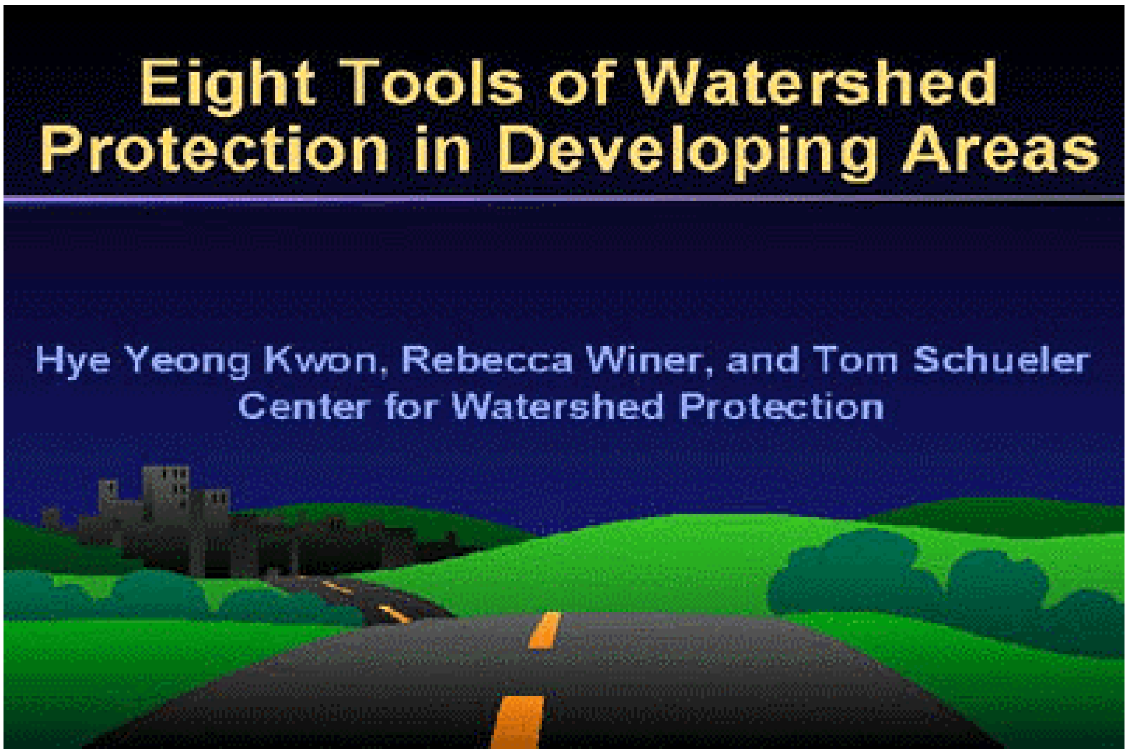
U.S. Environmental Protection Agency

Watershed Academy Web

Distance Learning Modules on Watershed Management

http://www.epa.gov/watertrain



NOTICE: This PDF file was adapted from an on-line training module of the EPA's ***Watershed Academy Web***, found at http://www.epa.gov/watertrain. To the extent possible, it contains the same material as the on-line version. Some interactive parts of the module had to be reformatted for this noninteractive text presentation. A self-test is included at the end of the file. Underlined terms throughout this module appear in the **glossary** at the end of the file.

This document does not constitute EPA policy. Mention of trade names or commercial products does not constitute endorsement or recommendation for use.

Links to non-EPA web sites do not imply any official EPA endorsement of or responsibility for the opinions, ideas, data, or products presented at those locations or guarantee the validity of the information provided. Links to non-EPA servers are provided solely as a pointer to information that might be useful to EPA staff and the public.

Introduction

This module outlines a watershed protection approach that applies eight tools to protect or restore aquatic resources in an urbanized or developing watershed. It describes the nature and purpose of the eight watershed protection tools, outlines some specific techniques for applying the tools, and highlights some key choices a watershed manager (used here as a catch-all term for any persons, agencies or organizations who contribute to managing watersheds) should consider when applying or adapting the tools within a given watershed. Underlined terms in this narrative are defined in the glossary at the end of this module.

Links to non-EPA sites do not imply any official EPA endorsement of or responsibility for the opinions, ideas, data, or products presented at those locations, or guarantee the validity of the information provided. Links to non-EPA servers are provided solely as a pointer to information on topics related to environmental protection that may be useful to EPA staff and the public.

The eight tools are (Figure 1):

Tool 1. Land Use Planning

Tool 2. Land Conservation

Tool 3. Aquatic Buffers

Tool 4. Better Site Design

Tool 5. Erosion and Sediment Control

Tool 6. Stormwater Best Management Practices (see Glossary on page 24)

Tool 7. Non-Stormwater Discharges

Tool 8. Watershed Stewardship Programs

Figure 1

Watershed protection is about making choices about what tools to apply and in what combination. The eight watershed protection tools roughly correspond to the stages of the development cycle from initial land use planning, site design, and construction through home ownership. As a result, a watershed manager will generally need to apply some form of all eight tools in every watershed to provide comprehensive watershed protection. The tools, however, are applied in different ways depending on what type of water resource is being protected. Each of these tools is an essential element of a comprehensive watershed protection approach and their goal is to provide local communities with a realistic approach for maintaining a quality environment for future generations.

Tool 1: Land Use Planning

Since impervious cover has such a strong influence on watershed quality, a watershed manager must critically analyze the degree and location of future development (and impervious cover) that is expected in a watershed (Figure 2). Consequently, land use planning ranks as perhaps the single most important watershed protection tool. When preparing a watershed plan, a watershed manager needs to:

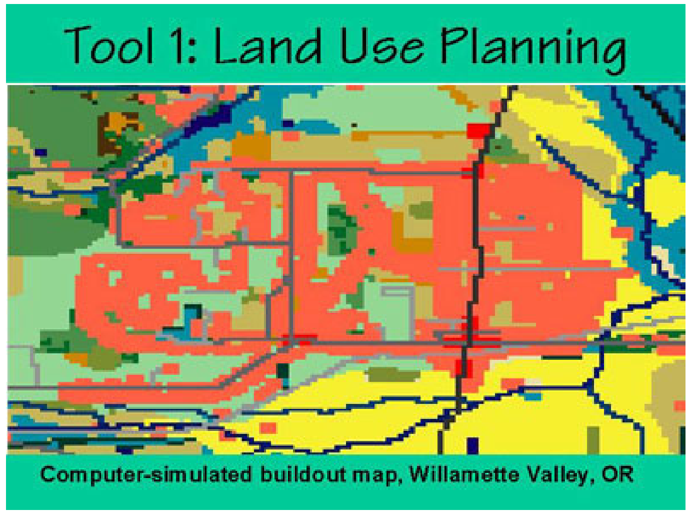


Figure 2

- Predict the impacts of future land use change on water resources.
- Obtain consensus on the most important water resource goals in the watershed.
- Develop a future land use plan that can help meet these goals.
- Select the most acceptable and effective land use planning technique to reduce or shift future impervious cover.
- Select the most appropriate combination of other watershed protection tools to apply to individual subwatersheds.
- Devise an ongoing management structure to adopt and implement the watershed plan.

Land use planning is best conducted at the subwatershed scale, where it is recognized that stream quality is related to land use and consequently impervious cover (Figure 3). One of the goals of land use planning is to shift development toward subwatersheds that can support a particular type of land use and/or density. The basic goal of the watershed plan is to apply land use planning techniques to redirect development, preserve sensitive areas, and maintain or reduce the impervious cover within a given watershed.

