several options for corrective measures that you may wish to consider employing in order to address problems or concerns in your watershed are offered under "Recommended Actions." The recommended actions for those guidelines that are relevant to your group's vision for what the watershed should look like in the future represent some possible actions for attaining the goals for the watershed. The pertinent actions can then serve as a logical starting point and a good foundation for the development of a watershed management plan.

RESOURCE MANAGEMENT GUIDELINES

LAND USE

Residential, Commercial, and Industrial Development

Guideline #1: Existing development without stormwater management

Existing development without stormwater management facilities should be retrofitted to preserve and protect water quality and quantity and aquatic habitat.

Recommended actions:

- Identify potential stormwater retrofit sites based on a comprehensive watershed assessment. On-site infiltration features such as bioretention basins, rain gardens, and swales help return discharge levels to predevelopment levels. Consider using LID techniques for retrofit opportunities.
- Strive to replace impervious surfaces with pervious surfaces, such as gravel, pervious pavement, or grass in those areas where infiltration will not adversely impact groundwater quality. Many paved areas can still function as intended with a different surface.
- Evaluate and amend building codes and local ordinances to include technologies to store and utilize stormwater runoff for green roofs, toilet flushing, and irrigation.
- Encourage planting of trees in any urban open space areas, including along streets as part of residential and commercial landscaping and recreation areas to decrease runoff potential and thermal impact on stream ecology.
- Consider setting local tree "canopy cover" goals.
- Provide or encourage opportunities for redevelopment where possible.

Guideline #2: Existing development with stormwater management

Existing stormwater management facilities should be evaluated, retrofitted, and maintained to improve water quality and quantity management.

Recommended actions:

- Inventory and evaluate stormwater management practices in your city, town, or county. Stormwater sewers, combined sewer overflows, and sanitary sewers all have different impacts on urban and suburban streams. Learn the difference, and locate the types of treatment for different areas of your watershed.

- Retrofit existing stormwater management facilities where possible to maximize water quality benefits.
- Maintain existing stormwater management facilities.

Guideline #3: New Development—Planning

Areas identified in local land use plans for new development should be developed in a manner that minimizes impacts to habitat and water quality.

Recommended actions:

- Inventory and prioritize areas for conservation and restoration that provide significant water quality or habitat benefits such as forests, wetlands, and groundwater recharge areas.
- Identify and map areas that are susceptible to erosion, including steep slopes and highly erodible soils (as defined by the Natural Resource Conservation Service).
- Use the inventory of resource lands to guide the location and design of new developments to minimize environmental impact.
- Incorporate identified resource areas into local open space and recreation plans.
- Implement growth strategies that encourage development in areas designated to be served by public utilities.
- New development should be constructed adjacent to existing development in areas with adequate water resources, and in areas with the necessary infrastructure in place on the adjacent property prior to development. (Infrastructure includes public water, central sewer service, and roads.)
- New development not adjacent to existing development may be considered as "good development" if it has adequate water resources and infrastructure and if it is characterized by compact, mixed-use development. (Compact, mixed-use development is defined as a mix of residential, commercial, employment office, and civic land uses.)
- New development should be directed within growth boundaries, growth areas, urban service limits of villages, towns, cities, or other urbanized areas, to the extent such limits are set.

Guideline #4: New Development—Site Design and Construction

New development should be designed and constructed to preserve and protect aquatic habitat, water quality, groundwater levels, and stream flow.

Recommended actions:

- Subdivision designs should limit road crossings, minimize impervious cover, encourage cluster development, utilize minimum road widths, and encourage alternative transportation technologies.
- Subdivision designs should maximize open space and avoid areas with highly erodible soils, protect existing riparian buffers and wetlands, and minimize forest fragmentation.
- Encourage the use of low-impact development techniques.
- Prior to land disturbance, prepare and implement an approved erosion and sediment control plan or similar administrative document that contains erosion and sediment control provisions.
- To the extent practicable, implement post-construction stormwater BMP's that maximize stormwater infiltration, minimize point source stormwater discharges to surface waters, and maintain post-development peak runoff discharges at levels similar to predevelopment levels.
- Consider temperature impacts when choosing building colors and materials. Light color surfaces and vegetated areas absorb less heat and reduce thermal impacts of stormwater runoff. Design parking areas with shading and pervious materials where appropriate.
- Encourage planting and maintenance of native trees in any urban open space areas, including along streets as part of residential and commercial landscaping and recreation areas to decrease runoff potential and thermal impact of open space on stream ecology.
- Consider setting local tree "canopy cover" goals.

Guideline #5: Roads, Highways, Bridges, and Utilities

Site, design, construct and maintain roads, bridges and utilities so that sensitive and valuable aquatic ecosystems and areas providing important water quality benefits are protected from adverse effects and provide passage for aquatic life.

Recommended actions:

- Avoid building roads, bridges, and utilities in areas that provide important water quality benefits, that are particularly susceptible to erosion or sediment loss, or that provide important or critical passage for aquatic life.
- Limit land disturbance such as clearing, grading, and cut and fill to reduce erosion and sediment loss.
- Design roads, bridges, and utilities to limit disturbance of natural drainage features and vegetation.
- Divert stormwater from roads and highways to roadside swales or bioretention facilities for quality treatment and quantity management. Several smaller treatment practices are generally better than fewer larger facilities.
- Retrofit and maintain storm drains with stormwater filters such as sand filters, sediment traps, and oil and grease separators to treat stormwater runoff.
- Crossings should be designed to be perpendicular to streams and located on straight reaches.
- Culverts and other crossings should be designed to provide fish passage and maintain the natural stream channel geometry.
- Follow the appropriate guidelines for exotic/invasive species to control invasive weeds on roads, highways, and railway lines.
- Locate sewer lines a minimum of 50 feet from stream banks.
- Follow recommended BMPs for street and bridge cleaning.
- Do not use de-icing compounds containing nitrogen.
- Use road chemicals as necessary for safety, while minimizing effects of road chemical runoff on aquatic life. Use the least harmful effective chemical available and feasible
- Funds currently utilized to maintain utilities and roads within riparian corridors should also be allocated to restore stream channels and retrofit stormwater management facilities.

