WETLANDS & WATERSHEDS

Using Local Watershed Plans to Protect Wetlands

CENTER FOR WATERSHED PROTECTION

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Wetlands & Watersheds Article #2

Prepared by:

Karen Cappiella, Anne Kitchell, and Tom Schueler
Center for Watershed Protection
8390 Main Street, 2nd Floor
Ellicott City, MD 21043
www.cwp.org
www.stormwatercenter.net

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Article 2 of the Wetlands & Watersheds Article Series

Karen Cappiella, Anne Kitchell, and Tom Schueler
Center for Watershed Protection
8390 Main Street, 2nd Floor
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www.cwp.org

Executive Summary

Watersheds are significantly influenced by their wetlands. The capacity of wetlands to attenuate floods, absorb pollutants, recharge groundwater, provide wildlife habitat, and protect erodible shorelines are important watershed functions. Despite performing these critical functions, wetlands are seldom integrated into local watershed plans. Instead, wetland managers regulate individual wetlands on a site-by-site basis. This approach fails to consider cumulative wetland functions, and is often segregated along regulatory and jurisdictional lines. At the same time, communities are realizing they can only solve their water resource problems by using a watershed approach. Wetland managers may find it useful to evolve towards a watershed approach as well.

This article briefly describes a proposed framework for integrating wetland management in the context of local, state, and tribal watershed planning efforts. This planning framework outlines the rationale for managing wetlands at the watershed scale, describes the basics of the watershed planning process, and outlines 11 recommended watershed planning elements that relate to wetlands. These planning elements, or principles, help ensure that a watershed plan adequately addresses wetland management issues. The principles are presented in Table E-1, along with specific methods for meeting them.

Table 2. Principles of Watershed Planning for Wetlands

Watershed Planning Principles to Protect Wetlands	Specific Methods
1. Compile Wetland Information on a Watershed Basis	1.1 Review existing plans 1.2 Compile additional data
2. Assess Local Wetland Protection Capacity	2.1 Conduct Needs and Capabilities Assessment 2.2 Conduct 8 Tools Audit
3. Identify Wetland Partners and Roles	3.1 Involve wetland partners in stakeholder process 3.2 Consult with wetland partners for technical support 3.3 Form partnerships for implementation
4. Define Wetland Goals and Objectives for the Watershed	4.1 Define wetland goals 4.2 Define specific wetland objectives
5. Create an Inventory of Wetlands in the Watershed	5.1 Update existing wetland maps 5.2 Estimate historic wetlands coverage 5.3 Delineate wetland contributing drainage areas 5.4 Estimate wetland functions 5.5 Estimate wetland condition 5.6 Estimate effects of future land use changes on wetlands

Table 2. Principles of Watershed Planning for Wetlands	
Watershed Planning Principles to Protect Wetlands	**Specific Methods**
6. Screen Wetlands for Further Assessment	6.1 Screen for priority subwatersheds using wetland metrics 6.2 Screen wetland inventory for conservation sites 6.3 Screen wetland inventory for sensitive wetlands 6.4 Screen wetland inventory for restoration sites
7. Evaluate Wetlands in the Field	7.1 Conduct rapid assessment of wetland impacts 7.2 Conduct detailed wetland assessments
8. Adapt Watershed Tools to Protect Wetlands	8.1 Review 8 Tools Audit 8.2 Make specific recommendations for each tool
9. Prioritize Wetland Recommendations	9.1 Compile list of wetland recommendations 9.2 Rank recommendations to identify priorities
10. Coordinate Implementation of Wetland Recommendations	10.1 Implement changes to local programs and regulations 10.2 Coordinate with wetland regulatory agencies 10.3 Implement projects with wetland partners
11. Monitor Progress Toward Wetland Goals	11.1 Update the wetland inventory 11.2 Track implementation of wetland projects 11.3 Conduct wetland monitoring

The article is organized by these 11 principles and provides a conceptual approach for local watershed and/or wetland managers to improve watershed management plans by addressing the gaps in wetland protection. While the planning framework can be used in all watershed planning scenarios, it is particularly helpful in watersheds that contain a large number of small or isolated wetlands that may not be fully protected and that are under considerable development pressure.

About the Wetlands & Watersheds Article Series

The Wetlands & Watersheds article series was developed by the Center for Watershed Protection (CWP) in cooperation with the United States Environmental Protection Agency (USEPA). Funding for this project was provided by USEPA under cooperative agreements number CD-83192901-0 and WD-83264101-0.

Collectively, wetlands provide many watershed benefits, including pollutant removal, flood storage, wildlife habitat, groundwater recharge, and erosion control. While watersheds and wetlands are interconnected systems, their management is often segregated along regulatory and jurisdictional lines. Recent initiatives, such as the National Wetlands Mitigation Action Plan, provide a potential framework to integrate wetland protection in the context of larger local and state watershed planning efforts. However, no specific guidance exists for managing wetlands in the context of local watershed plans, and local governments often lack the tools and knowledge to effectively protect critical wetlands. This project was designed to fill this gap by expanding CWP's current watershed protection guidance, tools, and resources to integrate wetlands into larger watershed protection efforts. A key message conveyed in this new guidance is that wetlands should not be managed separately from other water resources because they are integral to water resource management.

This project included *research* on urban wetlands and local protection tools, *synthesis* of the research into a series of articles, and *transfer* of wetland protection tools and resources to wetland and watershed professionals across the country. The audience for the articles includes local natural resources managers and land planners who would benefit from guidance on local tools for protecting wetlands. The Wetlands & Watersheds article series currently includes three articles:

Article 1: Direct and Indirect Impacts of Land Development on Wetland Quality
This article reviews the direct and indirect impacts of urbanization on wetlands, and describes how impacts to wetlands affect watershed health.

Article 2: Using Local Watershed Plans to Protect Wetlands
This article presents detailed methods for integrating wetland management into the local watershed planning process.

Article 3: Adapting Watershed Tools to Protect Wetlands
This article describes 37 techniques for protecting wetlands through local programs and ordinances.

Other wetland-related products of this project include wetland slideshows, an annotated bibliography of wetland research, a listing of key wetland web resources, and more products available on the newly expanded CWP wetlands website at www.cwp.org/wetlands/index.htm. The article series will be continued in 2006 with the production of three additional articles on the following topics:

- Model Ordinance for Local Wetland Protection
- Urban Wetland Restoration Techniques
- Local Tools for Protecting Vulnerable Wetlands and Aquatic Resources

The CWP project team included:

- Karen Cappiella
- Tom Schueler
- Tiffany Wright
- Anne Kitchell
- Neely Law
- Julie Tasillo
- Jennifer Tomlinson
- Lauren Lasher
- Hye Yeong Kwon
- David Hirschman

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Introduction

Watersheds are significantly influenced by their wetlands. The capacity of wetlands to attenuate floods, absorb pollutants, recharge groundwater, provide wildlife habitat, and protect erodible shorelines are important watershed functions. Despite performing these critical functions, wetlands are seldom integrated into local watershed plans. Traditionally, wetland managers regulate individual wetlands on a site-by-site basis. This approach fails to consider cumulative wetland functions, and is often segregated along regulatory and jurisdictional lines. At the same time, communities are realizing they can only solve their water resource problems by using a watershed approach. Wetland managers may find it useful to evolve towards a watershed approach as well.

This article briefly describes a proposed framework for integrating wetland management in the context of local, state, and tribal watershed planning efforts. This planning framework outlines the rationale for managing wetlands at the watershed scale, describes the basics of the watershed planning process, and outlines recommended watershed planning elements that relate to wetlands. This article presents a conceptual approach for local watershed and/or wetland managers to improve watershed management plans by addressing the gaps in wetland protection. While the planning framework can be used in all watershed planning scenarios, it is particularly helpful in watersheds that contain a large number of small or isolated wetlands that may not be fully protected and that are under considerable development pressure.

Why Manage Wetlands at the Watershed Scale?

Wetlands loss is largely attributed to physical alterations made through the removal or addition of material such as dredging, filling, or draining. These direct impacts are largely regulated through the federal and state wetland permitting process, yet many wetlands remain susceptible to indirect impacts, such as those caused by uncontrolled stormwater discharges from upstream development (Figure 1). Altered hydrology, increased pollutant loadings, and buffer encroachment caused by urbanization often promote the spread of invasive species, reduce native habitat, and increase sediment deposition. Article 1 reviews these indirect impacts of urbanization on wetland quality.

Land use practices causing indirect wetland impacts can be managed at the local level through zoning, subdivision ordinances, stormwater criteria, and other development regulations. Many

communities are turning to small watershed planning to efficiently direct the application of local regulatory tools (i.e. stream buffers, floodplain restrictions, erosion and sediment control regulations). Wetland protection, however, has historically been delegated to federal or state permitting authorities who have no control over local land use decisions; this limits their ability to protect wetlands from the indirect impacts associated with urbanization.

Figure 1. Indirect impacts to wetlands can result from hydrologic changes, such as impoundment, and from input of pollutants contained in runoff from upstream development

Incorporating wetland protection into the local watershed planning process can help minimize impacts to wetlands. Practically, this means that local wetlands must be inventoried, assessed and managed in the context of the entire watershed rather than on a site-by-site basis. A watershed approach requires a broader understanding of how wetlands function within the watershed and the benefits they provide. Watershed planning will allow communities to make better choices on preserving the highest quality wetlands, protecting the most vulnerable wetlands, and finding the best sites for wetland restoration. A watershed plan can also be used to inform wetland permit decisions made by state and federal agencies, and to identify opportunities for voluntary wetland conservation and restoration programs. Other benefits to communities include: improved achievement of watershed goals, improved protection and restoration of wetlands, improved ability to allocate lands to their most appropriate uses, and improved ability to meet landowner needs for complying with wetland regulations (ASWM, 2001).

Gaps in the current approach to wetland permit programs also make a case to implement wetland protection at the local watershed scale. Perhaps the most important gap is a 2001 U. S. Supreme Court ruling (the "SWANCC ruling") that determined that isolated, non-navigable and intrastate

waters wetlands are no longer protected under the Clean Water Act (CWA) Section 404 based solely on the Migratory Bird Rule (U. S. Supreme Court, 2001). The U.S. Environmental Protection Agency (USEPA) estimates that around 20 million acres of wetlands are at risk due to this ruling. The exact number of wetlands at risk will be defined by court decisions as they interpret the SWANCC ruling and define these isolated wetlands. Even wetlands that are still regulated under Section 404 may still be at risk according to two independent reports conducted by the National Research Council (NRC, 2001) and the U.S. General Accounting Office (GAO, 2001). Both reports concluded that compensatory mitigation has not achieved the goal of no net loss of wetlands for wetland functions. The NRC report recommended a watershed approach to improve wetland permit decision-making. Box 1 summarizes additional reasons why local communities may choose to manage wetlands at the watershed scale.

Box 1. Making the Case for Wetlands and Watershed Planning

- Wetlands are indirectly impacted by uncontrolled stormwater discharges from adjacent or upstream development. Federal and state permitting programs do not regulate indirect impacts to wetlands. Indirect impacts can be effectively managed at the local level through land use and development regulations.
- Impacts to wetlands can greatly affect watershed health. Healthy wetlands provide many important watershed functions, such as pollutant removal, flood storage, erosion control, wildlife habitat, and groundwater recharge.
- Wetland regulatory programs currently do not distinguish between wetlands that have different functions. A watershed scale inventory and preliminary assessment of wetland functions allows communities to make more informed decisions about the highest quality wetlands to preserve, the most vulnerable wetlands to protect, and the best sites for wetland restoration, rather than using a site-by-site approach.
- Some isolated wetlands are outside the geographic jurisdiction of federal and state permitting programs. Local wetland protection regulations can be structured to capture these unprotected wetlands.
- A watershed plan can be used to inform wetland permit decisions made by state and federal agencies, and to identify the best opportunities for voluntary wetland conservation and restoration, as well as the most critical locations for wetland mitigation.
- Recent management of wetlands on a site-by-site basis has failed to meet “no net loss” of function standard (NRC, 2001). The current site-by-site approach does not consider cumulative impacts to wetlands. A local watershed approach to wetlands can do both these things.

In recent years, federal agencies have recognized the importance of a watershed approach to wetland protection, and that wetland function is as important as wetland acreage. In response to recommendations made by NRC (2001) and GAO (2001), an interagency team drafted the National Mitigation Action Plan (MAP) to improve the effectiveness, accountability, and procedure for evaluating success of the compensatory mitigation program. The MAP endorses the goal of no net loss of wetlands and outlines specific action items that address the concerns of these independent evaluations (MAP Interagency Workgroup, 2002). Four of these action items relate to integrating compensatory mitigation into a watershed context. The MAP provides a potential framework to integrate wetland protection in the context of larger watershed planning efforts, and this article seeks to provide more detail on how to achieve it at the local level.

Wetlands in the Watershed Planning Process

Many communities realize the value of local watershed plans to not only protect land and water resources, but can also meet other local, state and federal regulatory drivers, such as comprehensive planning, total maximum daily loads (TMDLs), and the National Pollutant Discharge Elimination System (NPDES) program. Because the characteristics, local politics, and regulatory drivers are different within each watershed, the planning process and resulting documents will be unique in each community. Although some variation is to be expected, several common steps should be followed to create and implement effective watershed plans.

The Watershed Planning Process

The watershed planning process can be described by the eight steps presented in Table 1. Each step combines desktop analysis, field assessment, stakeholder involvement, and management methods. The process is meant to be flexible and will vary slightly depending on the type of watershed and its level of development, as well as the resources available. Effective watershed planning generally occurs at the scale of 100 square miles or less. At this scale, fewer jurisdictions and stakeholders are involved, impacts can be more easily understood, and opportunities for watershed protection and restoration can be rapidly identified and implemented. More detail on these steps and how to implement them can be found in CWP (2005). Schueler and Kitchell (2005) provides guidance on specific methods to restore urban subwatersheds as part of a watershed plan.

Table 1. Wetlands in the Watershed Planning Process

Watershed Planning Step	Description	Wetland Context
Step 1: Develop Watershed Planning Goals	The goals, objectives, and indicators that will guide the watershed plan are developed based on existing watershed data, local capacity to implement the plan, and stakeholder concerns.	Wetland-specific goals, objectives, and indicators can be developed, and wetland functions can be considered in developing other watershed goals.
Step 2: Classify and Screen Priority Subwatersheds	Communities with limited resources must target a subset of priority subwatersheds--typically those most vulnerable to development or with the greatest restoration potential--on which to focus watershed planning efforts.	Wetland data can be incorporated into the subwatershed prioritization process.
Step 3: Identify Watershed Planning Opportunities	Existing programs and regulations are evaluated in the context of watershed planning, and field assessments are conducted to identify potential protection and restoration opportunities.	Opportunities for wetland conservation, protection and restoration in the watershed can be identified.
Step 4: Conduct Detailed Assessments	Detailed field investigations of candidate projects are conducted to acquire more detailed information to develop initial project designs.	Detailed assessments of wetland functions, condition, or restorability can be conducted for specific opportunities.
Step 5: Assemble Recommendations into Plan	Recommended projects and changes to existing local programs and regulations are prioritized and transformed into a draft watershed plan.	Recommendations for wetland conservation, protection and restoration can be finalized and prioritized for inclusion in the plan.