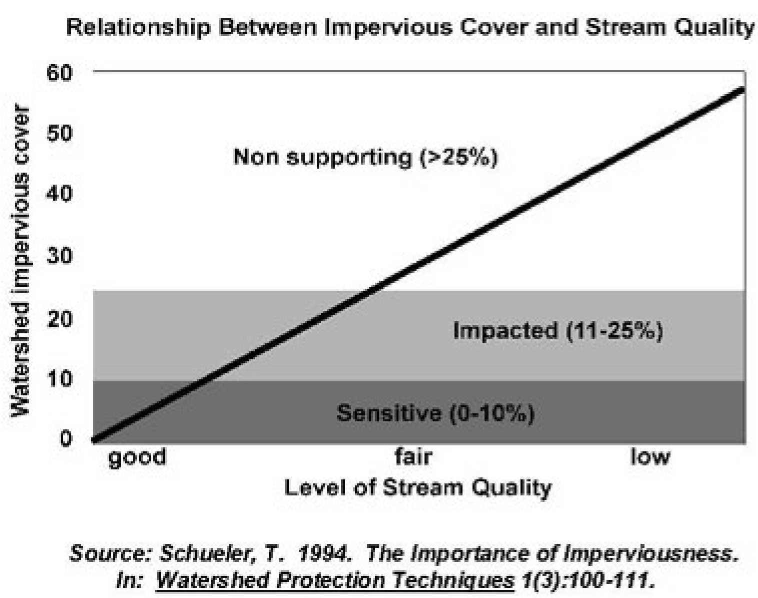
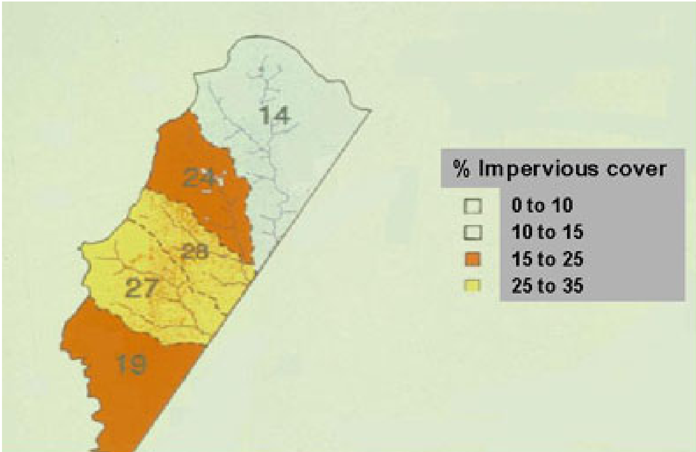


Figure 3



Classification of subwatersheds in Montgomery County, MD based on their percent impervious cover.

Figure 4

Understanding the concept of impervious cover is essential to understanding one of the biggest ways that urbanization impacts our streams. Impervious cover is defined as the sum total of all hard surfaces within a watershed including rooftops, parking lots, streets, sidewalks, driveways, and surfaces that are impermeable to infiltration of rainfall into underlying soils/groundwater. Impervious cover changes the natural landscape and is a major influence on aquatic resources because instead of allowing precipitation to permeate the ground, it runs off. Generally the more impervious surface there is in a watershed, the less the amount of groundwater recharge, plus the more runoff and related erosion in streambeds from greater flow. Further, studies show a direct correlation between the percentage of impervious cover in a watershed and the level of degradation to aquatic organisms. Streams degraded by high percentages of impervious surface in their watersheds are often prone to larger and more frequent floods (which cause property damage as well as ecological harm) and lower base flows (which degrades or eliminates fish and other stream life, as well as reducing the aesthetics of the stream). Impervious surfaces also raise the temperature of runoff, which reduces dissolved oxygen in the stream, harms some gamefish populations, and promotes excess algal growth.

Classification of subwatersheds by the amount of impervious cover (Figure 4) is one step toward determining land use planning goals. Although presence of vegetated streamside buffer zones or wetlands can help counteract impervious cover impacts, a watershed exceeding 10% impervious cover will generally not be able to support a high quality stream system. In this particular classification system, subwatersheds with impervious cover of less than 10% are classified as sensitive. A subwatershed with 10 - 25% impervious cover is classified as a degraded or impacted system. Any stream's watershed having greater than 25% impervious is classified as a non-supporting stream with characteristics such as eroding banks, poor biological diversity, and high bacterial levels.

Land Use Planning Techniques

Within the discipline of land use planning, a wide variety of techniques can be used to manage land use and impervious cover in subwatersheds (Figure 5):

Figure 5

Watershed-based Zoning: This technique is the foundation of a land use planning process using subwatershed boundaries as the basis for future land use decisions. Watershed based zoning involves defining existing watershed conditions, measuring current and potential future impervious cover, classifying subwatersheds based on the amount of future imperviousness, and most importantly modifying master plans and zoning to shift the locations and density of future development to the appropriate subwatershed management categories (Figure 6). A watershed based zoning approach should include the following nine steps:

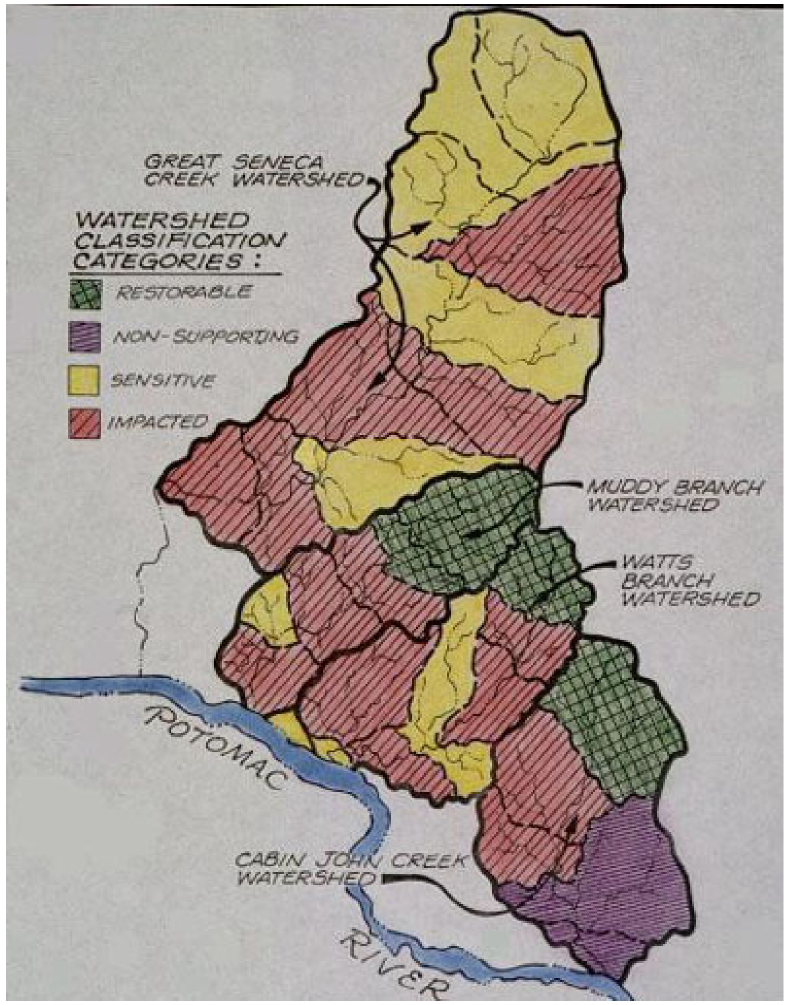


Figure 6

1. Conduct a comprehensive stream inventory.
2. Measure current levels of impervious cover.
3. Verify impervious cover/stream quality relationships.
4. Project future levels of impervious cover.
5. Classify subwatersheds based on stream management "templates" and current impervious cover.
6. Modify master plans/zoning to correspond to subwatershed impervious cover targets and other management strategies identified in Subwatershed Management Templates.
7. Incorporate management priorities from larger watershed management units such as river basins or larger watersheds.
8. Adopt specific watershed protection strategies for each subwatershed.
9. Conduct long term monitoring over a prescribed cycle to assess watershed status.

Overlay Zoning (Figure 7): This land use management technique consists of superimposing additional regulatory standards, specifying permitted uses that are otherwise restricted, or applying specific development criteria onto existing zoning provisions. Overlay zones are mapped districts that place special restrictions or specific development criteria without changing the base zoning. As shown in the maps at left, overlay zones can also be created to protect wetlands, forests, historic sites, or even barrier islands and their surrounding resources. The advantage of overlay zones is that specific criteria can be applied to isolated areas and overlay districts are not necessarily restricted by the limits of the underlying base zoning. An overlay zone may take up only part of an underlying zone or may even encompass several underlying zones. Often, the utilization of an overlay zone is optional.