Guideline #6: Business and Home Site Maintenence

The impact of business and home maintenance, including lawn care, on local water bodies should be minimized.

Recommended actions:

- Encourage the practice of conservation landscaping for ecological and economic benefits and reduce acreage of managed landscapes, including lawns.
- Minimize watering, fertilizing, and pesticide use on lawns. Fertilize plantings with organic compost instead of chemical fertilizers.
- Implement lawn maintenance practices promoted by the Cooperative Extension Services Master Gardener Programs.
- Implement pollution prevention and education programs to reduce nonpoint source pollutants from residential and business lawn care activities.
- Attach downspouts to rain barrels or rain gardens or discharge low-velocity flows over vegetated areas. Discharge and treat stormwater on homeowner properties where possible.
- Develop or expand existing educational programs for homeowners about the proper use of fertilizers and pesticides on lawn gardens.
- Develop a strategy to educate pet owners on how to manage pet waste to minimize nutrient and bacteriological contamination of local waters.
- Check with local Extension agents regarding home water quality assessment (Home*A*Syst or Farm*A*Syst) materials.
- Through the local regulatory authority, require the development of nutrient management plans and integrated pesticide management for golf courses.
- Participate in state led "Businesses for the Bay" program (http://www.chesapeakebay.net/b4bay.htm). If you own a business, identify ways to reduce potential environmental impacts. As a consumer, patronize businesses that participate in this type of program.

Agricultural Areas

Guideline #1: Whole farm management

Sediment, pesticides, and fertilizer should be managed by land owners/operators to minimize discharge into streams, rivers, and lakes.

Recommended actions:

- Assess the best management practices (BMPs) utilized on farms and forests within your watershed. Utilize the knowledge of local Natural Resource Conservation Service (NRCS), soil and water conservation district, and state forestry staff to determine which BMPs might be useful for particular farming and forestry operations.
- Prepare and implement soil and water conservation plans, nutrient management plans, Integrated Pest Management plans, and/or whole farm plans. Consult the local soil conservation district office and state forestry staff for assistance in the preparation of these plans.
- Identify crop fields and implement where appropriate conservation tillage methods such as no-till, terracing, or contour strip cropping.
- Use native plantings for soil stabilization in natural areas such as riparian areas for maximum water quality and habitat benefits.
- Plant cover crops over winter to minimize soil erosion and retain soil nutrients that would otherwise enter groundwater or would be carried in runoff.
- Encourage natural vegetative plantings such as native trees and warm season grasses on nontillable soils and within pastures.
- Minimize pesticide usage. Follow Integrated Pest Management practices.
- Use, store, and dispose of pesticides properly, as directed by the pesticide label.

Guideline #2: Protection of sensitive areas adjacent to farmland

Sensitive areas such as stream banks, wetlands, estuaries, ponds, lakeshores, sinkholes, and riparian zones should be protected by land owners and farm operators from the physical disturbance and direct loading of herbicides, pesticides, excess nutrients from fertilizers and animal waste, and sediment from farming practices.

Recommended actions:

- Control access of terrestrial livestock to sensitive areas listed above.

- Provide stream crossings or hardened watering access for drinking.
- Provide alternative drinking water locations.
- Locate salt and additional shade, if needed, away from sensitive areas.
- Use improved grazing management (e.g., herding, pasture rotation).
- State, federal, and local agriculture support agencies should encourage the planting of trees along roads and around all water retention facilities to decrease runoff potential, provide soil shading, and decrease the thermal impact of open space on stream ecologies.
- Implement the pasture components of a conservation management system (CMS) as defined in the "Field Office Technical Guide" of the USDA-Natural Resource Conservation Service (NRCS) by applying the progressive planning approach of the USDA-NRCS to reduce erosion.

WATER QUALITY AND QUANTITY

Water Quality and Habitat

Guideline #1: Chemical indicators of water quality

Waters should meet, or if possible, be better than, the applicable numerical and qualitative criteria established by each jurisdiction.

Recommended actions:

- Identify water bodies that do not meet water quality standards to target for restoration.
- Prioritize restoration of water bodies that fail to meet water quality standards in order to maximize water quality and habitat benefits.
- Identify water bodies that meet or are better than water quality standards to target for watershed protection
- Provide adequate support for restoration of waters that fail to meet water quality standards due to chemical contaminants, physical impairments (excess sedimentation), or human-made obstructions (such as dams and weirs).
- Maintain full implementation of federal, state, and local regulatory programs and voluntary programs that support water quality standards, including those for water resource permits, antidegradation policies, enforcement, TMDLs, Coastal Nonpoint Pollution Control Programs, and nutrient and sediment controls.