Table 1. Wetlands in the Watershed Planning Process		
Watershed Planning Step	**Description**	**Wetland Context**
Step 6: Determine If Watershed Plan Meets Goals	The proposed combination of watershed plan recommendations is evaluated to determine if they are capable of meeting watershed goals.	The effect of wetland conservation, protection, and restoration on watershed goals can be evaluated.
Step 7: Implement the Plan	The final plan is implemented, and much of the effort is devoted to the final design, engineering and permitting for individual projects and to programmatic and regulatory changes.	Wetland conservation, protection and restoration measures recommended in the plan can be implemented.
Step 8: Measure Improvements Over Time	Progress of implementation and success of individual projects is measured and tracked over time and results are used to periodically update the plan.	Changes in wetland acreage and function in the watershed can be tracked over time.

As illustrated in Table 1, wetland management can be addressed during every step in the local watershed planning process. Specific guidance on how to incorporate wetlands into watershed plans has been lacking until now, which explains the lack of focus on wetlands in many existing watershed plans. This article attempts to fill that gap.

Watershed Planning Principles for Wetland Protection

Several key ingredients need to be addressed in a watershed plan to effectively protect wetlands. As such, 11 watershed planning principles are presented below that help ensure that the plan adequately addresses wetland management issues. Please note that these principles do not necessarily need to be addressed in the order they are presented here. To protect wetlands, communities developing a watershed plan should:

1. Compile wetland information on a watershed basis.
2. Assess local wetland protection capacity.
3. Identify wetland partners and roles.
4. Define wetland goals and objectives for the watershed.
5. Create an inventory of wetlands in the watershed.
6. Screen wetlands for further assessment.
7. Evaluate wetlands in the field.
8. Adapt watershed tools to protect wetlands.
9. Prioritize wetland recommendations.
10. Coordinate implementation of wetland recommendations.

11. Monitor progress toward wetland goals.

The remainder of this article is organized around these watershed planning principles for wetlands, and provides specific methods to meet them. Both the principles and methods are presented in Table 2. An important term used in these principles and methods is wetland recommendations. Wetland recommendations include recommendations made for three types of measures: wetland conservation, protection and restoration. Box 2 defines all three types of wetland recommendations.

A fourth type of recommendation that is not discussed in this article is wetland creation. In urban areas, created wetlands can be used to manage stormwater runoff; however, wetland creation is generally not recommended as an approach for mitigation because created wetlands are most difficult to establish and are less likely to replace the functions and values of the wetlands destroyed. Use of created wetlands to manage stormwater is addressed in Article 3.

Table 2. Principles of Watershed Planning for Wetlands

Watershed Planning Principles to Protect Wetlands	Specific Methods
1. Compile Wetland Information on a Watershed Basis	1.1 Review existing plans 1.2 Compile additional data
2. Assess Local Wetland Protection Capacity	2.1 Conduct Needs and Capabilities Assessment 2.2 Conduct 8 Tools Audit
3. Identify Wetland Partners and Roles	3.1 Involve wetland partners in stakeholder process 3.2 Consult with wetland partners for technical support 3.3 Form partnerships for implementation
4. Define Wetland Goals and Objectives for the Watershed	4.1 Define wetland goals 4.2 Define specific wetland objectives
5. Create an Inventory of Wetlands in the Watershed	5.1 Update existing wetland maps 5.2 Estimate historic wetlands coverage 5.3 Delineate wetland contributing drainage areas 5.4 Estimate wetland functions 5.5 Estimate wetland condition 5.6 Estimate effects of future land use changes on wetlands
6. Screen Wetlands for Further Assessment	6.1 Screen for priority subwatersheds using wetland metrics 6.2 Screen wetland inventory for conservation sites 6.3 Screen wetland inventory for sensitive wetlands 6.4 Screen wetland inventory for restoration sites
7. Evaluate Wetlands in the Field	7.1 Conduct rapid assessment of wetland impacts 7.2 Conduct detailed wetland assessments
8. Adapt Watershed Tools to Protect Wetlands	8.1 Review 8 Tools Audit 8.2 Make specific recommendations for each tool
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10. Coordinate Implementation of Wetland Recommendations	10.1 Implement changes to local programs and regulations 10.2 Coordinate with wetland regulatory agencies 10.3 Implement projects with wetland partners
11. Monitor Progress Toward Wetland Goals	11.1 Update the wetland inventory 11.2 Track implementation of wetland projects 11.3 Conduct wetland monitoring

Box 2. Types of Wetland Recommendations

- *Wetland Protection*: involves the application of land development regulations and other measures to prevent or reduce impacts to wetlands as a result of land development and other activities. Wetland protection regulations can be applied in or near wetlands, or within the wetland CDA to protect sensitive wetlands.
- *Wetland Conservation*: includes the use of land acquisition, easements and other conservation tools to permanently protect high quality wetlands from future development.
- *Wetland Restoration:* involves changing the hydrology, elevation, soils or plant community of a currently degraded wetland or a former wetland. When restoration is applied to a currently degraded wetland, only its function is restored, while when restoration is applied to a former wetland, both the wetland area and function are restored.

Principle 1: Compile Wetland Information on a Watershed Basis

The beginning stage of a watershed plan compiles existing data to provide a foundation for evaluating watershed conditions. It is important to explore all avenues to compile watershed data to understand the scope of work previously done and reduce duplication of efforts. Types of data to compile include mapping layers, reports, monitoring data, modeling results, demographic data, and regulations. At this stage, existing plans or reports that focus on wetland should be reviewed. Additional wetland-specific data, such as mapping data, wetland monitoring and assessment data, statistics on wetland permits and loss, and local wetland regulations, should be compiled for the watershed plan. Each is described below and in Table 3.

Table 3. Types of Wetland Information

Information Type	Examples
Existing Plans and Reports	Special Area Management Plans, Advanced Identification, Wetland Conservation Plans
Mapping	Mapped wetland layers and wetland indicator layers
Monitoring Data	305(b) monitoring data, North American Breeding Bird surveys, Natural Heritage surveys, flooding analyses, natural resource inventories, U.S. Fish and Wildlife Service (USFWS) status and trends reports
Statistics	Wetland loss and permitting statistics
Regulations	Wetland protection ordinances and local development regulations

1.1 Review Existing Plans

Existing wetland reports and plans that should be acquired include copies of State Wetland Conservation Plans, Special Area Management Plans (SAMPs), and Advanced Identification (ADID). Each is described in Box 3. These plans provide a good basis for conducting an inventory of wetlands in the watershed, and the inventory may actually be skipped if it has already been done for the watershed as part of one of these plans. In addition, results and recommendations made in these plans should be considered and incorporated into a watershed plan. Other useful resources include mitigation plans developed by state highway agencies and utility companies that contain information on possible restoration sites or wetland functions.

Box 3. Wetland Related Documents

- State Wetland Conservation Plans are strategies developed by states to achieve no net loss and other wetland management goals by integrating both regulatory and non-regulatory approaches to protecting wetlands.
- Special Area Management Plans (SAMPs) are plans conducted by the U.S. Army Corps of Engineers (USACE) in environmentally sensitive areas facing strong development pressure, with a sponsoring local agency, strong public involvement, and an agreement by all parties that the plan will result in a definitive wetland regulatory product.
- Advanced Identification (ADID) is a project undertaken by the U.S. Environmental Protection Agency (USEPA) with USACE and states/tribes to collect information on the location and functions of wetlands of a specified area in advance of permit application, and to identify wetlands generally suitable or unsuitable for fill. The information collected does not always result in a formal plan, and cannot be used as a basis for regulatory decisions.

Other more general plans that may contain wetland data include: local land use plans, Source Water Assessment Plans, Scenic and Wild River plans, floodplain management and greenway plans, coastal zone plans, North American Waterfowl Management Plans, and Statewide Comprehensive Outdoor Recreation Plans (SCORPs).

1.2 Compile Additional Data

Wetland mapping data is perhaps the most important type of wetland information to compile for a watershed plan. Geographic Information Systems (GIS) is the primary tool to store, organize and analyze all mapping data generated throughout the watershed planning process. Wetland mapping data for the watershed should be compiled into this watershed-based GIS. Wetland mapping data includes both "mapped wetland layers" and "wetland indicator layers," which are used to infer where wetlands might be located, and are supplemental to mapped wetland layers. Preference should be given to the most recent and the most accurate layers available. Tables 4 and 5 provide a summary of common wetland mapping layers and their sources. The U. S. Geological Survey (USGS) National Map service at http://nationalmap.gov/ can also be used to determine which layers are available for a particular region, and to download the data.

Table 4. Wetland Mapping Layers

Wetland Mapping Data	Description	Source
National Wetlands Inventory (NWI)	Based on data from 1980's*, and tends to underestimate wetland coverage, specifically wetlands smaller than 3 acres and ephemeral wetlands. Maps cover 90% of U.S., but only 40% of the lower 48 states is available in GIS.	http://wetlands.fws.gov/
State or local wetland inventories	Local inventories can be the most accurate source of wetland data, but not all localities have them. Inventory completeness depends on intended use, procedures used, and difficulty of identifying certain wetland types.	Varies (may be digital). Check with local planning agency, state natural resources department

Table 4. Wetland Mapping Layers		
Wetland Mapping Data	**Description**	**Source**
Natural Resources Conservation Service (NRCS) wetland determinations	Also known as farmed wetlands or "Swampbuster" maps. Available as paper maps only for individual sites	Contact local Soil Conservation District office
USACE Section 404 permit wetland determinations	Paper maps of individual sites can be requested. A centralized database is under construction that may be searched by watershed	Contact regional Army Corps for Engineers district office
Created or restored wetlands	Locally generated layers of mitigation sites and stormwater treatment practices (STPs)	State transportation departments or USACE district office may be a good source for mitigation sites. Local public works or other department may have STP layer
*NWI are currently being updated in certain USFWS priority areas using mid-1990s and more recent imagery.		

Table 5. Wetland Indicator Layers		
Wetland Mapping Data	**Description**	**Source**
NRCS hydric soils and inclusions	State-wide or county-wide soil survey maps that designate hydric soils and inclusions (patches of hydric soil too small to map). Not all communities have soils digitally but you can get paper maps often from county soil conservation district.	http://soildatamart.nrcs.usda.gov/
Federal Emergency Management Agency (FEMA) floodplains	Flood data is available for 100-yr and 500-yr floodplains	www.msc.fema.gov/product.shtml
Topography	Digital elevation maps or Digital Line Graphs (DLGs)	Available from USGS and local sources
State or local vegetation maps and surveys	Maps created from satellite imagery, plant surveys and other sources that identify wetland vegetation	Varies
Aerial photos	High resolution aerials (no more than 5 years old and 1" = 600') can be used with photo-interpretation to identify wetlands. Photos older than 5 years may be used if there has not been much recent development.	www.spaceimaging.com

Any available wetland monitoring and assessment data should also be compiled. Wetland monitoring data may include surveys of physical wetland characteristics or biological condition, water quality data, and hydrologic studies. Data may be available from wetland-specific studies, or may be included within larger watershed-wide, or state or regional studies, such as natural resource inventory reports, flooding analyses, and water quality studies. Specific examples include Breeding Bird Surveys and CWA 305(b) state water quality reports available at http://www.epa.gov/owow/monitoring/databases.html. Volunteer monitoring databases and state

water quality data collected in support of water quality designations should also be explored. Few states monitor wetland health or have fully incorporated wetlands into their water quality programs, but some wetland-specific data may exist. For more information and links to state wetland monitoring programs, see http://www.epa.gov/owow/wetlands/monitor/.

Statistics on wetland permitting and loss are available from three sources: the USACE, the National Resources Inventory (NRI), and the U.S. Fish and Wildlife Service (USFWS) reports on status and trends of wetlands in the U.S. The USFWS was tasked with developing reports at regular 10-year intervals to track wetland acres lost and gained nationally, including rates of loss, wetland types affected, and causes of loss. The NRI, which is conducted by the NRCS, is a statistical survey of land use and natural resource conditions and trends on non-federal lands in the U.S. Both the NRI data and the USFWS reports can provide general estimates of wetland losses on a state or national level, but are not meant to provide detailed assessments of wetland losses or gains in a watershed.

The best records for tracking *permitted* wetland losses may be permit records and summaries of permit applications, available from USACE district offices. These records summarize the acres impacted, type of impacts, and mitigation required. Statistics regarding the percentage of permits granted, types of wetlands commonly impacted and acres impacted can be generated from this data. Compilation of the data can be labor-intensive, so USACE district offices should be consulted to see if a review of permitting status has already been done for the watershed. A new database to track permits is under development and will be available soon to facilitate this process. For more information, see http://www.mitigationactionplan.gov/OMBILdatabase.html.

Finally, wetland regulations that affect wetlands in the watershed should be assembled for review. This includes copies of any federal, state, regional, tribal or local regulations that protect wetlands, as well as information regarding wetland programs, although this may not be contained neatly within a single document. All regulations that apply to the land development process should be compiled as well, including zoning, subdivision, stormwater management, erosion and sediment control, and natural resource protection regulations. While these regulations may not currently address wetlands, it is necessary to review them to determine if they can be modified to prevent or reduce impacts to downstream wetlands.

Principle 2: Assess Local Wetland Protection Capacity

Effective watershed plans should always include an initial assessment of the local government capacity to actually implement the watershed plan. This assessment provides a way to organize basic watershed and community demographics, and key watershed management resources, and to evaluate how local programs and regulations measure up to specific watershed protection benchmarks. By organizing data on local capacity, key areas that need to be improved are easily identified. Two tools developed for this purpose are the Needs and Capabilities Assessment (NCA) and the 8 Tools Audit (Schueler and Kitchell, 2005). Both of these tools include an evaluation of wetland-specific programs and resources, and should be completed for each community in the watershed in order to get a sense of the local capacity to protect wetlands. Each is summarized below.

2.1 Conduct Needs and Capabilities Assessment

The NCA is a broad level questionnaire designed to help local governments understand its strengths and weaknesses, and identify programs and resources to develop and implement effective watershed plans. The NCA identifies regulatory drivers, partners, and community resources that can be used as technical and financial support for watershed planning. While many of the questions in the NCA affect all types of watershed resources, some are specific to wetlands. Examples include:

- How many acres of wetlands were impacted under the section 404 Program in the past five years in your watershed?
- Does your community have a current/accurate wetland inventory? If so, does this inventory include an assessment of wetland function?
- Do you know of any state or regional initiatives or directives that serve as drivers for local wetland protection?
- Does your state play a role in administering wetland permitting?

The NCA assists in identifying some of the key wetland contacts that should be included in watershed planning efforts. Examples include key USACE district staff, wetland consultants, highway department wetland mitigation project managers, local natural resource planners, wetland ecologists from local universities, and NRCS wetland restoration specialists. The result of the NCA is a draft report to be reviewed with key stakeholders, and ultimately used to set watershed goals and objectives. The complete NCA form is provided as Attachment A.

