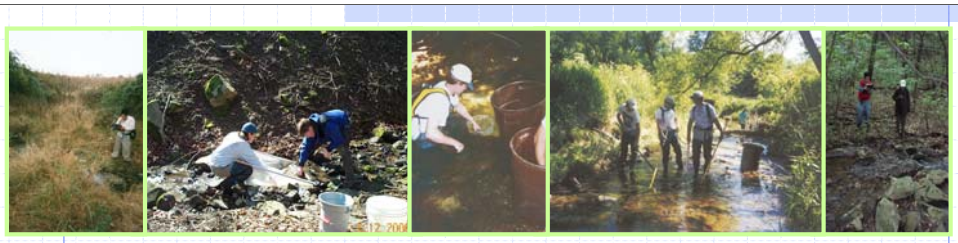


The Eight Tools of Watershed Protection

Tom Schueler
Center for Watershed Protection

EPA Webcast

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

- Watershed Research
- Watershed Practices
- Watershed Applications
- Watershed Learning
- Watershed Capacity

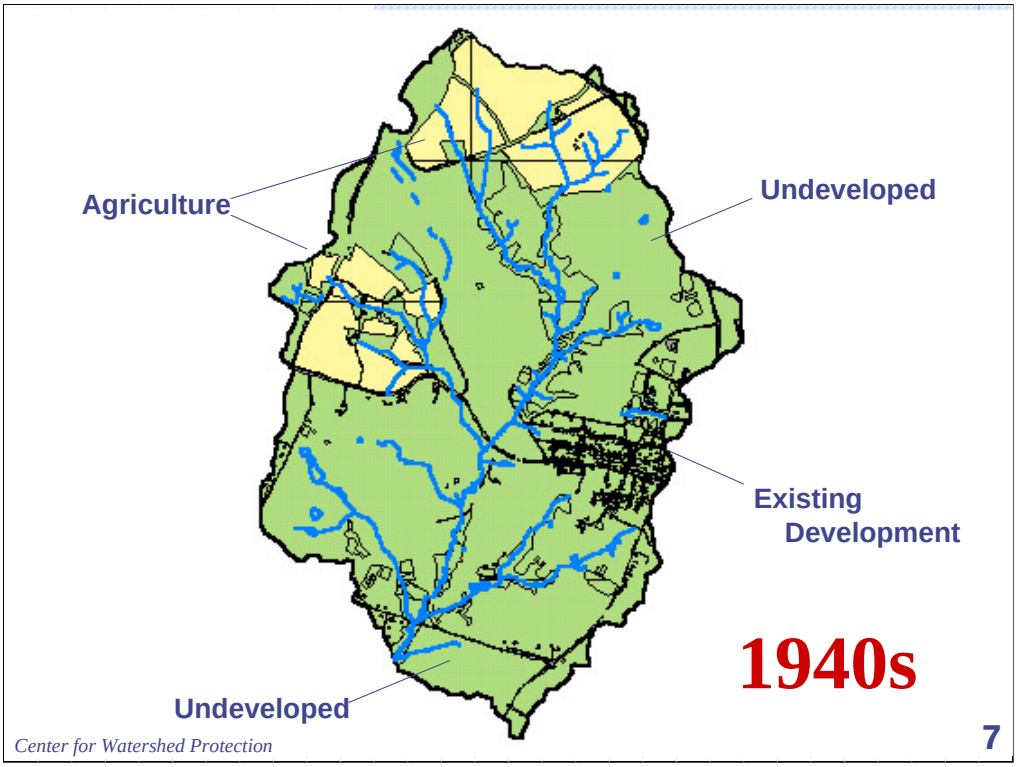
Key Themes

1. Relationship between impervious cover and stream quality
2. 8 tools to protect streams from development
3. CWP Watershed Behavior Quiz

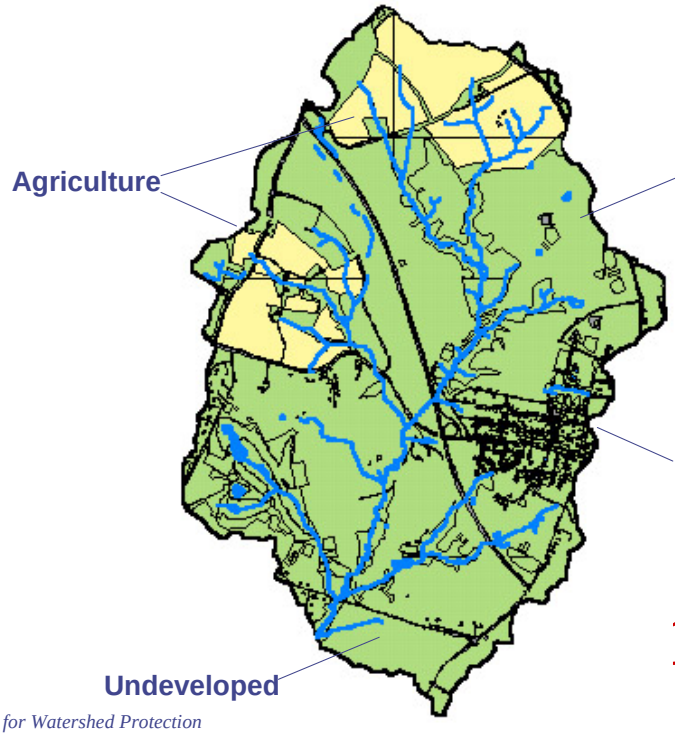

Impervious Cover
Photo Copyright 1999, Center for Watershed Protection

5

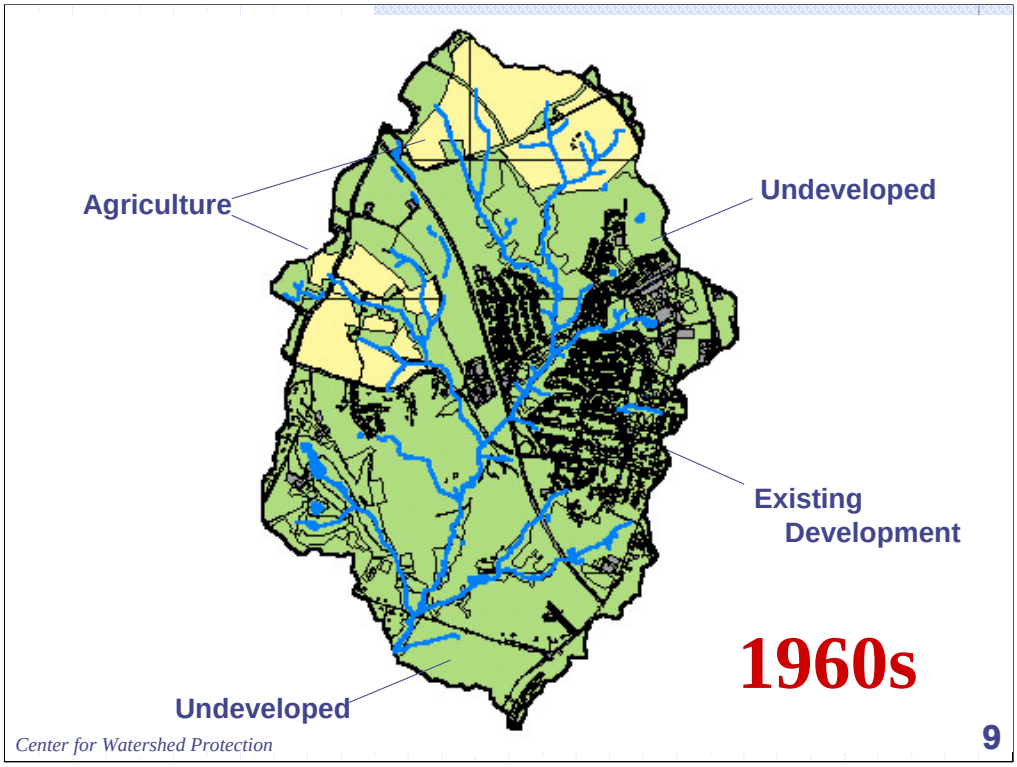
Components of Impervious Cover in the Urban Landscape