- Encourage the elimination or reduction of discharges to and withdrawals from surface and/or groundwaters wherever possible to protect or improve water quality through nondischarge or withdrawal alternatives. Techniques may include, but are not limited to, spray irrigation, various forms of reuse and/or recycling within production and treatment processes, or the transfer of discharge to collateral processes (i.e., co-generation, or re-mining usable resources from the waste stream).
- Integrate management (monitoring, protection, restoration, use) of various water, natural resource, and land use programs to achieve and maintain chemical and physical water quality standards to meet human health, living resources, water supply, water quantity, and stream stability goals.
- Identify waters with chemical blockages to fish passage as a result of mine drainage. Encourage removal of chemical blockages in conjunction with removal of physical barriers.
- Encourage property owners and businesses to conduct regular maintenance on septic systems.
- Encourage practices that benefit water quality and water quantity management, including stormwater management practices and the conservation and restoration of wetlands and forests in stream corridors.

Guideline #2: Irrigation water quality management

Irrigation systems should be managed to prevent contamination of surface and groundwaters from fertilizers and chemicals.

Recommended actions:

- When a fertilizer, pesticide, or other chemical is applied into or through an irrigation system (chemigation), include backflow preventers for wells.
- Prevent the discharge of chemigated waters from the edge of fields and into groundwater by limiting application to what can be immediately absorbed by the soil.
- Install a tailwater management system with furrow irrigation systems.
- Monitor groundwater quality regularly.

Guideline #3: General biological indicators of water quality and habitat

The composition of native aquatic biological communities should reflect conditions found in reference streams or other measures of desirable conditions and should be used as a measure of the health of the stream corridor and the watershed in general.

Recommended actions:

- Implement recommended actions to protect in-stream water quality as prescribed in sections on land use and natural resources and habitat.
- Control and, when possible, eradicate exotic and invasive species, using methods appropriate for the species that are the least harmful to the remaining ecosystem and targeting those with the greatest potential to damage native aquatic biological communities.
- Enhance existing monitoring programs that document aquatic biological communities, including the following:
- Identify species compositions and distributions.
- Determine biomass and patterns of fluctuations by species.
- Determine habitat utilization and habitat requirements, by measuring physical habitat and water quality at the same sites where biological communities are monitored.
- Target monitoring efforts where stream restoration may be needed, but do not neglect to protect those areas that are in better condition.
- Encourage volunteer monitoring of aquatic animal and plant communities, through existing monitoring programs to enhance data usage.
- Support the enforcement of all fishing and hunting regulations.
- Refine existing fisheries management plans, and develop new management plans for all species that are harvested, stressing multi-species and ecosystem approaches consistent with state and federal guidelines.
- Prioritize corrective actions to be taken to improve aquatic biological communities by targeting actions where they are the most needed and the most cost-effective.
- Continue and expand outreach efforts on the importance of aquatic biological communities and what the public can do to protect and enhance them.

Guideline #4: Fish communities

Fish species that are harvested commercially and/or recreationally should be managed to ensure the long-term sustainability of those fisheries for future generations; fish species that are not harvested should be managed to protect, enhance, and restore their ecological role in the food web.

Recommended actions:

- Assess fish populations/habitat within the targeted watershed. Data and/or technical assistance should be available through state natural resource agencies.
- Use state-approved standardized monitoring and assessment techniques to develop Indices of Biotic Integrity (IBI's) that allow intrastate and baywide comparisons.
- Identify, prioritize, and implement habitat improvement projects based on the results of fish population and habitat assessments, including the removal of chemical and physical blockages.
- Protect populations of harvested and nonharvested fish by minimizing by-catch and the impacts of exotic and invasive species.
- Continue to implement all adopted fishery management plans, and revise them as needed using the "Guidelines for Developing and Revising Fishery Management Plans" adopted by the Chesapeake Executive Council in 1998. (http://www.chesapeakebay.net/pubs/454.pdf)

Guideline #5: Macroinvertebrate and benthic animal communities

Maintain or restore the macroinvertebrate and benthic animal communities that are typical of the physiographic region and reference conditions.

Recommended actions:

- Assess macroinvertebrate populations and habitat within the targeted watershed. Data and/or technical assistance should be available through state natural resource agencies.
- Use state-approved standardized monitoring and assessment techniques to develop IBI's that allow intrastate and baywide comparisons.
- Consider "seeding" a restored stream with benthic macroinvertebrates where recruitment via normal dispersal mechanisms is not adequate based on results of ongoing pilot projects (e.g., in Baltimore County).

Guideline #6: Plant communities

Maintain or restore the riparian and aquatic native plant communities that are appropriate to stream corridors in the physiographic region or reference conditions.

Recommended actions:

- Use native aquatic and terrestrial plants in stream restoration and stormwater management projects where it is appropriate, especially where natural recruitment is unlikely.
- Target diverse plantings to stabilize stream banks and sediments, improve water quality, and provide in-stream food and cover. (Refer also to the recommended actions for riparian zones under, "Streams" in the, "Natural Resources and Habitats" section of these guidelines.)
- Encourage the expansion and connection of contiguous forests through conservation easements, greenways, and other land conservation mechanisms.
- Control exotic and invasive plant species that compete with native species.
- Support local volunteer native seed collection programs.

Guideline #7: Amphibian and reptile communities

All existing critical habitats should be preserved, and former critical habitats should be restored for native amphibians and reptiles in stream corridors; human-caused mortality to amphibians and reptiles should be minimized.

Recommended actions:

- Identify and prioritize critical amphibian and reptile habitats.
- Prioritize habitat preservation and restoration efforts in stream corridors to protect or restore high functional value headwater and riparian wetlands that provide critical habitats for amphibians and reptiles.
- Promote the construction of wetlands to address stormwater and enhance habitat in urban areas for amphibians, reptiles, and other wildlife.
- Connect and expand contiguous habitats for amphibians and reptiles in stream corridors to facilitate migration.

