Integrating Wetlands into Watershed Protection Efforts

May 17, 2006 Webcast

Tom Schueler
Center for Watershed Protection

The Watershed Academy

EPA

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About the Center for Watershed Protection

- Non-profit 501(c)3, non-advocacy organization
- Work with watershed groups, local, state, and federal governments
- Provide tools communities need to protect streams, lakes, and rivers
- 20 staff in Ellicott City, MD
- www.cwp.org
- www.stormwatercenter.net

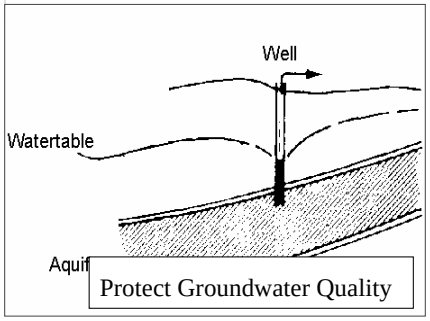
May is American Wetlands Month

Events are planned throughout the country to celebrate wetlands—perhaps one is scheduled in your neighborhood!

For more info, see EPA's Web site:
www.epa.gov/owow/wetland/awm

Protect Fisheries

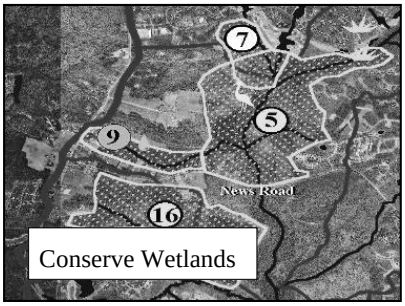
Protect Forests and Farms



Protect Groundwater Quality

Protect Drinking Water Quality

Protect Coastal Resources



Conserve Wetlands

Protect Lake Water Quality

Maintain Stream Quality

Key Themes

- Wetlands and Watershed Functions
- Impact of Land Development on Wetlands
- The Case for Local Wetland Protection
- The Eight Tool Approach
- Resources

8. Watershed Stewardship

1. Watershed Planning

2. Land Conservation

7. Non-Stormwater Discharges

The 8 Tools of Watershed Protection

Remember me?

3. Aquatic Buffers

6. Stormwater Management

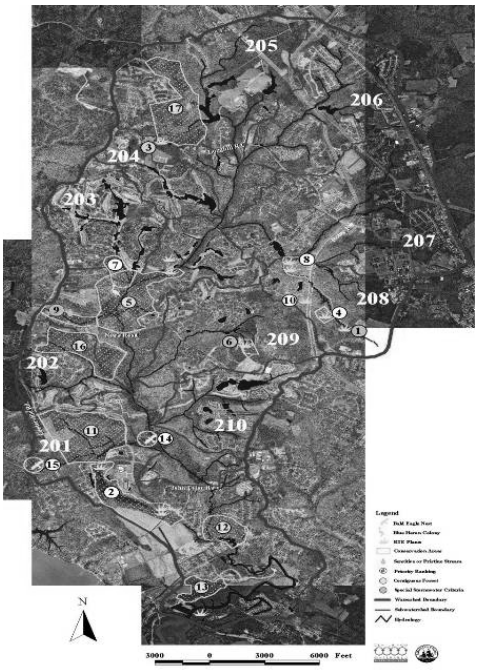
5. Erosion & Sediment Control

4. Better Site Design

Watershed Benefits of Wetlands

Depends on size and landscape position:

- Flood storage
- Pollutant removal
- Groundwater
- Habitat
- Shoreline/stream protection



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This is an example conservation areas map that prioritizes areas based on a combination of factors, such as habitat for heron rookeries, RTE plant species, contiguous forests, or riparian corridors.

Minimum Wetland Cover to Perform Watershed Functions

Watershed Function	% Wetland Cover
Water Quality	1-5 %
Phosphorous retention	15%
Nitrogen removal	5%
Flood Control	7%
Nitrogen retention	3.4% - 8.8%

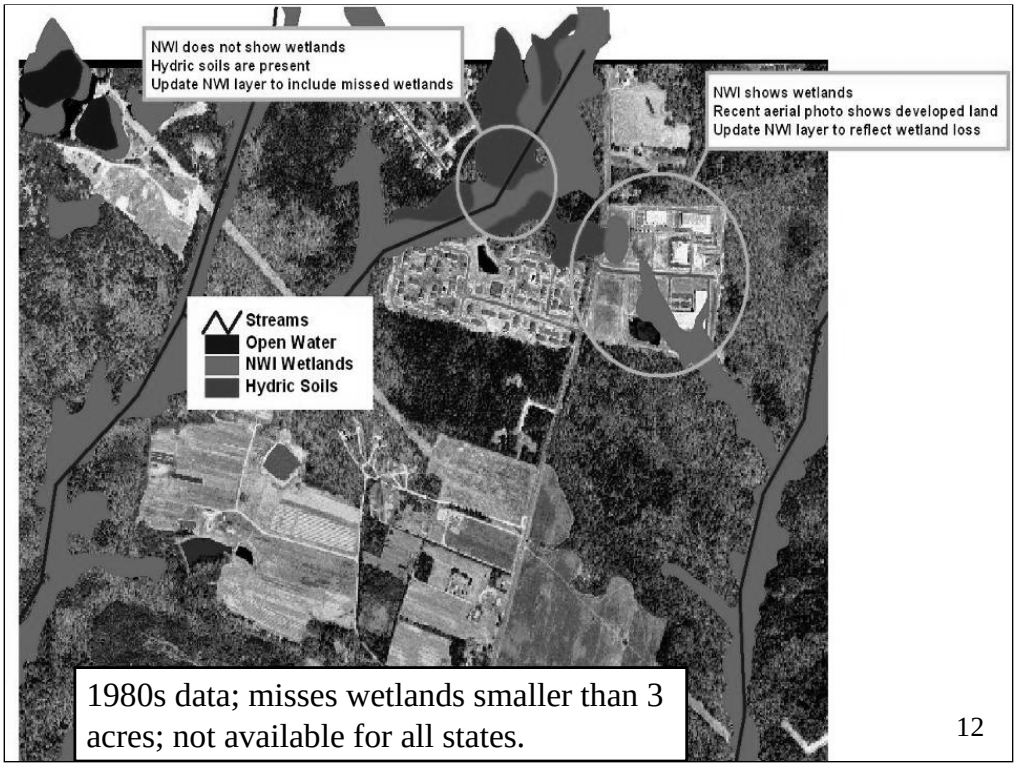
Source: Mitsch and Gosselink, 2000

Replacing Lost Wetland Functions

Wetland Function	Replacement Alternatives
Pollutant removal	Water treatment plants; stormwater practices, best management practices
Flood attenuation	Stormwater detention ponds, dikes and levees, floodplain management
Groundwater recharge	Deeper wells; injection wells; alternative water sources
Shoreline protection	Shoreline and stream bank stabilization
Wildlife	Habitat restoration; species stocking

Protecting Urban Wetlands: Basic Concepts

- Wetland Inventory
- Landscape Position (HGM)
- Contributing Drainage Area (CDA)
- Wetland Function
- Wetland Sensitivity

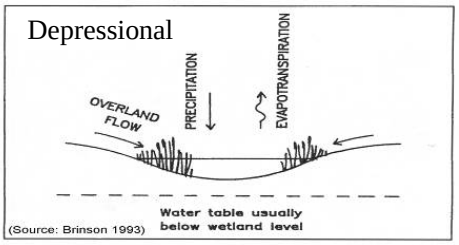


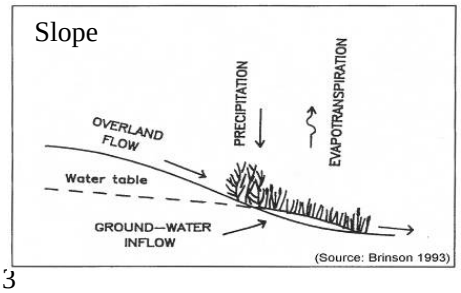
1980s data; misses wetlands smaller than 3 acres; not available for all states.

