Stormwater Phase II Requirements: Improving Stormwater Quality Over the Long-Term

Webcast
November 16, 2005
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U.S. EPA

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Today's Discussion

- What's an NPDES Permit and how does it work?
- Why is stormwater a problem?
- What is the NPDES stormwater program all about and how can I get involved?
- Permanent Stormwater Controls (Post-Construction)
- Smart Growth and Low Impact Development

"Storm Water" or
"Stormwater?"
Is it one word or two?

Part I

What's a National Pollutant Discharge Elimination System (NPDES) Permit and how does it work?

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NPDES Statutory Framework

All "point" sources
"Discharging Pollutants"
into "Waters of the U.S."

→

Must obtain an NPDES permit from an authorized State or EPA

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NPDES Permits

- Illegal for point source (pipe, ditch, channel, tunnel, vessel, rolling stock, or other manmade conveyance) to discharge pollutants to surface waters without a permit
- Permit is a license granting permission to discharge
  - **Not a right: permit is revocable "for cause" (e.g., non-compliance)**

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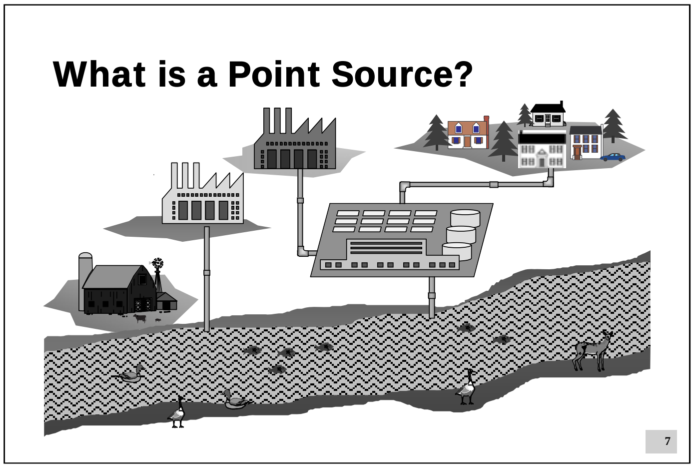

We can use this illustration to help discuss some of the key terms presented in the previous slide and to put into perspective a conceptual picture of the universe of the NPDES Program.

To begin, pollutants can enter surface waters through a variety of pathways. As you can see from the slide .. pollutants may be discharged from residential areas, industrial facilities, publicly owned treatment works (POTWs) and agricultural or livestock operations. For regulatory purposes ... discharges to surface waters are generally categorized as either "point sources" or "non-point sources".

"Point" Source" is defined as *any discernable, confined and discrete conveyance ... from which pollutants are or may be discharged (see Glossary - 8).*

- Typical point source discharges include discharges from POTWs and industrial facilities.
- some others:

  landfill leachate collection system

  CAFO -- depends on size of operation

What is **<u>not</u>** a point source?

- Indirect discharges
- Residents
- Wild animals
- Agricultural activities .... While provisions of the NPDES program do address certain specific types of agricultural activities ... **the majority of agricultural activities are defined as non-point sources** and are exempt from regulation under the NPDES Program.
  - Concentrated Animal Feeding Operations (CAFOs) **are**


Point Source Pollution
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Point Source

- Any discernable, confined, discrete conveyance, including, but not limited to, any pipe, ditch, channel, tunnel, conduit, well, discrete fissure, rolling stock, concentrated animal feeding operation, some vessels, or other floating craft from which pollutants are or may be discharged. (CWA Sec. 502(14))
- Does not include return flows from irrigated agriculture.

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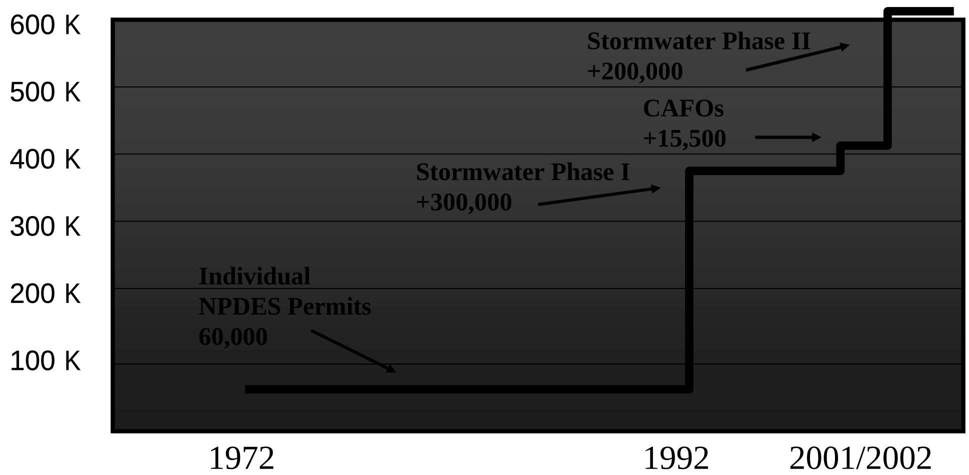
Pollutant

- Means dredged spoil, solid waste, incinerator residue, filter backwash, sewage sludge, munitions, chemical wastes, biological materials, (some) radioactive materials, heat, wrecked or discarded equipment, rock, sand, cellar dirt and industrial, municipal, and agricultural waste discharged into water

(CWA Sec. 502(6))

Growth of the NPDES Program

(Number of facilities or sources)



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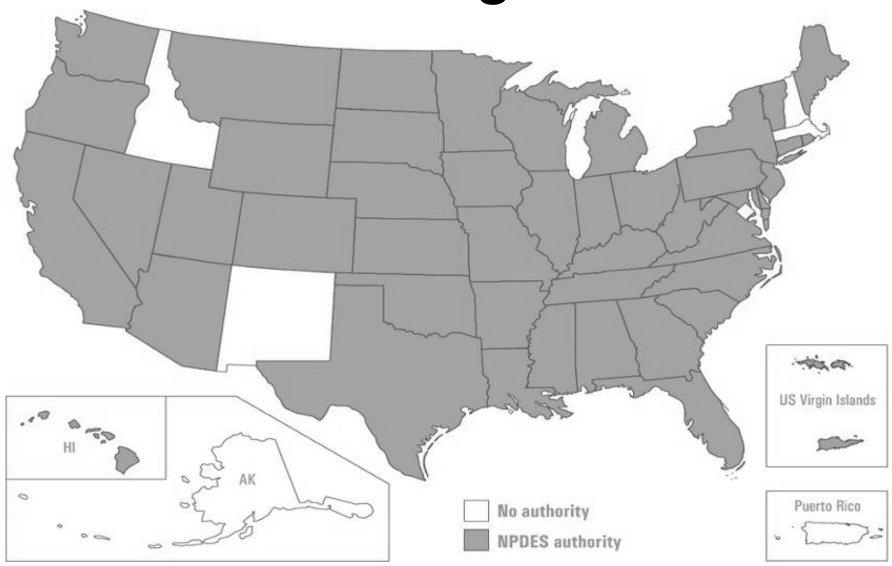
State NPDES Program Authority



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NPDES Permits

- Permit term: 5 years
- Issued by authorized states, tribes, or EPA
- Public review and comment on draft permits
- Administrative and judicial appeal processes

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Permit Review/Comment

- Public notice/30-day comment period (minimum)
- Public hearing (if sufficient interest/controversy)
  - **Comment period extended 30 days**
- EPA review of certain state-issued permits
  - **"Major" municipal and industrial**
  - **General permits**
  - **Subject to widespread public interest**

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NPDES: Enforcement

- Penalties:
  - **Fines for violations (exceed limits, fail to report) up to $32,500 per day**
  - **Imprisonment for criminal violations (repeated, willful violations)**
  - **Supplemental environmental projects (SEP) - money goes to restoration projects, not to U.S. Treasury**
- Citizen suits: directed against dischargers
  - **Must provide 60-day notice to EPA, state, and tribe to give them a chance to take action**

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NPDES Permit Program

- Two categories of NPDES permits
  - **Individual**
  - **General**
- Issued by states, territories, tribes, or EPA (permit term 5 years)
- Public review and comment on draft permits

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It's time to play….