2.2 Conduct 8 Tools Audit

The 8 Tools Audit provides a more detailed level of analysis to evaluate local environmental regulations and programs related to watershed protection. This audit can quickly identify gaps in local regulations, as well as existing regulations and programs that can be applied to watershed protection efforts. The 8 Tools Audit includes a series of questions that are organized by the eight tools of watershed protection, which roughly correspond to the stages of the development cycle from initial land use planning, site design, and construction, through home ownership. Watershed managers generally need to apply some form of all eight tools to provide comprehensive protection in watersheds facing land development. The eight tools are described further in CWP (1998). While many of the questions in the 8 Tools Audit affect all watershed resources, some are specific to wetlands. Examples include:

- Does a local wetland protection ordinance or overlay zone exist in your community?
- Has your community, region or state identified sensitive wetlands in your watershed? If so, have contributing drainage areas to these wetland been delineated?
- Is there a wetland buffer ordinance in your community?

The results of the 8 Tools Audit should be used to make recommendations as part of an overall watershed plan (Principle 8). These recommendations target areas where local governments can improve codes, ordinances, and programs to provide better watershed protection. Specific recommendations for protecting wetlands are described in detail in Article 3. The complete 8 Tools Audit is provided as Attachment B.

Principle 3: Identify Wetland Partners and Roles

Watershed planning is driven by the goals of those that care for the watershed. It is critical to align the efforts and resources of stakeholders towards common goals in order to adopt and implement any watershed plan. Not all stakeholders are created equal. In a literal sense, each has a different stake in the outcome of the plan, has varying degrees of watershed awareness, concern and/or expertise, and is expected to perform a different role in the local watershed planning process. Stakeholders can generally be grouped into the general public, agencies, watershed partners, and potential funders. A subset of these stakeholders has the expertise, interest, or resource capacity to help make wetland-related decisions and implement wetland goals of the watershed plan. This group is referred to as 'wetland partners' and they and their roles in the watershed plan should be defined early on in the process. Three important roles for wetland partners are involvement in the stakeholder process, technical support, and implementation.

3.1 Involve Wetland Partners in Stakeholder Process

Wetland partners should be involved in the stakeholder process for the watershed plan to ensure that wetland interests are fully integrated into the plan. Potential wetland partners to include in this process are: state and federal regulatory staff, wetland scientists, local wetland planners, land trusts, state and federal natural resource agencies, highway departments, utility companies, or other agencies with defined mitigation needs. Stakeholders are generally involved in several stages of plan creation, including: refining local goals and objectives, stakeholder meetings to give input on the draft plan, neighborhood consultation meetings to give input on specific proposed projects, and external review of the plan. Wetland partners can be involved in all these areas and may be particularly helpful in the goal setting process to agree on wetland specific goals and objectives for the watershed plan. Wetland partners can also function as a subcommittee and report out on wetland issues or findings to a wider range of watershed stakeholders at general stakeholder meetings.

3.2 Consult with Wetland Partners for Technical Support

Wetland partners have the unique ability to be technical advisors to the watershed plan. This is an important role because wetland science is very complex and those creating the local watershed plan may not always have the necessary expertise or background to make certain decisions. Communities may wish to consult with wetland partners, such as wetland scientists and consultants and wetland regulatory staff, to develop the following technical elements of the watershed plan:

- Statistics to support consensus on the specific numeric acreage goals for wetland protection, conservation and restoration
- Rates and causes of historic and current wetland loss in the watershed
- Potential direct and indirect impacts to wetlands in the watershed as a result of future land development
- Summaries of recent state and federal permitting activity and analysis of trends and effectiveness of program
- List of local wetland community types in the watershed that are considered sensitive
- Recommended rapid and/or detailed wetland assessment protocols

3.3 Form Partnerships for Implementation

Wetland partners can also help implement wetland protection, conservation, and restoration projects contained in the plan. Partners may provide funding or technical expertise, or can actually perform the implementation themselves. By working with wetland partners early in the planning process, implementation is more likely to happen. Wetland partners who can help with implementation include land trusts, non-profits, highway and utility departments that have defined mitigation needs, federal government programs that fund restoration, consultants, other local or regional governments, and wetland regulatory agencies.

Principle 4: Define Wetland Goals and Objectives for the Watershed

Watershed goals and objectives are defined early on in the watershed planning process to help guide the watershed plan, and are initially developed based on a review of existing data and refined through a stakeholder process. Except in watersheds where there are no wetlands, or the wetlands are severely degraded beyond restoration, specific goals and objectives related to wetlands should be contained as part of a watershed plan. While this is the ideal situation, not all stakeholders may agree that wetlands are important, and some may fear that focusing on wetland protection will limit much-needed economic development and growth in their watersheds. Therefore, the goal-setting process should also include an education component to make the public aware of how wetland protection can actually help to achieve larger watershed goals.

4.1 Define Wetland Goals

Goals are usually broad-level statements of purpose or intent that express what watershed planning should accomplish. Communities should consider developing watershed goals that are specific to wetlands. An example of a wetland-specific goal is to increase the total acreage of wetlands across the watershed. At a minimum, wetland-specific goals should be consistent with the national goal of no net loss of wetland area and function. This policy recognizes that wetland functions are significant to watershed health, and that no net loss of wetland acreage is not enough. Additional examples of wetland goals are provided in Table 6.

4.2 Define Specific Wetland Objectives

Objectives are more precise statements of actions that must occur to achieve a watershed goal. Communities may wish to define wetland-specific objectives in the watershed plan, and should also consider the role of wetlands in meeting overall watershed goals. As an example, if a watershed goal is to reduce flooding, a wetland-related objective to help meet this goal is to acquire key wetland parcels that currently provide high flood control function. Table 6 provides examples of wetland objectives.

Table 6. Wetland Goals and Objectives	
Goals	**Objectives**
Reduce the impacts of land development on wetlands	• Revise stormwater management and erosion and sediment control regulations to protect wetlands from indirect impacts • Adopt local wetland protection regulations to reduce wetland loss from development
Conserve existing wetland habitat	• Work with Natural Heritage division to identify wetland communities that have high habitat value • Working with local land trusts, purchase at least 200 acres of key wetland parcels each year.
Increase overall wetland acreage in the watershed	• Inventory the watershed to identify the best restoration sites • Restore 500 acres of wetlands per year through the Partners for Fish and Wildlife Program • Revise monitoring requirements and performance criteria to improve success of restoration projects

Once goals and objectives are defined, indicators should be identified for each. Indicators are measurable parameters of aquatic health that are directly linked to a goal, and are used to track progress made over time. Examples of wetland indicators include: acres of wetlands in good condition, acres of wetlands providing surface water detention, acres of wetlands restored, acres of wetlands conserved, and acres of potentially unregulated wetlands (e.g., some isolated wetlands).

Principle 5: Create an Inventory of Wetlands in the Watershed

Watershed planning should always include a baseline assessment of wetland resources in the watershed. A baseline assessment provides the information required to make decisions about what to do next—e.g., focus resources on a particular area, select assessments--and should be based on the most current data available. While this sounds simple, many local governments do not have a clear picture of where their wetlands are located, what type they are, or the functions they provide. Existing maps and data may need to be updated to create accurate wetland inventory data to make more informed decisions. Just as important as having accurate information is not re-inventing the wheel. If SAMPS, ADID or other detailed wetlands inventories have already been done for the watershed, the inventory may simply need to be updated.

A wetland inventory in a watershed is completed using GIS, and consists of six steps. Box 4 defines some important terms used in this section: functions, conditions, and values.

5.1 Update existing wetland maps
5.2 Estimate historic wetland coverage
5.3 Delineate wetland contributing drainage areas
5.4 Estimate wetland functions

5.5 Estimate of wetland condition
5.6 Estimate effects of future land use changes on wetlands

Box 4. Defining Wetland Function, Conditions, and Values

Wetland functions are defined as the ecological processes wetlands provide, such as flood attenuation, habitat, shoreline protection, and nutrient removal.

Wetland condition describes how well the wetland is providing functions and values and is generally evaluated along a relative continuum ranging from full ecological integrity to highly impaired. If conditions are degraded by adjacent development, for example, that wetland may only be functioning at half its potential capacity were it not impacted.

Wetland social values are defined as those services that relate specifically to a human use (i.e. recreation, aesthetics, historic potential, education potential, urban quality of life).

5.1 Update Existing Wetland Maps

Existing wetland mapping data for the watershed will most likely need to be updated using GIS as part of the wetlands inventory. While some states, such as Maryland, have a detailed and reasonably accurate statewide wetlands layer, many jurisdictions must rely on the National Wetlands Inventory (NWI), which has a number of limitations. Digital NWI maps are only available for 42% of the lower 48 states, and much of the data is over 20 years old. NWI typically does not include wetlands smaller than one to three acres, ephemeral wetlands, farmed wetlands and certain wetland types that are difficult to photointerpret. Wetland indicator layers should be used to update and verify the NWI or other mapped wetland layer, if necessary. Recent aerial photos and hydric soils are probably the most important layers to obtain for this purpose. Simultaneous viewing of NWI, hydric soils, and recent aerial photos allows the user to identify where wetlands have been filled or drained or where wetlands are missing from the NWI layer (Figure 2). Tiner (1999) and Tiner (1996) describe a method for updating and refining the NWI at the local level using more recent aerials, soils, and aquatic vegetation surveys.

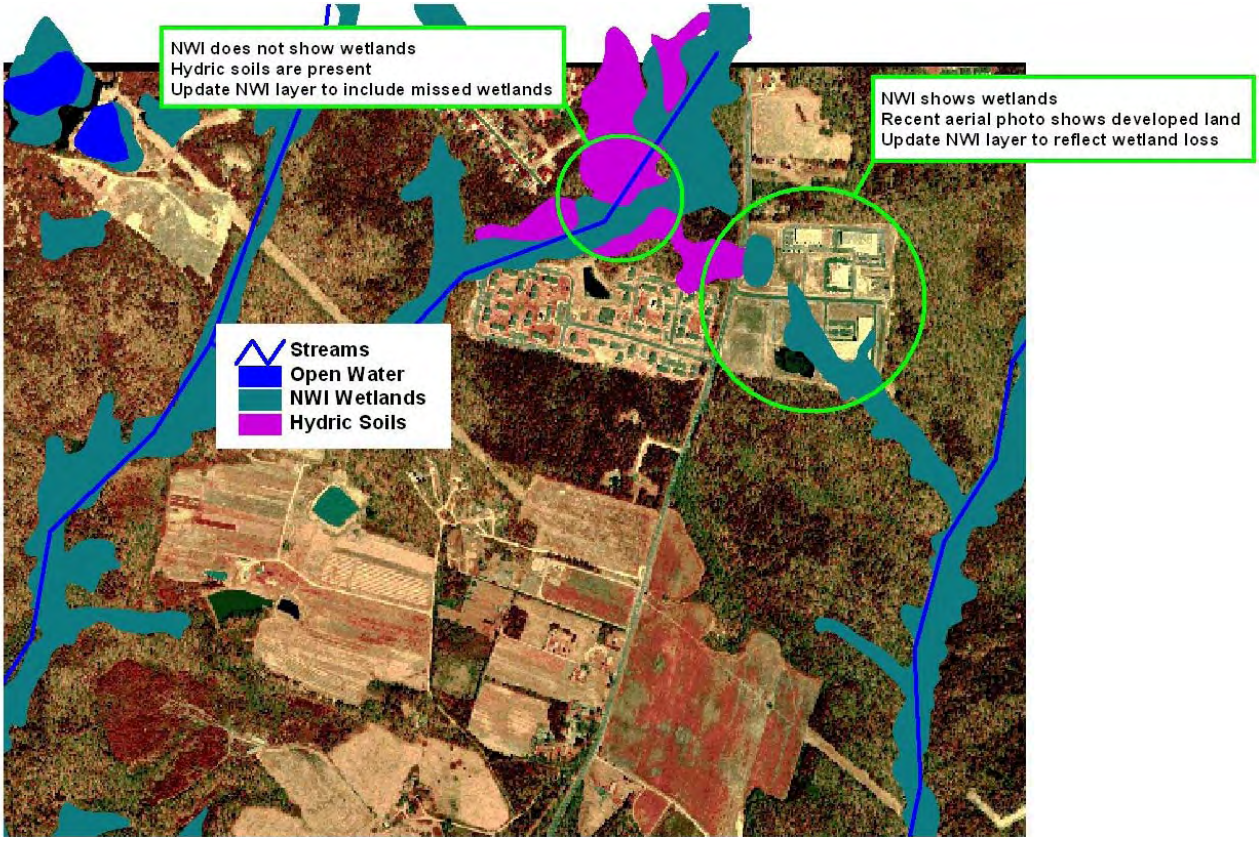

Figure 2. Using Mapped and Indicator Wetland Layers to Inventory Wetlands

5.2 Estimate Historic Wetlands Coverage

Historic wetland data for the watershed should be reviewed to get an idea of where wetlands were once located, the types most commonly lost, and the likely causes of their loss. Historic wetland data is important since it gives insight into the associated watershed functions that may have been lost. Historic wetland information drives goals objectives related to wetland functions. Potential sources of historic wetland information include: old USGS maps, Government Land Office survey maps and notes, old soil surveys, other historic maps, approved 404 permit reports, and interviews with botanists who are familiar with local historical plant communities. Ideally, this research would result in a map showing the location, types, and area of historic wetlands in the watershed (Figure 3).

If historical wetland data is not available, it may be possible to estimate coverage based on mapping data and certain assumptions. The West Eugene Wetlands Special Area Study (Lane Council of Governments, 1991) estimated historic wetland coverage by assuming that all land below 400 feet in elevation with hydric soil was formerly a wetland. Tiner (2005) describes a process for identifying historic wetlands in the Nanticoke River Watershed in MD/DE using NWI, soils, and aerial photos.