Water Quality

Guideline #1: Maintenance of adequate flow

Surface water and groundwater withdrawals and releases and groundwater base flow should be managed to maintain adequate flow in streams and wetlands to support aquatic resources and to prevent adverse impacts to stream water quality or stream bank stability.

Recommended actions:

- Encourage the use of innovative stormwater management and the use of pervious surfaces to maximize the amount of water that can recharge groundwater aquifers.
- Encourage development where municipal water supply is available, and limit development using private wells.
- Design and install stormwater management facilities that prevent erosive flows and damaging flooding. Conduct stream restoration in conjunction with water quantity management.
- Maintain existing stormwater management facilities.
- Encourage water reuse where it is viable, both to improve water quality (via reduced nutrients) and to increase water quantity (e.g., via reduced consumption for irrigation).

Guideline #2: Irrigation water quantity management

Irrigation systems should be managed so that the timing and quantity of water applied matches cropand landscaping needs and prevents runoff and overdrafting of the aquifer or surface water.

Recommended actions:

- Consider using drip irrigation.
- Install groundwater monitoring wells and monitor groundwater levels and withdrawals regularly.

NATURAL RESOURCES AND HABITATS

Forest Resources

Guideline #1: Forest conservation

Conserve forests and trees where they occur, and restore forests and trees wherever possible for the best land cover for water quality benefits.

Recommended actions:

- Conserve existing riparian forest out to 300 feet or to the greatest extent possible adjacent to stream banks.
- Aim to maintain or establish a 100 ft. buffer zone (35 ft. minimum) on either side of intermittent, perennial, or ephemeral stream or rivers where practicable.
- Prioritize forests for conservation
- Large blocks of contiguous forest.
- Older, mature forest with intact canopy.
- Close to streams.
- Tree stands that have never been farmed.
- Control exotic and invasive species that compete with native species.
- Minimize the use of pesticides in forest management. Use Integrated Pest Management approaches.

Guideline #2: Sensitive area protection

Protect sensitive areas such as water bodies, stream banks, wetlands, threatened or endangered aquatic species habitat areas, and high-erosion-hazard areas (landslide-prone areas) from the physical disturbance caused by forest management activities.

Recommended actions:

- Consult your state forestry agency for timber harvesting or road building restrictions and state recommended best management practices.
- Time any harvest activity for the season or moisture conditions when the least impact occurs.
- Prepare and implement an erosion and sedimentation control plan that fully considers potential water quality impacts.

- Reduce the risk of occurrence of landslides and severe erosion by identifying high-erosion-hazard areas and avoiding harvesting in such areas to the extent practicable.
- Limit road building and skids trails, and utilize harvest equipment that minimizes soil compaction and disturbance. New roads should be placed along slope contours and as far away as possible from streams.
- As far as is practicable, utilize harvest techniques that retain a partial canopy to promote natural regeneration and provides for protection from detrimental changes in temperatures in affected waterbodies.

Wetlands

Guidelines #1–4: Wetland preservation and restoration

1. Preserve existing wetlands and replace those wetlands impacted by anthropogenic activity.
2. Restore former wetlands and enhance existing wetlands to optimize water quality benefits and to improve riparian habitat and stream base flow conditions.
3. Design and construct wetlands for water quality treatment/improvement and to enhance wildlife habitat especially in urban areas.
4. Achieve a "no net loss" of wetland acreage and function resulting from regulated activities in wetlands.

Recommended actions

- Identify, to the extent practicable, all existing wetlands and sites of former wetlands, and assess site conditions.
- Prioritize wetland preservation for high functional value, critical habitat, and riparian wetlands or according to other local or state identified criteria.
- Identify all opportunities for restoration (including creation and enhancement) such as nonwetland hydric soils, drained or disturbed wetlands, or wetlands dominated by invasive species.
- Prioritize wetland restoration projects in headwater, riparian, and other ecologically significant areas to maximize water quality and quantity benefits and to connect or expand existing wetlands systems.

Streams

Guideline #1: Riparian zone

There should be a 100-foot (preferred) forested buffer on each side of all streams or a vegetated buffer of a width and composition established by the local or state regulatory or planning agency (35-feet is the minimum accepted buffer width).

Recommended actions:

- Identify and preserve existing forest and other vegetated buffers.
- Identify riparian zones without forest buffers.
- Prioritize areas for reforestation
  a. Headwater streams should be given highest priority for reforestation and protection.
  b. Establish contiguous buffers on both sides of the streams.
  c. Plant native species appropriate for the region and site.

Guideline #2: Stream bank erosion

Stream bank and channel structure (including sinuosity and bed material) should reflect those of reference streams (highest quality streams in similar physiographic settings and land use).

Recommended actions

- Develop and maintain a coordinated and comprehensive database of physical and biological reference streams and/or reference reaches.
- Identify stream reaches that do not reflect reference conditions, and determine sources of degradation.
- Identify areas, through stream walks or aerial photography, where streams have been straightened, piped, hardened, confined, eroded, or caused damaging floods. Identify potential sources of sediment such as stream bank erosion or upland inputs from disturbed areas.
- Implement the recommended stormwater management recommended actions suggested in Guideline #2 under "Land Use".
- Prioritize restoration opportunities to maximize water quality and habitat improvements
- Replace concrete channels with vegetation or other nonstructural natural materials.

- Restore and/or stabilize excessive sediment inputs from the watershed, such as eroding banks, with vegetation or other nonstructural natural material.
- Restore appropriate pool and riffle habitat and sinuosity in straightened channels.
- Daylight (uncover or expose) piped streams.
- Evaluate and implement mechanisms to manage stormwater to reduce quantity impacts.
- Restoration options should address water quality and quantity, stream bank stability, in-stream habitat, and the sediment supply to the stream from the watershed.