"Point Source or Nonpoint Source"

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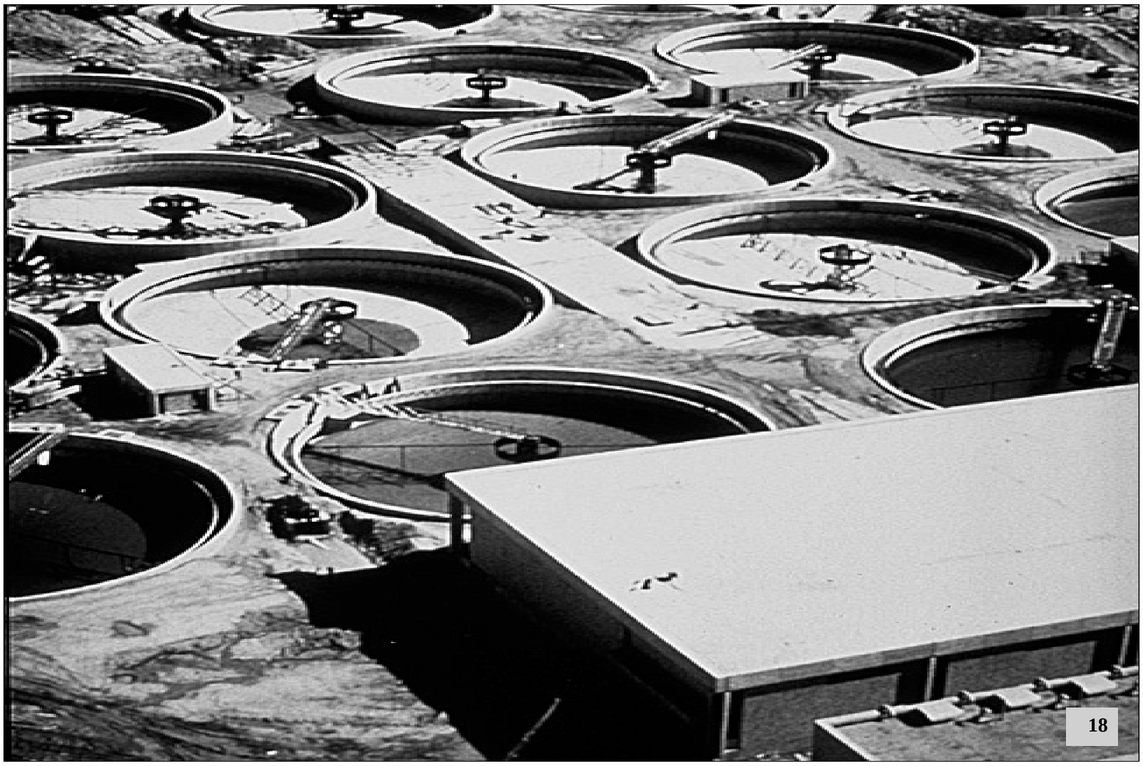
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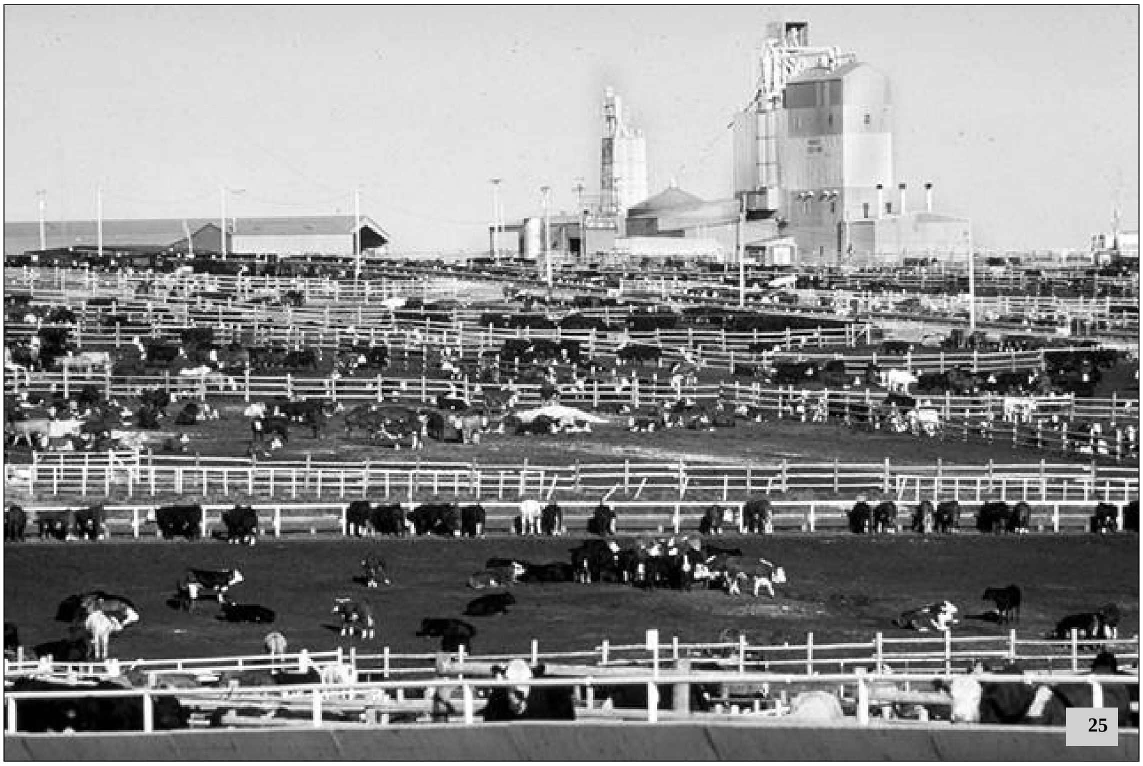
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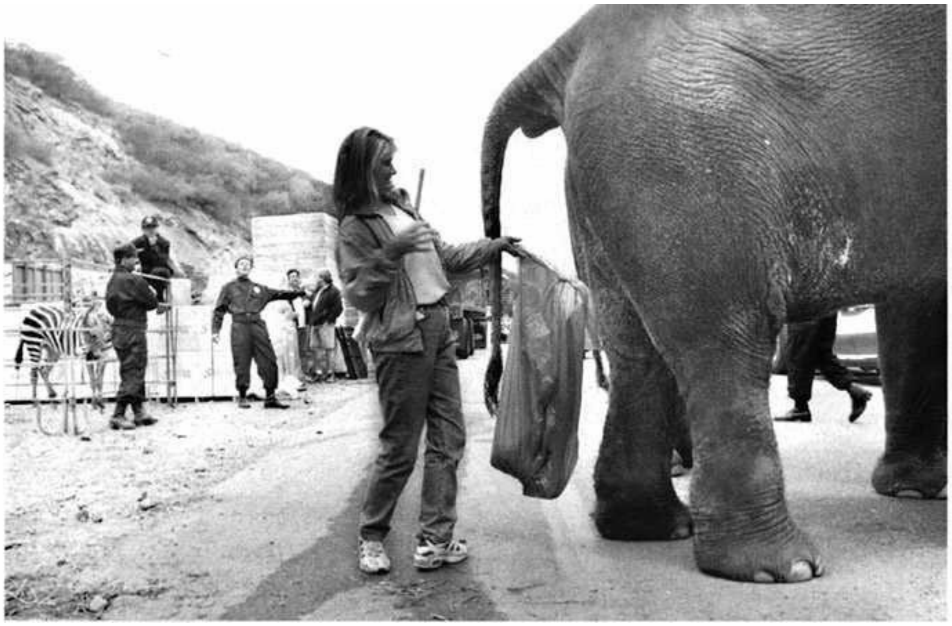