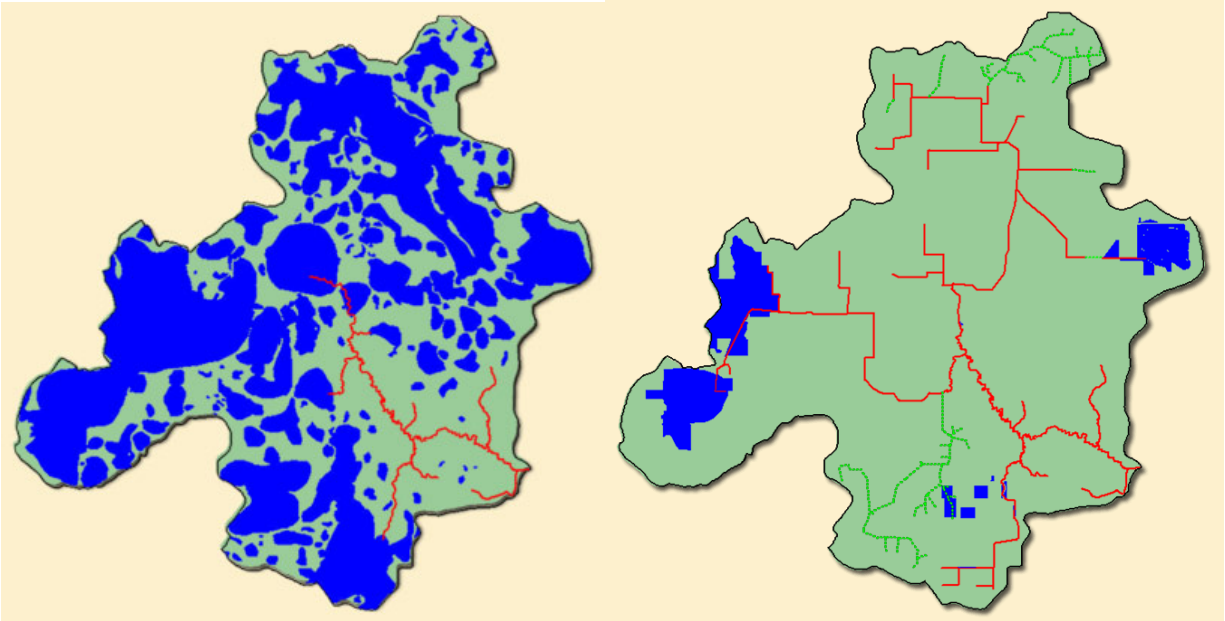

Figure 3. Historic (1854) and present-day (2003) wetland coverage in the Seven Mile Creek Watershed in Minnesota (Source: Cottonwood Water Quality Board)

Wetland nostalgia aside, the practical aspect of knowing where wetlands were once located is that it helps identify sites that may be suitable for wetland restoration. For example, as part of the Nanticoke study, Tiner (2005) identified two major types of wetland sites that appear suitable for restoration: former vegetated wetlands, and existing vegetated wetlands whose functions appear to be significantly impaired by ditching, excavation, and impoundment. He outlined a desktop process for prioritizing these locations by examining aerial photos, hydric soils, and existing wetland data. Criteria for identifying potential restoration sites are discussed later in this article.

5.3 Delineate Wetland Contributing Drainage Areas

Wetlands are sustained by a variety of water sources, including surface runoff, precipitation, seasonal or periodic flooding, and groundwater. A wetland's water budget is the sum of water contributions from all these sources minus any water losses or discharges. Specific landscape features that transmit water to wetlands are known as **contributing drainage areas (CDAs)**. While wetlands may be protected from direct impacts, such as dredging, filling, and draining, through federal and state permitting programs, their CDAs are seldom protected.

The boundaries of a wetland CDA have both surface runoff and groundwater components. The CDA from surface runoff is relatively simple to estimate, whereas the boundaries of groundwater recharge areas are more difficult to define (i.e., this requires a more complex analysis of hydrogeologic conditions). Since most wetlands receive surface runoff to some extent, delineating the surface drainage area may be sufficient to delineate the CDA. Communities may wish to delineate CDAs for their wetlands as part of the wetlands inventory.

Wetland contributing drainage areas (CDAs) are delineated using topographic maps. Results are limited by the resolution of the map, so, for wetlands smaller than 10 acres, or very flat landscapes, U.S. Geological Survey (USGS) topographic quadrangles are not sufficient (EPA,

2002). Finer-scale topographic data is recommended for more accurate results, and may be available from local agencies, such as the public works department. Because alterations to natural surface drainage may not be reflected on topographic maps, storm drainage maps, and maps of agricultural ditch drainage systems should be obtained, where possible, to develop a more accurate delineation. The wetland CDA boundary should be modified to include the area drained by storm sewers or drainage networks that discharge into the wetland or its tributaries.

Since the location of a wetland in the landscape plays a major role in wetland hydrology, pollutant retention, and the effects of increased stormwater inputs (EPA, 1996), the delineation method described above works best for wetlands in certain topographic positions. Article 3 provides specific instructions for delineating wetland CDA boundaries, with some modifications for wetlands in various landscape positions.

5.4 Estimate Wetland Functions

Managing wetlands at the watershed scale requires an understanding of the functions that wetlands provide to the watershed. Estimating wetland functions allows local governments to quantify what watershed functions are currently being provided, identify wetland functional goals, make recommendations for meeting these goals, and determine if goals are being met. This information is also necessary for mitigation plans, which are required to describe how the mitigation sites chosen contribute to overall watershed function (USACE, 2002). Not all wetlands provide the same types of functions, due to differences in type, size, location and other factors. Article 1 provides additional detail on the different watershed functions that wetland provide.

Field assessments are necessary to accurately evaluate wetland functions (see Principle 7 and Attachment C). However, desktop methods have been developed to make a preliminary assessment of wetland function remotely. Remote assessments are particularly important when evaluating functions at the watershed scale, since it is necessary to have some way to screen or narrow down the wetlands to target for further assessment to a more reasonable number due to resource limitations.

Tiner (2005) describes a process of deriving preliminary estimates of wetland function by merging NWI data with USGS topographic maps and aerial photos to derive hydrogeomorphic descriptors. These descriptors are based on the hydrogeomorphic (HGM) wetland classification system outlined by Brinson (1993a), which outlines major wetland types based on their position in the landscape. Table 7 provides a summary of six HGM wetland types and provides a general overview of the functions provided. Tiner (2003a) established an operational dichotomous key for assigning descriptors, which can then be used to predict wetland function. A summary table of this method is also provided in Table 1 (page 409) of Tiner (2005).

A report correlating wetland properties in the enhanced NWI database with the following ten wetland functions has been published: surface water detention, streamflow maintenance, nutrient transformation, sediment and other particulate retention, coastal storm surge detention, shoreline stabilization, provision of fish and shellfish habitat, provision of waterfowl and waterbird habitat, provision of other wildlife habitat, and conservation of biodiversity. For more information on correlating NWI data with wetland functions, see Tiner (2003b).

Table 7. Watershed Functions Provided by HGM Wetland Types		
HGM Wetland Type	**Description**	**Common Functions and Values**
Depressional	Topographic depression with closed contours that may have inlets or outlets, or lack them	• Flood storage • Habitat • Pollution treatment • Erosion control
Slope	Surface discharge of groundwater on sloping land that does not accumulate	• Habitat • Pollution prevention • Erosion control
Flat	Low topographic gradients, such as old glacial lake beds, with moderate to abundant rainfall	• Habitat • Pollution prevention • Flood storage • Limited recreational
Riverine	Occur in the floodplain and riparian corridor of larger streams and rivers (e.g., 2nd order and higher)	• Flood conveyance and storage • Shoreline protection and erosion control • Pollution treatment • Fish and waterfowl habitat • Recreation
Headwater Stream Channel	Occur in the channel and floodplain of headwater streams (e.g., 1st order)	• Flood conveyance and storage • Shoreline protection and erosion control • Pollution treatment • Recreation
Fringe	Adjacent to lakes or estuaries	• Habitat • Pollution treatment • Water supply protection (lake fringe only) • Shoreline protection and erosion control • Recreation
Adapted from Kusler (2003), Brinson (1993a), Brinson (1993b), Gwin et al. (1999), and Spivie and Ainslie (no date)		

Several good case studies exist for local application of preliminary assessment of wetland function. For example, Baldwin County, Alabama applied a model called the Remote Functional Wetland Assessment Model to evaluate wetland function. The model first classifies each wetland by HGM type, and then assigns each wetland points based on how it well it provides specific watershed functions based on a series of questions and spatial data (Stallman et al., 2005). Another example is an ADID study in Kane County, Illinois that evaluated wetlands in terms of their ability to provide habitat, water quality and stormwater storage (NIPC, 2004). Figure 4 illustrates a map that ranks wetlands in the Nanticoke Watershed, Maryland in terms of their ability to provide surface water detention. Additional methods for evaluating wetland function remotely are summarized in Table C-2.

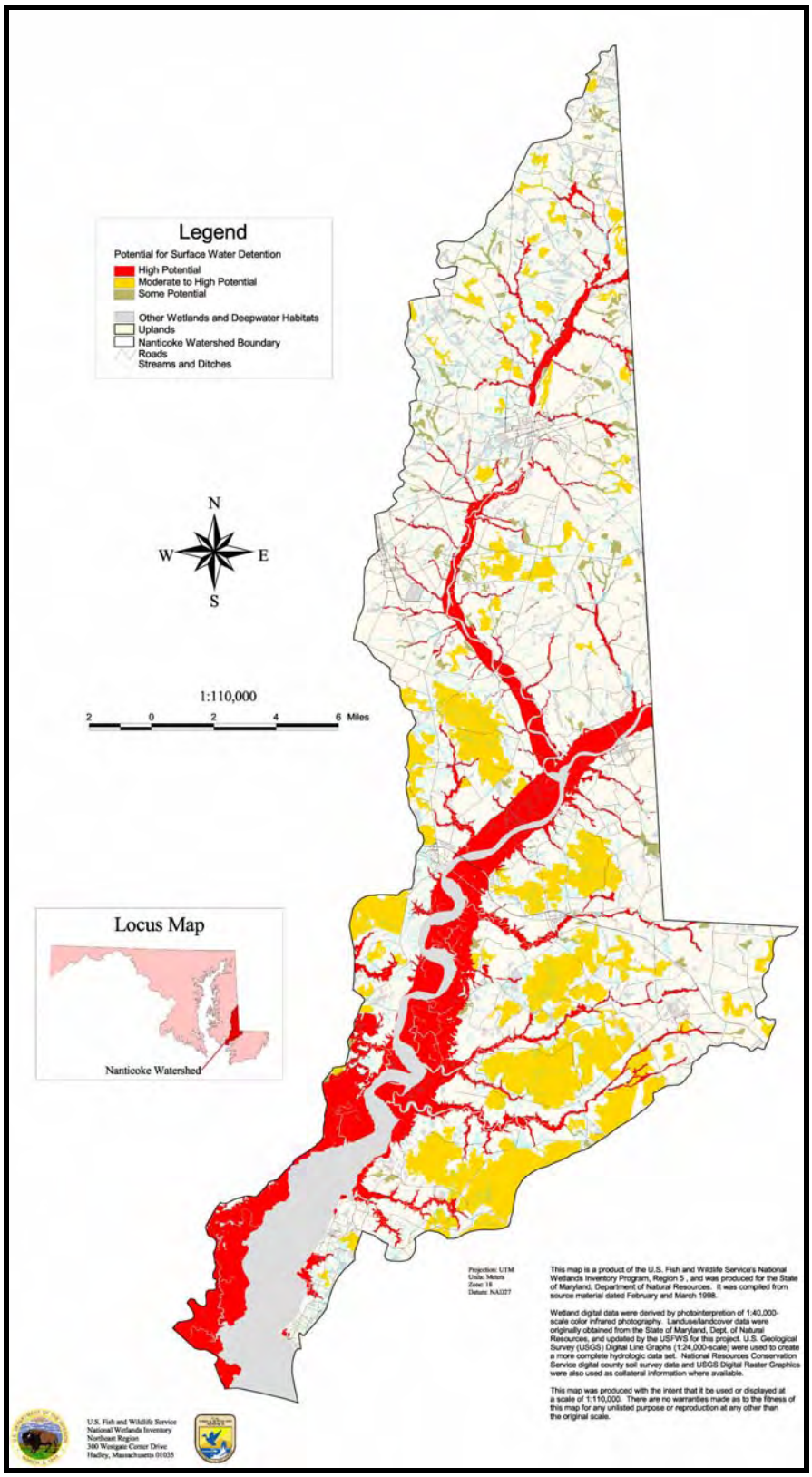

Figure 4. Potential wetlands of significance for surface water detention in the Nanticoke Watershed, Maryland (Source: Tiner et al., 2000)

While desktop estimates of wetland function have limitations, they do provide a cost-effective way to rapidly evaluate function and screen a large number of wetland sites to a manageable level. The process of estimating wetland functions in a watershed can also be applied to the historic wetland data to determine what functions have been lost over time. The results may help to determine what functions are desirable to restore in a particular watershed. Similarly, wetland functions that may potentially be lost due to future land use changes can be identified. Identifying the specific functions that individual wetlands are providing can offer more regulatory 'teeth' to protect wetlands from direct impacts. For example, if certain wetlands are designated as being critical to water quality, then states can deny the Section 401 water quality certification for specific permits that impact these wetlands. The preliminary estimate of wetland functions should be added to the wetland inventory.

5.5 Estimate Wetland Condition

Assessments of wetland function generally only measure the wetland's *capacity* to provide that function, while wetland *condition* describes how well the wetland is actually providing those functions. For example, if conditions are degraded by adjacent development, a wetland may only be functioning at half its potential capacity. Wetland condition is generally evaluated along a relative continuum ranging from full ecological integrity to highly impaired (Fennessey et al, 2004). To get a clearer picture of what functions are being provided by wetlands, an assessment of condition is necessary; however, field assessments condition are very resource-intensive to conduct on a watershed basis. Desktop methods have been developed at the landscape scale as an efficient way to make preliminary estimates of wetland condition.

Landscape-scale estimates of wetland condition focus on identifying indicators of disturbance in and around wetlands. The assumption is that wetlands that have a greater number of disturbance indicators will have a more degraded condition. Since this analysis is GIS-based, the results are limited by the accuracy and availability of disturbance indicators. Delineation of wetland CDAs may be needed in order to determine certain disturbance indicators (e.g., percent impervious cover in wetland CDA). Results should be verified and updated based on data from rapid field assessments of condition described later in this article. The combination of these two techniques ultimately provides a link between wetland condition and land disturbance.

A variety of indicators can be used to estimate wetland condition. Table 8 presents four commonly used indicators of wetland condition, and describes how they are derived and used. These indicators may not apply to all wetland types. Other factors that may be used to derive disturbance indicators include: fragmentation, % standing or open water, proximity to other wetlands, proximity to roads, road density, size and shape of wetland, population density, water quality impairments, Breeding Bird surveys, connectivity, wetland type, and more (NEIWPCC and RIDEM, 2005). Article 1 provides a detailed review of impacts to wetlands that links various indicators with wetland impacts.

Table 8. Deriving Wetland Conditions from Mapping Data		
Indicator	**Derivation**	**Links to Condition**
Hydrologic Alterations	Check NWI codes for special modifiers indicating wetland is partially drained/ditched (d), diked/impounded (h) or excavated (x). Analyze storm drainage maps, hydrologic maps, road networks, and NRCS maps, aerial photos	Evidence of ditching, stream channelization above wetland, dams, ditches, tile drains, culverts, outfalls to wetland, filling, grading, dredging, and road crossings in/around wetland likely degrades wetland condition.
Number of Vegetation Classes*	Determine the number of community types within the wetland using plant community surveys or mapping	Greater number of vegetative classes typically means better condition
Buffer Condition	Determine width and integrity of vegetative buffer using aerial photography or vegetative cover maps	Buffer width and continuity is often used as an indicator of wetland conditions (Brooks et al., 2002).
Surrounding Land Use and Land Cover	Analyze land use and land cover data for the contributing drainage area to the wetland, or within a 300-500 foot radius around the wetland. Calculate metrics such as percent impervious cover (IC), percent pervious cover, and percent of each land use in the area of interest. Pollutant loadings from various land uses can also be estimated (USEPA, 2002a)	Wetland condition likely degrades with increasing IC and when urban land uses are dominant (Taylor, 1993; Taylor et al., 1995). Conversely, if pervious cover (especially forest cover) is high, condition is usually good.
Adapted from Fennessey et al., 2004 *It is important to note that a lower number of vegetative classes does not always indicate poor condition. Certain wetland types (e.g., tidally influenced wetlands, prairie potholes) may naturally have simple plant communities.		