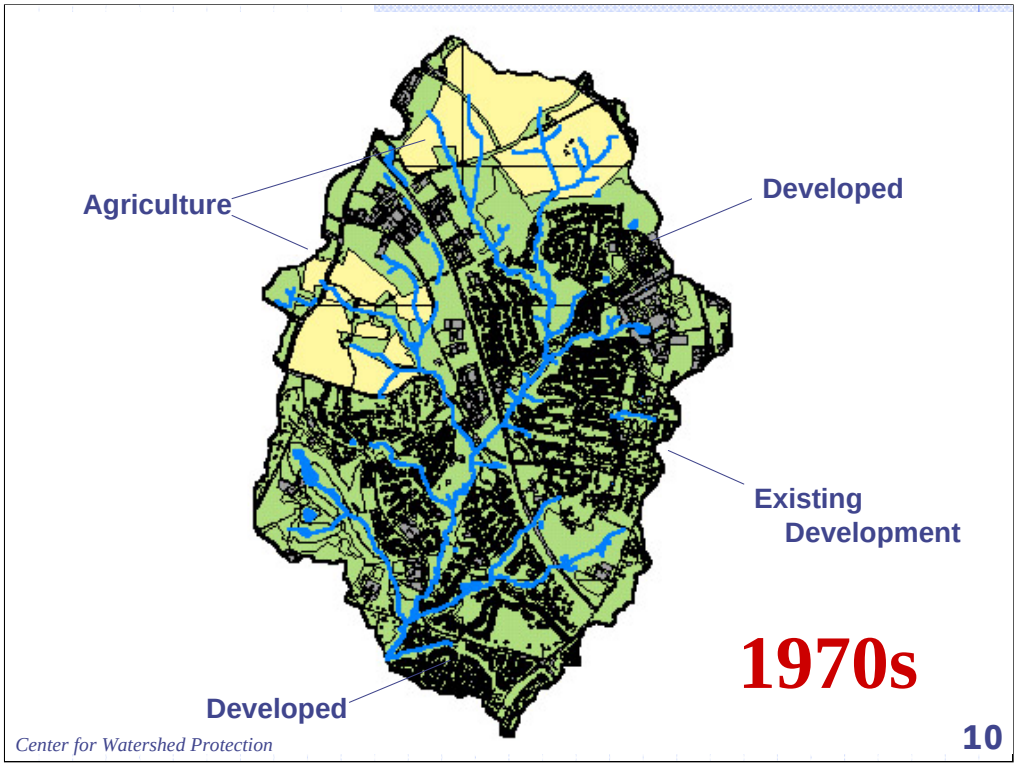


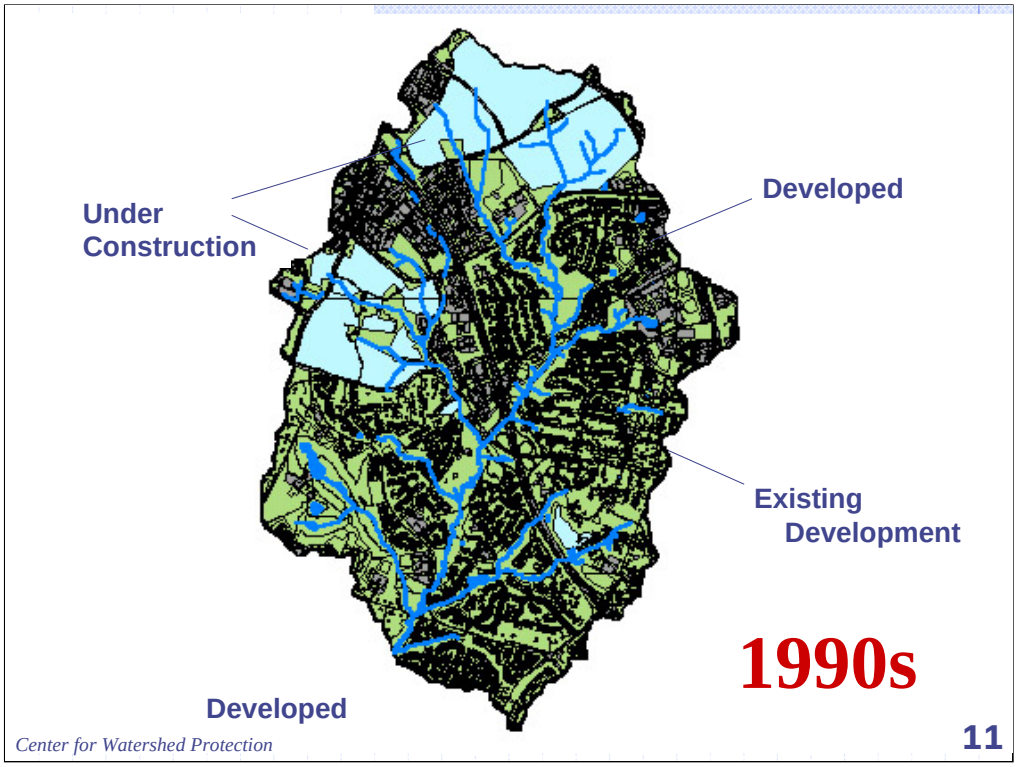
Unless effective zoning and planning is put into place, a watershed can become builtout in a relatively short time span. This particular illustrates the rapid development of a watershed over just a few decades. Notice the jump in the amount of development that occurred in the watershed from the 1960s to 1970s.

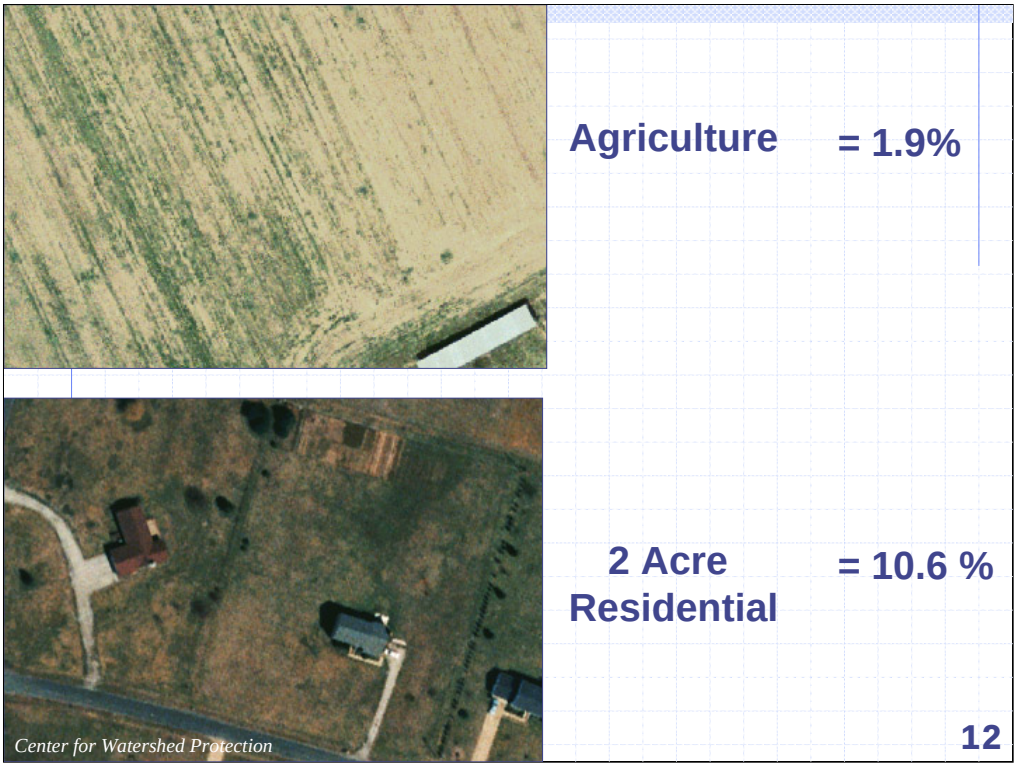

Agriculture
Undeveloped
Existing
Development
Undeveloped

1950s


Agriculture
Undeveloped
Existing
Development
Undeveloped
1960s


Agriculture
Developed
Existing
Development
1970s
Developed

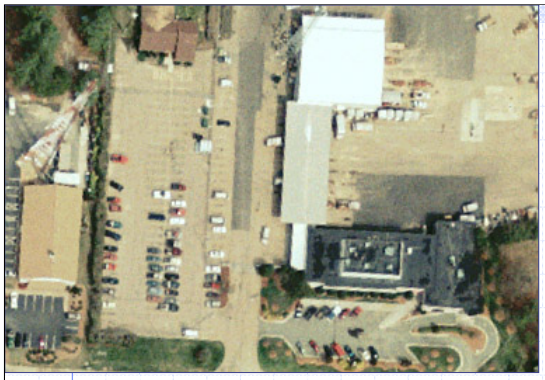

Under
Construction
Developed
Existing
Development
1990s
Developed



Land Use and zoning categories can be used to predict and estimate the amount of impervious cover. For an area zoned, agriculture, you can expect this area to have an impervious cover percentage around 1.9%. A subdivision that has 1 dwelling unit per 2 acres is about 10.6% impervious. As you can see, it doesn't take a whole lot of development to reach 10%.

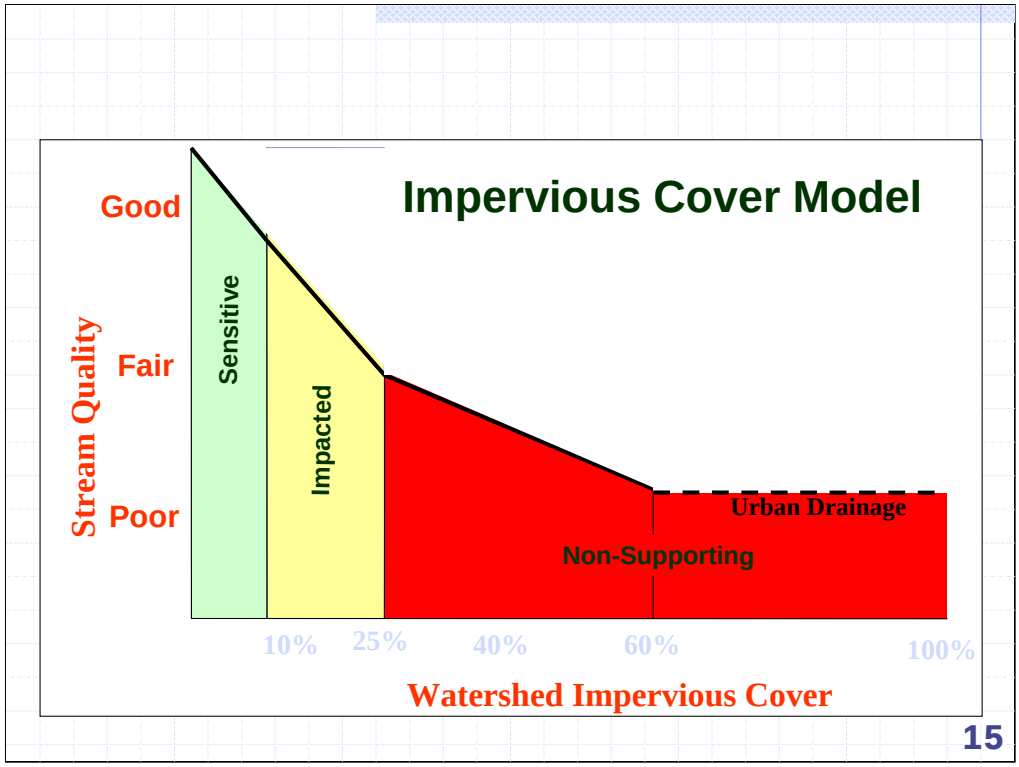
1 Acre Residential **= 14.3 %**

½ Acre Residential **= 21.2 %**



Light Industrial = 53.4 %

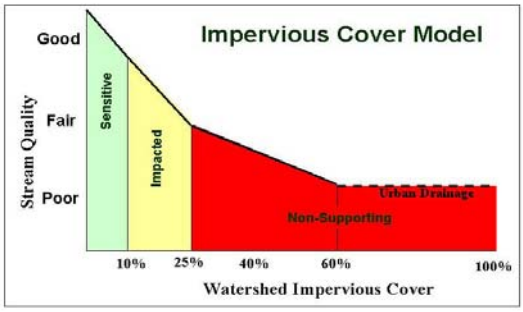
Commercial = 72.2 %

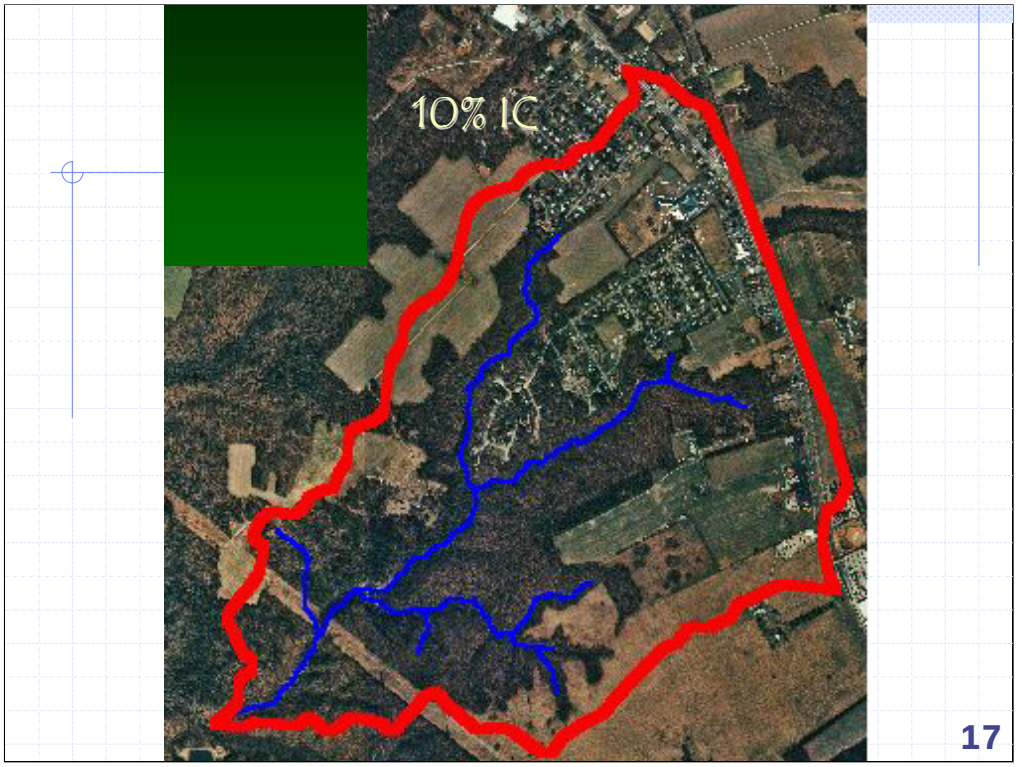

Impervious Cover Model
Good
Fair
Poor
Stream Quality
Sensitive
Impacted
Non-Supporting
Urban Drainage
10%
25%
40%
60%
100%
Watershed Impervious Cover