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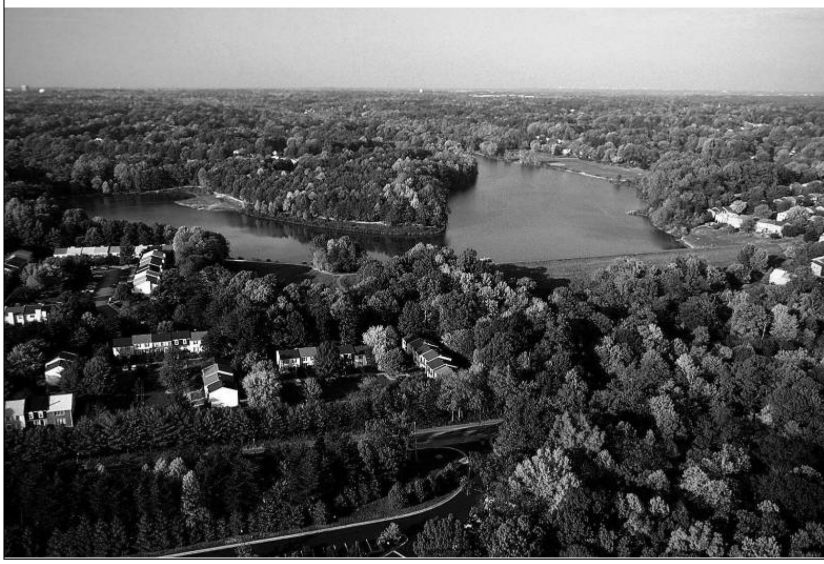
Questions??



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Part II

Why is Stormwater a Problem?

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Why is Stormwater a Problem?

- Impervious surfaces and disturbed land contribute to changes in quality and quantity
- Pollutants include sediments, nutrients, bacteria, chemicals, metals, etc.
- Problems include scouring, temperature changes, siltation, fish kills, shellfish bans, etc.

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Why is Stormwater a Problem?

Urban Runoff is the Source of Problems in:

- 34,871 miles or 13% of all Impaired Rivers and Streams
- 1,369,327 acres or 18% of all Impaired Lakes
- 5045 square miles or 32% of all Impaired Estuaries

*** Note: The National Water Quality Inventory (305(b) Report) describes the quality of assessed waters. Many of the nation's rivers, lakes and estuaries remain unassessed. The percentages above are based on assessed waters only.**

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Common Pollutants in Urban Stormwater

- Sediment
- Nutrients
- Oxygen-Demanding Substances
- Pathogens
- Trash
- Road Salts
- Oil and Grease
- Heavy Metals
- Heat
- PAHs

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Effects of Development on Stormwater Runoff

Increases:

- Impervious surface area
- Stormwater volume
- Stormwater velocity
- Deposition of pollutants

Decreases:

- Stormwater quality
- Ground water recharge
- Baseflow
- Natural drainage systems including riparian vegetative cover

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Consequences of Development to Urban Streams

- Increased rate and severity of flooding
- Increased erosion of stream banks and bottoms (stream widening and channelization)
- Increased sedimentation
- Increased chemical pollution
- Altered biological populations
- Degradation of riparian habitat
- Increased stream temperatures (loss of riparian cover)

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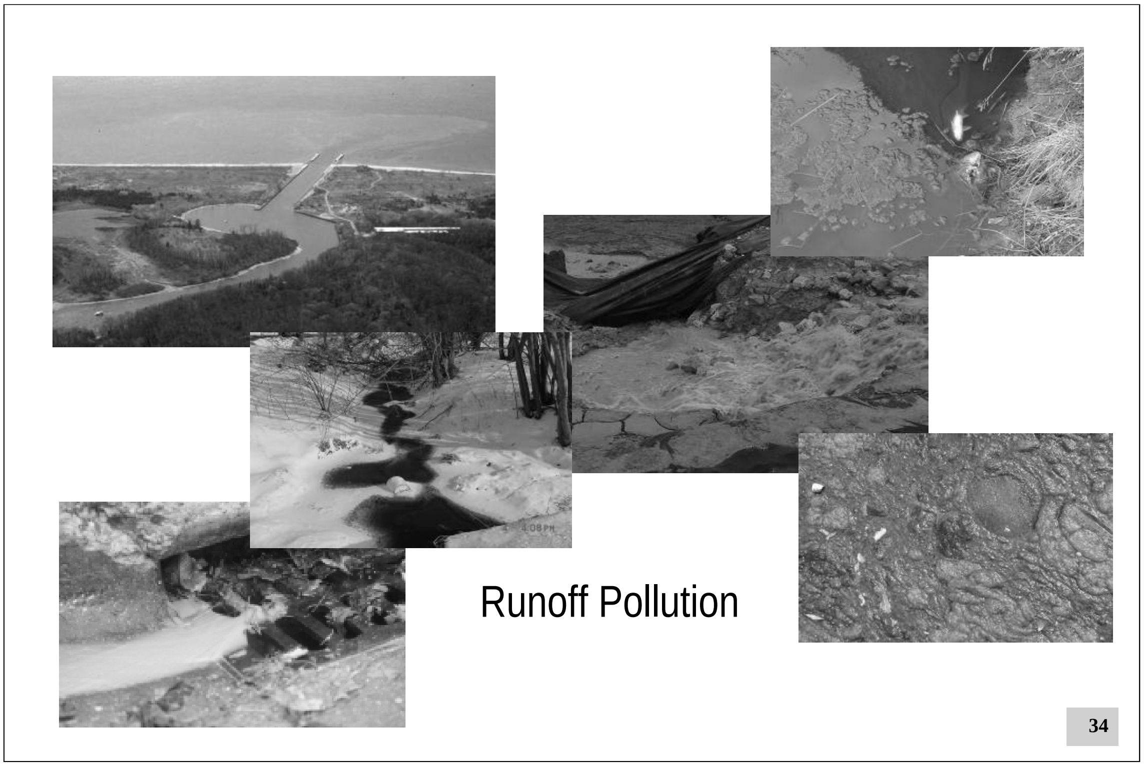

Lots of existing water quality problems and other environmental degradation attributable to the nonpoint sources realm. NURP, etc.