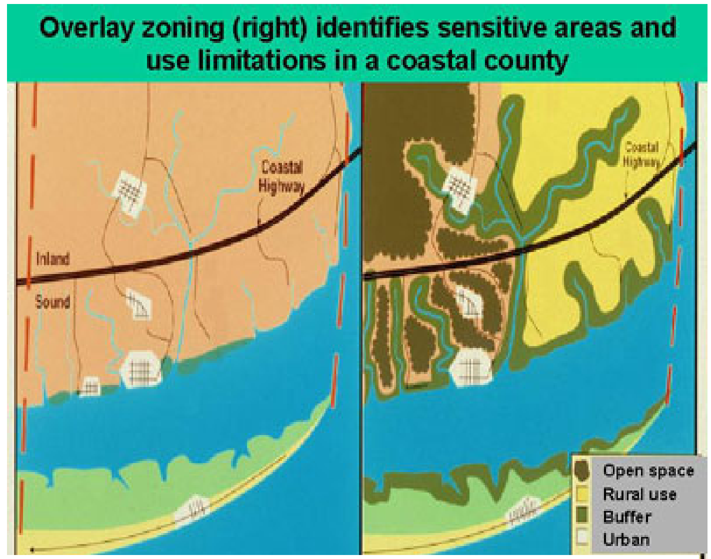


Figure 7

Impervious Overlay Zoning: This specific type of overlay zoning limits future impervious area by estimating the environmental impacts of future impervious cover and setting a limit on the maximum imperviousness within a given planning area. Site development proposals are then reviewed in the context of an imperviousness cap. Subdivision layout options must then conform to the total impervious limit of the planning area.

Performance Zoning: This technique is designed to ensure an acceptable level of performance within a given zoning district such as providing a certain open space ratio, an impervious area target, or a desirable density. Performance zoning is a flexible approach that has been employed in a variety of fashions in several different communities across the country. Some performance factors include: traffic or noise generation limits, lighting requirements, stormwater runoff quality and quantity criteria, protection of wildlife and vegetation, and even architectural style criteria.

Urban Growth Boundaries: This planning technique establishes a dividing line between areas appropriate for urban and suburban development, and areas appropriate for agriculture, rural and resource protection. Boundaries are typically set up for a 10 or 20 year period and should be maintained for the duration of the life of the planning period. Boundaries may be examined at planning period renewal intervals to assess whether conditions have changed between planning cycles to ensure a consistent playing field for both the marketplace and citizens.

Urban growth boundaries are sometimes called development service districts, and include areas where public service is already provided (e.g. sewer, water, roads, police, fire, and schools). The delineation of the boundary is crucial. Listed in Figure 8 are several important issues to consider in establishing an urban growth boundary.

Figure 8

Large Lot Zoning: This land use planning technique is perhaps most widely used to try to mitigate the impacts of development on water quality. The technique involves zoning development at very low densities to disperse impervious cover over very large areas. Densities of 1 lot per 2, 5, or even 10 acres are not uncommon. From the standpoint of watershed protection, large lot zoning is most effective when lots are extremely large (2 to 20 acre lots). While large lot zoning does tend to reduce the impervious cover and therefore the amount of stormwater runoff at a particular location, it also spreads development over vast areas. The road networks required to connect these large lots can actually increase the total amount of imperviousness created for each dwelling unit. In addition, large lot zoning contributes to regional sprawl. Sprawl-like development increases the expense of providing community services such a fire protection, water and sewer systems, and school transportation. Sprawl also increases the amount of land converted from forest or farmland to lawns.

Infill/Community Redevelopment: Infill development encourages new development in unused or underutilized land in existing urban areas. Community redevelopment is a planning initiative to foster revitalization of existing neighborhoods by redeveloping existing buildings and properties that are severely blighted or damaged. Infill and redevelopment can be employed in either large or small projects. Some of the existing impediments to more widespread implementation of these types of projects include: the existing condition of a potential redevelopment site in terms of environmental constraints, the restrictive nature of many land use regulations, and pressing social and economic issues.

Transfer of Development Rights (TDRs): This land use management technique can support local comprehensive planning goals and facilitate Watershed Based Zoning proposals by transferring development potential from sensitive subwatersheds to subwatersheds designated for growth. The principle of TDRs puts to creative use the premise that ownership of land entails certain property rights and therefore individual rights can be bought and sold to accomplish various community planning objectives.

Key Land Use Planning Choices for the Watershed Manager

When applying the land use planning tool, a watershed manager needs to answer some hard questions relating to land use and watershed planning. Take some time to read the questions in Figure 9 and consider how they apply to your own watershed.

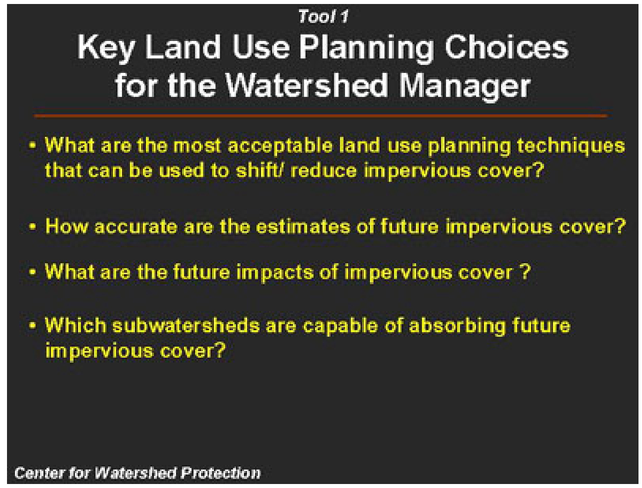


Figure 9

Tool 2: Land Conservation

Whereas the first tool emphasizes how much impervious cover is created in a watershed, the second tool focuses on land conservation (Figure 10). Five types of land may need to be conserved in a subwatershed:

- Critical habitats;
- Aquatic corridors;
- Hydrologic reserve areas;
- Water pollution hazards; and
- Cultural areas.

Figure 10

A watershed manager must choose which of these natural and cultural areas must be conserved in a subwatershed in order to sustain the integrity of its aquatic and terrestrial ecosystems, and to maintain desired human uses from its waters. Four out of five are clearly important because they are key parts of healthy watersheds that should be conserved; water pollution hazards, however, seem out of place on the list. Nevertheless, such areas are intentionally “conserved” at locations carefully selected to minimize their negative impacts on important water resources.

While land conservation is most important in sensitive watersheds, it is also a critical tool for other types of resources. Each subwatershed should have its own land conservation strategy based on its management category, inventory of conservation areas, and land ownership patterns.

The five conservation areas are not always differentiable. Some of the natural areas may overlap among the conservation areas. For example, a freshwater wetland may serve as a critical habitat, be part of the aquatic corridor, and also comprise part of the hydrologic reserve areas. However, the bulk of the most critical areas are covered in at least one of these five categories.

Critical habitat (Figure 11): Critical habitats can be defined as the essential spaces for plant and animal communities or populations. Examples of critical habitats include tidal wetlands, freshwater wetlands, large forest clumps, springs, spawning areas in streams, habitat for rare or endangered species, potential restoration areas, native vegetation areas, and coves.

Figure 11

Aquatic Corridor (Figure 12): The aquatic corridor is the area where land and water meet. This can include floodplains, stream channels, springs and seeps, small estuarine coves, littoral areas, stream crossings, shorelines, riparian forest, caves, and sinkholes.

Hydrologic Reserve (Figure 13, next page): Hydrologic reserves are any undeveloped areas responsible for maintaining the predevelopment hydrologic response of a watershed. The three most common land uses are crops, forest, and pasture. From a hydrologic standpoint, forest is the most desirable land use followed by pasture, then crops.