Landscape Position
HGM Wetland Classification

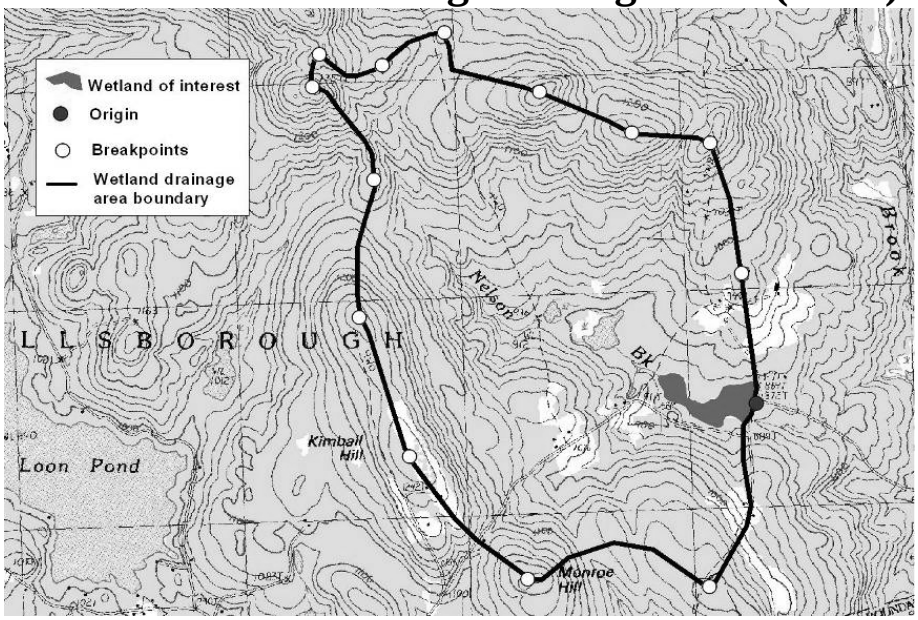
- Depressional
- Slope
- Riverine
- Fringe
- Flat
- Headwater Stream Channel

Landscape position influences Contributing Drainage Area and wetland sensitivity



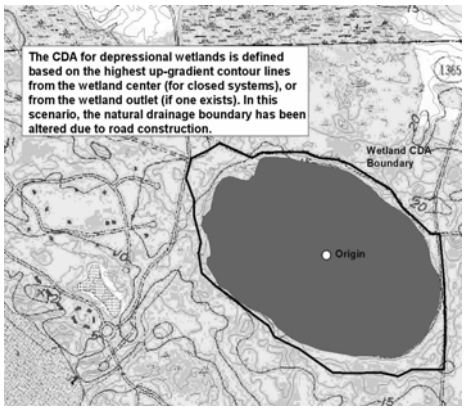


Delineate Contributing Drainage Area (CDA)

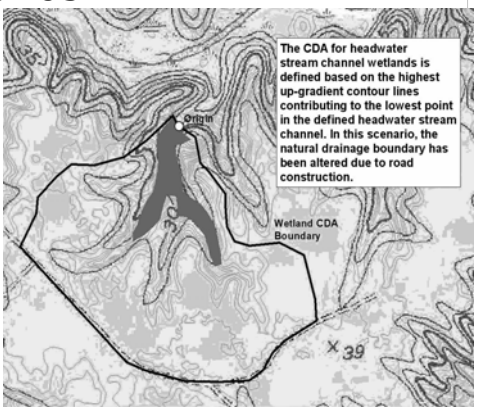


Adapted from Ammann and Lindley Stone, 1991

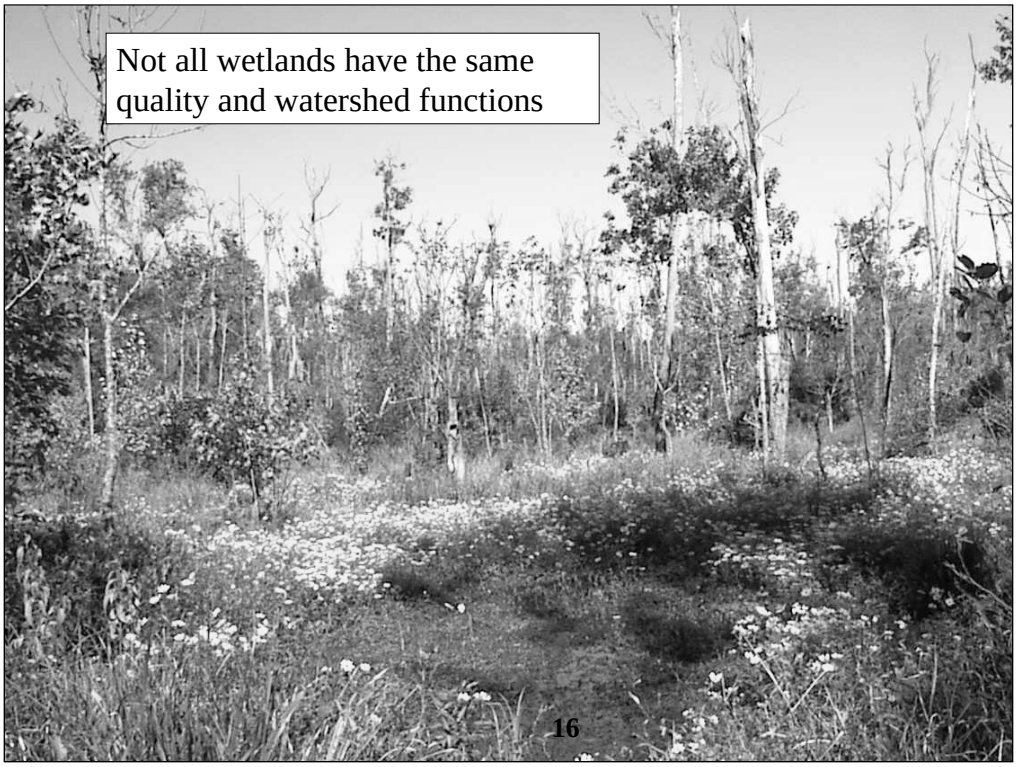
CDA Delineation Methods for Different Wetlands