Guideline #3: Fish blockages

There should be no chemical or physical impediments to fish migration in streams.

Recommended actions:

- Identify all chemical and physical blockages to fish passage and migration.
- Prioritize removal of blockages to maximize access and improve overall stream habitat. Blockages may be removed as part of flood control or infrastructure maintenance projects.

Habitats

Guideline #1: Exotic and invasive species

Minimize the environmental impacts of exotic and invasive species.

Recommended actions:

- Prevent the introduction of new exotic and invasive species.
- Minimize or avoid any environmental disturbances that encourage the invasion of unwanted species.
- Follow the "Chesapeake Bay Policy for the Introduction of Non-indigenous Aquatic Species" (adopted in 1993) before introducing any exotic species to the watershed (e.g., Asian oyster).
- In cooperation with appropriate federal and state agencies, eradicate exotic and invasive species that have been recently established in limited areas (e.g., zebra mussel, snakehead fish) and control exotic and invasive species that have

been previously established, using triage to focus control efforts where they will have the greatest benefit to the ecosystem.

- Develop or expand existing educational programs about exotic and invasive species.

Guideline #2: Threatened and endangered species

Populations of all threatened and endangered species, and their critical habitat, should be preserved and restored.

Recommended actions:

- Support full implementation of federal and state regulatory programs and voluntary programs that support the protection and restoration of threatened and endangered species.
- Identify, prioritize, and implement projects to preserve and restore threatened and endangered species habitats based on functional value, presence of critical habitat, and feasibility, or according to other local or state identified criteria.

Guideline #3: Waterbird and waterfowl communities

Preserve and enhance populations and habitats of native waterbirds and waterfowl.

Recommended actions

- Control exotic and invasive waterfowl (consistent with laws and regulations) that compete with native waterfowl species for food and breeding sites.
- Protect and restore habitats for waterbirds and waterfowl, including breeding and stopover habitats outside the Chesapeake Bay watershed.
- Where lack of nesting structures is limiting reproduction, provide such structures (e.g., wood duck boxes and osprey platforms), following existing laws and regulations.
- Continue to implement the "Chesapeake Bay Waterfowl Policy and Management Plan" adopted by the Chesapeake Executive Council in 1990 and other similar controlling documents such as the "North American Waterfowl Management Plan" and the "United States Shorebird Conservation Plan".

Lakes, Ponds, Impoundments and Shorelines

Guideline #1: Exotic and invasive species

Preserve natural diversity and prevent introduction and/or expansion of exotic and/or invasive plant and animal species within lakes, ponds, and impoundments.

Recommended actions:

- Remove any aquatic plants or animals found on the propeller, the anchor, the bottom of boats, the trailer, or in live-wells. Dispose of them away from the water and before entering new waters.
- Provide outreach on aquatic exotic and invasive species, instructing what lake users and landowners can do to prevent the spread of harmful exotic species.
- Encourage participation in volunteer monitoring of invasive species.

Guideline #2: Shoreline erosion and stabilization

Protect and preserve natural riparian and shoreline areas along lakes, ponds, and impoundments.

Recommended actions:

- Minimize the use of hard structure bulkheads and walls, except where they are essential for channel integrity.
- Encourage alternative shoreline restoration techniques such as bioengineering or biostructural stabilization

Guideline #3: Water quality

Reduce nutrient, sediment, and other contaminant inputs from tributaries and other point and nonpoint sources throughout the watershed.

Recommended actions:

- Identify and minimize the introduction of contaminants to lakes, ponds, or impoundments through the implementation of appropriate best management practices.
- Provide educational outreach, training, and workshops on lake management issues to help educate homeowners and riparian users on various lake dynamics, lake management, and nonpoint source issues. Explain what they can do to help protect the lake system.

- Encourage property owners and businesses to conduct regular maintenance on septic systems.
- Encourage participation in water quality monitoring programs.

Guideline #4: Reduce sources of pollution to surface waters from boating activities and marinas.

Recommended actions:

- Participate in federal or state clean marinas programs, which promote clean boating, clean facilities, and clean operations.

  Maryland: http://www.dnr.state.md.us/boating/cleanmarina/

  Virginia: http://www.deq.state.va.us/vacleanmarina/

  Pennsylvania: http://sites.state.pa.us/PA_Exec/Fish_Boat/boatinf.htm

  Delaware: http://www.dnrec.state.de.us/dnrec2000/divisions/soil/dcmp/ipcleanmarina.htm

  District of Columbia: http://webteam.nbc.gov/green/sustain/marina.html

  New York: http://www.nysefc.org/newweb9/CVAPhome.htm

- Support and promote participation in all local and regional programs designed to reduce impacts from nonpoint sources of pollution.