Water Pollution Hazard (Figure 14, next page): This conservation area is defined as any land use or activity that is expected to create a relatively high risk of potential water pollution. Examples of water pollution hazards may include septic systems, landfills, hazardous waste generators, above or below ground tanks,

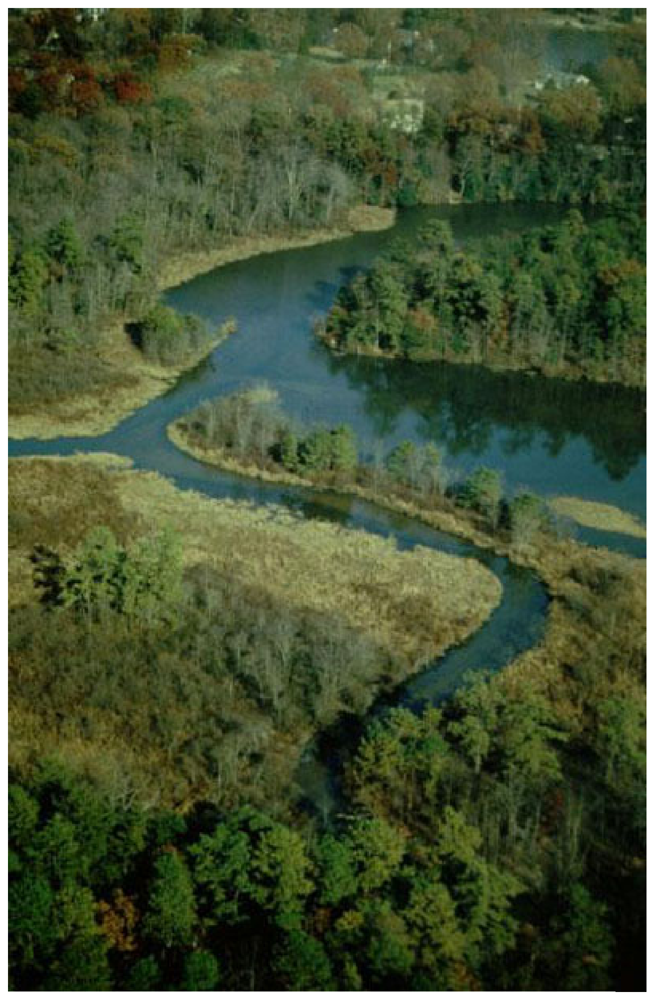


Figure 12

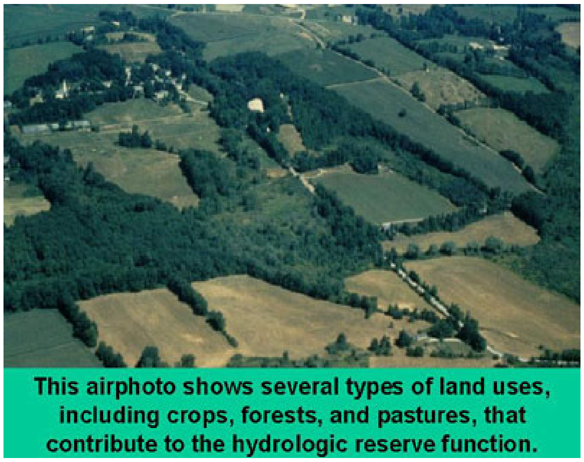


Figure 13

Figure 14

land application sites, impervious cover, stormwater “hotspots”, and road and salt storage areas. One way to avoid possible contamination to waterways is to locate such facilities at a designated distance away from the waterbody in order to decrease the chance of contamination.

Cultural Areas (Figure 15): Cultural areas provide a sense of place in the landscape and are important habitats for people. Examples of conservation areas include historic or archeologic sites, trails, parkland, scenic views, water access, bridges, and recreational areas.

Land Conservation Techniques (Figure 16): Numerous techniques can be used to conserve land which provide a continuum ranging from absolute protection to very limited protection. One of these techniques includes buying the land or the use of conservation easements. Conservation easements retain the original owner but pass part of the interest of the property to someone else and prevent the property from being developed.

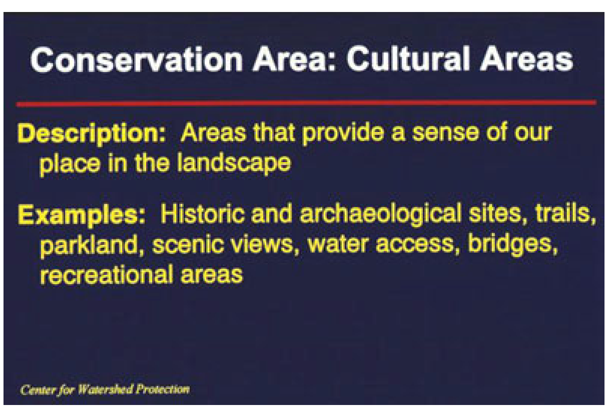


Figure 15

Figure 16

The third technique is to regulate land alteration. A law which restricts development on an area designated as a wetland is a good example of land alteration regulation. Another technique deals with hazard regulations which dictate where potential water pollution hazards can be placed in relation to waterbodies. The fifth technique, open space development, is the use of designs which incorporate open areas into a development site. These areas can be used for either passive or active recreational activity or preserved as naturally vegetated land. Since it is neither practical nor feasible to regulate everyone and everything, landowner and public sector stewardship are both important techniques to the conservation of land.

Key Land Conservation Choices for the Watershed Manager

When applying the land conservation tool, a watershed manager must make some careful choices about the mix of conservation areas to protect and what techniques to employ. Given the large areas that need to be conserved within some subwatersheds, many different conservation techniques need to be applied to cover the patchwork of public and private lands across a subwatershed. Some of the land conservation choices a watershed manager often has to make include the questions in Figure 17; how do these apply to your watershed?

Figure 17

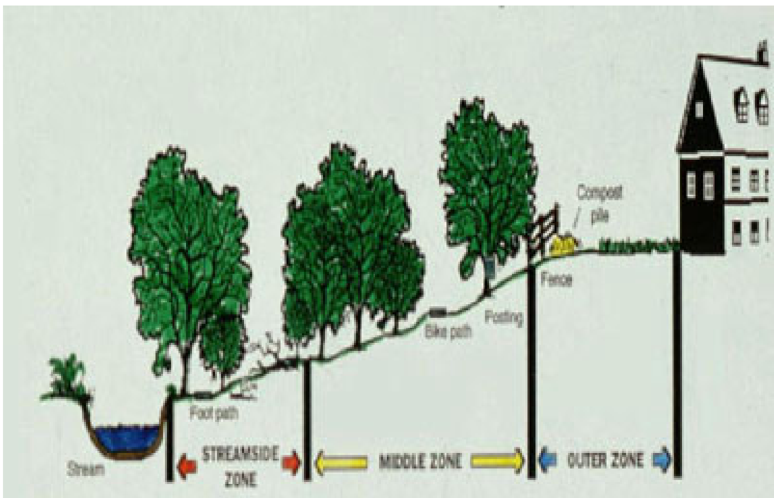
Tool 3: Aquatic Buffers

The aquatic corridor, where land and water meet, deserves special protection in the form of buffers (Figure 18). A buffer can be placed along a stream, shoreline, or around a natural wetland. A buffer has many uses and benefits. Its primary use is to physically protect and separate a stream, lake, or wetland from a wide variety of water pollutants and habitat impacts that can arise from too much land use too close to the water.

Figure 18

For streams, a network of buffers act as a right-of-way during floods and sustains the integrity of stream ecosystems and habitats. Technically, buffers are one type of land conservation area, but they are especially important because they:

- regulate light and temperature conditions, improving the habitat for aquatic plants and animals.
- are effective in removing sediment, nutrients, and bacteria from stormwater and groundwater
- help to stabilize and protect the streambanks.