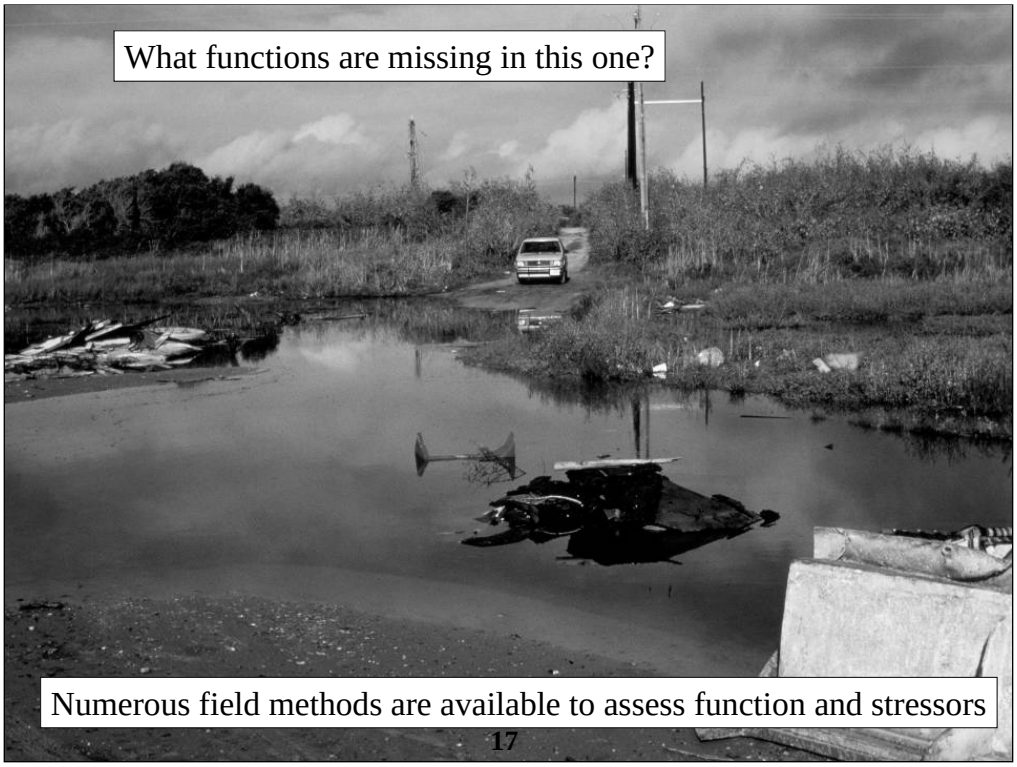


Depressional wetlands



Headwater stream channel wetlands


Not all wetlands have the same quality and watershed functions


What functions are missing in this one?
Numerous field methods are available to assess function and stressors

Normally Sensitive	Not Very Sensitive
▪Sedge meadows ▪Bogs and fens ▪Coniferous swamps ▪Lowland hardwood swamps ▪Seasonally flooded basins ▪Vernal pools ▪Wetlands containing rare, threatened or endangered (RTE) species	▪Phragmites marshes ▪Reed canary grass meadows ▪Purple loosestrife ▪Floodplain forests ▪Fringe wetlands ▪Treatment wetlands ▪Cattail marshes ▪Highly degraded wetlands

Q& A Break

Picture by Donald J. Leopold, from Welsch et al., 1995

Direct Impacts on Wetlands

- **Dredging**
- **Filling**
- **Draining**
- **Dumping**

Direct Impact: Development

A forested wetland (left) was filled to build a subdivision (right)

Source: Buzzard's Bay National Estuary Program

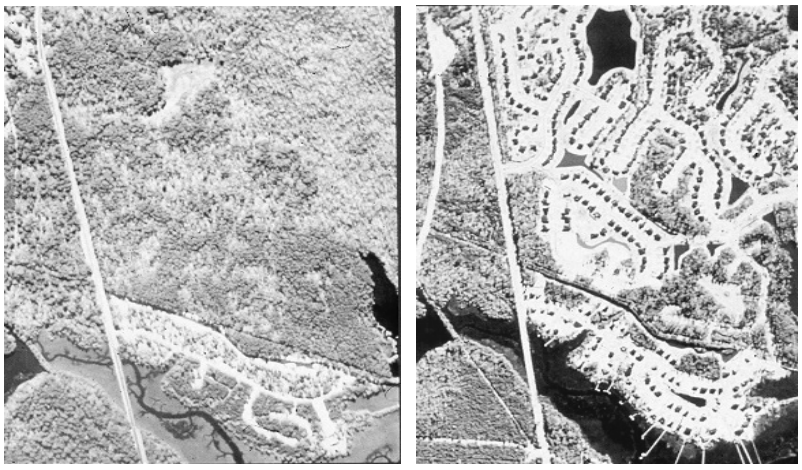
Death by a thousand cuts: Wetland fills for road crossings are often allowed under general permits

Source: Minnesotans for Responsible Recreation

Wetland Loss Continues in Urban Watersheds

- Smaller and isolated wetlands are not fully protected
- Mitigation often occurs out of the watershed
- Mitigation does not always replace the same wetland type (e.g., out-of-kind)
- Mitigation is not done or is unsuccessful (NAS, 2001)

Wetland Development Pressures are Great, Particularly Along the Coast



1994 25 **1999**

This slide illustrates land and impervious cover changes in a portion of Horlbeck creek's watershed.

As you can see, approximately 70 hectares for forest were cleared to make way for a new residential housing development. This resulted in increases in impervious cover typical of levels in suburban creeks.

These changes to forested tracts of land are typical of the type of urbanization currently occurring the tri-county area.

National Wetland Loss: 1950 to 1997

Time Period	Net Annual Rate of Loss	Percent of total loss from development	Source
1950s to 1970s	458,000 acres	8%	Frayer et al. (1983)
Mid-1970s to mid-1980s	290,000 acres	5%	Dahl and Johnson (1991)
1986 to 1997	58,500 acres	51%	Dahl (2000)
1998-2004		61%	Dahl (2006)

Research on Indirect Impacts of Land Development on Wetlands

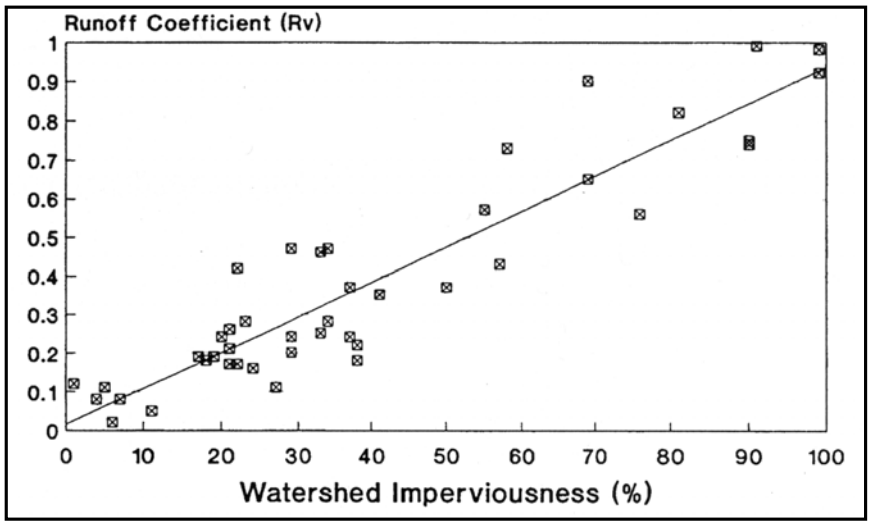
- More than 100 articles on the indirect impacts of development on wetlands were reviewed
- More than 40% published in last 5 years
- Wide range of scientific disciplines
- From 30 U.S. states and Canadian Provinces.