The resulting estimates of wetland condition should be added to wetland maps, and later used in screening wetlands for further assessment. Table D-2 in Attachment D summarizes various desktop methods for evaluating wetland condition.

5.5 Estimate Effects of Future Land Use Changes on Wetlands

Communities may want to evaluate potential wetland impacts in watersheds expected to experience growth and land use changes in the future. Analyzing patterns of future land use can identify potential wetland loss, serve as a reality check of specific numeric wetland goals, and help to identify specific management methods needed to achieve these goals. Predicting the exact location and nature of future land uses in the watershed can be an arduous and time-consuming process; therefore, an evaluation of development pressure may be a more reasonable alternative to use for estimating the relative effect of future land use changes on wetlands.

Development pressure is a measure of the potential for future growth in a watershed that can provide a clue to both the timing and location of future land development. The idea is to identify portions of the watershed where most of future growth will be concentrated based on local zoning and land use regulations. Next, currently developed land and permanently protected lands are subtracted from this growth area. Finally, the relative development pressure (e.g., high, medium, low) for these future growth areas is estimated based on local development restrictions, growth patterns and projections, and development capacity based on planned services. The types of data used to evaluate development pressure include:

- Urban growth boundaries
- Priority funding areas
- Zoning categories and allowable densities
- Future impervious cover estimates
- Roads and existing infrastructure
- Proposed sewer/water service areas
- Existing sewer and water service capacity
- Parcel boundaries and associated real estate data
- "Unbuildable" land (based on local regulations--may include steep slopes, floodplains, wetlands, buffers, or areas subject to natural hazards)
- Permanently protected lands (e.g., conservation zones, easements)
- Developed land
- Population growth projections

Much of this analysis can be done using GIS with the input of other data such as population projections, comprehensive plans, interviews with local planners, and local land values. Development pressure can be evaluated as High, Medium or Low for individual subwatersheds, or even for individual parcels of land within the CDA (depending on the level of detail and resources available). The exact criteria for determining what constitutes High, Medium, or Low development pressure will vary in each community. The wetland inventory should be updated with development pressure estimates.

The purpose of this analysis is to answer two questions: 1) what is the likelihood of this area being developed in the near future, and 2) if developed, what are the associated land use impacts to the wetland? The resulting information can be used to prioritize wetlands for conservation, estimate potential loss of wetland functions under different development scenarios, estimate future wetland conditions, target restoration and/or mitigation banks, and adopt more stringent development regulations for vulnerable wetland CDAs.

Principle 6: Screen Wetlands for Further Assessment

The wetland inventory is useful to identify wetland locations and types and understanding basic wetland functions. However, decisions about which individual wetlands should be conserved, protected, or restored must be based on real field data and an analysis of other watershed data. Given the complexity of most wetland assessment methods and expertise and time needed to conduct them, it may not be realistic to assess all wetlands in the watershed. Therefore, wetlands must be screened to narrow down sites for further assessment and make some initial decisions about potential sites for conservation, protection, and restoration.

Screening wetlands for further assessment means narrowing the focus of field assessments to certain watershed locations and/or wetland types. Screening methods for wetlands are described below and include:

6.1 Screen for priority subwatersheds using wetland metrics
6.2 Screen wetland inventory for conservation sites
6.3 Screen wetland inventory for sensitive wetlands
6.4 Screen wetland inventory for restoration sites

6.1 Screen for Priority Subwatersheds Using Wetland Metrics

Most watershed plans limit the focus of detailed field assessments and specific project recommendations to one or more priority subwatersheds, because limited funding and resources make it infeasible to physically evaluate all potential resources in the watershed at one time. Priority subwatersheds are selected based on an analysis of many watershed factors, including information from the wetland inventory. Identification of priority subwatersheds is the first level of screening that is done to reduce the number of wetlands to evaluate in the field.

Priority subwatersheds are identified in the watershed planning process through a technique called the Comparative Subwatershed Analysis (CSA). The CSA is a method to compare and rank subwatersheds based on various metrics. Metrics are usually numeric values that are used to characterize subwatersheds based on a single characteristic. A combination of important metrics is selected for the CSA, and points are assigned to each metric. Metrics are calculated for each subwatershed and points added to result in a rank. The metrics and scoring system used in the CSA is user-defined and will be unique to each watershed based on watershed goals. Typically, degraded subwatersheds that have the highest restoration potential and/or relatively pristine subwatersheds that are highly vulnerable to future development are identified as priorities. For more info in the CSA, see Schueler and Kitchell (2005).

Data from the wetland inventory and other wetland data can be converted into metrics for use in selecting priority subwatersheds through the CSA. This will ensure that wetlands are considered when identifying priority subwatersheds. Examples of wetland metrics are given in Box 5.

Box 5. Wetland Metrics for Use in Screening Priority Subwatersheds

- Sum of wetlands (% of subwatershed)
- Wetlands providing surface water detention (% of wetlands)
- Wetlands providing nutrient transformation (% of wetlands)
- Wetlands providing streamflow maintenance (% of wetlands)
- Wetlands providing sediment retention (% of wetlands)
- Wetlands providing shoreline stabilization (% of wetlands)
- Wetlands providing habitat for fish and shellfish (% of wetlands)
- Wetlands providing habitat for waterfowl and waterbirds (% of wetlands)
- Wetlands providing habitat for other wildlife (% of wetlands)
- Wetlands providing biodiversity value (% of wetlands)
- Permitted wetland impacts under CWA Section 404 (% of wetlands impacted annually)
- Wetlands not protected by easement or other conservation measure (% of wetlands)
- Potentially unregulated (e.g., isolated) wetlands (% of wetlands)
- Rare wetland types (% of wetlands)
- Wetlands in good or excellent condition (% of subwatershed)
- Wetlands on parcels with high or moderate development pressure (% of subwatershed)

The metrics presented in Box 5 can easily be modified to meet the needs of the community or watershed. For example, if conservation of a particular species is an important watershed goal, then the percent of wetlands that provide habitat for that wildlife species may be included as a metric. This would require local knowledge of the specific habitat requirements of that species, and the ability to identify wetlands that meet those criteria based on available data.

6.2 Screen Wetland Inventory for Conservation Sites

Wetlands that are likely candidates for conservation should be initially identified as part of the screening process based on the wetland inventory. These are generally high quality wetlands that have high functional value and are in good condition, or wetlands that provide some special social or economic value. Wetlands that meet several of the criteria outlined in Table 9 are generally good candidates for conservation. Specific criteria for selecting conservation sites should be defined by the community.

Table 9. Criteria for Selecting Wetland Conservation Sites

Criteria	Priorities for Conservation
Condition	Good or excellent, as determined by preliminary estimate of wetland condition
Functional capacity	High for functions of interest (e.g., flood control), as determined from preliminary estimate of wetland function
Regulatory status	May not be protected under current regulations (e.g. isolated wetlands), designated as high quality or outstanding natural resource water
Development pressure	High, as determined from analysis of development pressure
Location in watershed	Located in headwaters or priority subwatershed
Size	Large, contiguous area
Ownership	Willing landowner
Type	Locally rare or difficult-to-replace wetland types
Connectivity	Adjacent to existing wetland, forest, or parkland
Special designation	Identified for conservation by state natural heritage agencies, SAMP, ADID, or wetland conservation plan, officially designated reference sites

The result is a map of potential conservation sites to visit in the field to verify that wetlands exist, wetland classifications are correct, and evaluate function and/or condition (Figure 5). This desktop analysis should be updated based on results of field assessments of wetland function and condition. Ultimately, wetland sites are ranked to identify conservation priorities for recommendation in the watershed plan.

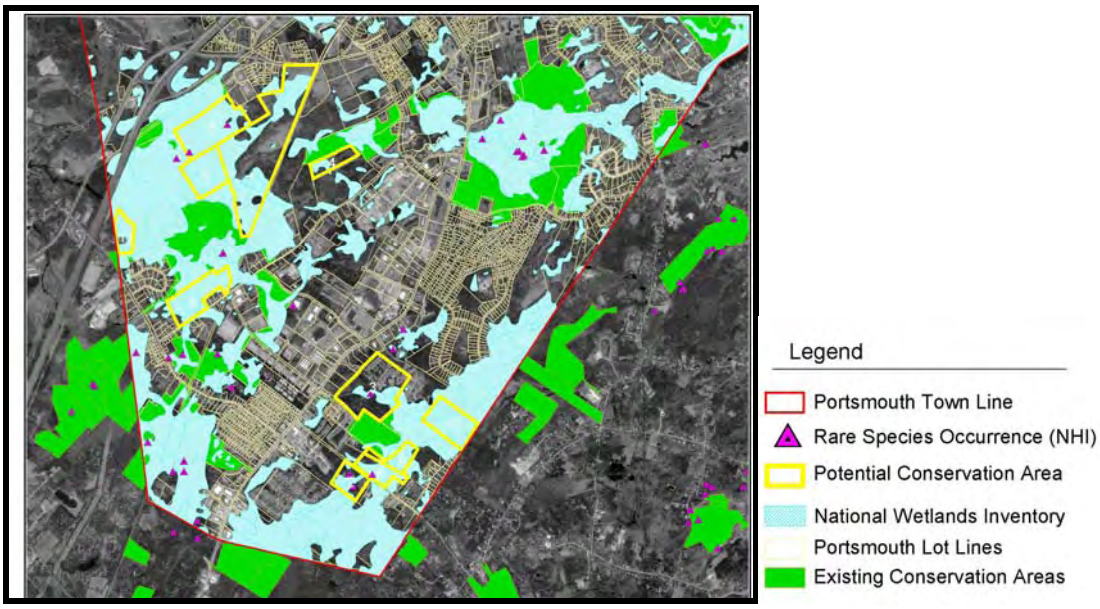

Figure 5. Map of potential wetland conservation sites in Portsmouth, New Hampshire (Source: Gove Environmental Services, Inc)

6.3 Screen Wetland Inventory for Sensitive Wetlands

Some wetlands are sensitive to any disturbance, and will become degraded with even low-level inputs of urban stormwater. This degradation is typically expressed as reduced diversity and abundance of plant or animal species (see Article 1 for a review of research studies). The primary indicators of sensitivity are the type and condition of the wetland community (MNSWAG, 1997). Local governments should clearly designate what types of sensitive wetlands will be addressed as part of the local watershed planning process and screen the wetland inventory to identify sites that meet the criteria.

Identify Sensitive Wetland Communities

Some states, such as Minnesota and New Hampshire, have designated wetland community types they consider sensitive to land disturbance (MNSWAG, 1997; Mitchell, 1996). Classifying wetlands as sensitive or non-sensitive to stormwater runoff inputs provides a useful framework for managing stormwater inputs to different types of wetlands. Since wetland sensitivity varies regionally, communities should always consult with local wetland experts to develop their own locally adapted list of sensitive and non-sensitive wetlands. Table 10 presents some general examples of sensitive and non-sensitive wetland communities.

Table 10. Examples of Sensitive and Non-Sensitive Wetland Types	
Normally Sensitive	**Not Very Sensitive**
• Sedge meadows • Open bogs • Coniferous bogs • Pocosins • Calcareous fens • Coniferous swamps (e.g., Atlantic White Cedar) • Lowland hardwood swamps • Low prairies • Prairie potholes • Seasonally flooded basins • Basin marshes and sandy pondshore marshes • Vernal pools • Emergent wetlands with thin-stemmed species • Wetlands containing rare, threatened or endangered (RTE) species • Wetlands whose water budget is dominated by groundwater or precipitation	• Cattail marshes • Phragmites marshes • Reed canary grass meadows • Deep marshes dominated by purple loosestrife • Floodplain forests • Riverine wetlands • Fringe wetlands along lakes • Fringe wetlands along estuaries • Treatment wetlands • Highly degraded wetlands • Gravel pits • Cultivated hydric soils • Dredge or fill material disposal sites
Sources: Brinson (1993b), MNSWAG (1997), Chase, et al (1997); Phillips (1996); Kusler (2003); Azous and Horner (1997), Ehrenfeld and Schneider (1991). Note: this table provides general examples only. Communities need to consult with local, state, and tribal wetland experts to determine the sensitivity of wetland types present	

Wetland condition also affects how sensitive a wetland is to stormwater impacts. Wetlands that are in good condition (e.g., not degraded) typically have more diverse plant communities and therefore are more likely to contain species that are somewhat conservative in habitat. These conservative species have a lower tolerance for disturbance, and usually drop out of a community as disturbance increases. Thus, stormwater impacts can reduce diversity at a site and alter the condition of good quality areas. Since degraded areas, by definition, have reduced species diversity and tend to be dominated by disturbance-adapted species, stormwater impacts are unlikely to further degrade the plant community.

Screen Wetland Inventory

Once communities have developed a local list of sensitive wetland communities, they can screen the wetland inventory to find overlap with wetlands in good or excellent condition. Screening results in a wetland map layer that meets some combination of the criteria defined by the community for wetland sensitivity. Other specially designated wetlands such as locally rare types, or difficult-to-replace wetlands may also be designated as sensitive for management purposes. A map of sensitive wetlands is shown in Figure x. Ultimately, this information will be updated based on field results and the final suite of sensitive wetlands will be protected by ordinance.

Communities generally protect sensitive wetlands by using an overlay zone that protects all wetlands and delineates sensitive wetland CDAs. Stricter development criteria are implemented within the sensitive wetland CDAs to reduce stormwater impacts by minimizing impervious cover, conserving natural areas, reducing pollution, and infiltrating runoff. Examples of performance criteria that might be triggered by development within a sensitive wetland CDA

include: special stormwater management criteria to protect sensitive wetlands, more frequent erosion and sediment control inspections, and use of open space design. Sensitive wetlands may also be potential conservation sites. Article 3 describes methods for delineating wetland CDAs and protecting them using zoning and other techniques.

6.4 Screen Wetland Inventory for Restoration Sites

Potential wetland restoration sites include former wetlands or existing degraded wetlands. Each proposed site should be initially screened based on an analysis of mapping data. The historical analysis of wetland data is particularly useful since it shows former wetlands that have been drained or filled. Potential criteria for selecting sites for wetland restoration are presented in Table 11. Because not all potential sites can actually be restored due to cost and other feasibility factors, screening criteria can be used later on to rank sites by assigning points to each criteria. Communities should define their own criteria for identifying restoration sites that align with any mitigation requirements set by wetland regulatory agencies.

Table 11. Criteria for Identifying Wetland Restoration Sites

Criteria	Priorities for Restoration
Soils	Hydric soils present, as determined from NRCS soils data
Connectivity	Adjacent to existing wetland
Development pressure	Low to moderate, as determined from analysis of development pressure
Location in watershed	Located in headwaters, stream valley, floodplain, or priority subwatershed
Ownership	Willing landowner
Feasibility	Land use is compatible with restoration, cause of impacts are known and controllable, hydrology is suitable for restoration, wetland type if relatively simple-to-restore (e.g., ditched or tile-drained wetlands, tidal wetlands)
Functional capacity	High for functions of interest (e.g., flood control), as determined from preliminary estimate of wetland function

Tiner (2005) describes a method for identifying potential restoration sites based on NWI data. Potential restoration sites include former wetlands with: effectively drained hydric soil map units, filled areas with no development, impounded areas, excavated areas, and farmed wetlands. Restoration sites may also be degraded/altered wetlands that are: partly drained, impounded, excavated, farmed or tidally restricted. This analysis can also be conducted as part of a service provided by the NWI Program. This service generates an historical assessment of pre-settlement wetland types, acreage, functions and general trends; a watershed characterization of current wetland status and functions; and an identification of potential wetland restoration sites.