The three zone buffer is a general structural approach for establishing basic buffer functions

Figure 19

The basic structure of a stream buffer in an urban setting is broken up into three zones which differ in functions, width, vegetative target, and allowed uses (Figure 19). In the eastern and northwestern US the streamside zone is often maintained as mature forest, with strict limitations on all other uses (in some arid desert or grassland regions of the country a forested buffer may be unachievable). The streamside zone also produces the shade and woody debris that is so important to stream quality and biota. The middle zone is typically a 50 to 100 feet wide forested area that is managed to allow some clearing. The outer zone, usually about 25 feet wide, is ideally forest but also can include turf. The three zone buffer is variable in width and should be increased to allow for protection of special areas such as wetlands and the floodplain.

Once established, the boundaries of buffers need to be clearly marked and enforced (Figure 20). A buffer that is well planned, designed, and maintained can help maximize its many potential benefits. Buffers are important because they make up an integral part of the watershed protection strategy and complement other programs and efforts to protect water quality.

This tree preservation area is clearly marked during the construction stage to prevent any clearing.

Figure 20

Key Buffer Choices for the Watershed Manager

When applying the buffer tool, a watershed manager must make some careful choices about which kinds of buffers are needed and how wide they must be. In many cases, a new buffer ordinance may need to be adopted or an old one revised to establish a more effective buffer network within a subwatershed. A watershed manager faces many tough questions, such as the ones in Figure 21, when designing a buffer program for a subwatershed.

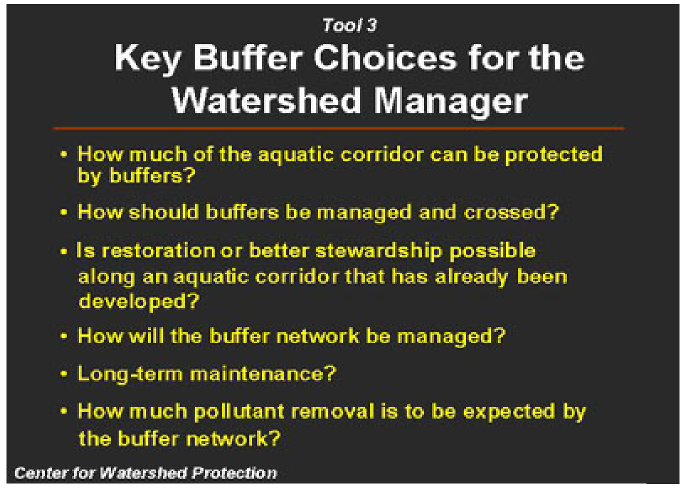


Figure 21

Tool 4: Better Site Design

Urban development (Figure 22) is often characterized by large amounts of impervious cover. Wide streets, huge cul de sacs (Figure 23), long driveways, and sidewalks lining both sides of the street are all features of site design that create impervious cover and consume natural areas. Many innovative site planning techniques have been shown to sharply reduce the impact of new development. Developers, however, are often unable to use these techniques in many communities because of outdated local zoning, parking or subdivision codes.

Figure 22

Three categories of better site design that have special merit for watershed protection include:

- Residential streets and parking lots;
- Lot development; and,
- Conservation of natural areas.

Figure 23

Residential Street and Parking Lots (Figure 24, next page): Approximately 65% of total impervious cover in the landscape is “habitat for cars,” in the form of parking lots, roads, and driveways. Much of this impervious cover is often unnecessary and can be minimized at every stage of parking lot and residential street planning and design.

Lot Development (Figure 25): "Habitat for people" (the area used in house lots) is a necessary part of any community, but many lot development practices result in excessive impervious cover and clearing of natural areas. These impacts can be reduced by changing the shape, orientation, and layout of residential lots. One popular technique, open space design development, minimizes lot sizes within a compact developed portion of a property while leaving the remaining portion open.

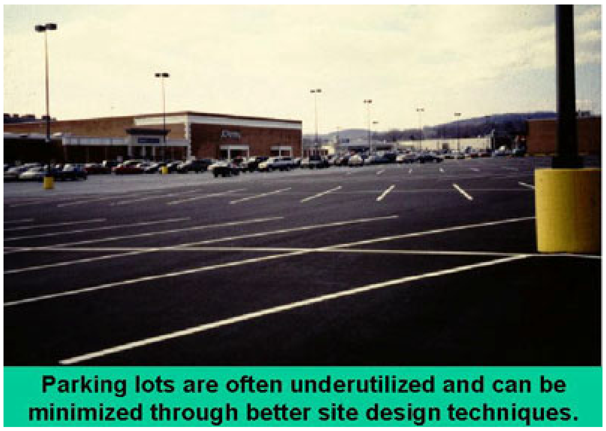


Figure 24

Figure 25

Conservation of Natural Areas: The goals are to protect all bodies of water and existing vegetation and minimize clearing. These techniques include the establishment and maintenance of buffers, tree conservation, and providing conservation incentives.

Key Site Design Choices for the Watershed Manager

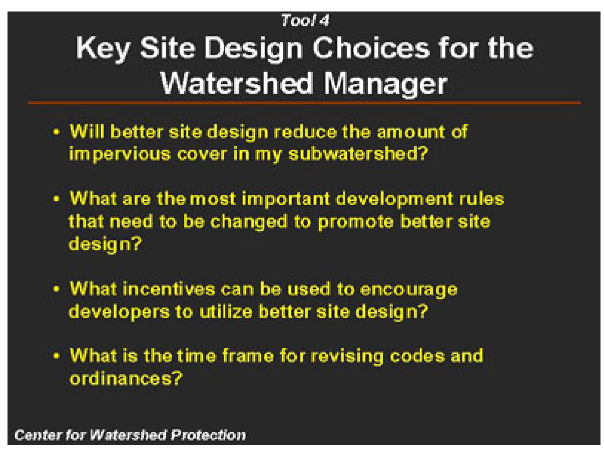


Figure 26

When using the better site design tool, a watershed manager should be realistic about how much impervious cover can be reduced through better site design in a subwatershed (Figure 26). While better site designs can reduce the impacts of individual development projects, the cumulative impact of too much development can still degrade water resources, no matter how well each site is designed. The value of the site design tool appears to be greatest in those subwatersheds that are approaching their maximum impervious cover limit. Thus, a watershed manager needs to make some careful choices on how to best promote better site designs within a subwatershed. For more information on the principles of better site design, refer to the "Better Site Design" module at this Internet site.

Tool 5: Erosion and Sediment Control

Figure 27

Perhaps the most destructive stage of the development cycle is the relatively short period when vegetation is cleared and a site is graded to create a buildable landscape. The potential impacts to receiving waters are particularly severe at this stage. Trees and topsoil are removed, soils are exposed to erosion, natural topography and drainage patterns are altered, and sensitive areas are often disturbed.

Thus, the fifth watershed protection tool seeks to reduce sediment loss during construction and to ensure that conservation areas, buffers, and forests are not cleared or otherwise disturbed during construction (Figure 27). Every community should have an effective erosion and sediment control program to reduce the potentially severe impacts generated by the construction process. There are numerous techniques to provide erosion and sediment control (ESC) (Figure 28) and the most effective is to minimize clearing. Some examples include regulations that require exposed soil to be stabilized within 7 to 10 days. Other common methods of erosion and sediment control include sedimentation basins and silt fences (Figure 29). Unfortunately, without proper installation and maintenance, erosion and sediment controls are ineffective.

Ten Elements of an Effective Erosion and Sediment Control (ESC) Plan

1. Minimize Needless Clearing and Grading
2. Protect Waterways and Stabilize Drainage Ways
3. Phase Construction to Limit Soil Exposure and Compaction
4. Stabilize Exposed Soils Immediately
5. Protect Steep Slopes and Cuts
6. Install Perimeter Controls to Filter Sediments
7. Employ Advanced Sediment Settling Controls
8. Certify Contractors on ESC Plan Implementation
9. Adjust ESC Plan at Construction Site
10. Assess ESC Practices After Storms

Figure 28

Figure 29

Key Erosion and Sediment Control Choices for the Watershed Manager

Every community should have an effective erosion and sediment control program to reduce the potentially severe impacts generated by the construction process. The watershed manager should play a key role in defining which specific ESC practices need to be applied within the subwatershed to best protect sensitive aquatic communities, reduce sediment loads, and maintain the boundaries of conservation areas and buffers. Some of the key decisions that watershed managers often make at the subwatershed level are listed in Figure 30.