Lit review article to appear on CWP wetland website soon!

Indirect Impacts of Stormwater on Wetlands

- Alteration of wetland hydroperiods
- Increased nutrients
- Sediment deposition
- Invasive species
- Salt loading

Land Development Increases Runoff From the CDA



Runoff coefficients increase as watershed imperviousness increases

Source: Schueler, 2000

Hydrologic Stressors in Urban Wetlands

- Increased ponding
- Increased water level fluctuation
- Hydrologic drought
- Reduced groundwater input

Too much stormwater inundation kills trees

Hydrologic Drought

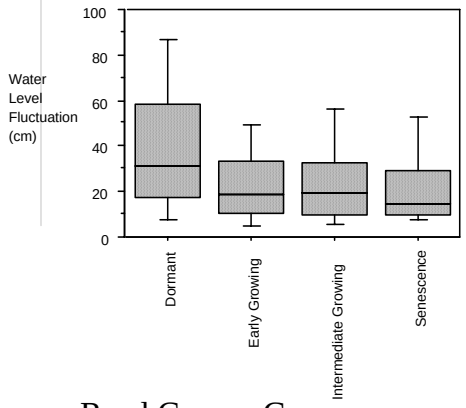
Riparian forests become upland forests as the water table lowers in response to urban channel incision

Road crossings interrupt urban streams and can affect hydrology of streams and wetlands

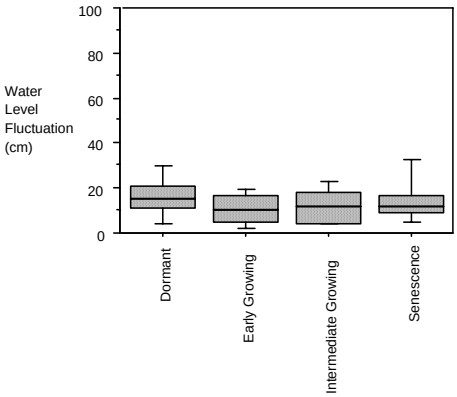
Impacts on Wetland Hydroperiod

- Stormwater increases the water level fluctuation (WLF) within the wetland
- Even a modest WLF or “bounce”:
  - Reduces wetland plant richness
  - Reduces thin stemmed species
  - Promotes invasive species
  - Reduces amphibian diversity

Plant Species and Water Level Fluctuations



Reed Canary Grass



Cattail

From Cooke and Azous (1997)

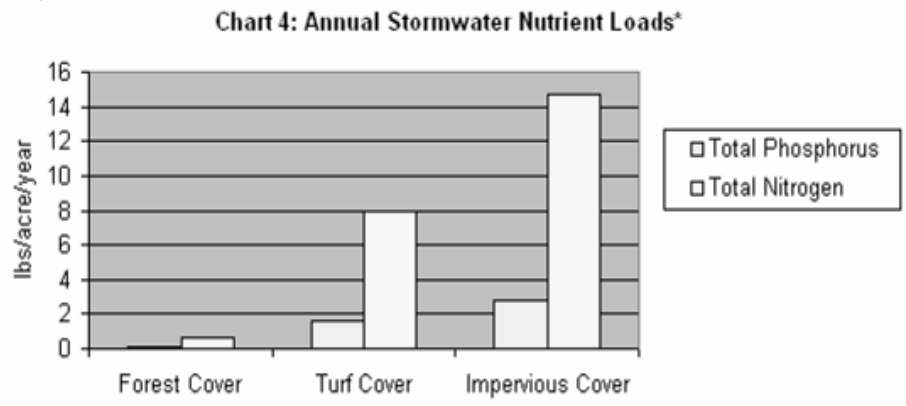
Water quality stressors

- Sediment accumulation
- Sediment contamination
- Nutrients
- Chloride
- Metals

Median Nutrient Concentrations in Stormwater

Constituent	Residential	Commercial	Open Space
Total Phosphorus	0.3 mg/l	0.22 mg/l	0.25 mg/l
Nitrate	2.0 mg/l	2.2 mg/l	1.2 mg/l
Source: NSQD, CWP, 2004			

Flow x Concentration = Annual Nutrient Load



Evidence of high nutrient input in a Delaware Bald Cypress Swamp

Photo by Jason Tomlinson

Biological Response: Plant Community

- 50% of studies link changes in hydroperiod and WLF to:
  - Reduced plant species richness
  - Loss of sensitive plant species
  - Increased number of invasive plants
  - Tree mortality (60% of freshwater wetlands are forested)
- Some wetland communities are more sensitive than others (fens, bogs).

Biological Response: Animal Community

- Hydrological and water quality stressors and changes in plant community lead to declining species richness for
  - Macroinvertebrates
  - Amphibians
  - Reptiles
  - Birds
- Other factors such as proximity to roads, culverts and other disturbance play a role.

Wetland Assessments

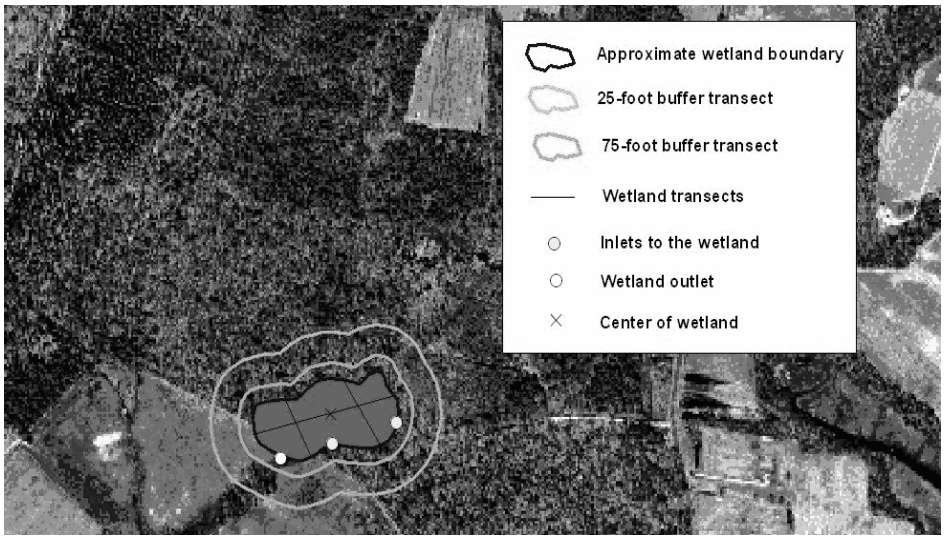
- Condition, function and restorability
- Different wetlands perform different functions
- Many different techniques (200+) are currently available to assess wetland functions and values