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Transportation: runoff from roads, parking lots, runways

Pollutants: salt, sand, soil, zinc, petroleum products, copper, phosphorus, glycols

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Turf grass management and other yard care activities

Pollutants: nutrients, soil, pesticides

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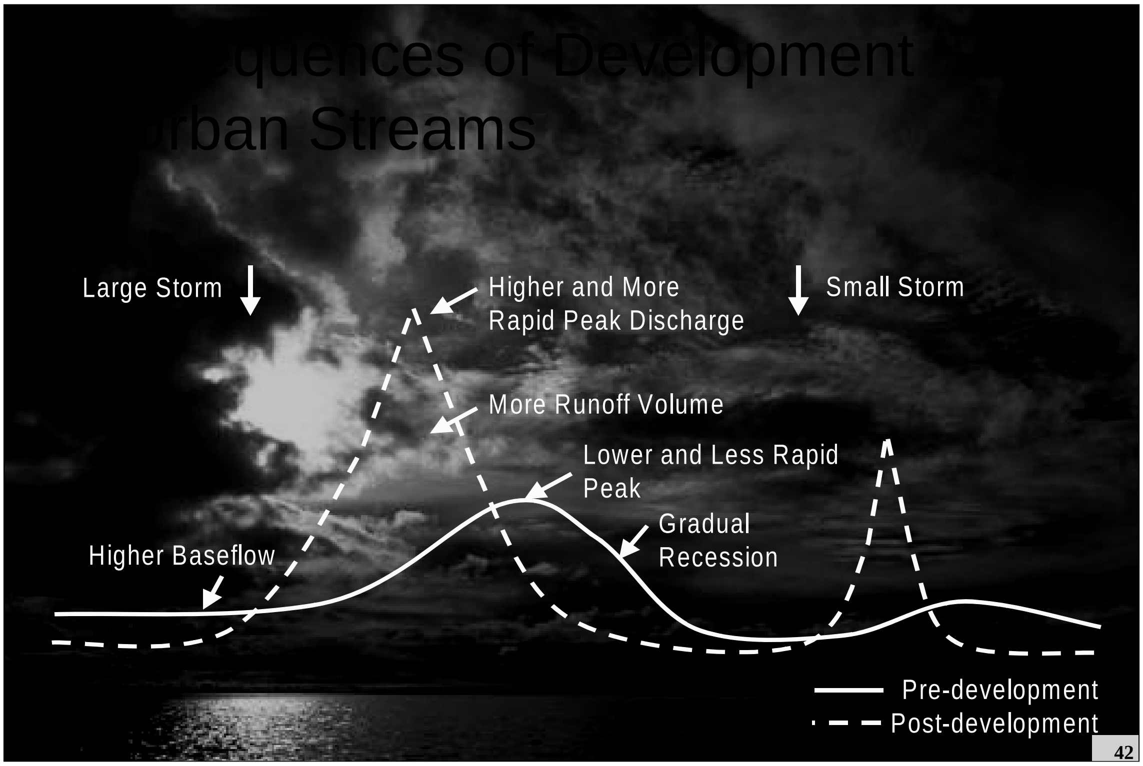
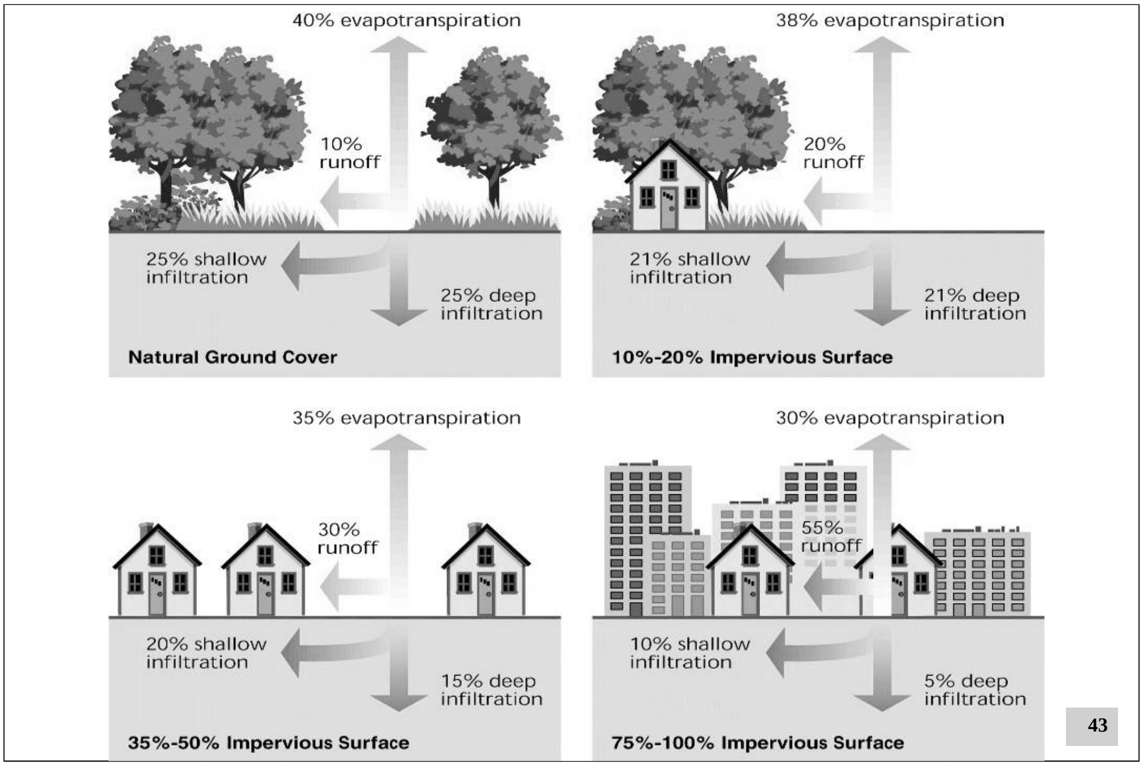
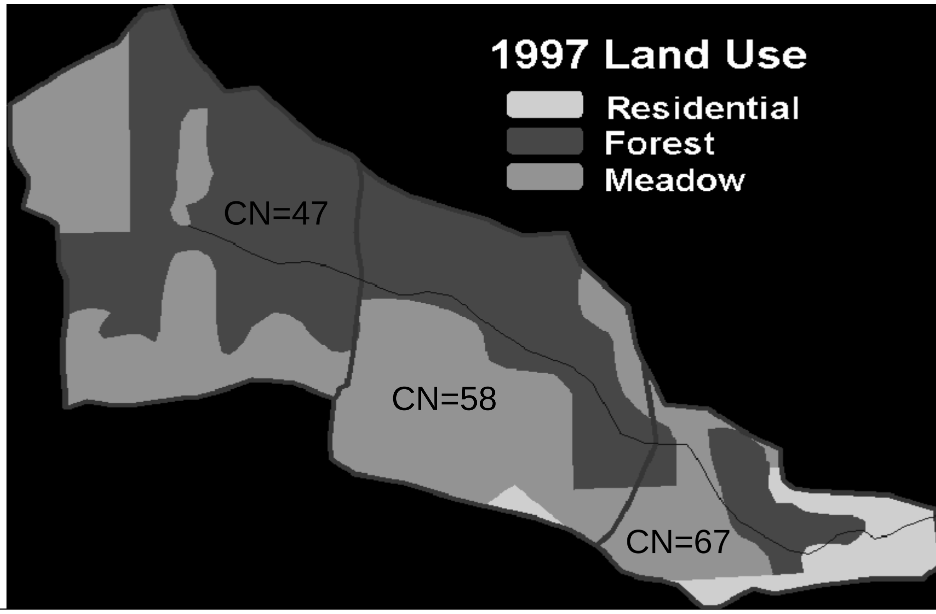