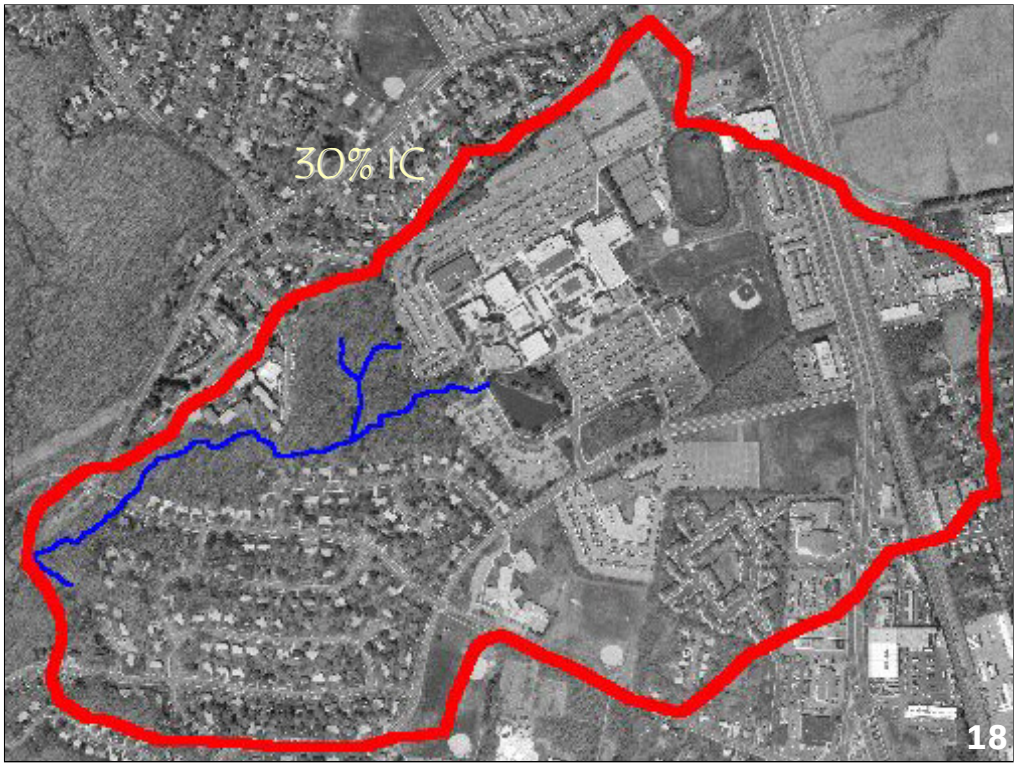
ICM Disclaimer

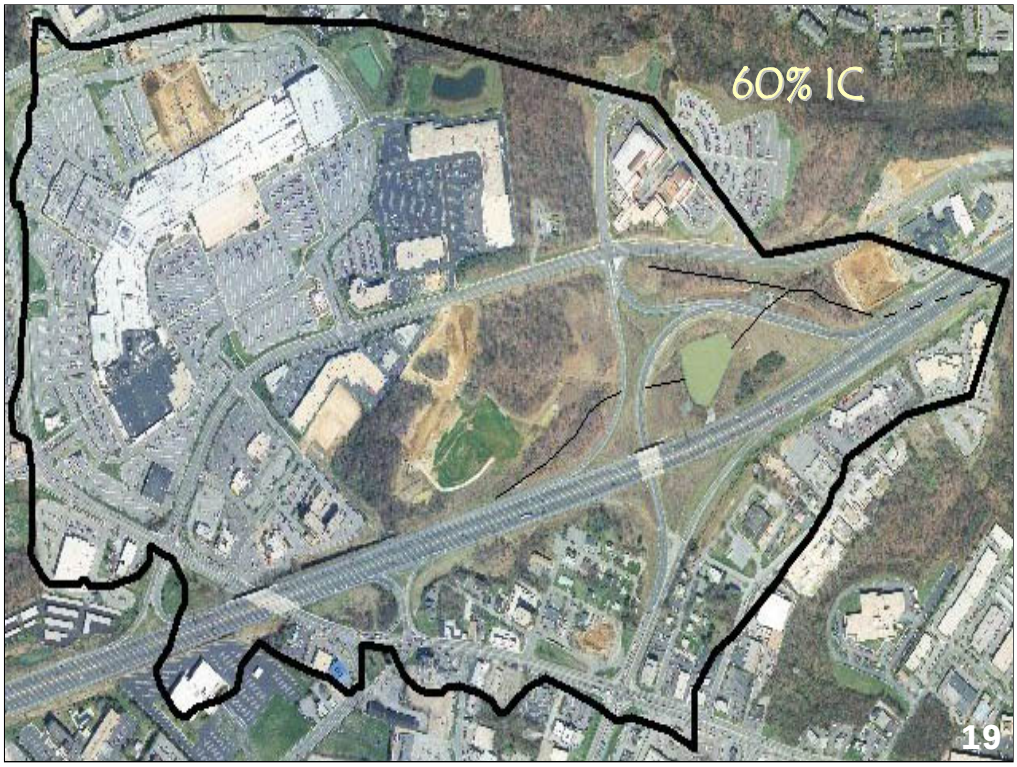
"ICM predictions are general, and may not fully apply to every stream. Factors such as stream gradient, stream order, stream type, age of subwatershed development, prior land use, past management practices can and will make some streams depart from these predictions"

Must be 18 or older to enter. Not valid in TX, UT and AK. APR of 6.15%. Not everyone qualifies for special financing. Offer may restricted due to Acts of God. You can never win. Center not liable for any damages, we don't have any $ even if we are

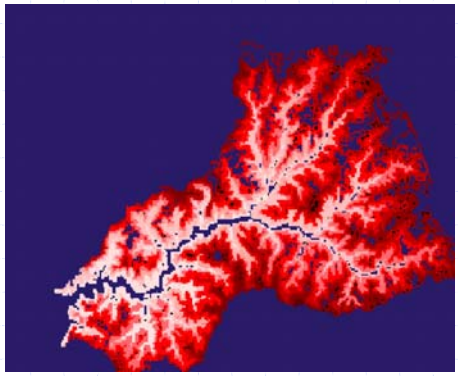



10% IC


30% IC
18


60% IC
19


75% IC
20



Discussion Time:

What are the issues involved in measuring and projecting impervious cover?

Review of Recent Research

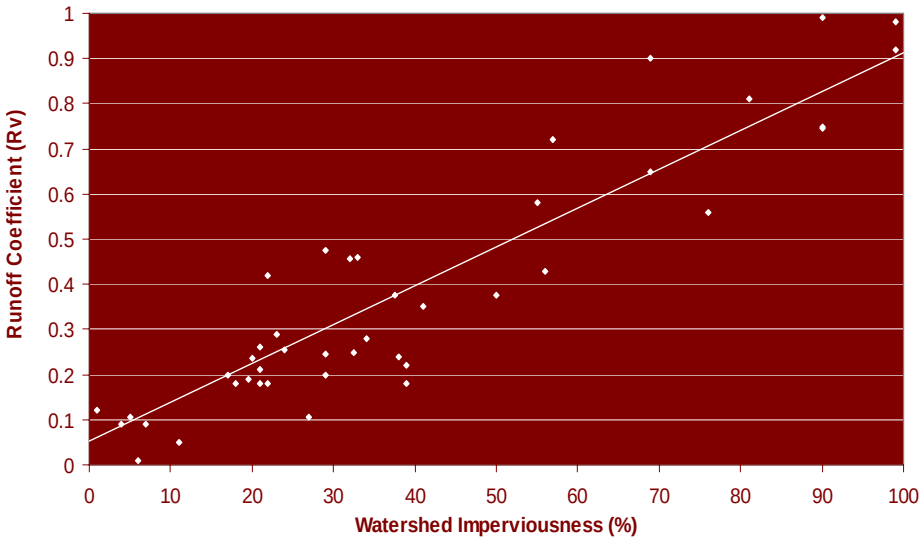
At least 150 new studies on impervious cover/aquatic quality relationships since 1994

Hydrological Indicators

- Increased stormwater runoff
- Increased frequency of flooding
- Floodplain expansion
- Diminished baseflow
- Increased bankfull flooding

Relationship Between Watershed Imperviousness (I) and the Storm Runoff Coefficient (Rv)

(Source: Schueler, 1987)




Copyright 2000, Center for Watershed Protection

Physical Indicators

- Loss of headwater streams
- Floodplain encroachment
- Loss of intact riparian buffer
- Stream interruption
- Increased number of crossings/fish barriers

Stream Habitat Indicators

- Channel enlargement
- Increased sediment load
- Declining stream habitat scores
- Large woody debris
- Stream warming

This slide illustrates how impervious cover can alter the geomorphology of a stream channel.

In watersheds with less than 5% impervious cover, streams are typically stable and pristine, provide a variety of habitats, maintain a diverse aquatic population and have good tree coverage.

While this stream at 8-10% Impervious Cover is still relatively stable signs of stream erosion are more apparent, and there is some loss of good habitat.