What We Look for:

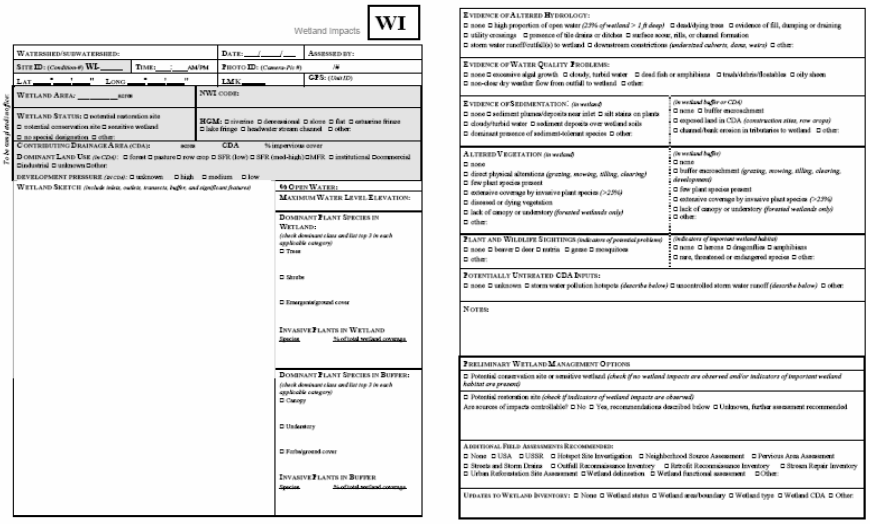
- Evidence of altered hydrology
- Evidence of water quality problems
- Evidence of sedimentation
- Altered vegetation
- Plant and wildlife sightings
- Untreated stormwater inputs

Where we look for it:

- Within the wetland
- At all wetland inlets and outlets
- Wetland buffer
- Wetland contributing drainage area



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



The Wetland Impact Tool –
Part of the Unified Stream Assessment

Q & A Break

Why Current Wetland Permitting is Not Enough

- Wetland hydrology is not protected
- Located in low point of a site and receives stormwater discharges
- Quality/sensitivity not considered in stormwater permitting
- Wetlands and stormwater are managed in different silos
- Does not address cumulative impacts at watershed level

Benefits of Local Watershed Approach to Wetland Management

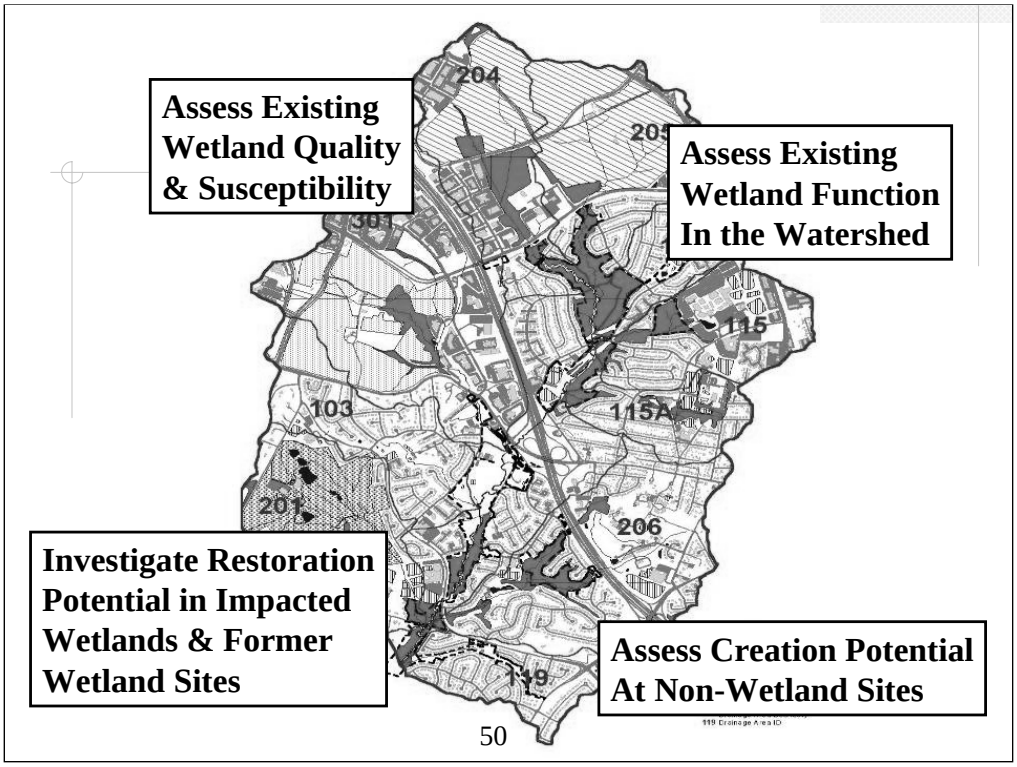
- Manage indirect impacts through land use and local development ordinances.
- Manage cumulative impacts at watershed level
- Address “no net loss” of wetland function
- Protect high quality and vulnerable wetlands
- Identify best wetland restoration and mitigation sites
- Consider adoption of local wetland protection regulations
- Inform better permit decisions
- ID opportunities for voluntary wetland conservation and restoration

Tool #1 Land Use Planning

Use watershed-based zoning and planning, overlay zones, and urban growth boundaries to dictate where development occurs

To Protect Wetlands:

- Incorporate wetland management into local watershed plans
- Adopt a local wetland protection ordinance
- Adopt floodplain, stream buffer and/or hydric soil ordinances (indirect protection)


Assess Existing Wetland Quality & Susceptibility
Assess Existing Wetland Function In the Watershed
Investigate Restoration Potential in Impacted Wetlands & Former Wetland Sites
Assess Creation Potential At Non-Wetland Sites
204
205
301
115
115A
103
201
206
119

Watershed Planning Principles to Protect Wetlands

- Compile wetland information on a watershed basis.
- Assess local wetland protection capacity.
- Invite wetland partners
- Define wetland goals and objectives for the watershed.
- Inventory wetlands in the watershed.
- Screen wetlands for further management

Same basic steps- just greater effort to integrate wetlands as a critical element of the watershed plan

Watershed Planning Principles to Protect Wetlands

- Evaluate wetlands in the field.
- Adapt watershed tools and local regs to protect wetlands.
- Prioritize wetland recommendations.
- Coordinate implementation of wetland recommendations with partners.
- Monitor progress toward wetland goals using watershed-based GIS

More watershed planning guidance can be found in forthcoming CWP Article 2

Special Stakeholders to Involve in Watershed Plans

- State and Federal regulatory staff
- Wetland scientists
- Local wetland planners
- Land trusts
- State and federal natural resource agencies
- Agencies with defined mitigation needs (e.g. highway departments, utility companies, etc.)