Large Storm
Higher and More
Rapid Peak Discharge
Small Storm
More Runoff Volume
Lower and Less Rapid
Peak
Gradual
Recession
Higher Baseflow
Pre-development
Post-development
42


40% evapotranspiration
10% runoff
25% shallow infiltration
25% deep infiltration
Natural Ground Cover
38% evapotranspiration
20% runoff
21% shallow infiltration
21% deep infiltration
10%-20% Impervious Surface
35% evapotranspiration
30% runoff
20% shallow infiltration
15% deep infiltration
35%-50% Impervious Surface
30% evapotranspiration
55% runoff
10% shallow infiltration
5% deep infiltration
75%-100% Impervious Surface
43

Blakeslee Creek



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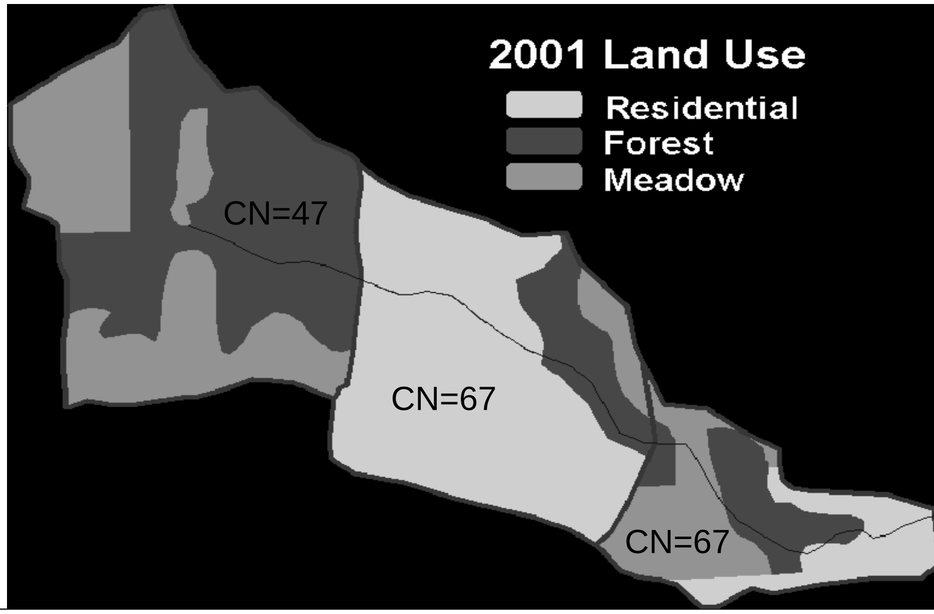
Blakeslee Creek



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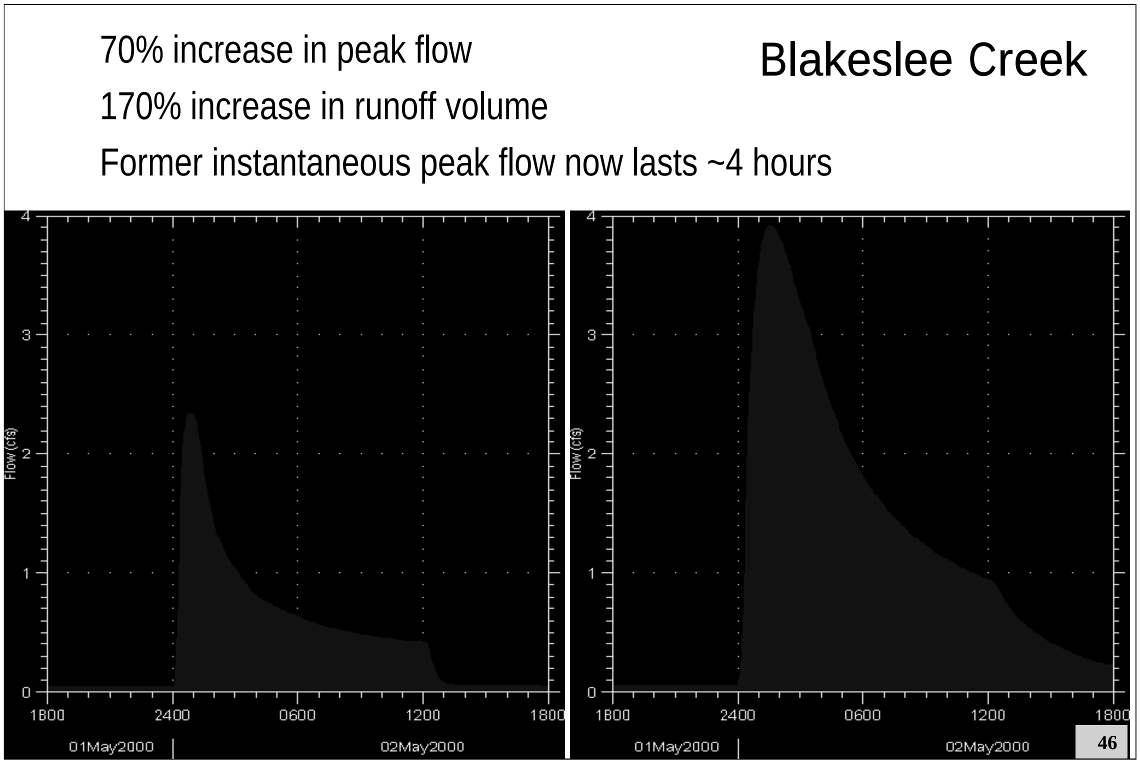
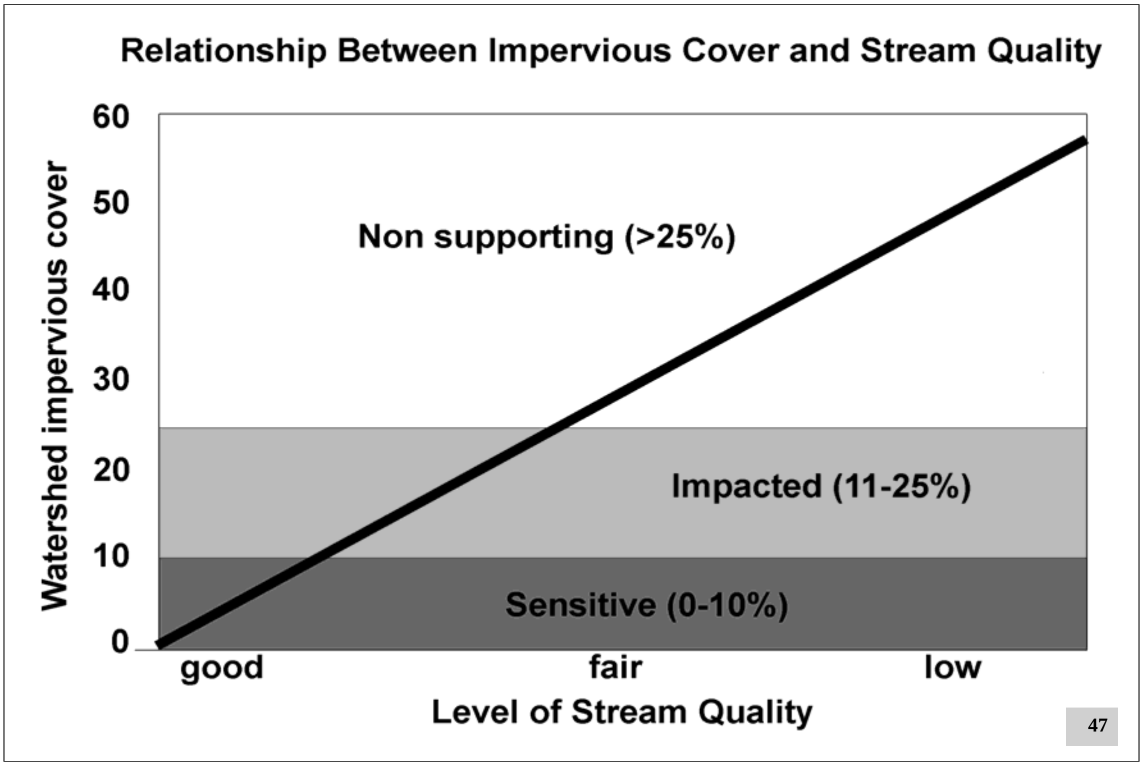
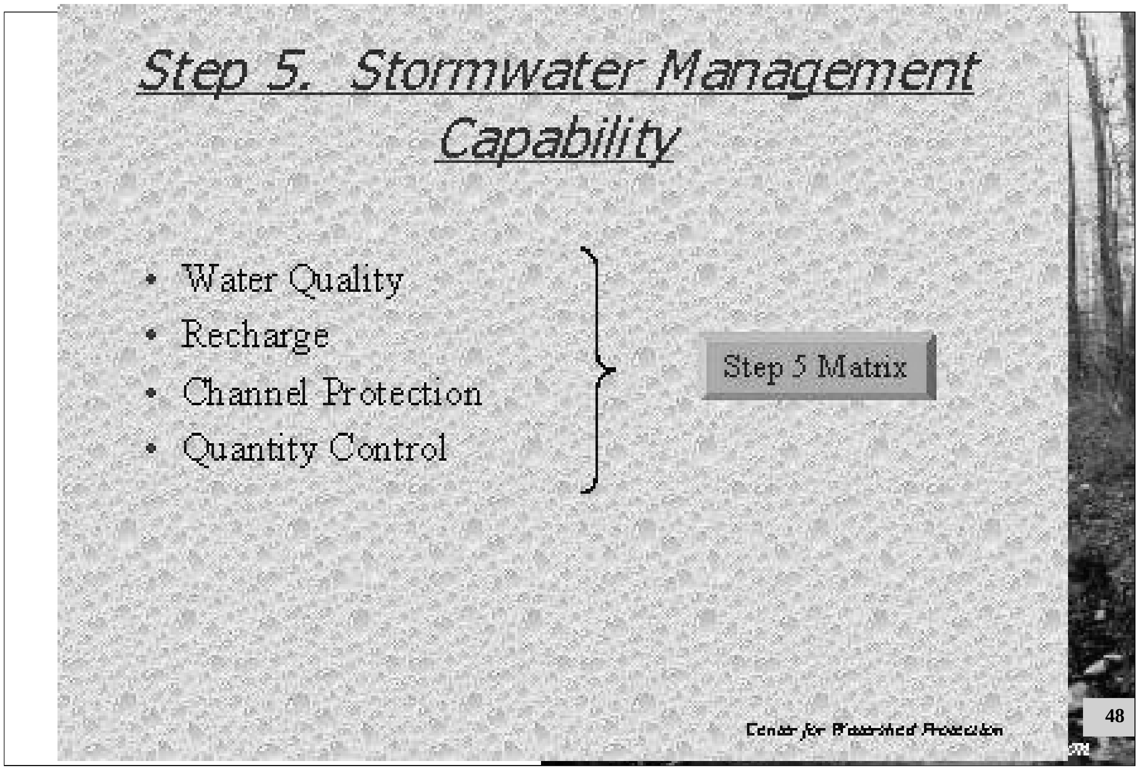