APPENDICES

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Principles of Good Development

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**Bowker Creek Watershed Management Plan—
Vision, Goals and Priority Actions**

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Appendix A – CONTACT INFORMATION

Chesapeake Bay Program – (800) YOUR BAY or (800) 968-7229
http://www.chesapeakebay.net or http://www.chesapeakebay.net/watershedplanning.htm

District of Columbia
Department of Health, Environmental Health Administration, Watershed Protection Division – (202) 535-2240
http://dchealth.dc.gov/services/administration_offices/environmental/watershed/watershed_division.shtm

Maryland
Department of Natural Resources – (410) 260-8570
http://www.dnr.state.md.us or http://www.dnr.state.md.us/bays.html or
http://www.dnr.state.md.us/streams/index.html

Department of the Environment – (410) 537-3000 or (800) 633-6101
http://www.mde.state.md.us

Pennsylvania
Department of Environmental Protection, Bureau of Watershed Management – (717) 783-2300
http://www.dep.state.pa.us/dep/deputate/watermgt/wc/

Department of Conservation & Natural Resources – (717) 787-2869
http://www.dcnr.state.pa.us/

Pennsylvania State Association of Township Supervisors – (717) 763-0960
http://www.psats.org/

Pennsylvania Growing Smarter – (888) 223-6837
http://www.landuseinpa.com

Virginia
Department of Environmental Quality, Office of Water Quality Programs – (804) 698-4462
http://www.deq.state.va.us/watersheds/homepage.html

Department of Conservation & Recreation – (804) 371-7486
http://www.dcr.state.va.us/ or http://www.dcr.state.va.us/sw/bayshed.htm

Chesapeake Bay Local Assistance Department – (800) CHESBAY or (800) 243-7229
http://www.cblad.state.va.us/

Delaware
Department of Natural Resources & Environmental Control – (302) 739-4590
Division of Water Resources - Watersheds
http://www.dnrec.state.de.us/dnrec2000/Watershed.asp

Watershed Assessment Section
http://www.dnrec.state.de.us/water2000/Sections/Watershed/DWRWatershed.htm

New York
Department of Environmental Conservation, Office of Natural Resources and Water Quality, Division of Water – (518) 402-8233
http://www.dec.state.ny.us/

West Virginia
Department of Environmental Protection, Office of Water and Waste Management – (304) 558-2107
http://www.dep.state.wv.us/item.cfm?ssid=11

Nonprofit Organizations
Alliance for the Chesapeake Bay – MD: (410) 377-6270, PA: (717) 737-8622, VA: (804) 775-0951, DC: (202) 466-4633
http://www.acb-online.org/

Bay LOGIN: Chesapeake Bay Local Government Environmental Information Network – (202) 962-3633
http://www.baylogin.org

Chesapeake Bay Foundation –– (410) 268-8816
http://www.cbf.org

Center for Watershed Protection – (410) 461-8323
http://www.cwp.org

Canaan Valley Institute – (800) 922-3601
http://canaanvi.org/assistance/programs.asp

International City/County Management Association (ICMA) (202) 289-4262
http://www.icma.org

Local Government Environmental Assistance Network – (877) TO LGEAN or (877) 865-4326
http://www.lgean.org -

Appendix B

CBP Principles of Good Development: For Use in Defining and Tracking Sound Land Use Commitment–Reduction of Harmful Sprawl on Forest and Agricultural Lands

[Revised per June 10, 2002, Land Growth & Stewardship Subcommittee meeting]

When considering the potential for development on forest and agricultural lands, it should be done only as a part of a long-term framework to ensure preservation of resource lands and it should have coherent, well-defined boundaries. Furthermore, development on forest and agricultural lands should occur only after alternatives to develop other lands have been thoroughly explored and dismissed.

1. Maintains the sustainable use of forest and agricultural lands by not fragmenting such lands into pieces or patches that render these uses impractical or uneconomic, or that significantly reduce their quality as wildlife habitat.

2. Does not adversely affect water quality (surface or groundwater) and seeks to maintain or restore the natural hydrologic functions of the site, by incorporating environmentally sensitive or low impact development designs, limitations on impervious cover, and other innovative stormwater management techniques.

3. Protects Most Valued Resource Lands (identified in the Resource Lands Assessment or by a locality) and those lands identified by a community for habitat, economic or cultural viability.

4. Protects, conserves or restores natural stream corridors, riparian forest buffers and wetlands.

5. In rural areas has a maximum density of one unit per twenty (20) acres, while within urban or suburban areas has a minimum gross density of three (3) units per acre.

6a. Except as allowed under item 6b, is constructed adjacent to existing development in areas with adequate water resources, and the necessary infrastructure is in place on the adjacent property prior to development. (Infrastructure includes public water, central sewer service and roads.)

6b. New development not adjacent to existing development may be considered as good development if it has adequate water resources and the necessary infrastructure, and is characterized by compact, mixed-use development. Compact, mixed-use development is defined as a mix of residential, commercial, employment/office, and civic land uses.

7. Is designed to prevent fragmentation of open space or ecological, economic, and cultural resource lands and to minimize the number of parcels created to encompass such lands.

8. Is within growth boundaries, growth areas, urban service limits of villages, towns, cities or other urbanized areas, to the extent such limits are set.

9. Optimizes existing road density and incorporates transportation strategies that minimize new roads and auto dependency.

Appendix C

BOWKER CREEK WATERSHED MANAGEMENT PLAN (DRAFT) SUMMARY

The Bowker Creek watershed is located in the Capital Regional District (CRD), extending from the University of Victoria to the north, through the District of Saanich and the City of Victoria, to the District of Oak Bay. A draft Watershed Management Plan has been developed under the sponsorship of the CRD. A forum of landowners, regulatory agencies, community groups, environmental organizations, local residents, and local and senior government staff was convened by the CRD to develop an integrated Watershed Management Plan for Bowker Creek. In a series of workshops, the Forum created a **V*ision Statement*** intended to describe a desirable future condition of the watershed and identified four ***Goals*** for achieving the vision.

A Vision for the Bowker Creek Watershed

The varied human uses and natural areas in the Bowker Watershed are managed to minimize runoff and pollution, making Bowker Creek a healthy stream that supports habitat for native vegetation and wildlife, and provides a community greenway to connect neighborhoods.