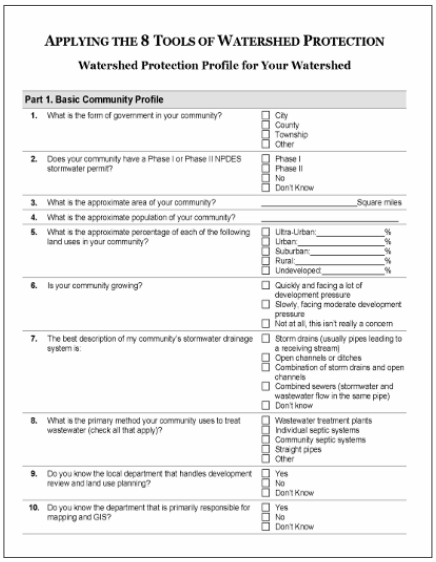
Wetland partners can add a lot to the plan

- Provide statistics to support acreage goals for wetland protection, conservation and restoration
- Rates and causes of historic and current wetland loss in the watershed
- Summarize recent state and federal permitting activity.
- Identify sensitive wetland community types in the watershed.
- Recommend wetland assessment protocols.

Assess Wetland Protection Capacity

- 8 Tool Audit
- Used to evaluate existing local capacity to implement the 8 Tools
- Identifies key areas that need to be improved
- Should be completed for each jurisdiction in the watershed

Soon to be available on www.cwp.org



APPLYING THE 8 TOOLS OF WATERSHED PROTECTION

Watershed Protection Profile for Your Watershed

Part 1. Basic Community Profile

1.	What is the form of government in your community?	☐ City ☐ County ☐ Township ☐ Other
2.	Does your community have a Phase I or Phase II NPDES stormwater permit?	☐ Phase I ☐ Phase II ☐ No ☐ Don't Know
3.	What is the approximate area of your community?	_____Square miles
4.	What is the approximate population of your community?	_____
5.	What is the approximate percentage of each of the following land uses in your community?	☐ Ultra-Urban:_____% ☐ Urban:_____% ☐ Suburban:_____% ☐ Rural:_____% ☐ Undeveloped:_____%
6.	Is your community growing?	☐ Quickly and facing a lot of development pressure ☐ Slowly, facing moderate development pressure ☐ Not at all, this isn't really a concern
7.	The best description of my community's stormwater drainage system is:	☐ Storm drains (usually pipes leading to a receiving stream) ☐ Open channels or ditches ☐ Combination of storm drains and open channels ☐ Combined sewers (stormwater and wastewater flow in the same pipe) ☐ Don't know
8.	What is the primary method your community uses to treat wastewater (check all that apply)?	☐ Wastewater treatment plants ☐ Individual septic systems ☐ Community septic systems ☐ Straight pipes ☐ Other
9.	Do you know the local department that handles development review and land use planning?	☐ Yes ☐ No ☐ Don't Know
10.	Do you know the department that is primarily responsible for mapping and GIS?	☐ Yes ☐ No ☐ Don't Know

Q & A Break

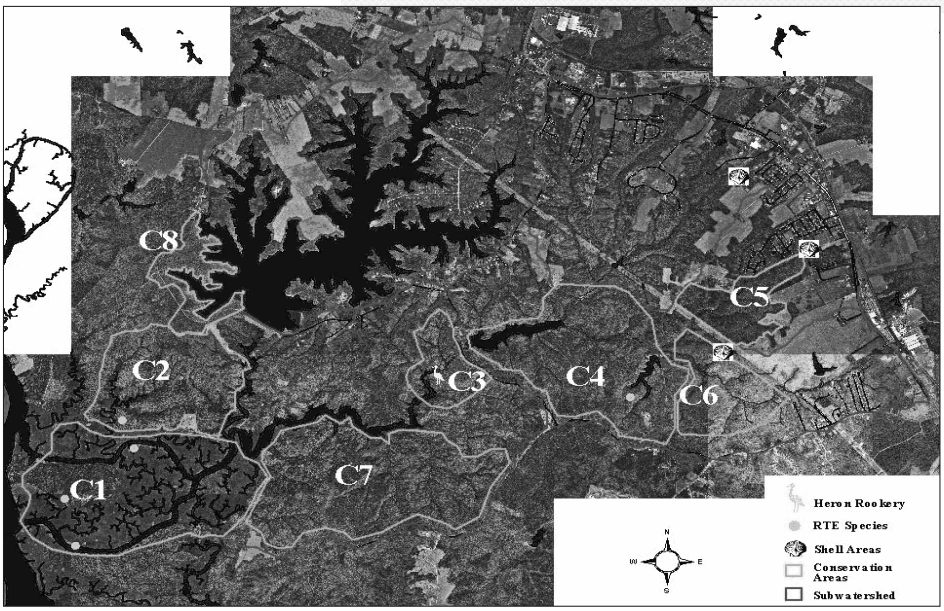
Tool #2 Land Conservation

Conserve critical habitat areas and other important natural or cultural resources

- Conduct wetland inventory
- Identify priority wetlands to be conserved
- Select land conservation techniques

Create a Wetland Inventory

1. Update existing wetland maps
2. Estimate historic wetland coverage
3. Delineate wetland contributing drainage areas
4. Estimate wetland functions
5. Estimate wetland condition
6. Forecast effects of future land use changes on wetlands



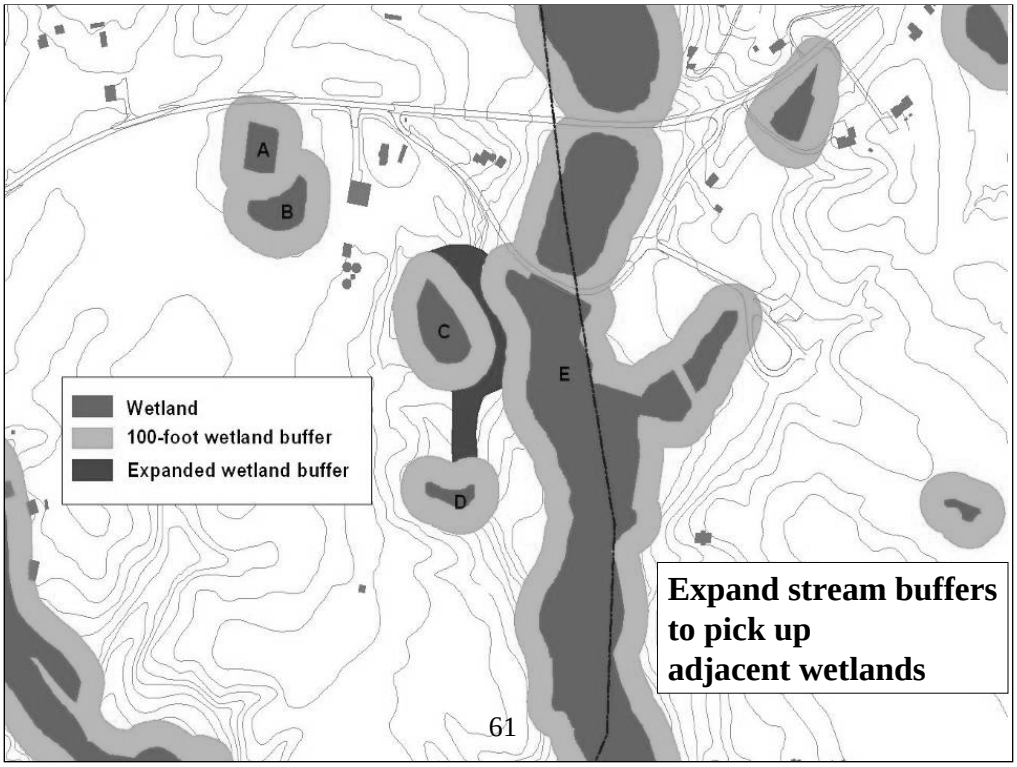
Priority conservation areas (in green)
identified for the Yarmouth Creek Watershed, Virginia