70% increase in peak flow, 167% increase in runoff volume, former instantaneous peak flow now lasts ~4 hours


Relationship Between Impervious Cover and Stream Quality
Watershed impervious cover
60
50
40
30
20
10
0
Non supporting (>25%)
Impacted (11-25%)
Sensitive (0-10%)
good
fair
low
Level of Stream Quality
47



This matrix examines the capability of each STP option to meet stormwater management criteria. It shows whether an STP can meet requirements for:

Water Quality. The matrix tells whether each practice can be used to provide water quality treatment effectively. For more detail, consult the pollutant removal matrix.

Recharge. The matrix indicates whether each practice can provide ground water recharge, in support of recharge requirements. It may also be possible to meet this requirement using stormwater credits.

Channel Protection. The matrix indicates whether the STP can typically provide channel protection storage. The finding that a particular S TP cannot meet the channel protection requirement does not necessarily imply that the STP should be eliminated from consideration, but is a reminder that more than one practice may be needed at a site (e.g., a bioretention area and a downstream ED pond).

Quantity Control The matrix shows whether an STP can typically meet the overbank flooding criteria for the site. Again, the finding that a particular STP cannot meet the requirement does not necessarily mean that it should be eliminated from consideration, but rather is a reminder that more than one practice may be needed at a site (e.g., a bioretention area and a downstream stormwater detention pond).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At 10% impervious cover, the stream is more visibly impacted. The stream has approximately doubled its original size, tree roots are exposed, and the pool and riffle structure seen in sensitive streams is lost.


[redacted]
51
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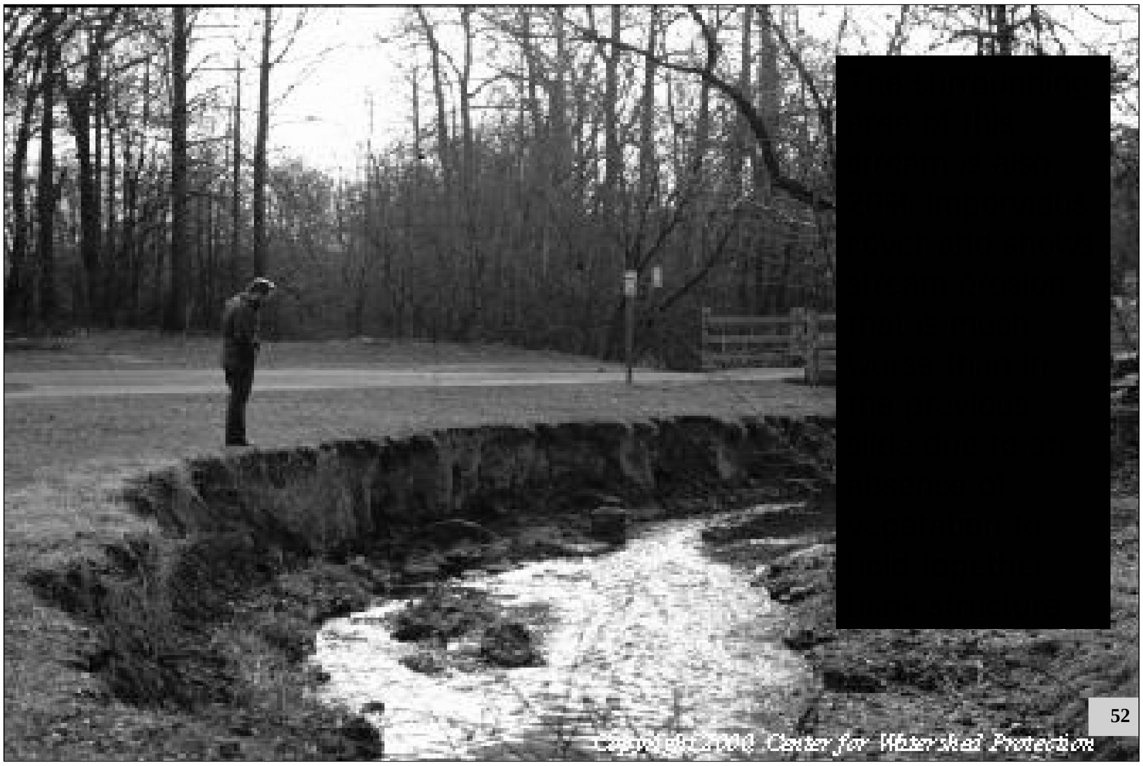
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Questions??