Costs for these services vary with the type and density of wetlands in a geographic area, the amount of historic loss, the currentness of the NWI data, and the availability of digital data sources (e.g., land use/cover and soils). For example, for a moderately developed area along the Atlantic Coastal Plain (an area of extensive wetlands and considerable losses), the cost for these services is estimated at $100-$150/square mile where land use/land cover and soils data are available, and $50-$75/square mile if NWI layers have been updated.

The result is a map of potential restoration sites to evaluate further in the field (Figure 6). Field assessment is necessary to confirm assumptions based on mapping data and further evaluate restoration feasibility. Maps should be updated based on results of field assessments.

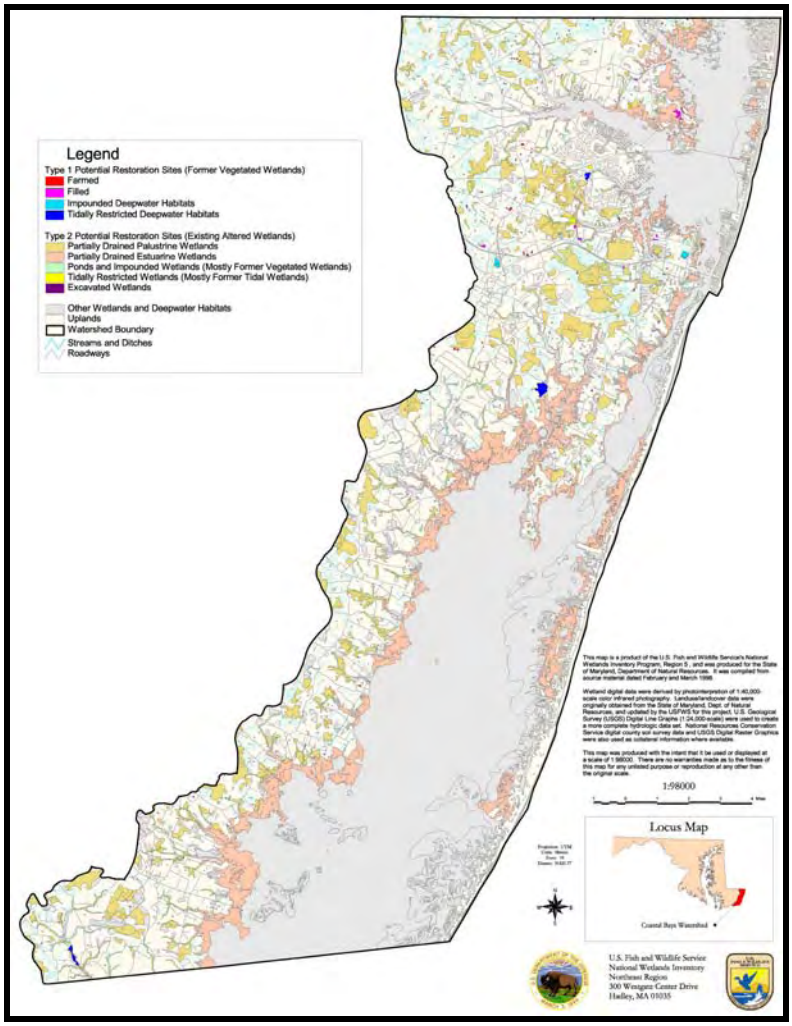

Figure 6. Potential wetland restoration sites in the Coastal Bays Watershed, Maryland (Source: Tiner et al., 2000)

Principle 7: Evaluate Wetlands in the Field

Good watershed plans always include some level of field evaluation to get a sense of on-the-ground conditions and identify potential opportunities for improvement. Screening wetlands for further assessment described in Principle 6 can reduce field effort, but never replaces getting out in the field to assess actual conditions. Field assessments are used to verify desktop assumptions, evaluate actual conditions, and update desktop analyses with real data in order to make better management decisions. Wetland assessments can range from a rapid survey of observable impacts to more detailed assessments of functional capacity, reference conditions, or restoration potential. The rapid approach may prove more ideal for short-term watershed and wetland

planning, followed by more detailed assessments where appropriate. Both options are described below.

7.1 Conduct Rapid Assessment of Wetland Impacts

While dozens of wetland assessment methods exist, many are quite complex and communities may not always have the staff expertise to incorporate the information they provide to improve local wetland or watershed management efforts. Communities may want to rapidly assess individual wetlands in the field to identify sources of impairment and make preliminary wetland management designations. To this end, the Wetland Impact (WI) form has been created. The WI form specifically is intended to help watershed managers:

- Verify information in existing wetland inventories, including identifying any unmapped or unlisted wetlands
- Document observable evidence of wetland impacts or stressors
- Provide enough data to support more detailed investigations of the potential for eliminating or reducing sources of impacts to wetlands
- Develop, verify and update preliminary lists of wetland restoration sites, conservation sites and sensitive wetlands

The WI is intended as a supplement to the Unified Stream Assessment (USA). The USA is a streamwalk method designed to identify individual impairments and restoration opportunities within the urban stream corridor, such as stream bank erosion, buffer impairment, outfalls, sewer leaks, and other impairments (Kitchell and Schueler, 2004). The WI is conducted in the wetland interior, the perimeter of the buffer, and the contributing drainage area, if it is known. Field crews look for indicators of wetland impacts in each zone based on presence of physical indicators. The indicators have been borrowed from a variety of wetland assessment methods, most notably the Pennsylvania Stressor Checklist (Brooks et al., 2002). The WI is most useful for assessing depressional, flat, and slope wetlands, and is suggested for use in wetlands less than 25 acres (wetlands greater than 25 acres can be assessed with this method provided they are broken down into smaller assessment units).

The WI should be conducted as part of an overall watershed assessment strategy and is designed for municipal staff, natural resource planners, wetland consultants, and trained watershed groups. A field crew of three is ideal to perform the WI, although it may be conducted with two staff. Crew members should possess a good local working knowledge of wetland types, wetland plant communities, and urban hydrology.

Survey sites are initially identified from NWI maps, or preferably, a more detailed GIS-based wetland inventory. The amount of time needed to survey each wetland site will vary based on the experience of field crew, wetland size and complexity, environmental conditions, accessibility, and complexity of impacts and upland conditions. The goal of the WI survey is to limit the assessment time needed at each wetland to approximately 30 to 60 minutes. As always, communities are encouraged to customize the WI to meet local needs.
The WI requires several advance preparation tasks before a crew can go out into the field, as follows:

1. Identify which wetlands to evaluate (based on screening in Principle 6)
2. Prepare base field maps
3. Choose local wetland quality indicators
4. Train and equip field crews
5. Complete header information on the WI form

Attachment D provides instructions on completing each of these advance preparation steps. The field protocol for the WI involves the following six steps:

1. Identify the approximate wetland boundaries
2. Walk several transects across the wetland to evaluate conditions
3. Walk the wetland perimeter at a distance of 25 feet and 75 feet away from the assumed boundary to evaluate buffer conditions
4. Evaluate all direct hydrologic connections to the wetland and follow them upstream to investigate conditions
5. Evaluate the wetland outlet (if one exists) to look for flow constrictions
6. Look for indicators of wetland stress throughout steps 1-5, as well as opportunities to minimize impacts

Table 12 presents the types of indicators that are evaluated in the WI and Figure 7 illustrates the WI protocol. The WI field form and instructions for completion are provided in Attachment D.

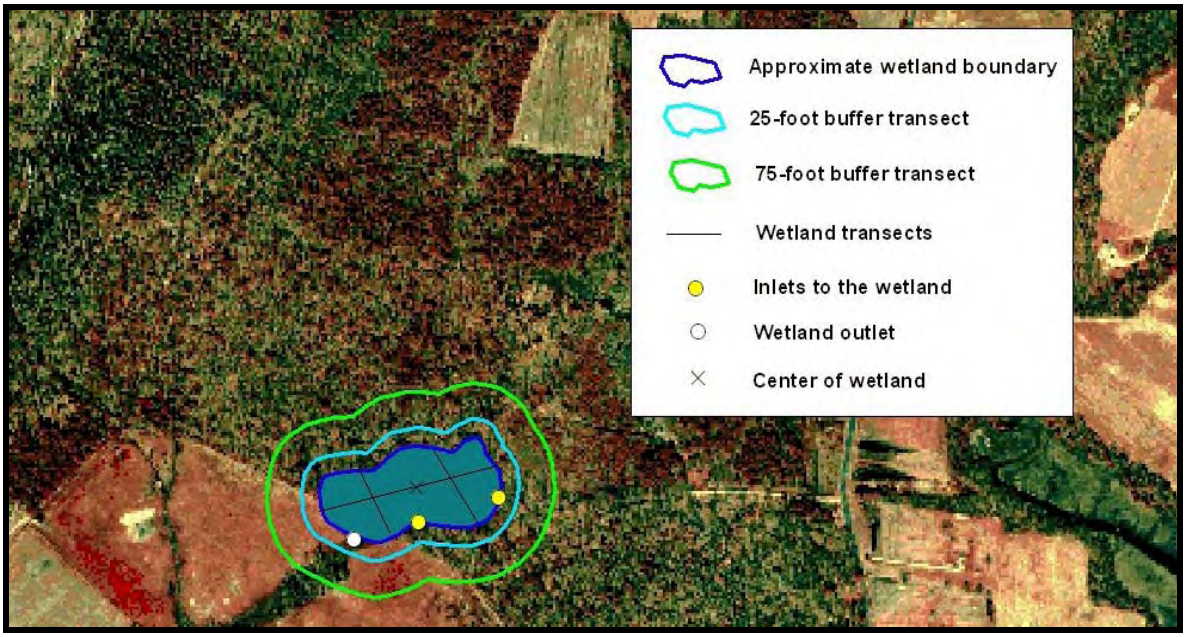

Figure 7. Parts of a wetland evaluated using the Wetland Impact (WI) protocol

Table 12. Field Indicators of Wetland Stress Used in the Wetland Impact Assessment		
Category	**Indicators**	**Where the Indicators are Evaluated**
Evidence of altered hydrology	• High proportion of open water • Presence of dead or dying trees • Evidence of fill or dumping • Presence of utility crossings that modify hydrology • Presence of tile drains, ditches or other method of draining	Within the wetland
	• Stormwater runoff/outfalls to wetland	At all wetland inlets
	• Downstream constrictions such as weirs, culverts, dams	At all wetland outlets
Evidence of water quality problems	• Excessive algal growth • Cloudy/turbid water • Dead fish or amphibians • Trash • Oil sheen	Within the wetland
	• Non-clear dry weather flow from outfalls	At all wetland inlets
Evidence of sedimentation	• Sediment plumes/deposits near inlets • Silt stains on plants • Cloudy/turbid water • Sediment deposits over wetland soils • Dominant presence of sediment tolerant species	Within the wetland
	• Buffer encroachment	Wetland buffer
	• Exposed land • Channel/bank erosion	Wetland CDA
Altered vegetation	• Direct physical alterations • Few plant species present • Extensive coverage by invasive species • Diseased or dying trees • Lack of canopy or understory (in forested wetlands)	Within the wetland
	• Buffer encroachment • Few plant species present • Extensive coverage by invasive species • Lack of canopy or understory (in forested buffers)	Wetland buffer
Plant and wildlife sightings	• Presence of species that are indicators of potential problems (e.g., beaver, geese, nutria, mosquitoes, deer) • Presence of species that are indicators of important wetland habitat (e.g., herons, dragonflies, amphibians, RTE species)	Within the wetland and wetland buffer
Potentially untreated CDA inputs	• Stormwater pollution hotspots • Uncontrolled stormwater runoff	Wetland CDA

The WI assessment requires crews to determine a preliminary management option for the wetland. This can include designating the wetland as a potential conservation site or sensitive wetland, or designating the wetland as a potential restoration site. If no impacts are observed or if indicators of important wetland habitat are present, the wetland is a potential conservation site or sensitive wetland, depending on the screening criteria used to initially identify potential conservation sites and sensitive wetlands. Detailed assessments of wetland function may also be recommended for these wetlands.

If indicators of wetland impacts are observed, the wetland may be a potential restoration candidate. The crew should make a determination about whether the sources of impacts are controllable. If the sources of impacts are obvious and readily observable in the field, the crew should make initial recommendations for managing these stressors. For example, a crew may recommend enforcement of ESC regulations on an active construction site adjacent to the wetland, or recommend restricting mowing or clearing at the site to allow regeneration of wetland vegetation.

If the sources of impacts are not readily observable from the wetland site, additional field assessment in the CDA will be necessary to determine if impacts are controllable, and to make recommendations for reducing or eliminating them. Additional field assessments that may be recommended are listed in Table 13 along with the typical resulting management recommendations. In addition, changes to local regulations and programs, such as stormwater management or erosion and sediment control regulations, may be needed to control the sources of wetland impacts (Article 3). If additional field assessments are recommended, the unique site ID should be cross-referenced to the WI form for later coordination of data.

Table 13. Further Assessments Recommended to Evaluate Stressors to Wetlands

Assessment Protocol	Description	Recommendations Resulting from Assessment
Unified Stream Assessment (Kitchell and Schueler, 2004)	A continuous streamwalk method to evaluate impacts and identify restoration opportunities along the stream corridor	Stormwater retrofits, stream repair, buffer reforestation, stream cleanups, illicit discharge investigations
Unified Subwatershed and Site Reconnaissance (Wright et al., 2004)	A windshield survey of upland areas to evaluate pollution sources and identify restoration opportunities. Includes four assessments described below.	See specific recommendations below
	The Neighborhood Source Assessment evaluates pollutant-producing behaviors in individual neighborhoods	Downspout disconnection, pet waste management, natural landscaping and reforestation, stormwater retrofits
	The Pervious Area Assessment evaluates condition of natural area remnants and reforestation potential	Upland reforestation, soil amendments, invasive species control
	The Hotspot Site Investigation creates an inventory of stormwater hotspots and rates severity with regard to potential for generating pollutants	Permit enforcement, stormwater retrofits, pollution prevention
	The Streets and Storm Drains form estimates severity of pollutant accumulation in streets and storm drains	Storm drain stenciling, street sweeping, catch basin cleanouts, stormwater retrofits
Retrofit Reconnaissance Inventory (CWP, in press)	Evaluates potential storage and on-site stormwater retrofit sites to develop concept designs for stormwater retrofits	Conversion of dry pond to wet pond, flow attenuation devices, stormwater ponds and wetlands, filtering practices, rain barrels, compost amendments, rain gardens, green roofs

Table 13. Further Assessments Recommended to Evaluate Stressors to Wetlands		
Assessment Protocol	**Description**	**Recommendations Resulting from Assessment**
Stream Repair Inventory (Schueler and Brown, 2004)	Evaluates defined stream reaches to develop concept designs for stream repair projects	Stream cleanup, bank stabilization, flow deflection, grade control, in-stream habitat enhancement, flow diversion, fish barrier removal, comprehensive stream restoration
Urban Reforestation Site Assessment (Cappiella et al., 2006)	Evaluates urban planting sites to develop planting plans for reforestation projects	Reforestation
Outfall Reconnaissance Inventory (Brown et al., 2004)	Survey of stormwater outfalls to detect suspected illicit discharges and track down and fix their specific sources	Infrastructure modification or repair, spill containment and cleanup procedures

It is important to note that these additional field assessments are primarily intended to evaluate whether a particular stressor is controllable, and do not evaluate the feasibility of restoring wetland *functions* once the stressor is eliminated. Restorability of wetland functions is dependent on a variety of factors, such as wetland type, and often will take years to determine if success has been achieved. Additional field assessments may determine that the sources of impacts to the wetland are not controllable. Examples of stressors that may be difficult to control include:

- Water quality problems due to groundwater contamination
- Stormwater runoff from CDA that is too abundant to manage
- Limited space in CDA to install stormwater treatment practices
- Current stressors can be controlled but high development pressure and lack of stormwater management regulations may undo any restoration efforts with new development
- Abundance of nuisance species or invasive species (may make restoration efforts difficult)

Finally, since one goal of the WI is to verify and update the desktop wetland inventory, the crew should make note of any updates needed to the wetland inventory. A complete description of the WI protocol and a blank WI field from are provided in Attachment D.