Tool #3 Aquatic Buffers

Using vegetative barriers to protect water resources from disturbance

To Protect Wetlands:

- Require vegetated buffers around all wetlands
  - Increase the width around sensitive wetlands
- Expand buffers to connect wetlands with other critical habitats
- Increase stream buffer widths to protect downstream wetlands


A
B
C
D
E
Wetland
100-foot wetland buffer
Expanded wetland buffer
Expand stream buffers to pick up adjacent wetlands

Tool #4 Better Site Design

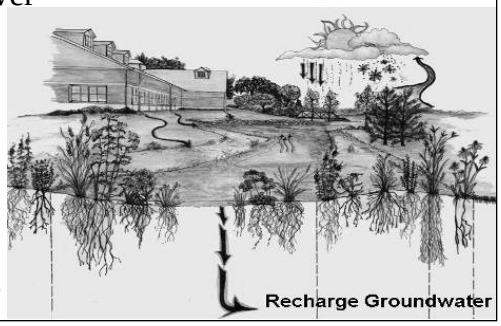
Increases open space to conserve natural areas and reduces impervious cover at individual developments

To Protect Wetlands:

- Minimize wetland crossings
- Promote use of open space design to protect wetlands
- Encourage designs that use natural drainage and LID

LID and Wetlands

- Maximize on-site recharge and infiltration
- Minimize site impervious cover (IC)
- Disconnect rooftop and other IC
- Use pervious areas for filtering
- Use swales rather than curb/gutters
- Conserve existing forest cover
- Reforest turf areas



Tool #5 Erosion & Sediment Control

Minimize uncontrolled sediment and erosion from construction sites

To Protect Wetlands:

- Require perimeter controls along wetland buffer boundaries
- Require more rapid stabilization in CDA
- Reduce disturbance thresholds that trigger ESC plans
- Increase frequency of site inspections
- Increase ESC requirements during rainy season
- Encourage site fingerprinting or construction phasing

Tool #6 Storm Water Management

Install practices to reduce quantity and increase quality of water before discharge or infiltration

To Protect Wetlands:

Upgrade local stormwater criteria to provide specific guidance on wetland protection when:

- Working in or near the wetland
- Working in the Contributing Drainage Area

Stormwater Criteria When Working In or Near Wetlands

- Prohibit use of natural wetlands for stormwater treatment
- Discourage constrictions at wetland outlets
- No discharge of untreated stormwater into wetlands
- Fingerprint stormwater treatment practices (STPs) around natural wetlands
- Avoid locating STPs in wetland buffers

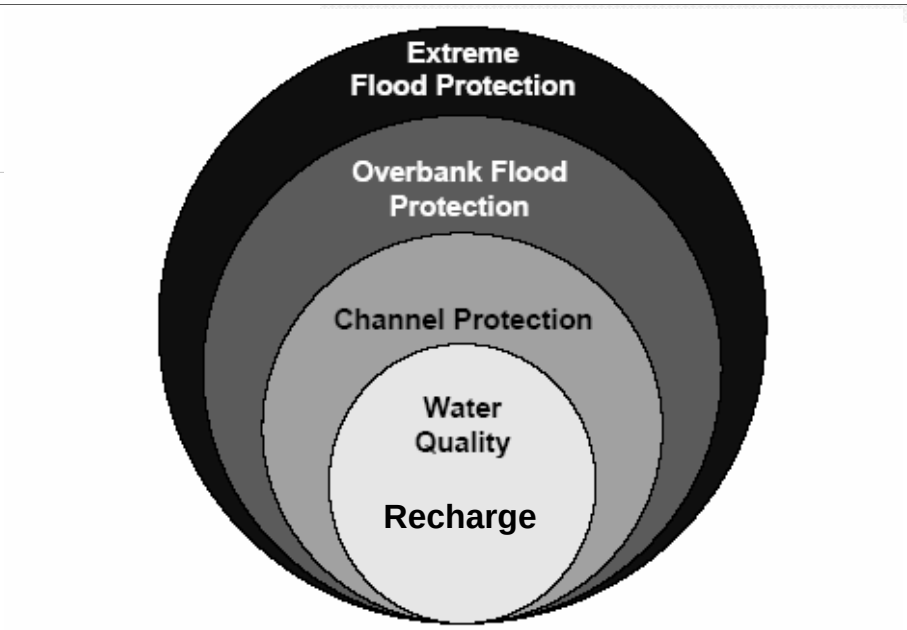
Tip: Include these restrictions when adopting or revising Local MS4 stormwater ordinances

Stormwater Criteria When Working in the Contributing Drainage Area

Special Stormwater Sizing Criteria

- Recharge
- Water Quality
- Hydroperiod Standards

- Preferred Stormwater Practices



Special Stormwater Criteria refers to more stringent sizing criteria that are applied to protect sensitive wetlands located in the CDA that are likely to receive stormwater discharge.

Criteria:
Recharge

- Maximize on-site infiltration and recharge regardless of soil type
- Promote recharge through use of stormwater credits
- Require recharge volume be provided, based on soil type (either MD or NJ Method)

Recharge criteria are a powerful incentive to make Better Site Design and LID happen

Criteria:
Water Quality

- Provide full water quality treatment prior to discharge to a downgradient wetland
- In most cases, this means capturing and treating runoff from the 1.0 to 1.2 inch rainfall event
- More stringent treatment may be required for nutrient sensitive wetlands (e.g., bogs and fens)
- No net increase in phosphorus load

Criteria: Hydroperiods

- Maximum Storm Bounce
  - No more than six inches above existing elevation
- Inundation Duration
  - No more than 24 hours longer than existing duration for a 1 year storm
- Discharge Rate
  - No increase in average discharge rate for wetland

For sensitive wetlands only

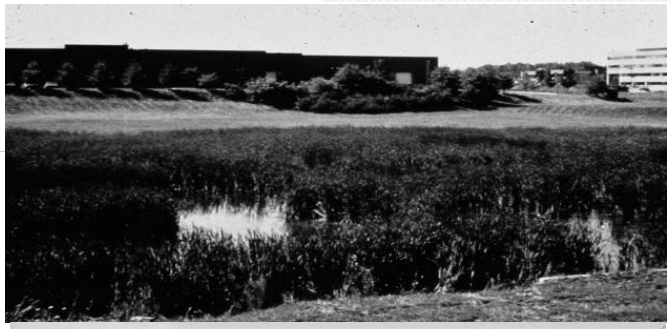
Advanced WLF Criteria

- Design to maintain wetland hydroperiod
- Keep mean monthly Water Level Fluctuation (WLF) less than 8 inches
- No more than six WLF excursions of more than 6 inches per year
- Limit duration of WLF to less than three days
- Source: Puget Sound Wetland Guidelines