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Part III

What is the NPDES stormwater program all about and how can I get involved?

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Regulatory History

- Before 1987 stormwater considered a non-point source and not regulated

- Water Quality Act of 1987 brought some stormwater into the NPDES program
  - **Permits required for municipalities over 100,000**
  - **Permits required for industrial activities**
  - **EPA must consider who else to permit "to protect water quality"**

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The "Phases"

- Phase I – 1990
  - **Medium and large municipalities (over 100,000)**
  - **Construction sites (over 5 acres)**
  - **Industrial activity (10 categories)**

- Phase II – 1999
  - **Smaller municipalities in "urbanized areas"**
  - **Construction sites (1-5 acres)**
  - **"No exposure" expanded**

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Permitting Framework

- Three parts of the stormwater program
  - **Industrial**
  - **Construction**
  - **Municipal**
- All three emphasize pollution prevention
- Best Management Practices used to limit exposure of pollutants to stormwater rather than "treatment systems"

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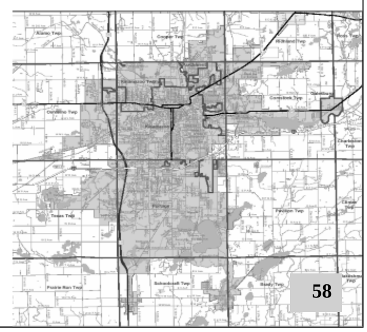
Municipal Stormwater

- Stormwater discharges from municipal storm sewer systems in urban areas meeting appropriate population and population density criteria to qualify as an ‘urbanizing area’ as determined by the U.S. Census Bureau.



What is an MS4?

- A municipal separate storm sewer system (MS4) is:
- A conveyance or system of conveyances... owned by a state, city, town, or other public entity that discharges to waters of the U.S. and is:
  - **designed or used for collecting or conveying stormwater**
  - **not a combined sewer**
  - **not part of a Publicly Owned Treatment Works (POTW)**

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Urbanized Areas, 2000 Census

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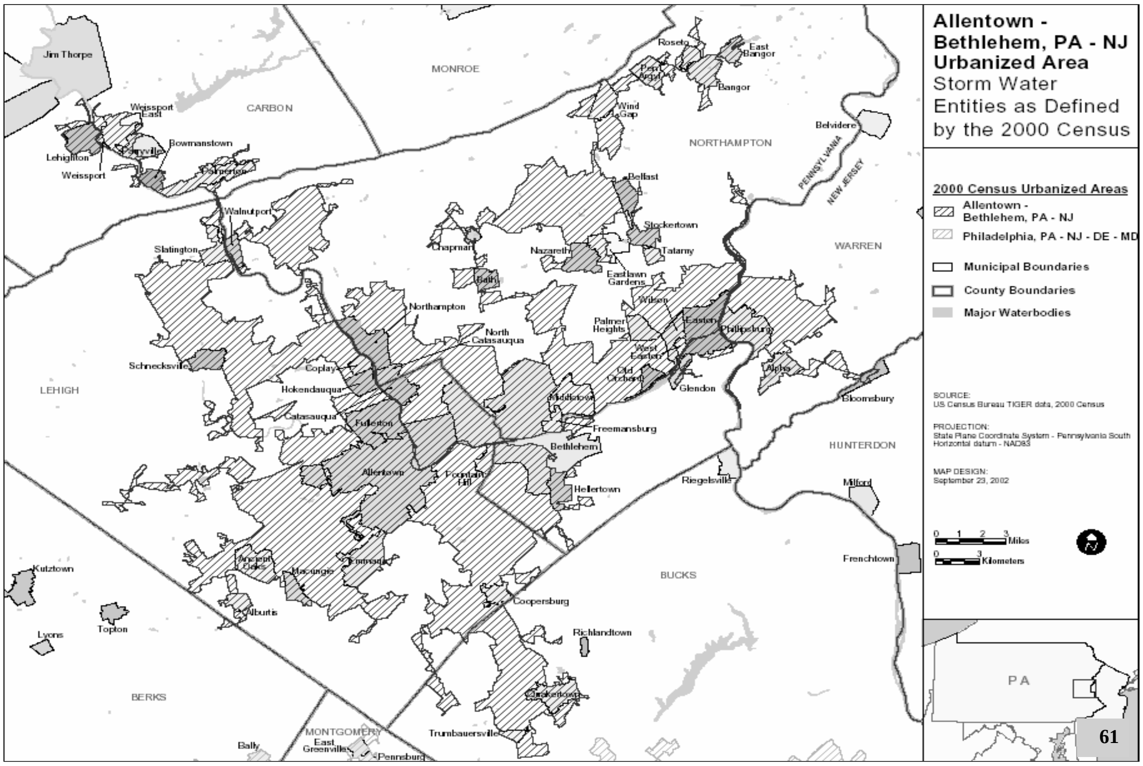
Allentown - Bethlehem, PA - NJ Urbanized Area
Storm Water Entities as Defined by the 2000 Census
2000 Census Urbanized Areas
Allentown - Bethlehem, PA - NJ
Philadelphia, PA - NJ - DE - MD
Municipal Boundaries
County Boundaries
Major Waterbodies
SOURCE:
US Census Bureau TIGER data, 2000 Census
PROJECTION:
State Plane Coordinate System - Pennsylvania South
Horizontal datum - NAD83
MAP DESIGN:
September 23, 2002
Miles
Kilometers
PA
61
MONROE
CARBON
NORTHAMPTON
LEHIGH
WARREN
HUNTERDON
BUCKS
BERKS
MONTGOMERY
PENNSYLVANIA
NEW JERSEY
Jim Thorpe
Weissport East
Bowmanstown
Lehighton
Weissport
Parryville
Palmerton
Walnutport
Slatington
Roseto
Pen Argyl
East Bangor
Bangor
Wind Gap
Belvidere
Bellast
Stockertown
Tatamy
Chapman
Nazareth
Bath
Eastlawn Gardens
Wilson
Northampton
North Catasauqua
Palmer Heights
Easton
Phillipsburg
West Easton
Old Orchard
Alpha
Glendon
Bloomsbury
Schnecksville
Coplay
Hokendauqua
Catasauqua
Fullerton
Freemansburg
Bethlehem
Allentown
Fountain Hill
Hellertown
Riegelsville
Milford
Frenchtown
Kutztown
Ancient Oaks
Macungie
Emmaus
Alburtis
Topton
Lyons
Coopersburg
Richlandtown
Quakertown
Trumbauersville
Bally
East Greenville
Pennsburg

Phase I Coverage

- Covers municipalities with populations over 100,000
- Many MS4s in places less than 100,000 have been designated by the permitting authority
- Approximately 235 permits covering 1,000 MS4s have been issued

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Phase II Coverage

- Covers approximately 5000 smaller municipalities and governmental entities in "urbanized areas"
- Urbanized areas are determined by the Census Bureau
- Permitting authorities can also designate additional small MS4s that are outside of urbanized areas