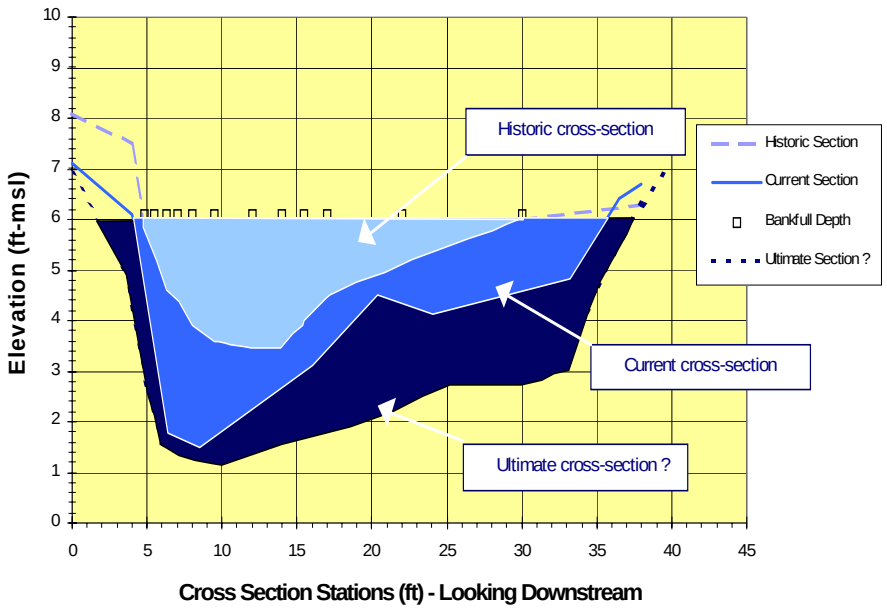
The surrounding area of this stream is approximately 20% impervious cover. Stream erosion is much worse than in the previous slide due to an absence of vegetation to hold together bank structure. The amount of erosion has been so great that the drain pipe that once rested on the stream bottom is now 2 feet above the water.

This stream has a surrounding area of approximately 30% impervious cover. The channel is deeply cut down, there is little to no bank vegetation to prevent erosion, and there is little habitat structure.

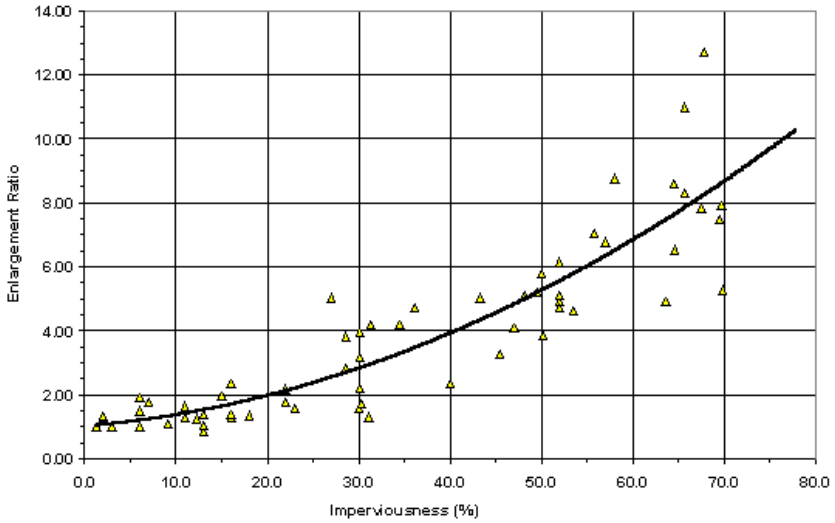
Above 65% impervious cover, the stream geomorphology is typically completely destroys by channelization. Concrete or pipes provide little to no habitat and support little to no aquatic organisms.

Source: Leopold, 1994

30

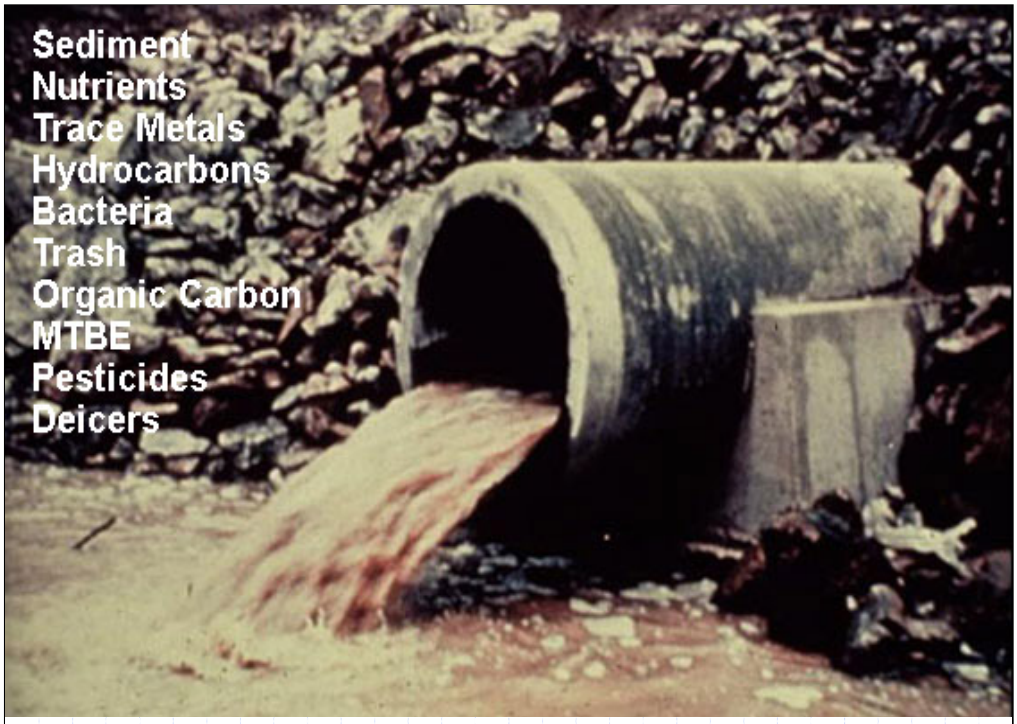

Elevation (ft-msl)
10
9
8
7
6
5
4
3
2
1
0
0
5
10
15
20
25
30
35
40
45
Cross Section Stations (ft) - Looking Downstream
Historic cross-section
Current cross-section
Ultimate cross-section ?
Historic Section
Current Section
Bankfull Depth
Ultimate Section ?

Channel Enlargement as a Function of Impervious Cover



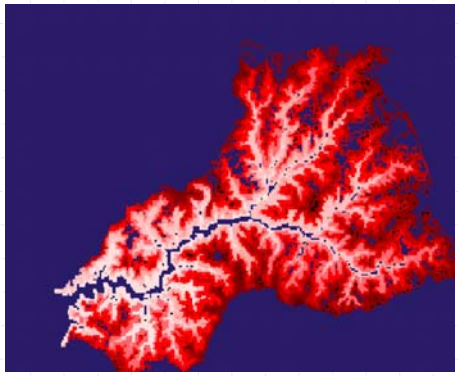
Water quality indicators

- Violations of Bacteria standards
- Nutrients and eutrophication
- Aquatic life toxicity
- Sediment contamination
- Trash and debris loads


Sediment
Nutrients
Trace Metals
Hydrocarbons
Bacteria
Trash
Organic Carbon
MTBE
Pesticides
Deicers

Aquatic Diversity Indicators

- Aquatic Insect Diversity
- Sensitive Insects
- Fish Diversity Scores
- Trout and Salmon
- Wetland and Floodplain Plant Diversity
- Amphibian Diversity



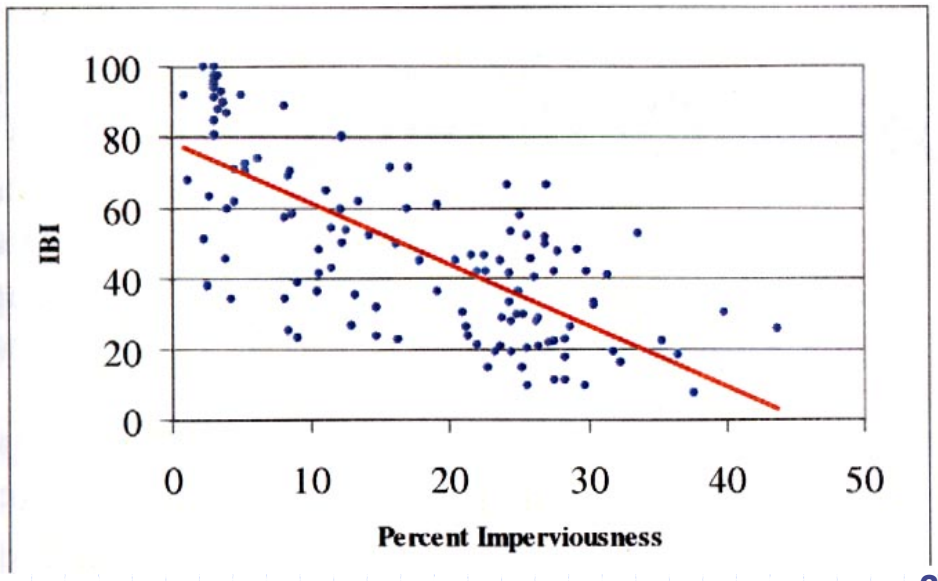
Discussion Time:

What is the scientific basis for the ICM model?


Photo Copyright 1999, Center for Watershed Protection


Photo Copyright 1999, Center for Watershed Protection

Index of Biological Integrity vs. Impervious Cover



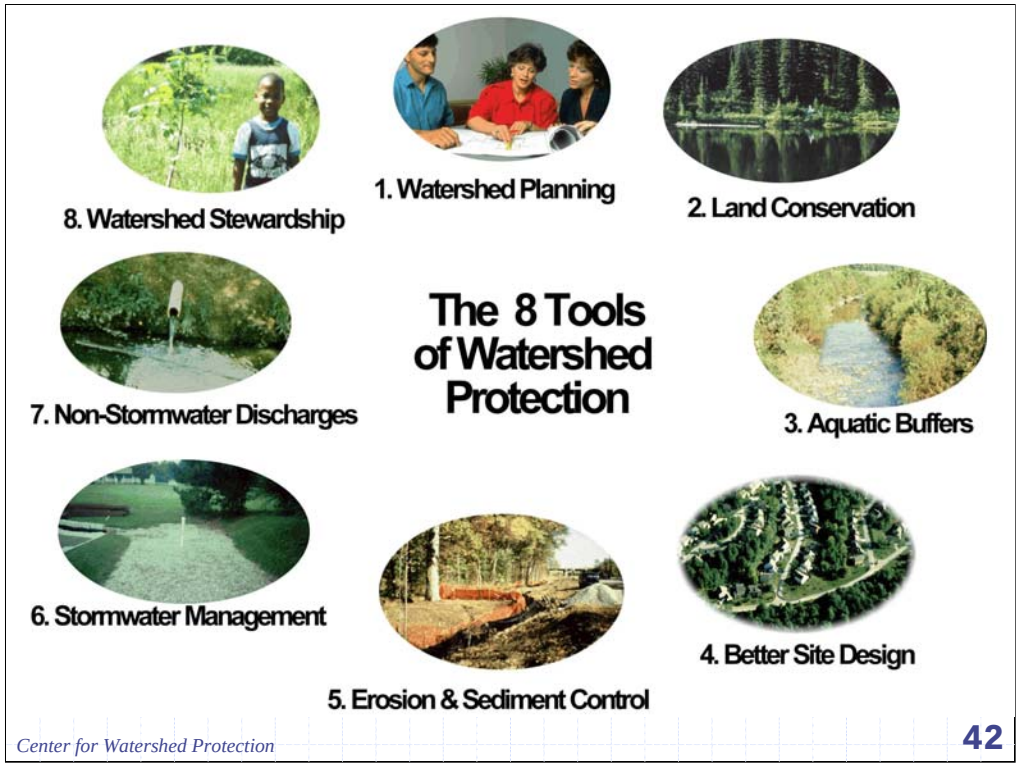
(Fairfax County, 2001)

IC also associated with:

Urban heat islands…vehicle pollutant emissions…PAH and metal levels in sediments….forest fragmentation….loss of streamside forest cover….Increased risks of spills, leaks, illicit discharges, illegal dumping and sewer overflows…bacteria sources….shellfish and beach closure…and many other factors

Other Watershed Indicators

- Watershed forest cover (65%)
- Streamside forest cover (65% of network)
- Watershed turf cover (?)
- Road density

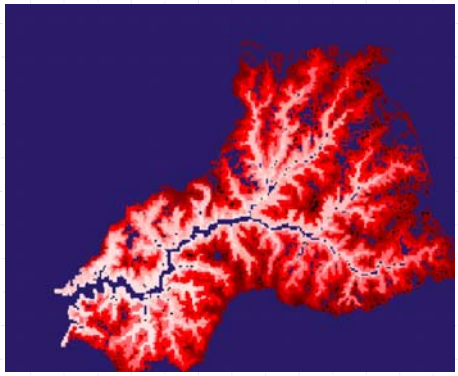


Communities have found that no matter what watershed they are working in, the same 8 basic management tools are needed to mitigate the impacts of development: watershed planning, land conservation, aquatic buffers, better site design, erosion and sediment control, stormwater management, non-stormwater discharges, and watershed stewardship programs.