Requires long term continuous simulation hydrologic modeling for design

Preferred Stormwater Practices

- Infiltration
- Bioretention
- Bypass to downstream pond
- Upstream stormwater wetland
- Upstream stormwater pond



The First Generation of Stormwater Wetlands

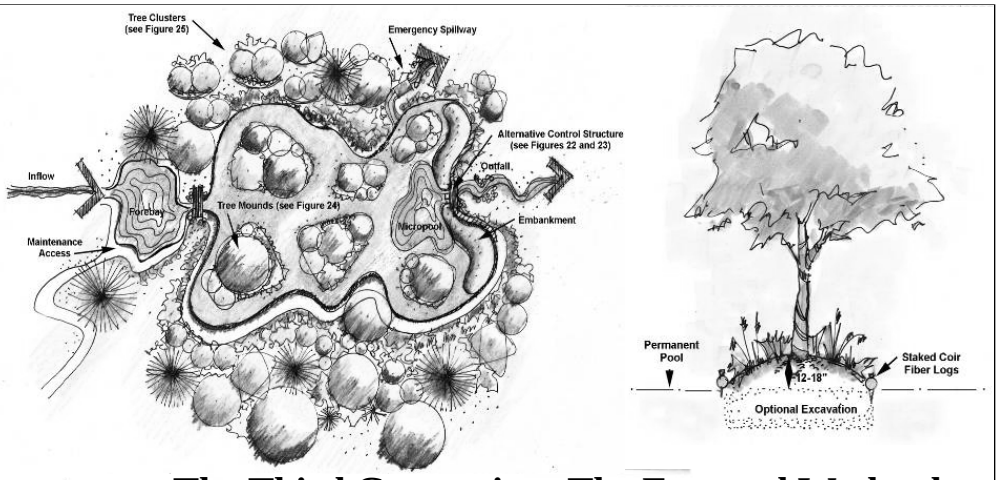
Hmmm..look a lot like degraded natural wetlands

This is a photo of a shallow marsh. Note how the wetland vegetation creates a circuitous path through the marsh.

Stormwater wetlands are structural practices similar to stormwater ponds that incorporate wetland plants into the design. As stormwater runoff flows through the wetland, pollutant removal is achieved through settling and biological uptake within the practice. Wetlands are among the most effective stormwater practices in terms of pollutant removal, and also offer aesthetic value. While natural wetlands can sometimes be used to treat stormwater runoff that has been properly pretreated, stormwater wetlands are fundamentally different from natural wetland systems. Stormwater wetlands are designed specifically for the purpose of treating stormwater runoff, and typically have less biodiversity than natural wetlands both in terms of plant and animal life. There are several design variations of the stormwater wetland, each design differing in the relative amounts of shallow and deep water, and dry storage above the wetland.

Wetlands are widely applicable stormwater management practices. Like stormwater ponds, they have limited applicability in highly urbanized settings, and in arid climates, but have few other restrictions. Most wetland designs can provide water quality, channel protection, overbank flood, and extreme flood control. However, due to the tendency of wetlands to intercept water tables, they do not typically meet recharge requirements.

The Second Generation:
Better diversity but still the freshwater emergent model



The Third Generation: The Forested Wetland

Tool #7 Non-Storm Water Discharges

Addresses how wastewater and non-stormwater discharges are handled

To Protect Wetlands:

- Require regular septic system inspections
- Require enhanced nutrient removal from on-site wastewater treatment systems
- Actively enforce dumping restrictions in wetlands and their buffers
- Consider alternative mosquito control methods
- Conduct illicit discharge surveys at outfalls to wetlands

Based on field surveys of wetland impacts

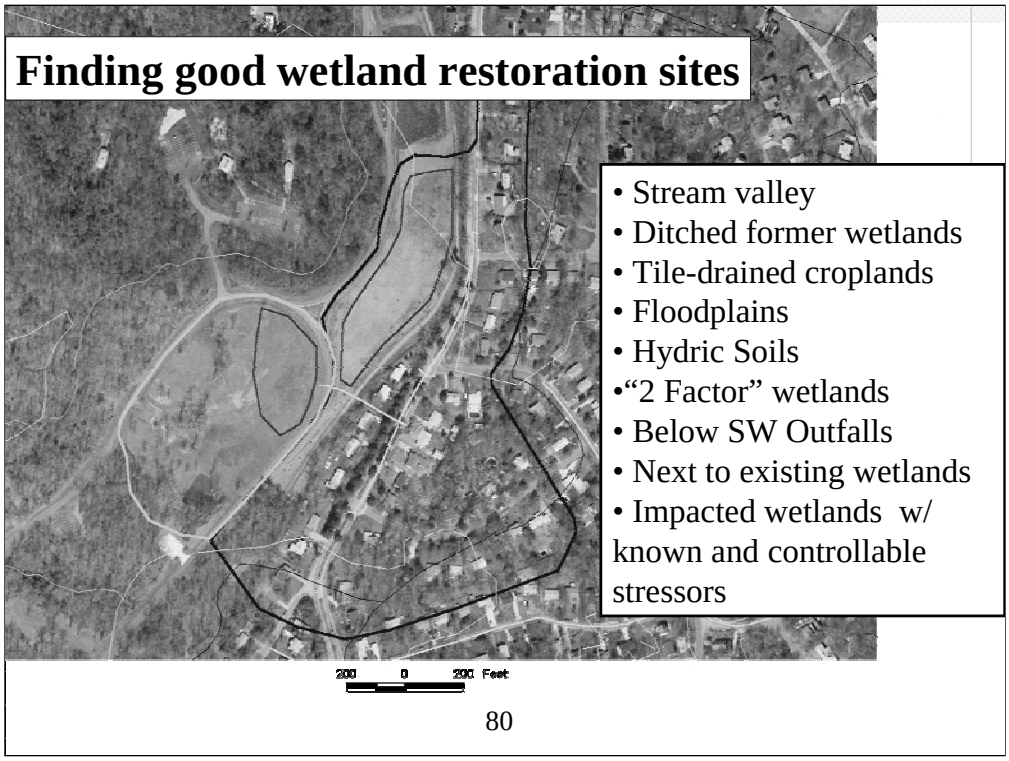
It’s easier to choose which non-stormwater discharge programs to apply

Tool #8 Watershed Stewardship

Increase awareness and understanding of watersheds and promote better stewardship of private lands

To Protect and Restore Wetlands:

- Post signs to identify wetlands, buffers, and CDA boundaries
- Incorporate wetlands into watershed education programs
- Manage invasive wetland plants
- Establish volunteer wetland monitoring and adoption programs
- Encourage wetland landowner stewardship
- Engage in systematic watershed restoration



With the advance of GIS technology, more and more communities have accurate mapping and database capabilities. These resources can increase the efficiency with which retrofit inventories can be conducted.

Q & A Break

Picture by Donald J. Leopold, from Welsch et al., 1995

Wetland Resources

- Article 1: Wetland Impacts, Watershed Woes?
- Article 2: Protecting Wetlands Locally Through Watershed Planning
- Article 3: Adapting Watershed Tools to Protect Wetlands

Available at http://www.cwp.org/wetlands/articles.htm

Additional Resources