Goal 1 Individuals, community and special interest groups, institutions, government, and decision-makers take responsibility for actions that affect water quality in the watershed.

Goal 2 Manage flows effectively.

Goal 3 Improve and expand public areas, natural areas, and biodiversity in the watershed.

Goal 4 Achieve and maintain acceptable water quality in the watershed.

The Forum developed an **Action Plan** for meeting these goals, including short term and long term objectives and specific actions. To facilitate the implementation of each identified action, the Plan identifies:

- a lead agency and contact
- support agencies
- resources needed to undertake each action
- timing of when the action should occur, and
- potential sources of funding and other resources.

Priority Actions have been identified to provide direction for immediate and long term planning

1. Identify likely sources of pollution, both point and non-point.
2. Adopt and enforce the municipal storm drain and watercourse protection bylaws, based on the CRD model.
3. Monitor and report on water quality in the watershed.
4. Ensure local plans include and reflect Bowker Creek watershed management plan elements where appropriate.
5. Prepare a Master Drainage Plan (MDP).
6. Implement a land acquisition plan to act on identified opportunities for increasing public areas or opening the watercourse.
7. Adopt and incorporate into Bylaws development guidelines that require the use of pervious surfaces and onsite management of precipitation in new development and redevelopment.
8. Prepare and promote regulatory Codes of Practice for those business sectors with potential to contribute to stormwater pollution.
9. Encourage voluntary actions to prevent pollution (promote best management practices, public education and outreach).
10. Designate a corridor along Bowker Creek in all appropriate greenways plans.

Your Comments on the Plan are Important

Your input would help to ensure that the Bowker Creek Watershed Management Plan reflects the vision and ideals of the entire community. Your comments will be considered by the Forum prior to presenting a final Plan to the Capital Regional District and the Municipalities of Saanich, Victoria, and Oak Bay. The final Plan will be completed by December 2002. If adopted, this Plan will become an important part of the decision making process for local governments.

PLEASE PROVIDE YOUR COMMENTS BY OCTOBER 23, 2002.

For More Information

Copies of the Draft Plan can be reviewed/obtained from the CRD Environmental Services Department at 524 Yates Street, Victoria *or* on the CRD website at www.crd.bc.ca

Attend the Open House – 3-8 p.m., Wednesday, Oct. 16th, 2002, at 2964 Richmond Road, Victoria (Knox Presbyterian Church Hall)
Comment Forms are available on the CRD website, at Victoria, Saanich, and Oak Bay Municipal Halls and at the Open House.

Appendix D

Watershed Assessment Work Assignments

Assessment Project: _____

Date: _____ Prepared By: _____

Task/Work Item _____

_____

Person(s) Responsible: _____

_____

Kind of Information Needed:

Is the information available?

❑Yes (Where is it and who has it?)

❑No (Proceed with worksheet)

How much detail is needed?

What is the desired format for the data? (e.g., map, GIS data, table, document/report,)

Potential procedures/actions needed for collecting information:

Action	Timeframe	Estimated Cost	Person(s) Responsible

Schedule: Estimated Start Date: _____

Estimated Completion Date: _____

Status: ☐ **Future project** □ **Ongoing**

☐ **Complete** (Date completed:_____)

Appendix E – RIPARIAN AREA ASSESSMENT DATA SHEET

Site_____ Site ID_____

Stream name_____

Date_____ Time _____ Weather conditions_____

Volunteer names_____

Distances reported are: (circle one) measured (tape) measured (range finder) estimated

Length of segment assessed_____yards

Stream width: Upstream _____ Midpoint _____ Downstream _____

GPS coordinates (D,M,S): Upstream latitude _____ Upstream longitude _____

Downstream latitude _____ Downstream longitude _____

If GPS is not available and the site was drawn on a map, please check here ____ and include map

---

Riparian Area

1. Riparian Buffer Width
Score: Left Bank _____ Right Bank _____ (facing downstream)

Comments:

2. Riparian Vegetation Type
Score: Left Bank _____ Right Bank _____

Comments:

3. Riparian Vegetation Thickness
Score: Left Bank _____ Right Bank _____

Comments:

Bank

4. Bank Vegetation Type
Score: Left Bank _____ Right Bank _____
Comments:

5. Bank Vegetation Thickness
Score: Left Bank _____ Right Bank _____
Comments:

6. Bank Stability
Score: Left Bank _____ Right Bank _____
Comments:

7. Water Pathways
Score: Left Bank _____ Right Bank _____
Comments:

Channel

8. Channel Modification
Score: _____
Comments:

9. Shading (Canopy Cover)
Score: _____
Comments:

10. In-stream Cover
Score: _____
Comments:

11. Embeddedness (measure in a riffle)
Score: _____
Comments:

12. Aquatic Vegetation
Score: _____
Comments:

The following questions are simply fill-in-the-blank, and do not need to be rated.