7.2 Conduct Detailed Wetland Assessments

The WI can help a community screen which priority wetlands are appropriate for more detailed assessments, which often not feasible to conduct on a watershed scale. Detailed functional assessments of individual wetlands are important to quantify wetland impacts and potential functional losses triggered by Section 404 permit activity. They are also needed to establish compensatory mitigation ratios, evaluate restoration potential, or to design appropriate wetland restoration projects. Establishing reference conditions for HGM classes using remaining high quality wetlands requires extensive field assessment. Repeatable surveys are needed to establish baseline conditions and monitor wetland conditions or performance over time. Box 6 lists some additional uses of detailed wetland assessments.

Box 6. Various Uses of Detailed Wetland Assessments

- Assess legal jurisdiction
- Determine groundwater contributions
- Compare functions/values for ranking wetlands
- Determine environmental impact of proposed development, road crossing, utility, adjacent septic systems
- Determine potential economic or recreational uses
- Evaluate ambient condition to establish aquatic life use standards
- Determine compliance with regulations
- Establish reference conditions for HGM classes
- Establish compensatory mitigation ratios
- Assess anthropogenic impacts and determine restoration potential
- Design wetland restoration projects
- Monitor performance of restoration and mitigation projects
- Establish baseline for monitoring long-term conditions

Detailed wetland assessments have historically been relegated to environmental consultants and trained wetland ecologists due to the complexity of wetland ecosystems. Over 90 different wetland assessment methodologies exist across the country; however, no single method can be easily recommended (Kusler, 2004). These assessments can be time consuming, are often applicable to specific regions or wetland types, and do not easily account for natural variations within a single wetland type. Even the USACE does not recognize any one methodology as the best or most acceptable, and many states have developed their own protocols. Therefore, special consideration should be given to choosing an appropriate method.

Bartoldus (2000) has developed a selection matrix to assist wetland managers in distinguishing between approximately 40 existing wetland assessments and for choosing an appropriate protocol for use. These protocol descriptions and selection guidance are available on the USACE Ecosystem Management and Restoration Information system website http://el.erdc.usace.army.mil/emrrp/emris/. Fennessey et al., (2004) further refines Bartoldus' list to a handful of field methods that measure wetland condition and exclude social values. Adapting information presented by Bartoldus (2000), Fennessey et al., (2004), WWF (1992) and Hatfield et al., (2004), Table 14 summarizes features of a representative set of these methods including information on the time required, applicability, ability to measure condition and function, and other features of each method. An expanded version of this table is provided in Attachment C.

Table 14. Wetland Assessment Protocols

Name	Rapid	Region	Type	Condition/ Impacts	Function	Social	Restore
DE Method[1]	●	❍	●	●	●	❍	?
Descriptive Approach/ Highway Method	●	◗	●	◗	●	●	❍
Evaluation Planned Wetlands	●	●	●	◗	●	●	●
FL Wetland Rapid Assessment Procedure [1]	◗	❍	◗	●	◗	❍	●
Habitat Assessment Technique	●/❍	●	●	◗	◗	●	❍
Habitat Evaluation Procedures	❍	●	●	●	◗	❍	●
HGM Approach	●/❍	◗	◗	◗	●	●	●
MA Coastal Zone Mgmt Method[1]	●	❍	●	●	◗	❍	?
MN Routine Assessment Method	●	❍	◗	◗	●	●	●
MT Wetland Assessment Method[1]	●	❍	◗	●	●	◗	●
NH/CT Method	❍	❍	◗	❍	●	●	●
NJ Freshwater Wetland Mitigation Quality Assess.	❍	●	❍	●	●	❍	●
OH Rapid Assessment Method [1]	●	❍	◗	●	❍	●	?
OR Freshwater Wetlands Method	❍	❍	◗	❍	●	●	❍
Penn State Stressor Checklist[1]	●	❍	◗	●	❍	❍	❍
Rapid Assessment Procedure	●/❍	◗	❍	●	●	●	●
WA Wetland Function Assessment	●/❍	❍	❍	●	●	❍	●
Wetland Evaluation Technique	❍	●	●	●	●	●	❍
WETThings.	●	◗	●	●	◗	❍	●
Wetland Value Assessment Method (LA)	●	❍	❍	●	◗	❍	●
WI Rapid Assessment Method	◗	❍	◗	❍	●	●	❍

Adapted from Bartoldus (2000); Fennessey et al., (2004), WWF (1992), and Hatfield et al., (2004). See Appendix A for more detail.

[1]Methods recommended by Fennessey et al., (2004) based on four criteria: rapid; measures condition (social values not included); on-site assessment; and is verifiable.

Rapid: ● ≤1/2 day; ◗ ≤1 day; ❍ >1 day; ●/❍ rapid only if models exist already

Region (applied): ● Nation-wide application; ◗ regionally restricted; ❍ application to specific state or area within a state

Type (of wetland): ● can be used on all wetland types; ◗ limited; ❍ single type

Condition/Impacts: ● Measures condition or assesses relative level of impact; ◗ If social values are included, could be used as impact analysis; ❍ Does not measure condition or impact analysis

Function: ● Assesses multiple functions, ◗ predominantly habitat, ❍ unknown or no functional score

Social: ● Includes values (education, recreation) as "function"; ◗ social values used to group sites (high-low)

Restore: ● Method used to measure restoration potential, design, or assess mitigation site compliance

Before embarking upon detailed wetland assessments, check with the state natural resources agency and USACE district office to see what methods are recommended or required in the local area. If none are recommended, consider adopting or adapting an existing method rather than

creating a new protocol from scratch. Factors to consider when choosing a detailed assessment protocol are presented in Box 7.

Box 7: Tips for Adapting Wetland Assessment Protocols for Watershed Management

- Clearly define the goals of the assessment, as this will determine the type of assessment, indicators, and data output required of the chosen method.
- Field assessment protocols should evaluate a wetland's relative ability to provide for specific watershed functions of concern (e.g., pollutant removal, flood attenuation, habitat). Assessments that measure the overall condition and/or restorability of a wetland as it relates to current and future impacts from changing watershed land may also be useful in prioritization process.
- Some methods result in individual scores or rankings for each wetland function measured, others provide an overall score or ranking for the wetland as a whole, some have both. Depending on the assessment goals, consider which data product serves these needs best.
- In urban settings, it may be useful to evaluate social values, at least as a means to establish restoration and protection priorities. Alternatively, consider including value added features into the scoring mechanism that allow for wetlands of social significance, uniqueness, or presence of RTE's to be scored higher.
- There are seasonal or temporal considerations for conducting your assessment. For example, in winter, woody vegetation may be most prevalent; in summer, the aquatic submergent and herbaceous species will be dominant. Also consider how much time is available to complete the assessments and how much area there is to cover. It is better to complete assessments at one time.
- Make sure the selected protocol standardizes boundary selection of the wetlands to assess.
- There is no consensus among wetland scientists as to how many indicators are necessary to predict function.
- Consult a wetland scientist. Detailed wetland evaluations often require a highly trained wetland ecologist to modify procedures and conduct the assessment. This is particularly important when selecting a protocol that volunteers can use. Use of volunteers is more appropriate for the WI, rather than the detailed assessment. A list of volunteer-based wetland assessment methods are provided in Attachment C.

Principle 8: Adapt Watershed Tools to Protect Wetlands

Watershed plans should not be limited to a list of recommended projects to 'fix' watershed problems. To be effective, they must also protect watershed resources from future impacts by recommending changes to local programs, codes, and ordinances that regulate land use activities. These recommendations can be derived directly from the results of the 8 Tools Audit (described in Principle 2), which is organized by the eight tools of watershed protection. Table 15 describes the eight tools of watershed protection, and explains how each can be adapted to protect wetlands. For a more detailed discussion of the eight tools of watershed protection, see CWP

(1998). Adapting watershed tools to protect wetlands includes reviewing the result of the 8 Tools Audit and making specific recommendations for each tool to protect wetlands.

Table 15. Adapting the Eight Tools of Watershed Protection for Wetlands

Watershed Protection Tool	Description	How the Tool is Used to Protect Wetlands
1. Land Use Planning	Use land use planning techniques to redirect development, preserve sensitive areas, and maintain or reduce impervious cover in a given portion of the watershed	Use land use planning techniques to direct growth away from wetlands
2. Land Conservation	Apply land conservation techniques to permanently protect critical resources from being developed	Identify wetlands as priority lands for conservation
3. Aquatic Buffers	Provide special protection, in the form of a buffer, to the aquatic corridor to physically protect and separate water resources from future disturbance	Establish vegetated buffers around all wetlands
4. Better Site Design	Foster site design that protects watersheds by reducing the amount of impervious cover, and increasing conservation of natural areas	Design developments to minimize impacts to wetlands on the site
5. Erosion and Sediment Control	Mitigate impacts of sediment during the construction process by restricting clearing, requiring erosion and sediment controls, and enforcing these regulations	Modify ESC regulations to provide stricter controls in areas draining to wetlands
6. Stormwater Management	Install stormwater treatment practices to compensate for the hydrological changes caused by new and existing development	Outline special criteria to protect downstream wetlands from stormwater runoff
7. Non-Stormwater Discharges	Reduce pollutant discharges from non-stormwater sources, such as septic systems, illicit discharges, and spills	Establish restrictions on activities that have high potential for pollutant discharges in areas draining to wetlands
8. Watershed Stewardship	Increase public understanding and awareness about watersheds, promote better stewardship of private lands, and develop funding to sustain watershed management efforts	Ensure that wetlands are a key component of all watershed stewardship activities

8.1 Review 8 Tools Audit

The completed 8 Tools Audit should be reviewed to identify specific areas where wetland protect is lacking (Attachment B). Each question that pertains to wetlands is marked with a wetland symbol. Based on the results, specific recommendations can be made for each tool to protect wetlands as part of a watershed plan. For example, if the 8 Tools Audit indicates that buffer widths cannot currently be expanded to connect wetlands with their critical upland habitat, a recommendation might be to modify the wetland buffer ordinance to encourage this type of expansion.

8.2 Make Specific Recommendations for Each Tool

The eight tools can be adapted to meet unique water resource objectives, such as wetland protection, within a watershed plan. Table 16 presents a menu of specific techniques that communities can choose from when adapting the eight tools to protect wetlands---these are ultimately transformed into watershed plan recommendations. Some of these techniques are applied in or near wetlands, while others are applied within wetland CDAs. Communities may

use the techniques to protect all wetlands, or to protect sensitive wetlands or other special wetlands. The choice of techniques depends on the future wetland protection needs in the community, as well as the capacity of the community to implement the techniques. See Article 3 for more detail on adapting watershed tools to protect wetlands.

Table 16. Specific Techniques for Protecting Wetlands

Watershed Protection Tool	Wetland Protection Technique
1. Land Use Planning	• Incorporate wetland management into local watershed plans • Adopt a local wetland protection ordinance • Adopt floodplain, stream buffer, or hydric soil ordinance to indirectly protect wetlands
2. Land Conservation	• Identify priority wetlands to be conserved • Select techniques for conserving wetlands • Prioritize other conservation areas in wetland CDAs
3. Aquatic Buffers	• Require vegetated buffers around all wetlands • Expand wetland buffers to connect wetlands with critical habitats • Increase stream buffer widths to protect downstream wetlands
4. Better Site Design	• Encourage designs that minimize the number of wetland crossings • Encourage or require the use of open space design to protect wetlands • Encourage designs that utilize the natural drainage system
5. Erosion and Sediment Control	• Require perimeter control practices along wetland buffer boundaries • Encourage more rapid stabilization near wetlands • Reduce disturbance thresholds that trigger ESC plans • Increase ESC requirements during rainy season • Encourage use of site fingerprinting or construction phasing • Increase frequency of site inspections
6. Stormwater Treatment	• Prohibit use of natural wetlands for stormwater treatment • Discourage constrictions at wetland outlets • Restrict discharges of untreated stormwater to natural wetlands • Encourage fingerprinting of STPs around natural wetlands • Discourage installation of STPs within wetland buffers • Develop special sizing criteria for STPs • Promote effective STPs to protect downstream wetlands • Encourage the incorporation of wetland features into STPs and landscaping
7. Non-Stormwater Discharges	• Conduct illicit discharge surveys for all outfalls to wetlands • Actively enforce restrictions on dumping in wetlands and their buffers • Promote alternative mosquito control methods to reduce insecticide inputs to wetlands • Require enhanced nutrient removal from on-site waste water treatment systems • Require regular septic system inspections
8. Watershed Stewardship	• Incorporate wetlands into watershed education programs • Post signs to identify wetlands, buffers, and wetland CDA boundaries • Manage invasive wetland plants • Establish volunteer wetland monitoring and adoption programs • Encourage wetland landowner stewardship • Establish partnerships for funding and implementing wetland projects

Principle 9: Prioritize Wetland Recommendations

Effective watershed plans include specific recommendations to change local regulations and programs, and implement conservation and restoration projects at specific locations. Dozens or even hundreds of recommendations may be made in a typical watershed plan. In order to make the plan more palatable and improve the chances of implementation, recommendations must be prioritized. Wetland-specific recommendations can be prioritized by compiling the entire suite of wetland recommendations, and ranking each to identify priorities.

9.1 Compile List of Wetland Recommendations

The full suite of wetland recommendations derived in earlier desktop and field assessments should be compiled into one final list. This includes wetland restoration projects, wetland conservation sites, sensitive wetland designations, and regulatory and programmatic changes to protect wetlands. Wetland conservation and restoration sites and sensitive wetlands should include the best possible sites as determined from field assessments (Principle 7). The final list should include all supporting information for the recommendation, such as field forms, notes and sketches, maps, conceptual designs, and other data. Each recommendation should include guidance on implementation, including planning-level cost estimates, potential partners and funding sources, construction specifications, conceptual designs, and a maintenance schedule. This list will ultimately serve as an appendix to the watershed plan.