WATERSHED PLANNING 1

Management Implications

- Small watershed application
- Subwatershed classification
- Adapting the 8 tools for each type of watershed
- Need to measure watershed treatment

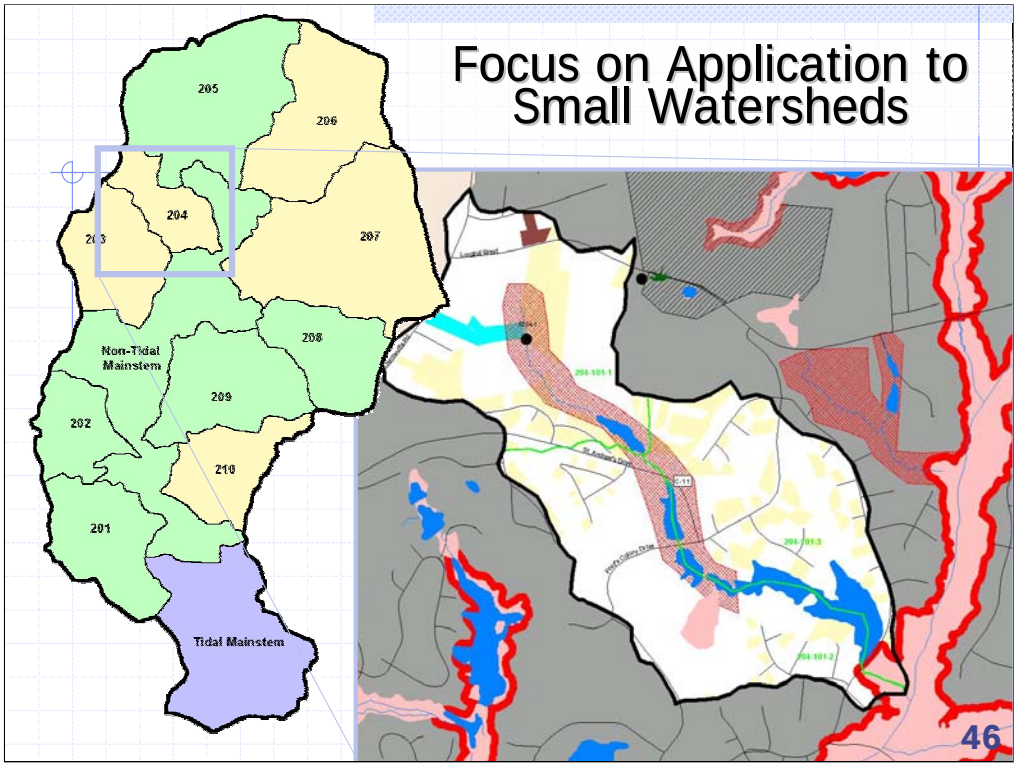


Discussion Time:

What are the planning implications of the ICM Model?

Are other watershed indicators helpful?

Focus on Application to Small Watersheds



Sensitive Streams

2 to 10% IC

- Most indicators in the good to excellent range.
- Not automatic, indicators will decline if poor land management practices exist in the subwatershed
- Some individual indicators are more sensitive and start to decline at 5 to 10% IC
- Other subwatershed metrics may have more predictive ability (forest cover, RFC, Turf cover)

Sensitive Streams

Key Planning Issue:

Predicts that even low intensity residential development will degrade streams even with watershed treatment

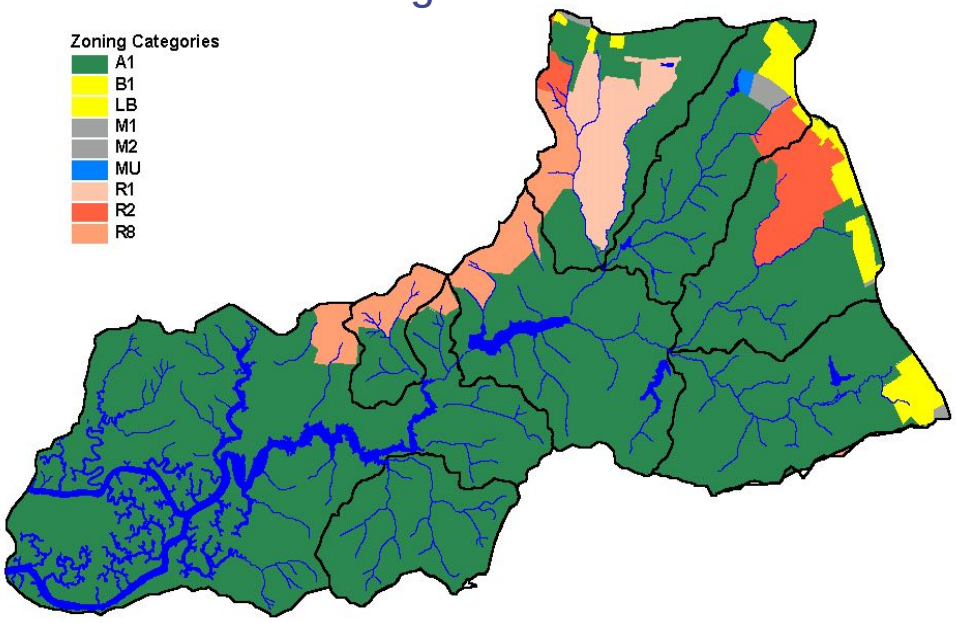
Response:

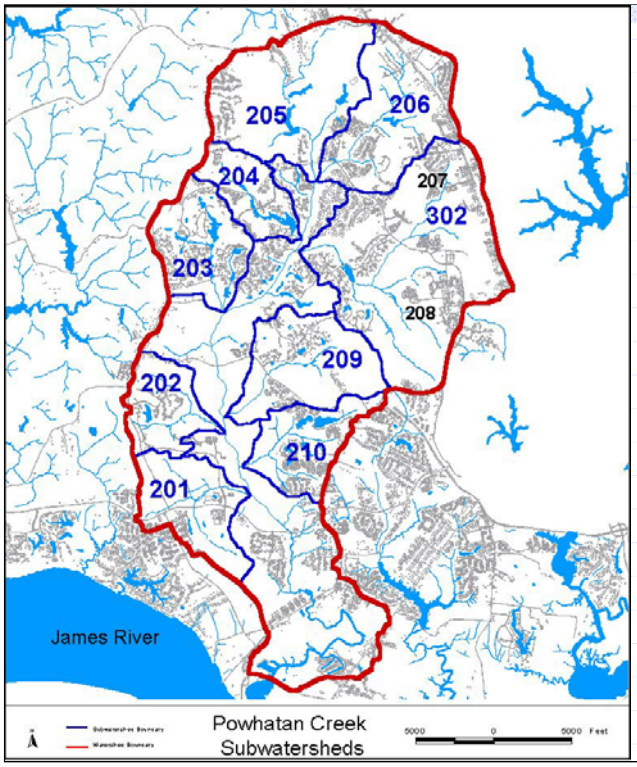
Aggressive down-zoning, land conservation, and buffers. No sewers. ICM is defensible, but only apply to most critical resources.

This presentation provides a simple introduction to the eight basic watershed protection tools. These tools are essential to the protection, preservation, and restoration of our lakes, streams, and estuaries. The challenge for the watershed manager is to select the right combination of practices to form the most effective plan based on the specific goals of the watershed.

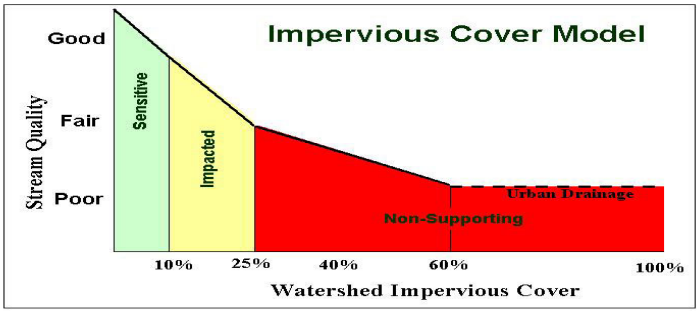
For more information on the watershed protection tools, please consult the *Rapid Watershed Planning Handbook*, 1998, available from the Center for Watershed Protection, 8391 Main Street, Ellicott City, MD 21043. Visit us online at www.cwp.org.

Land Use Planning for Sensitive Streams





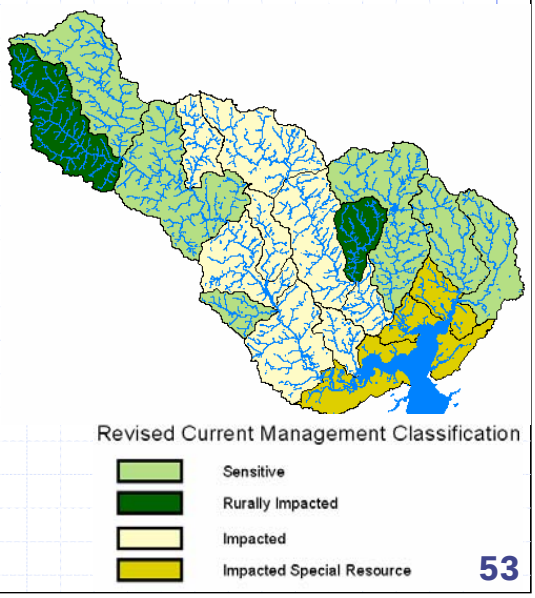
The ICM and Stream Classification: Powhatan Creek



Another Slide you'll Be getting Tired of

Classification	1998	2000	2020
Sensitive	8	6	0
Impacted	4	6	11
Non-Supporting	0	0	1

ICM used to classify and manage streams

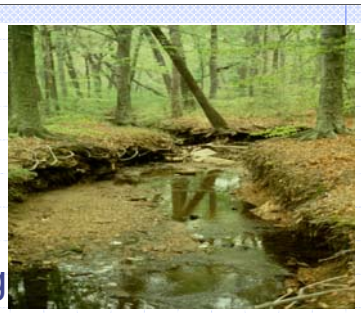


Why it is so hard to integrate land use into local watershed plans?