Substrate Classification

Class	**Description**	**Percentage (should total 100%)**
Bedrock	Bigger than a car	
Boulder	Basketball to car	
Cobble	Tennisball to basketball	
Coarse Gravel	Marble to tennisball	
Fine Gravel	Ladybug to marble	
Sand	Gritty between fingers	
Fines	Smooth, not gritty	

Drain Pipes
Are contributing (as opposed to withdrawing) drainpipes present in the stream? _____ If so, how many? _____

Livestock Use (check one)
Livestock have direct access to stream and heavy use is apparent _____
Livestock are not fenced from stream but heavy use not apparent _____
Livestock present in area but fenced from the stream _____
Not applicable, livestock not present _____

Riparian Area 50 Yards Above and Below Site Boundaries: (circle one for each category)

Upstream Right:	Developed/ Urban	Grasses/mix (mowed)	Grasses/mix (full height)	Shrub or mix	Forest or mix
Upstream Left:	Developed/ Urban	Grasses/mix (mowed)	Grasses/mix (full height)	Shrub or mix	Forest or mix
Downstream Right:	Developed/ Urban	Grasses/mix (mowed)	Grasses/mix (full height)	Shrub or mix	Forest or mix
Downstream Left:	Developed/ Urban	Grasses/mix (mowed)	Grasses/mix (full height)	Shrub or mix	Forest or mix

Dominant Land Use Outside the Buffer (check only one)

Right:

Developed/Urban	_____	Pasture	_____
Row-crop agriculture	_____	Forest	_____
Lawn	_____		

Left:

Developed/Urban	_____	Pasture	_____
Row-crop agriculture	_____	Forest	_____
Lawn	_____		

Overall, how would you rate this site? (circle one)

Poor Marginal Good Excellent

Suggestions for improvement of the riparian area: _____

_____

_____

_____

_____

_____

_____

Please draw a simple sketch of the area assessed:

Any additional comments: _____

_____

_____

_____

_____

_____

_____

_____

Thank you for helping assess this riparian area!

Use the following link for detailed instructions for completing the Riparian Area Assessment Data Sheet:
http://www.patrout.org/Riparian%20Assessment%20Instructions.doc

Appendix F – Coastal Watershed Survey Data Sheet

Surveyors: _____ Sector: _____ Site: _____
_____ Date: _____ Time: _____
_____ Rainfall: _____ # of Photos _____

Location (Describe landmarks and mark the site number on the sector map.)

Person(s) contacted at site:

Directions: Check off the appropriate items in categories 1-6.
Use the back side of this sheet for comments or site sketches.

1. POLLUTANT(s) (potential or known):
Toxic___ Bacteria ___ Nutrients___ Sediment___ Other_____

2. DIRECT DISCHARGE TO WATER BODY? Yes___ No___
Distance to water body or channel _____
Slope between location and water body or channel: flat___ moderate___ steep___

3. VEGETATED BUFFER? (between activity you are documenting and water body or channel)
Yes___ No___ Width____

4. SOURCE OF POLLUTANT(s)

Commercial & Residential:
___ Impervious areas
___ Septic system
___ Driveway
___ Lawn
___ Industrial runoff
___ Golf course runoff
___ Commercial runoff
___ Residential runoff
___ Construction site
___ Shoreline erosion
___ Other _____

Roads:
___ Ditch erosion
___ Shoulder erosion
___ Surface erosion
___ Culvert inlet/outlet
___ Stream crossing
___ Private road
___ Town road
___ State road
___ Logging road

___ Other _____

Agriculture:
___ Livestock grazing
___ Tilled fields
___ Manure/fertilizer spreading
___ Manure storage
___ Other _____
___ Other _____

Marinas:
___ Boat maintenance
___ Waste discharge
___ Impervious areas
___ Fueling station
___ Refuse disposal

Other Source: _____

5. SIZE OF AFFECTED AREA: Area or Length _____

6. COMMENTS, RECOMMENDATIONS, AND SKETCH (use back side)

INSTRUCTIONS: ***Please fill out the survey data sheet as follows.***

SURVEY INFORMATION BOX

Surveyors: Enter names of survey team members that identified the site.
Sector: Enter the number of the survey sector.
Site: Enter a site reference number 1, 2, etc. to give each site a unique identification.
Date and Time: Enter the date and time of day the problem was observed.
Rainfall: Enter the estimated rainfall amount during the past 24 hours.
Number of Photos: Record the number of photos taken at each site.*****
Location: This information is critical for the follow-up analysis. Indicate the location of the site on your sector map. Describe access roads and distances from reference points to the site on the data sheet.
Person(s) Contacted at Site: Indicate if your survey team talked with a property owner or anyone else while at the site.

1. **POLLUTANT(S):** Check the pollutants generated at the site that are impacting or may potentially impact a waterbody.
2. **RUNOFF:** Determine if there is a direct pathway for runoff to carry the pollutants into the water body. Indicate the distance of the site to nearest water body or channel, and estimate the slope of the land between the site to the nearest waterbody or channel.
3. **VEGETATED BUFFER:** Indicate if runoff from the site flows through a vegetated buffer before reaching the nearest water body or channel, and the buffer width. Check the type of vegetation growing in the buffer. Determine if runoff in the buffer can spread evenly as it flows through the buffer, rather than flowing into the buffer.
4. **SOURCE OF POLLUTANTS:** Check the land uses/sources generating pollutants at each site.
5. **SIZE OF AFFECTED AREA:** Try to estimate the size of the area involved, such as the length or an eroding road ditch or the area of exposed soil.
6. **COMMENTS SKETCHES:** Use the back side of the survey data sheet for any additional comments or any drawings that would help to describe the site for future follow-up work and to prioritize. Include any recommendations your survey team has to eliminate or reduce the severity of the problem that you have identified.

***NOTE:** Photographs should be taken where they can help document the nature and severity of the problem. They will be used by those who do the follow-up analysis and may be used for documentation in any efforts to obtain funding for remedial efforts in the watershed. One close and one distance photo should be taken for perspective. When taking a close shot, try to include some object in the photo to provide a reference of size.

(**Source:** Maine Department of Environmental Protection (DEP). 1996. *A Citizen's Guide to Coastal Watershed Surveys*. 78 pp.)