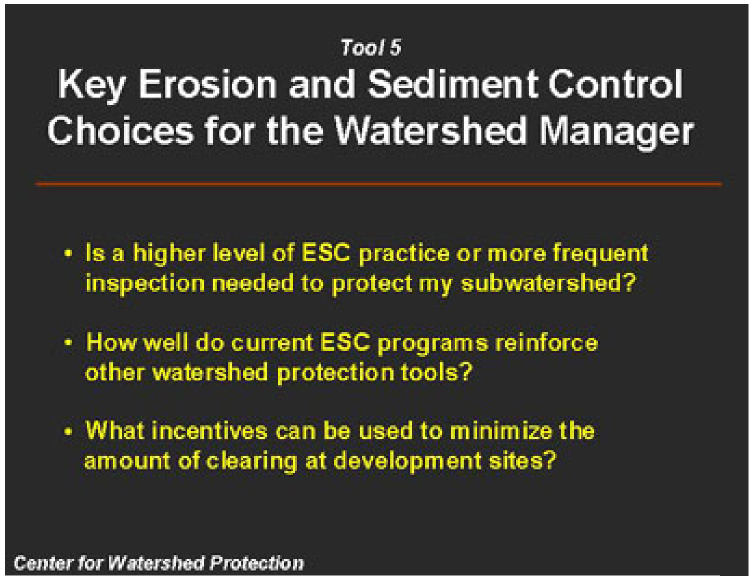


Figure 30

Tool 6: Stormwater Management Practices

A watershed manager needs to make careful choices about what stormwater management practices should be installed in the subwatershed to compensate for the hydrological changes caused by new and existing development. Stormwater management practices are used to delay, capture, store, treat, or infiltrate stormwater runoff (Figure 31). A key choice is to determine the primary stormwater objectives for a subwatershed that will govern the selection, design, and location of stormwater management practices at individual sites. While specific design objectives for stormwater management practices are often unique to each subwatershed, the general goals for stormwater management practices are often the same, and include:

Figure 31

- maintain groundwater quality and recharge;
- reduce stormwater pollutant loads;
- protect stream channels;
- prevent increased overbank flooding; and
- safely convey extreme floods.

There are numerous structural stormwater management techniques for controlling stormwater quantity and quality. These five practices can be categorized into five broad groups, including:

- ponds (Figure 32);
- wetlands (Figure 33);
- infiltration (Figure 34);
- filtering systems (Figure 35); and
- grassed channels (Figure 36, next page).


Stormwater wet ponds are characterized by a permanent pool of water.

Figure 32


Stormwater wetlands treat stormwater for both water quality and quantity.

Figure 33

While many advances have been made recently in innovative stormwater management designs, their ability to maintain resource quality in the absence of other watershed protection tools is limited. In fact, stormwater management practices designed or located improperly can sometimes cause more severe secondary environmental impacts than if they were not installed at all.


Bioretention areas are a filtering system often used in parking lots.

Figure 34


Infiltration trenches allow stormwater to percolate slowly into the soil.

Figure 35

Figure 36

Key Stormwater Management Choices for the Watershed Manager

Selecting the best stormwater management strategy can be a real challenge for the watershed manager. Some of the important issues and questions that watershed managers should address are listed in Figure 37.

Tool 7: Non-Stormwater Discharges

This tool is concerned with how wastewater and other non-stormwater flows are treated and discharged in a watershed (Figure 38). Key program elements consist of inspecting private septic systems, repairing or replacing failing systems, utilizing more advanced on-site septic controls, identifying and eliminating illicit connections from municipal stormwater systems, and spill prevention.

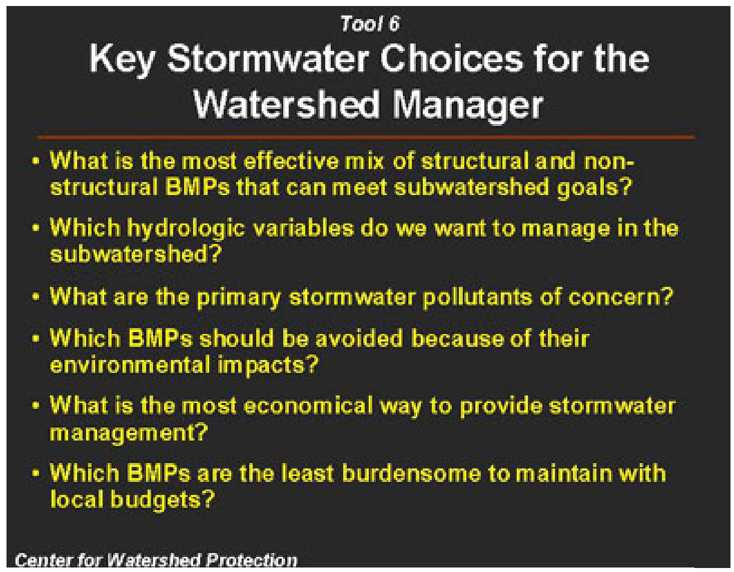


Figure 37

Figure 38

Most non-stormwater discharges are strictly governed under the National Pollutant Discharge Elimination System (NPDES) and require a state or federal permit. The three basic categories of non-stormwater discharges are septic systems, sanitary sewers, and other miscellaneous non-stormwater discharges.

1) Septic Systems, (Figure 39) or on-site sewage disposal systems, are used to treat and discharge wastewater from toilets, wash basins, bathtubs, washing machines, and other water consumptive items that can be sources of high pollutant loads. One out of four homes in the country uses a septic system, collectively discharging a trillion gallons of wastewater annually (NSFC, 1995). Because of their widespread use and high volume discharges, septic systems have the potential to pollute groundwater, lakes and streams if they are located improperly or if they fail. Even properly functioning septic systems can be a substantial source of nutrient loads in some settings. Unlike other non-stormwater discharges, septic systems are not regulated under NPDES, but are approved by local and state health agencies. It is estimated that as many as 20-25% of septic systems nationwide are not operating as designed, and are failing.

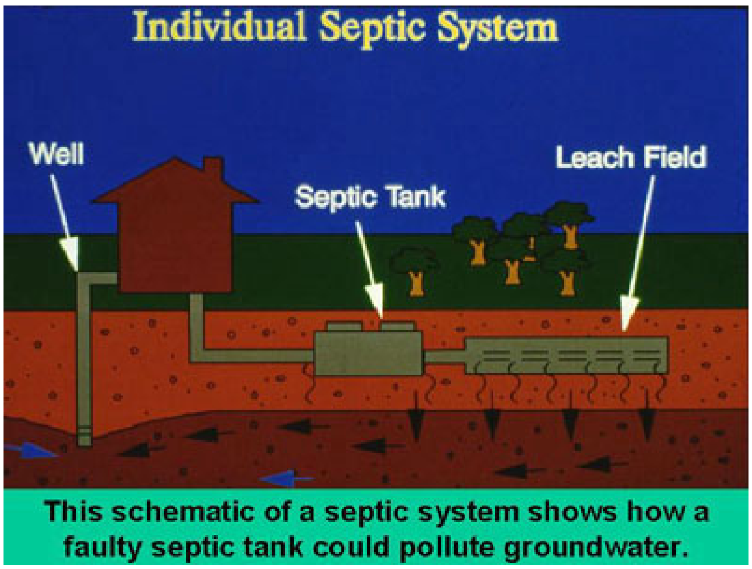


Figure 39

2) Sanitary sewers collect wastewater in a central sewer pipe and send it to a municipal treatment plant. Ideally, this permits more efficient collection of wastewater, and often higher levels of pollutant reduction. The extension of sanitary sewer lines is not without some risk, however, as it has the potential to induce more development than may have been possible in a watershed previously served only by on-site sewage disposal systems (particularly when soils are limiting). Most communities cannot refuse service to new developments within the water and sewer envelope, so the decision to extend lines into undeveloped areas will allow future developers to tap into the line.