1. Over-Zoning
2. Segregation between comprehensive and environmental planning
3. Uncertainty about the BMP effect
4. Confusion about scope of watershed plans
5. Lack of a watershed zoning unit

Impacted Streams

10 to 25% IC



- Show clear signs of declining stream health
- Stream indicators in the fair to good range
- Stream corridor may still be intact
- Available land in subwatershed to install practices
- Streams have highest restoration potential

Impacted streams

Key Issue:

What practices can minimize the expected decline in stream indicators, and by how much?

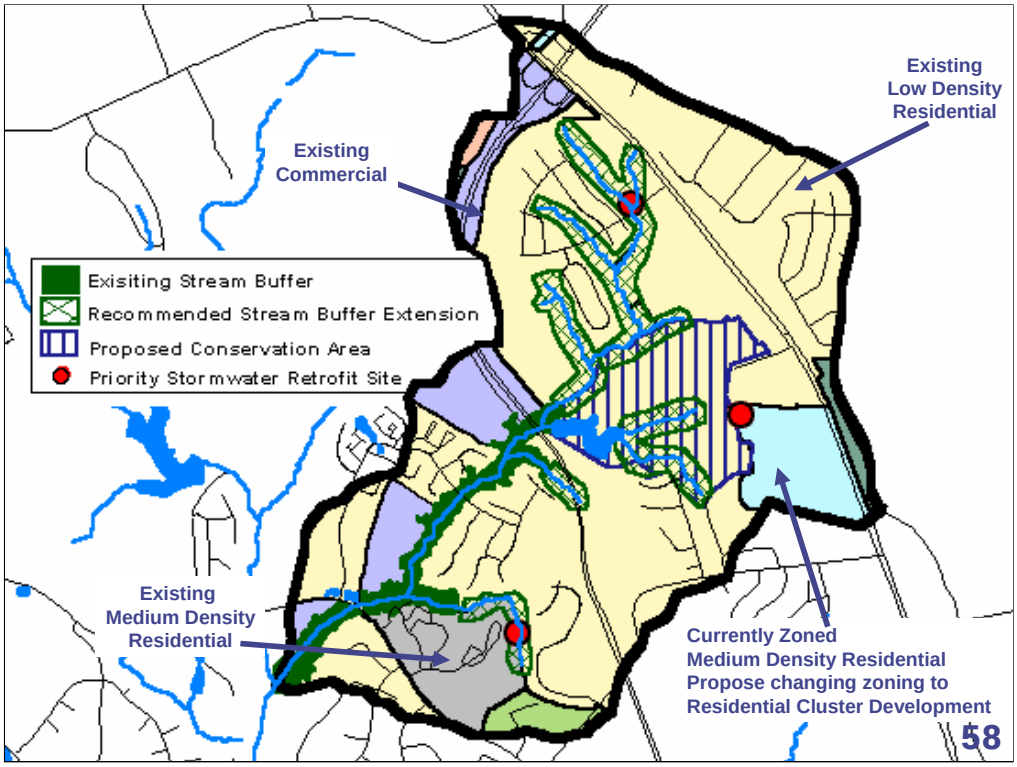
1. Apply all 8 Tools of Watershed Protection
2. Set goals for retaining forest cover, riparian continuity and overall watershed treatment
3. Keep on Testing

Powhatan Creek Watershed Management Plan

Prepared for:
James City County, VA

Prepared by:
Paul Sturm
Anne Kitchell
Center for Watershed Protection
8391 Main Street
Ellicott City, MD 21043

July 4, 2001


Existing
Low Density
Residential
Existing
Commercial
Exisiting Stream Buffer
Recommended Stream Buffer Extension
Proposed Conservation Area
Priority Stormwater Retrofit Site
Existing
Medium Density
Residential
Currently Zoned
Medium Density Residential
Propose changing zoning to
Residential Cluster Development
58

Non-Supporting Streams

25 to 60% IC

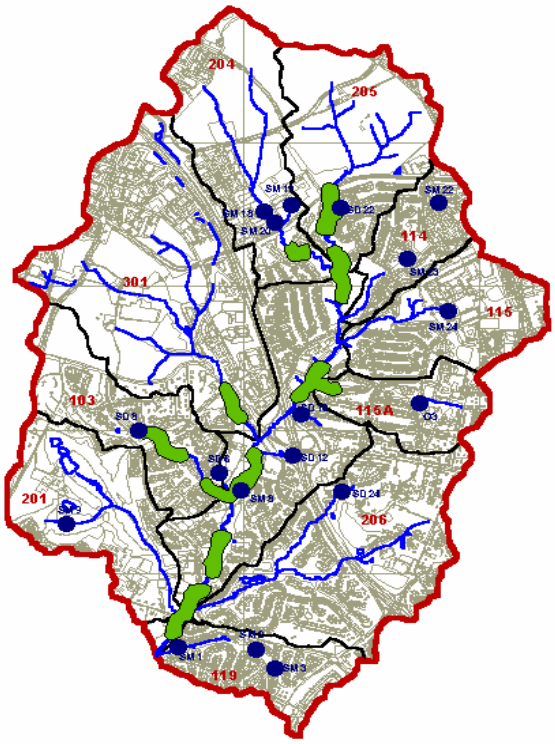
- Do not support a full range of designated uses
- Stream indicators in the fair to poor range
- Streams in 25 to 40% IC show promise for stream restoration
- Primary goals are to reduce pollutant loads, improve stream corridor or enhance appearance
- Allow water contact recreation during dry weather

Non-Supporting Streams

- Not likely to ever support a full range of designated uses

Responses:

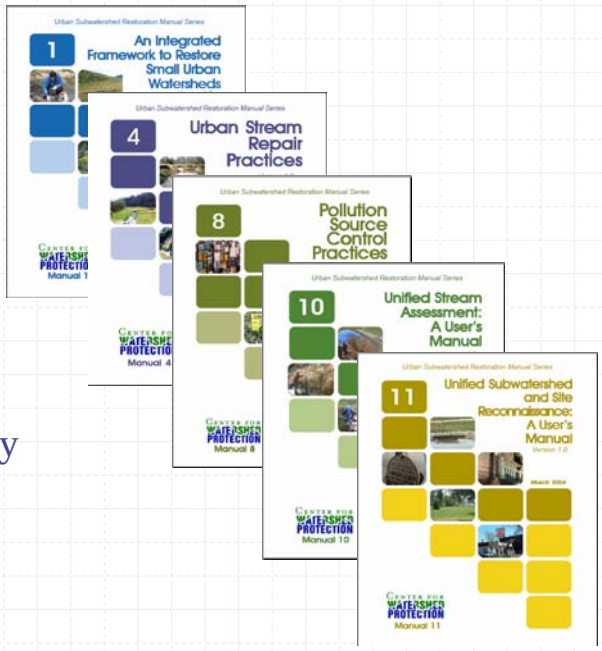
1. Evaluate streams in 25 to 40% IC for potential restoration
2. Support active redevelopment/infill to increase IC
3. Create an “urban drainage” classification for extremely high IC streams

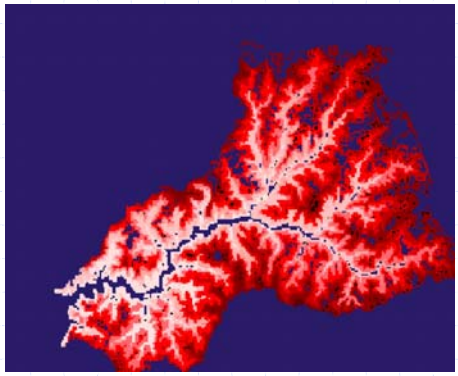


Assessing Subwatershed Restoration Potential

The Small Watershed Restoration Manual Series

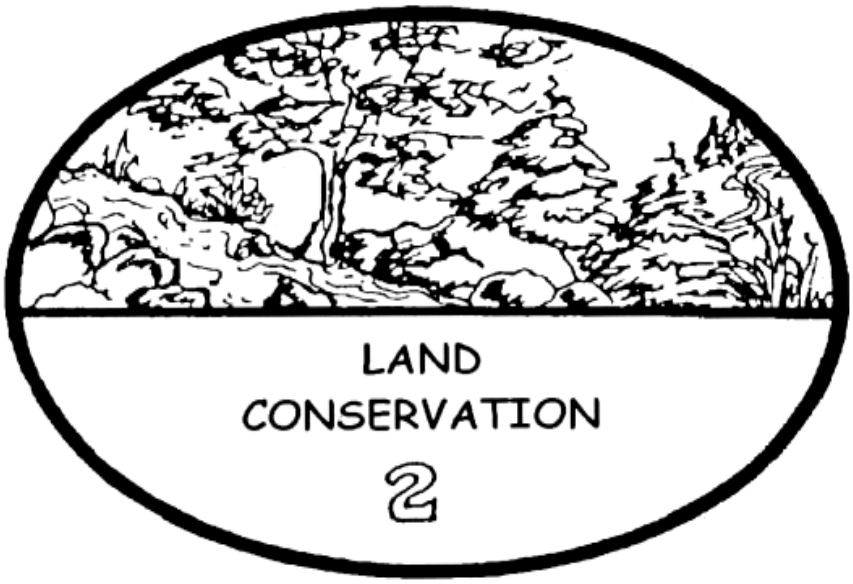
Check availability at **www.cwp.org**





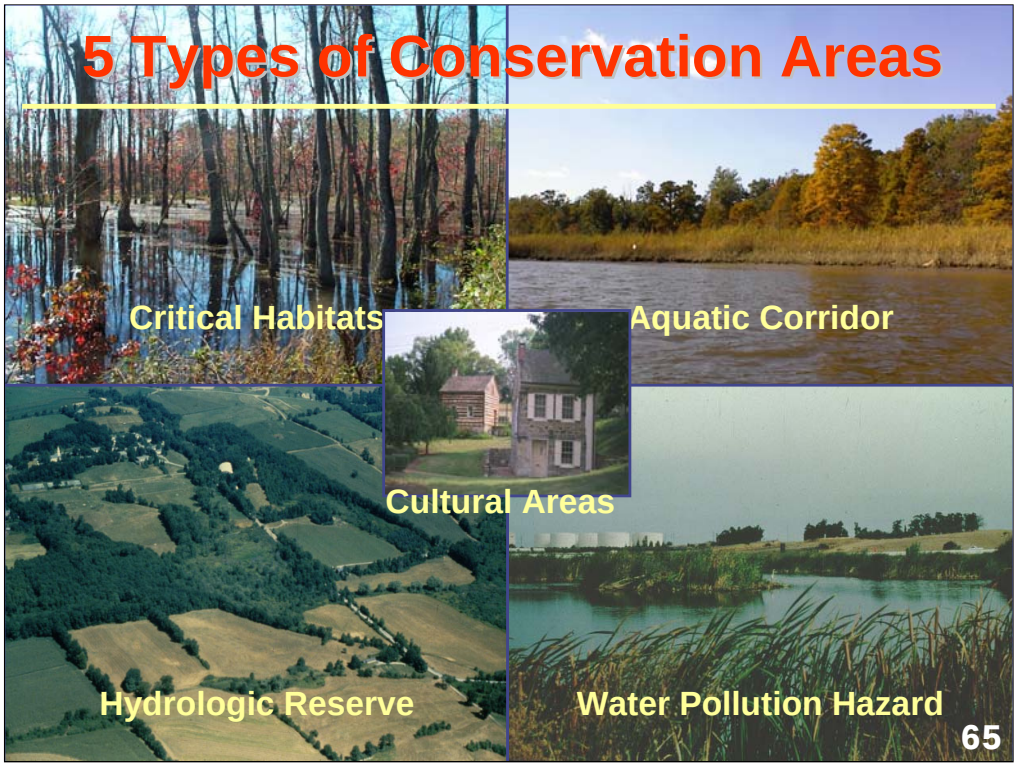
Discussion Time:

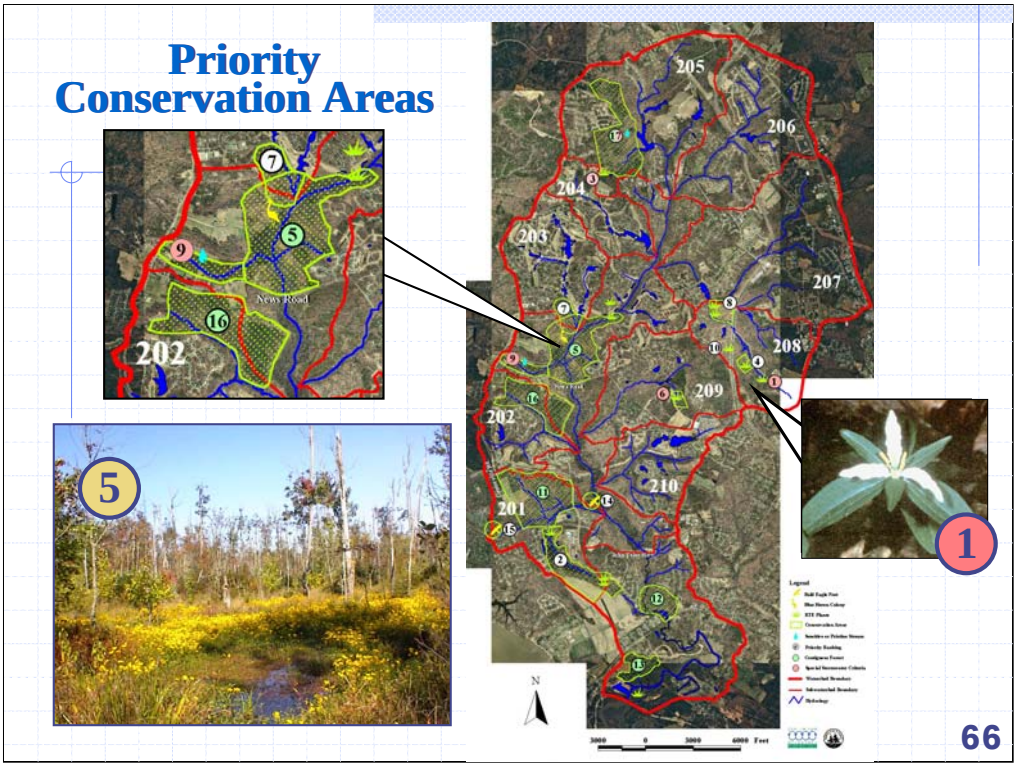
How should the ICM be used in watershed planning?



LAND
CONSERVATION
2

5 Types of Conservation Areas





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.

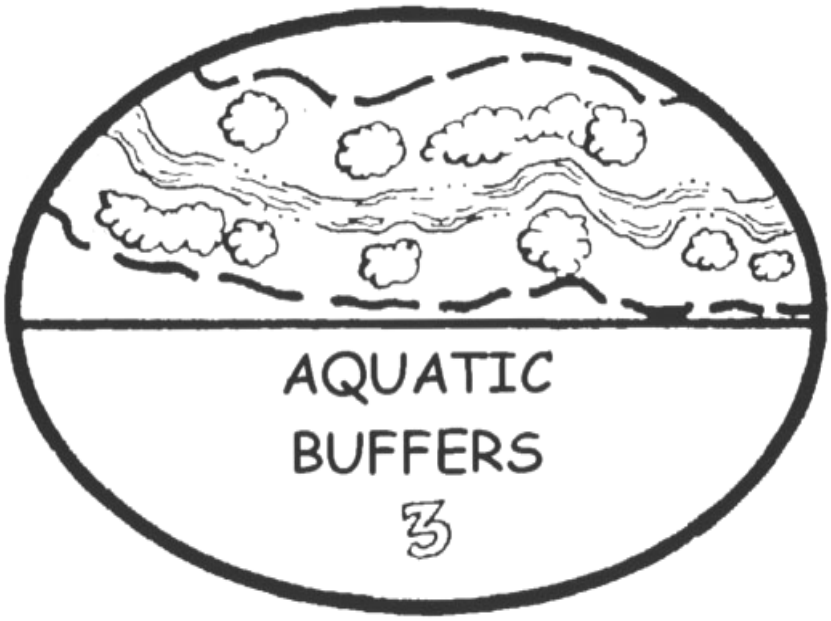
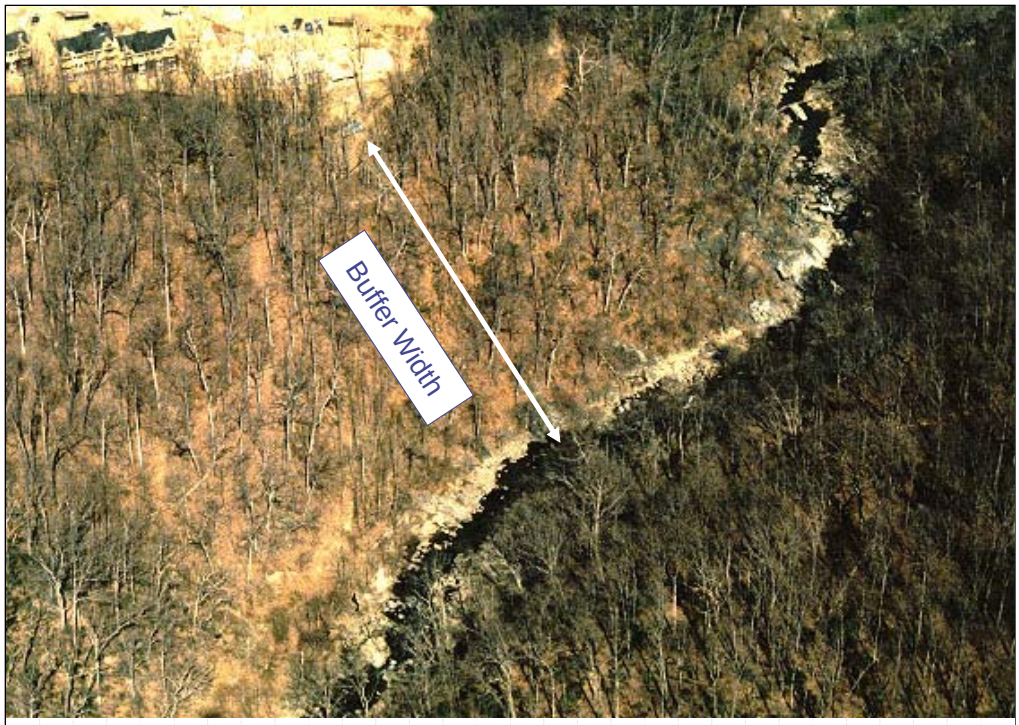
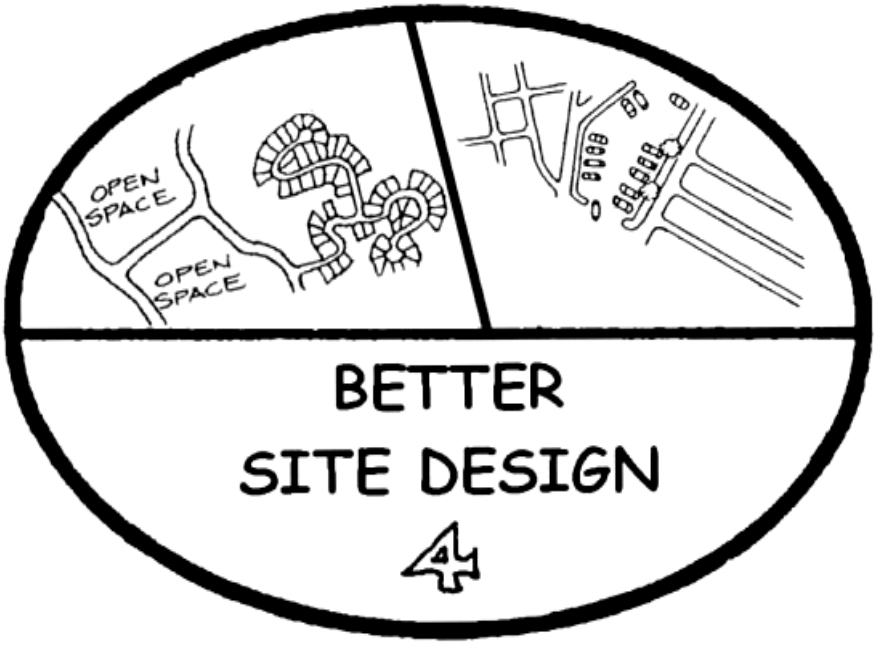

AQUATIC
BUFFERS
3


Photo Copyright 1999, Center for Watershed Protection


Buffer Width



BETTER
SITE DESIGN

4

Typical cul-de-sacs are often large enough to double as spaceship landing pads.

Typical streets are often excessively wide, increasing traffic speeds and making streets unfriendly to pedestrians.

Not so good.

Conventional Subdivision

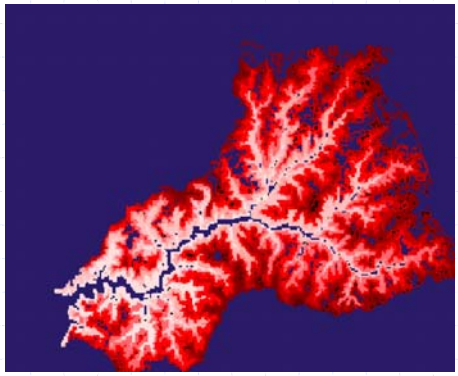
Good.

Open Space Subdivision

Parking lots are often underutilized and can be minimized through better site design techniques. 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 needless and can be minimized at every stage of parking lot and residential street planning and design.