9.2 Rank Recommendations to Identify Priorities

This method rates and ranks the full suite of watershed plan recommendations to identify priorities for short and long-term implementation. Each recommendation is rated and ranked according to pollutant reduction, cost, feasibility, public acceptance, and other key implementation factors. Ranking is typically done through a simple spreadsheet analysis, and the results are used to select priority recommendations for short and long-term implementation.

Project ranking allows all the watershed plan recommendations to be compared together on a common basis to find the most cost-effective and feasible combination for the watershed. One of the key ranking decisions is whether to evaluate recommendations within the same group (e.g., wetland restoration projects) or to evaluate all different types of recommendations together. There are pros and cons to each approach. In general, it is preferable to assess all types of recommendations at the same time, as long as the ranking factors are compatible among the groups.

For communities that choose to rank wetland recommendations separately, suggested ranking factors for wetland recommendations are presented in Table 17. For the most part, the factors presented apply to wetland conservation and restoration projects and wetland-related protection strategies that involved regulatory changes. However, it can be difficult to quantify the effect of a recommended regulatory or programmatic change versus a site-specific project. They may need to be tweaked accordingly. Schueler and Kitchell (2005) provide additional guidance on methods to rank recommendations as part of a watershed plan.

Table 17. Example Ranking Factors for Wetland Recommendations	
Ranking Factor	**Description**
Helps accomplish wetland goals	Estimate the number of wetland goals addressed by the recommendation, or rank the recommendation based on how well it conforms to specific objectives.
Watershed functions provided	Estimate how the recommendation will provide watershed functions such as pollutant removal, flood retention, habitat, or other benefit. For wetland restoration or conservation projects, estimates may be derived from information in the wetland inventory.
Total cost	Derive preliminary estimates of implementation cost from initial list of wetland recommendations.
Cost per reporting unit	Estimate the cost per reporting unit (e.g., acres planted, linear feet installed, systems installed) to enable relative comparison between recommendations with similar reporting units.
Permitting and approval burden	Evaluate what, if any, permits or approvals are required for implementation (e.g., Section 404 permit, approval from Board of Commissioners).
Maintenance burden	Determine the maintenance burden by estimating future long-term maintenance costs and identifying whether a responsible party has been designated to perform the maintenance.
Integration with other recommendations	Evaluate whether the recommendation can be integrated with other watershed recommendations to maximize benefits (e.g., upstream stormwater controls may be implemented in conjunction with wetland restoration downstream).
Community acceptance	Rank the community acceptance of the recommendation based on feedback from stakeholder meetings.
Partnership opportunities	Identify the number of partners that may be involved in implementation.
Public visibility	Examine the visibility and potential demonstration value of the recommendation.
Potential for success	Identify the potential for success based on factors such as the type and difficulty of the project, and level of effort required.

It is important once the ranking is complete to make sure that the priority wetland projects as a whole are able to meet the any numeric goals set for wetland acreage in the watershed. If goals are not going to be met with project implementation, the ranking may need to be re-evaluated and revised.

Principle 10: Coordinate Implementation of Wetland Recommendations

A watershed plan is not effective if it sits on a shelf collecting dust. Therefore, a good plan will outline a strategy for getting the recommendations implemented. The strategy will be unique in every community, but often involves identifying funding strategies and a timeframe for implementation, establishing a partnership structure, deciding on commitments for short-term recommendations, establishing capital and operating budget needs, and scheduling the briefings needed for plan adoption. Implementation of wetland recommendations must be coordinated with any existing wetland regulatory programs in order to avoid confusing, conflicting, or

duplicative requirements. Even recommendations that are done independently of the regulatory program still require coordination and planning to ensure that implementation happens.

10.1 Implement Changes to Local Programs and Regulations

Changes to local programs and regulations to provide better wetland protection can be made in various ways, depending on the local process and schedule for adopting/updating development regulations. Some possible options for implementing watershed plan recommendations include:

- Incorporate the watershed plan into the local comprehensive plan
- Elected officials endorse the plan or the goals of the plan
- Local government commits to/authorizes funding of short-term plan recommendations
- Local government converts plan recommendations into legislative language, and makes individual changes to codes and ordinances

One of the most effective adoption methods in regards to wetland protection is to incorporate the watershed plan into the comprehensive plan so that it directly drives the Section 404 permitting process. This method was used in Eugene, Oregon, where the ADID results (which are similar to wetland recommendations in a watershed plan) were incorporated into the City's comprehensive plan, and the identification of individual wetlands as suitable or unsuitable for fill now directly drive the Section 404 permitting process. Since the USACE must consider local zoning regulations when making permit decisions, another effective method to influence the permitting process is to make individual recommended zoning changes. For example, adopting a wetland overlay zone that requires a 1:20 mitigation ratio can be very effective in discouraging impacts to wetlands.

10.2 Coordinate with Wetland Regulatory Agencies

Some of the recommendations made as part of the watershed plan can be directly linked to existing regulatory programs, such as Section 404. Coordination between these existing programs is necessary to ensure that local requirements do not conflict with the federal or state program, or cause additional burden. Coordination between the local government and the wetland regulatory agency (typically the USACE) can be encouraged by forming a partnership in which both parties agree to certain terms. This partnership can be solidified in a memorandum of agreement (MOA). Terms of an MOA may include:

- The local government will ensure that regulatory agencies receive copies of the watershed plan, including maps and supporting information regarding sensitive wetlands, and priority sites for restoration and conservation in the watershed
- The local government will encourage regulators to be collaborative, creative and flexible
- The local government and regulatory agency will establish joint permit processing (if local permits are required) and coordinate the review procedure for permit applications to facilitate exchange of comments
- The regulatory agency will use the watershed plan in an advisory capacity when making permit decisions
- The regulatory agency will prioritize sites designated for restoration when directing compensatory mitigation to those locations

The watershed plan may provide a solid foundation to deny permits in certain circumstances. For example, certain wetlands designated as having high function or high habitat value may receive special scrutiny during permit review. Such a designation may trigger the USACE to require an individual permit, which allows for public review and comment.

10.3 Implement Projects with Wetland Partners

In addition to wetland projects that are implemented as part of the regulatory program, communities can pursue partnerships and funding opportunities for wetland projects unrelated to CWA regulation. The wetlands partners identified early in the watershed planning process will be invaluable at this stage. A list of federal funding sources for conservation and restoration is provided in Box 8. For additional information on wetlands grants, see: www.epa.gov/owow/wetlands/initiative/grantinfo.html

Box 8. Federal Funding Sources for Wetland Projects

- *Five-Star Restoration Program*: provides funds to support community-based wetland and riparian restoration projects
- *National Coastal Wetlands Conservation Grant Program*: provides matching grants for conservation and restoration of coastal wetlands
- *NOAA Community-Based Restoration Program*: provides financial assistance for community-based restoration of coastal wetlands
- *Partners for Fish and Wildlife Program*: provides financial assistance to private landowners to restore wetlands and habitat on their land
- *Coastal Wetlands Planning, Protection, and Restoration Act*: provides matching grants to coastal states to acquire, manage, restore and enhance wetlands
- *North American Wetlands Conservation Act Grant Program*: makes grants available to states and private organizations for wetland conservation
- *Wetlands Reserve Program*: provides financial incentives to private landowners for wetland conservation and restoration
- *Watershed Protection and Flood Protection Program*: provides technical and financial assistance to local governments for wetland restoration projects

Source: Kusler, 2003a, USEPA 2001

Priority wetland sites outlined in the plan can also inform the conservation and restoration programs run by state and federal government, non-profits, and other partners. Communities can also advertise the desirability of priority conservation areas identified in the plan for local, regional or state mitigation banks, and encourage private landowners to participate as sellers or partners. Conservation of priority wetlands and upland areas surrounding or linking these wetlands is of greater ecological value than conserving other lands and will generate more mitigation credit per real estate dollar invested (Hull et al., 2005).

Principle 11: Monitor Progress Toward Wetland Goals

It is important to regularly monitor progress toward meeting the watershed plan goals over time after the plan is adopted. To measure progress towards wetland-related goals of the plan,

communities should update their wetland inventory periodically, track implementation of individual wetland projects, and conduct wetland monitoring to evaluate success. Results should be used to revise wetland goals or update the watershed plan during the next planning cycle.

11.1 Update the Wetland Inventory

The wetland inventory should be updated periodically in order to track wetland gains and losses at the watershed scale, and to monitor progress toward numeric wetland acreage goals. Updates to the inventory may include revised wetland map layers, or revised data for individual wetland polygons, such as acreage, type, functions provided, condition, protection or restoration status, and sensitivity. Inventory revisions can be based on result of wetland monitoring and project tracking. Wetland CDA boundaries can also be delineated or updated within the inventory as needed. If desired, longer-term changes in wetland acreage and types due to natural succession may also be tracked using the wetland inventory. Larson et al. (1980) found that gains in wetland acreage in Massachusetts and Rhode Island were significantly greater than human-induced losses over time, due to removal of activities such as clearing for firewood and grazing, which allowed wetlands to become reforested over time.

11.2 Track Implementation of Wetland Projects

Managing the implementation of a potentially large number of restoration and conservation projects across a watershed over time can be a complex process that entails a large amount of data. It is a good idea for communities to create a project tracking system in order to better manage wetland data. Wetland projects, including wetland restoration, wetland conservation, and protection of sensitive wetlands, should all be included as part of this tracking effort. The project tracking system is often a simple spreadsheet linked to GIS. A new USACE permit tracking database will soon be linked to GIS that may help facilitate tracking of compensatory mitigation sites. Table 18 summarizes the kinds of information that should be tracked for each type of wetland project.

Table 18. Examples of Types of Information to Track for Wetland Projects

Type of Wetland Project	Types of Information to Track
All project types	Project ID, wetland type, wetland size, project cost, funding source, geographic coordinates, contact information for project site
Wetland restoration	Date installed, maintenance schedule/activities, party responsible for maintenance, desired functions, protocol used to evaluate functions, regulatory status
Wetland conservation	Type of conservation measure (e.g., easement), party responsible for implementation, number of years protected, condition, function, protocols used to assess condition/function
Protection of sensitive wetlands	Size of wetland CDA, type of protection measure (e.g., overlay zone), condition, function, protocols used to assess condition/function

11.3 Conduct Wetland Monitoring

Wetland monitoring can be conducted to support a number of goals, as indicated by Box 9. Wetland monitoring can be broadly classified into two categories: indicator monitoring and performance monitoring. Wetland indicators are measurable parameters of wetland health (such as plant diversity) that are directly linked to specific wetland goals, and are used to track progress over time in reaching the goal. Communities should map out a plan at the beginning of the watershed planning process for measuring success through wetland indicator monitoring,

which is normally scheduled to coincide with the monitoring of other watershed indicators as part of the larger watershed plan.

Box 9. Common Goals of Wetland Monitoring

- Measure effectiveness of wetland restoration projects by conducting baseline and follow-up monitoring to determine if restored wetland is providing the desired functions
- Improve water quality certification decisions for activities that require federal permits (e.g., CWA Section 404 permits) by developing wetland water quality standards
- Determine if wetlands are meeting identified beneficial uses
- Incorporate wetlands into CWA 305(b) water quality reports
- Characterize ambient (baseline) condition of existing wetlands
- Reveal trends in wetland condition over time, due to seasonal patterns, restoration efforts, or system stressors
- Identify thresholds for system stressors, i.e., how much can it be disturbed without causing degradation of functions and values
- Determine if compensatory mitigation projects are meeting established criteria
- Provide education and stewardship opportunities for watershed residents (e.g., volunteer monitoring programs)
- Refine indicators for rapid assessment techniques

Several incentives exist for communities to conduct wetland indicator monitoring. First, the Clean Water Act requires states and tribes monitor and report annually on the condition of all navigable waters, including wetlands. Because of this requirement, grants are available from USEPA for local, state, and tribal governments to establish wetland monitoring programs. Developing a comprehensive monitoring program is also one of three criteria that projects must meet to be prioritized for funding under USEPA's Wetland Program Development Grants. Additional resources for wetland monitoring can be found at USEPA Wetlands Monitoring and Assessment website: http://www.epa.gov/owow/wetlands/monitor/. Funding sources for establishing wetland monitoring programs is summarized at: www.epa.gov/owow/wetlands/initiative/#financial

Performance monitoring is conducted to evaluate the success of individual wetland restoration or compensatory mitigation projects. It is used to determine whether the project is successful in providing the desired functions or in meeting specific goals or performance criteria. Performance criteria will vary by region and by wetland type and may be based on reference wetlands. Performance criteria may also be derived from the USACE 1987 Wetland Delineation Manual. Although monitoring is required for all compensatory mitigation projects, recent surveys have indicated that, in many cases, the monitoring requirement is simply ignored. Communities may wish to establish a monitoring program that includes monitoring of

compensatory mitigation sites. Volunteer monitoring groups are ideal for wetland monitoring, and are a great way to involve stakeholders and generate support for implementation. Table D-3 summarizes some volunteer-based wetland assessment methods.

Summary

This article briefly outlined a proposed framework for integrating wetland management in the context of local, state, and tribal watershed planning efforts. This conceptual approach for local watershed/wetland management is particularly needed in watersheds with a large number of small or isolated wetlands that may not be fully protected and that are under considerable development pressure. In this approach, a watershed plan is created that meets the following principles:

1. Compile wetland information on a watershed basis.

2. Assess local wetland protection capacity.

3. Identify wetland partners and roles.

4. Define wetland goals and objectives for the watershed.

5. Create an inventory of wetlands in the watershed.

6. Screen wetlands for further assessment.

7. Evaluate wetlands in the field.

8. Adapt watershed tools to protect wetlands.

9. Prioritize wetland recommendations.

10. Coordinate implementation of wetland recommendations.

11. Monitor progress toward wetland goals.

The most important part of the resulting watershed plan is a list of recommendations, which are ultimately implemented in order to meet the goals of the plan. Box 10 provides some examples of wetland-specific recommendations included within a watershed plan.

Box 10. Wetland Recommendations in a Watershed Plan

- Adopt a wetland protection ordinance that protects all wetlands
- Expand stream buffer ordinance to include wetlands
- Revise stormwater ordinance to include sizing criteria for wetlands and restrict direct discharges to wetlands
- Adopt an open space design ordinance that requires the use of open space design in wetland CDAs
- Revise erosion and sediment control ordinance to require site fingerprinting, encourage more rapid stabilization, and increase inspection frequency in wetland CDAs
- Establish a wetland monitoring program
- Develop educational fact sheets on wetlands to accompany the current watershed education series
- Acquire top three priority wetland parcels per year
- Restore one priority wetland site per year using capital improvement funds
- Develop a plan to fund implementation of lower priority conservation and restoration projects

The approach presented in this article focuses mainly on those aspects of watershed planning that are unique to wetlands. A greater level of detail on how to conduct each of the methods of watershed planning is provided in Schueler and Kitchell (2005) and CWP (2005).

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