In addition, not all sanitary sewer conveyance and treatment systems are capable of achieving high levels of pollutant reduction. Examples include:

- package treatment plants;
- combined sewer overflows;
- sanitary sewer overflows; and,
- illicit or illegal connections to the storm drain network.

3) Other non-stormwater discharges (Figure 40). Wastewater is not the only non-stormwater discharge possible in a watershed. A planner should also investigate whether other non-stormwater discharges are a factor in the subwatershed. Examples include:

- industrial NPDES discharges;
- urban "return flows" (discharges caused by activities such as car washing and watering lawns);
- water diversions; and,
- runoff from confined animal feeding lots.

Figure 40

Key Non-Stormwater Discharge Choices for the Watershed Manager

One of the first priorities for a watershed manager is to conduct a quick inventory of the nature and extent of non-stormwater discharges in the subwatershed. If non-stormwater discharges appear to be a problem, a watershed manager may need to conduct a subwatershed survey. This usually involves a survey of the largest or most common wastewater discharges within the subwatershed, with a strong emphasis on how wastewater is actually conveyed within the subwatershed (i.e. via sanitary sewer, septic systems, etc.). Some issues are listed in Figure 41.

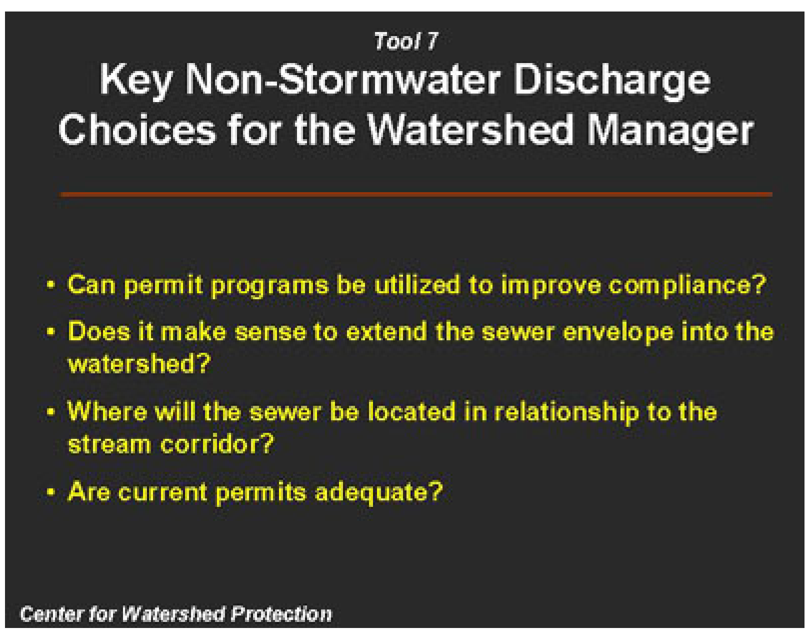


Figure 41

Tool 8: Watershed Stewardship Programs

Once a subwatershed is developed, communities still need to invest in ongoing watershed stewardship. The goals of watershed stewardship are to increase public awareness about watershed management efforts and to get local landowners' participation in the process to ensure stewardship on their own property and homes (Figure 42).

Figure 42

There are six basic programs that watershed managers should consider to promote greater watershed stewardship:

- Watershed advocacy
- Watershed education
- Watershed maintenance
- Pollution prevention
- Indicator monitoring
- Watershed restoration

Watershed Advocacy: Advocacy of watershed protection is important because it can lay the foundations for public support and greater watershed stewardship. One of the most important investments that can be made in a watershed is to seed and support a watershed management structure to carry out the long-term stewardship function. Often, grass roots watershed management organizations are uniquely prepared to handle many critical stewardship programs, given their watershed focus, volunteers, low cost and ability to reach into communities. Watershed organizations can be effective advocates for better land management and can develop broad popular support and involvement for watershed protection. Local governments often have an important role to play in watershed advocacy; in many watersheds, local governments create or direct the watershed management structure.

Watershed Education (Figure 43): A basic premise of watershed stewardship is that we must learn two things - that we all live in a watershed and that we understand how to live within it. The design of watershed education programs that create this awareness is of fundamental importance; some of the most effective programs merge learning, the enjoyment of outdoor recreation, and the development of personal involvement in watershed stewardship. Four types of watershed education programs are:

Interpretive trails, signs, and guided tours along waterways are tools for raising awareness of watershed values and encouraging personal stewardship in the community.

Figure 43

- watershed awareness: raising basic watershed awareness using signs, storm drain stenciling, streamwalks, maps
- personal stewardship: educating residents about the individual role they play in the watershed and communicating specific messages about positive and negative behaviors
- professional training: educating the development community on how to apply the tools of watershed protection
- watershed engagement: providing opportunities for the public to actively engage in watershed protection and restoration.

These citizen volunteers are planting trees in a stream corridor to help create a buffer.

Figure 44

Watershed Maintenance (Figure 44): Most watershed protection tools require maintenance if they are to properly function over the long run. Some of the most critical watershed "maintenance" functions include management of conservation areas and buffer networks, and maintenance of stormwater practices, septic systems, and sewer networks. Maintenance of the quality of watersheds may even require some replanting of natural vegetation cover and can also provide an opportunity for public involvement and education.

Pollution Prevention: Some businesses may need special training on how to manage their operations to prevent pollution and thereby protect the watershed. In some cases, local or state government may have a regulatory responsibility to develop pollution prevention programs for certain businesses and industrial categories (e.g., under industrial or municipal NPDES permits).

Watershed Indicator Monitoring (Figure 45): An ongoing stewardship responsibility is to monitor key indicators to track the health of the watershed. Public agencies, as well as private corporations, citizen groups, and even landowners should seriously consider monitoring to provide appropriate indicator data that will answer their own questions. Monitoring water quality can include assessing flow, the quantity and quality of aquatic biota, pollutant levels, and many other characteristics as appropriate to the type of water body and its problems.

Figure 45

Watershed Restoration: The last phase of watershed stewardship is to restore or at least rehabilitate streams that have been degraded by past development. Urban watershed restoration is an emerging art and science that seeks to remove pollutants and enhance habitat to restore urban streams. The urban watershed restoration process should include three main themes: stormwater retrofitting, source control through pollution prevention, and stream enhancement.

Key Stewardship Choices for the Watershed Manager

Some of the issues that watershed managers should address when designing watershed stewardship programs are listed in Figure 46. How many are relevant to your watershed, and your community?

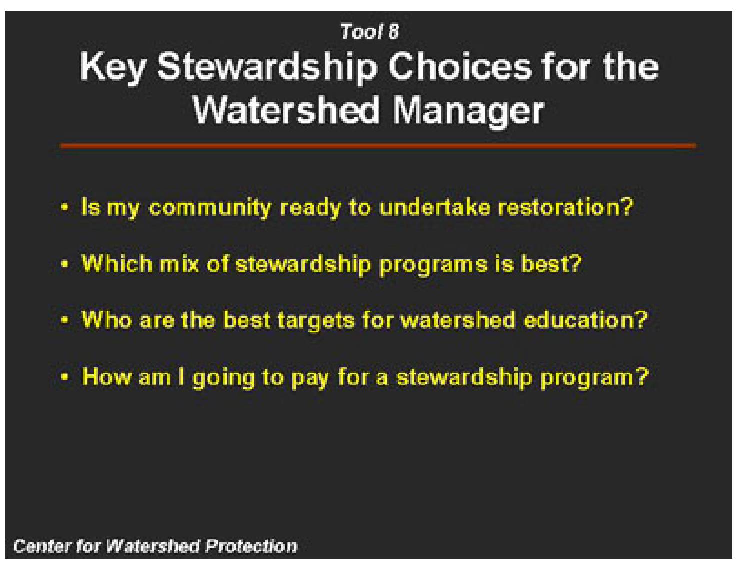


Figure 46

Summary

Figure 47

This module has provided a simple introduction to the eight basic watershed protection tools (Figure 47). These tools are essential to the protection, preservation, and restoration of our lakes, streams, and estuaries, and they also can benefit many terrestrial habitats and human activities in urbanized and developing watersheds. The biggest challenge for watershed managers is to select the right combination of practices to form the most effective plan based on the specific goals of their watershed. For more information on the watershed protection tools, please consult the 1998 *Rapid Watershed Planning Handbook* (www.cwp.org) developed by the Center for Watershed Protection.