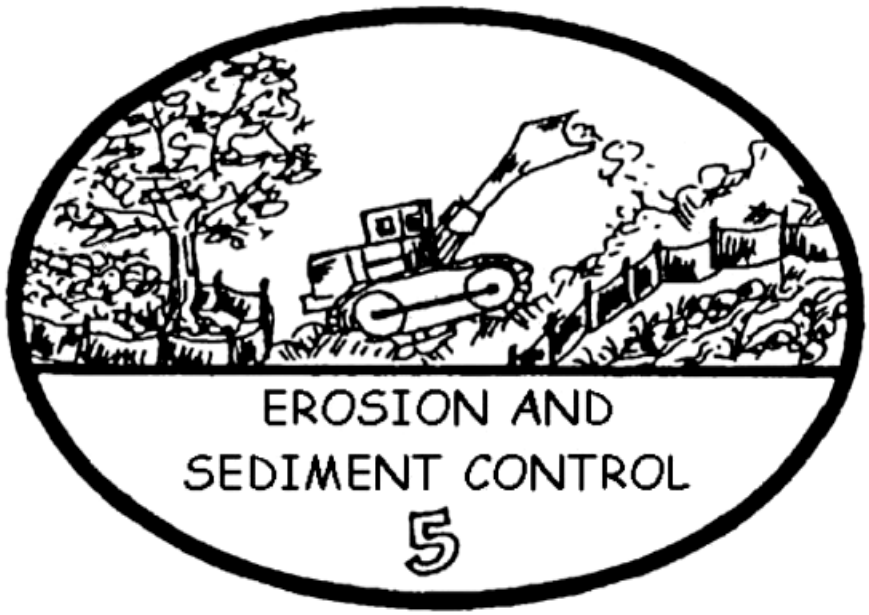
This example bioretention area is designed with trees, shrubs, and grass instead of mulch. The overflow structure in the middle of the picture allows larger storm volumes to bypass the filtration system to be conveyed directly to the drainage system.

Another alternative to managing rooftop runoff is to drain the runoff directly into rain barrels, which can store the water for later use in gardens, yards, or for house plants.



Discussion Time:

How can local development rules be changed to allow for better site design?



EROSION AND SEDIMENT CONTROL

5


Silt Fence
Hydroseeding
Check dams
Sediment Basin
80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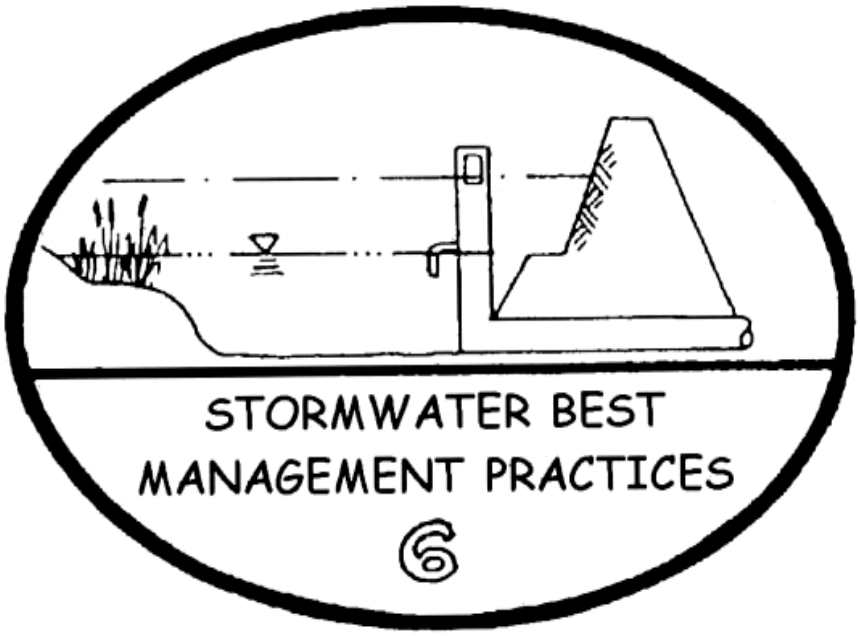
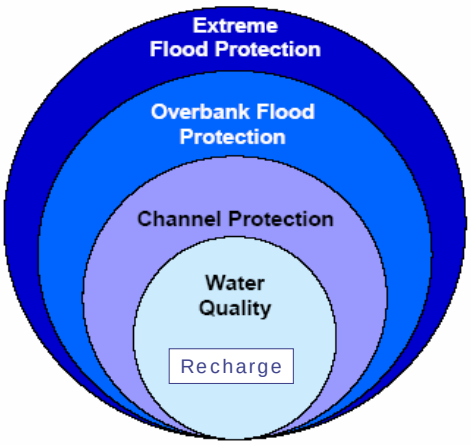


STORMWATER BEST MANAGEMENT PRACTICES

6

Tool 6:
Stormwater Management Practices



Practices handle five different kinds of rainfall events

84

Stormwater treatment practices in the watershed are often designed to achieve a specific target for phosphorus removal. Stormwater treatment can include Better Site Design techniques on residential lots and stormwater treatment practices such as ponds and wetlands for new development. For drinking water reservoirs, stormwater treatment practices should be sized and designed for maximum phosphorus removal. It is necessary to compute pre and post development phosphorus loads in order to determine how much load reduction is required. If it is not possible to meet the required reduction, a fee can be paid in lieu or stormwater practices can be used to provide phosphorus reduction elsewhere in the watershed.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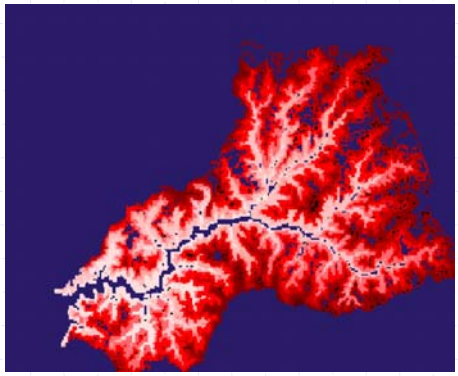
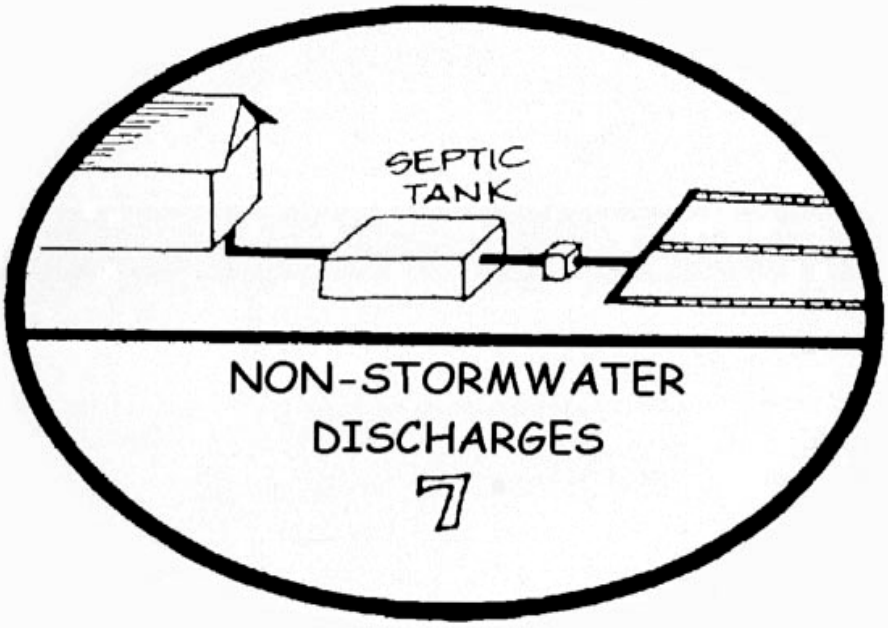
Stormwater Practices Show Moderate Ability to Remove Pollutants in Stormwater Runoff*



Discussion Time:

Can BMPs Offset the effect of Impervious Cover?



NON-STORMWATER
DISCHARGES
7


Confined Animal Feed Lots
Illicit Discharges
Failing Septic Systems
Sanitary Sewer Overflows

WATERSHED
STEWARDSHIP PROGRAMS
8


COMMON AREAS
Pet Wastes
Storm Water Practices
Stream Buffers
Storm Drains
DRIVEWAYS
Car Washing
Hosing/Blowing
Winter Deicing
Fluid Changing
ROOFTOPS
Downspout Retrofits
Add/Subtract IC
Household Haz Wastes
YARDS
Fertilization
Pesticide Use
Lawn Watering
Landscaping
Tree Canopy Cover
Yard Waste
Soil Reclamation
Erosion Control
Septic Systems
Swimming Pools

What are some key differences between two neighborhoods that may influence pollutant generation?

Question 1
What is the largest crop by area in most metropolitan areas?

Answer:

- Turfgrass is single largest crop by area in the Chesapeake Bay Basin
- Grows by 5 to 10% each decade
- 2/3 is the home lawn
- Nutrients, pesticides, and irrigation

Question 2
What proportion of homeowners apply fertilizer? How many over-fertilize?

Answer:

- Almost 90% of residents have a yard
- About 50% fertilize their yard
- Average of two applications per year
- 50% of fertilizers over-fertilize

Question 3

How many households own a dog?

What percentage of dog-walkers pick up after their pets?

Answer:

- About 40% of all households own a dog
- Only half of dog owners are dog walkers
- About 60% of dog-walkers claim to pick up after their dog “some or all of the time”
- What a bunch of liars

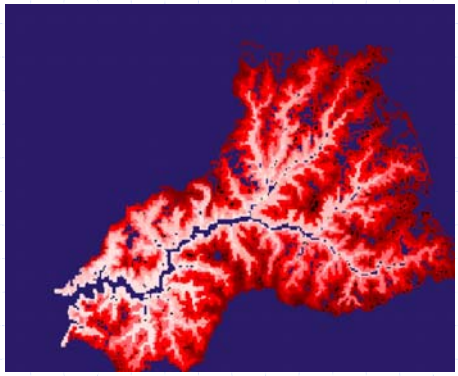
Question 5

What percentage of homeowners wash their own cars?

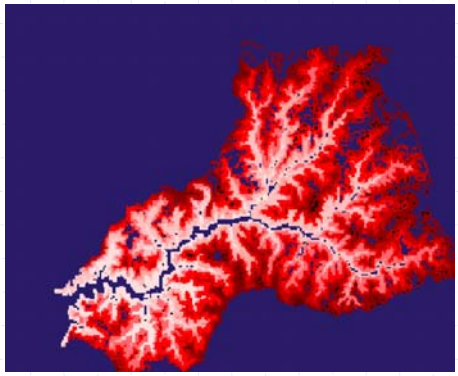
How frequently do they do it?

Answer:

- 60 to 70% of households wash their own cars
- 60% of these can be considered chronic car washers (wash at least once a month)
- 80% reported wash water drained directly to the street (and presumably the storm drain)
- ~ 800 gallons per hour with hose



Discussion Time:
How can we design more effective campaigns to change watershed behaviors?



Discussion Time:

Final Thoughts

Thank You

After viewing the links to additional resources, please complete our online feedback form.

Links to Additional Resources