A self-test to assess your comprehension is included on page 28 of this module.

Acknowledgments

This module was developed by the Center for Watershed Protection with assistance from the USEPA Office of Wetlands, Oceans and Watersheds/the Watershed Academy. Our thanks also to several technical reviewers: Donald Garofalo, Robert Goo, Charles Gregg, Karen Northup, and Terry Slonecker.

Glossary

Aquatic corridor. An area of land and water which is important to the integrity and quality of a stream, river, lake, wetland, or other body of water. An aquatic corridor usually consists of the actual body of water ("corridor" usually connotes a river or stream), the adjacent buffer, and a fringe of adjacent upland areas.

BMPs (Best Management Practices). Methods that have been determined to be the most effective, practical means of preventing or reducing pollution from non-point sources, such as pollutants carried by urban runoff.

Buffer. An area adjacent to a lake or estuarine shoreline, wetland edge, or streambank, where a) critically important ecological processes and water pollution control functions take place, and b) development may be restricted or prohibited for these reasons.

Cluster or Open Space Development. The use of designs which incorporate open space into a development site; these areas can be used for either passive or active recreational activity or preserved as naturally vegetated land

Combined Sewer Overflow. Discharge of a mixture of storm water and domestic waste, occurring when the flow capacity of a sewer system is exceeded during rainstorms.

Conservation easements. A practice used to apply and enforce restrictions to preserve natural resources. Typically, a landowner will grant very specific rights concerning a parcel of land to a qualified recipient (e.g. public agency or non profit land conservancy organization). The easement gives the recipient the right to enforce the restrictions. The recipient does not assume ownership but does assume long-term responsibility for enforcement and stewardship of the easement. For example, a wildlife management agency may obtain easements in forested floodplains from private landowners that help them manage wildlife and fish.

Floodplain. A generally flat, low-lying area adjacent to a stream or river that is subjected to inundation during high flows. The relative elevation of different floodplains determines their frequency of flooding, ranging from rare, severe storm events to flows experienced several times a year. For example, a "100-year floodplain" would include the area of inundation that has a frequency of occurring, on average, once every 100 years.

Illicit connections. Illegal and/or improper waste discharges into storm drainage systems and receiving waters.

Impacted stream or subwatershed. A very general, watershed imperviousness-based classification category for a subwatershed with 11 to 25% impervious cover. Urbanization is generally expected to lead to some impacts on stream quality, but the type and magnitude of these effects can vary significantly among different watersheds at similar levels of imperviousness.

Impervious cover. Any surface in the urban landscape that cannot effectively absorb or infiltrate rainfall; for example, sidewalks, rooftops, roads, and parking lots.

Imperviousness. The percentage of impervious cover by area within a development site or watershed, often calculated by identifying impervious surfaces from aerial photographs or maps.

National Pollutant Discharge Elimination System (NPDES). Established by Section 402 of the Clean Water Act, this federally mandated permit system is used for regulating point sources, which include discharges from industrial and municipal facilities and also stormwater discharges from discrete conveyances such as pipes or channels.

Non-stormwater flows. Runoff which occur from sources other than rainwater; for example, personal car washing, lawn watering overspray, street cleaning, or pressure-washing of restaurant waste disposal facilities.

Non-supporting stream or subwatershed. A very general, watershed imperviousness-based classification category for a stream or subwatershed with more than 25% total impervious cover. Urbanization is generally expected to lead to some impacts on stream quality, but the type and magnitude of these effects can vary significantly among different watersheds at similar levels of imperviousness. These non-supporting streams are usually not candidates for restoration of relatively healthy aquatic ecosystems, but often can benefit from some physical rehabilitation designed to reduce additional degradation – for example, excessive erosion and siltation – that affects downstream areas.

Open Space. A portion of a site which is permanently set aside for public or private use and will not be developed. The space may be used for passive or active recreation, or may be reserved to protect or buffer natural areas.

Package Treatment Plant. A small, onsite waste treatment facility designed to handle the specific needs of a specialized, small, or remotely located waste generator; for example, a treatment plant that services a trailer park.

Rooftop runoff. Rainwater which falls on rooftops, does not infiltrate into soil, and runs off the land.

Sensitive stream or subwatershed. A very general, watershed imperviousness-based classification category for a stream or a subwatershed with less than 10% impervious cover, that is potentially still capable of supporting stable channels and good to excellent biodiversity. Urbanization is generally expected to lead to some impacts on stream quality, but the type and magnitude of these effects can vary significantly among different watersheds at similar levels of imperviousness.

Stormwater "hotspots." Land uses or activities that generate highly contaminated runoff. Examples include fueling stations and airport de-icing facilities.

Stormwater best management practice. A structural or non structural technique designed to temporarily store or treat stormwater runoff in order to mitigate flooding, reduce pollution, and provide other amenities

Stormwater runoff. Rainwater which does not infiltrate into the soil and runs off the land

Subwatershed. A smaller geographic section of a larger watershed unit with a drainage area between 2 to 15 square miles and whose boundaries include all the land area draining to a point where two second order streams combine to form a third order stream

Transferable Development Rights (TDRs). A form of incentive for developers in which the developer purchases the rights to an undeveloped piece of property in exchange for the right to increase the number of dwelling units on another site. Often used to concentrate development density in certain land areas.

Watershed. An area of land that drains water, sediment and dissolved materials to a common receiving body or outlet. The term is not restricted to surface water runoff and includes interactions with subsurface water. Watersheds vary from the largest river basins to just acres or less in size. In urban watershed management, a watershed is seen as all the land which contributes runoff to a particular water body.

Zoning. A set of local government regulations and requirements that govern the use, placement, spacing and size of buildings and lots (as well as other types of land uses) within specific areas designated as zones primarily dedicated to certain land use types or patterns.

Self Test for Eight Tools of Watershed Protection Module

After you've completed the quiz, check your answers with the ones provided on page 30 of this document. A passing grade is 7 of 10 correct, or 70%.

1. Land use planning is the single most important tool of watershed protection.

☐ A. True.

☐ B. False.

2. The basic goals of land use planning are to: 1) apply land use planning techniques to redirect development while preserving sensitive areas and 2) to maintain or reduce the impervious cover within a given watershed.

☐ A. True.

☐ B. False.

3. A three zone buffer is a buffer that is in three zone types: an overlay zone, a performance zone and a large lot zone.

☐ A. True.

☐ B. False.

4. The most destructive stage of the development cycle is clearing and grading.

☐ A. True.

☐ B. False.

5. The most effective technique for providing erosion and sediment control is to create aquatic buffers.

☐ A. True.

☐ B. False.

6. Stormwater management practices can help to maintain groundwater recharge and quality, reduce stormwater pollutant loads, protect stream channels, prevent increased overbank flooding and safely convey extreme floods.

- [ ] A. True.
- [ ] B. False.

7. Structural stormwater management practices include ponds, wetlands, infiltration, filtering systems and open channels.

- [ ] A. True.
- [ ] B. False.

8. Properly functioning septic systems are never a source of nutrient loads.

- [ ] A. True.
- [ ] B. False.

9. Non-stormwater discharge flows include septic systems, sanitary sewers, and runoff from confined animal feeding lots.

- [ ] A. True.
- [ ] B. False.

10. Urban "return flows" are septic system or sanitary sewer backups.

- [ ] A. True.
- [ ] B. False.

Answers for Eight Tools of Watershed Protection Module Self Test

Q1: A Q2: A Q3: B Q4: A Q5: B Q6: A Q7: A Q8: B
Q9: A Q10: B