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Operators of MS4 Systems

- Cities
- Towns
- Counties
- Townships
- Boroughs
- Road Commissions
- Drain Commissions
- Drainage Districts
- Public School Systems
- Public Colleges and Universities
- State or Federal Prisons
- State or Federal Hospitals
- Military Installations
- State or National Parks
- DOTs

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Six Minimum Measures

- Public Education and Outreach
- Public Involvement/Participation
- Illicit Discharge Detection and Elimination
- Construction Site Runoff Control
- Post-Construction Stormwater Management in New and Redevelopment
- Pollution Prevention/Good Housekeeping for Municipal Operations

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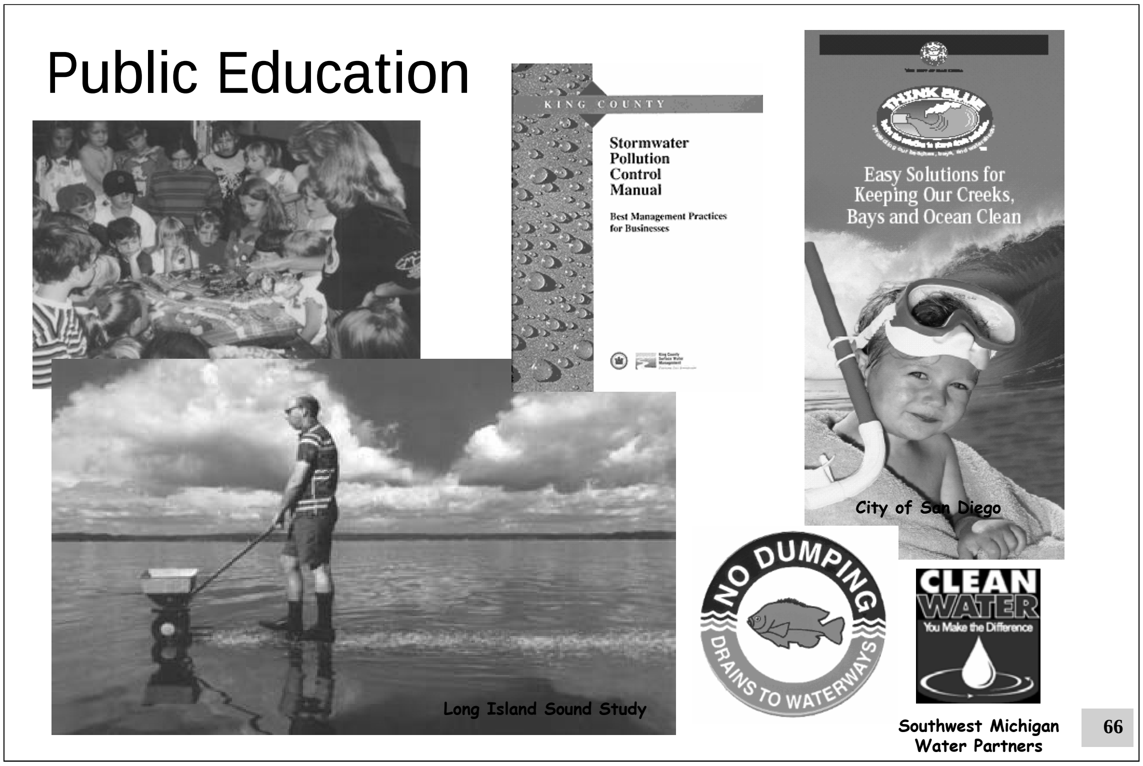
Public Education
KING COUNTY
Stormwater Pollution Control Manual
Best Management Practices for Businesses
THINK BLUE
Easy Solutions for Keeping Our Creeks, Bays and Ocean Clean
City of San Diego
Long Island Sound Study
NO DUMPING
DRAINS TO WATERWAYS
CLEAN WATER
You Make the Difference
Southwest Michigan Water Partners
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How Can Watershed Groups Help?

- Public Education
  - **Unlimited opportunities!**
  - **Watershed awareness**
  - **Understanding of particularly important problems**
  - **Changing citizen behaviors via “social marketing”**

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Public Involvement/Participation

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How Can Watershed Groups Help?

- Public Participation
  - **Foster the creation of and participate in stormwater/watershed citizen advisory groups**
  - **Watershed planning**
  - **Volunteer monitoring**
  - **Implementation of any of the other minimum measures**

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Illicit Discharge Detection and Elimination

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How Can Watershed Groups Help?

- Illicit Discharge Detection and Elimination
  - **Increase citizen awareness**
  - **Publicize “hotline”**
  - **Staff hotline**
  - **Walk streams and survey outfalls**
  - **Educate business with potential for illicit discharges**

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Construction Site Runoff Control

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How Can Watershed Groups Help?

- Managing Construction Sites
  - Drive-by assessments of construction sites and report results to municipality
  - Education of contractors and subcontractors on sediment and erosion controls
  - Educate other citizens and groups on recognizing common construction site problems

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Municipal Operations

- Street sweeping
- Vehicle maintenance
- Road repair
- Landscape maintenance
- Public works yards

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How Can Watershed Groups Help?

- Municipal Operations
  - Press municipal managers to properly train public works employees on good housekeeping/pollution prevention practices
  - Help raise awareness among other municipal employees (police, fire, building inspectors) to “see” stormwater problems
  - Report problems when identified
  - Report any catch basins and other facilities needing maintenance

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Questions??

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Part IV

Permanent or Post-Construction
Runoff Controls

Smart Growth and Low Impact
Development

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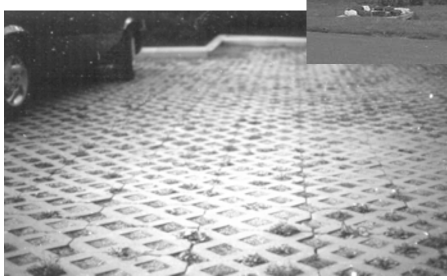
Post-Construction Stormwater Management



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Post-Construction Stormwater Management in New Development and Redevelopment

- Develop a program, using an ordinance or other regulatory means, to address runoff from new development and redevelopment projects that disturb >1 acre
- Implement strategies with a combination of structural and/or non-structural BMPs
- Ensure adequate long-term operation & maintenance (O&M) of BMPs

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•See **§ 122.34(b)(5)**.

•Less than 1 acre must be included in the MS4's post-construction program if it is part of a larger common plan of development or sale disturbing over 1 acre.

Why is this measure necessary?

•Development leads to an increase in:

–Type and quantity of pollutants

–Quantity of water (increased flows)

•Both increases have proven impacts on receiving waterbodies

•Prior planning and design to minimize these increases is most cost-effective approach

What are some implementation guidelines?

•Non-Structural BMPs

–Planning and procedures

–Site-based local controls

•Structural BMPs

–Storage practices

–Infiltration Practices

–Vegetative Practices

Post-Construction Stormwater Management in New Development and Redevelopment

- The BMPs chosen should:
  - **be appropriate for the local community**
  - **minimize water quality impacts**
  - **attempt to maintain pre-development runoff conditions**
- Participate in watershed planning efforts
- Assess existing ordinances, policies, and programs that address stormwater runoff quality
- Provide opportunities for public participation

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•See **§ 122.34(b)(5)**.

What are some implementation guidelines/examples of BMPs?

•*Non-Structural BMPs* are preventative actions that involve management and source controls, such as:

–Policies and ordinances that provide requirements and standards to direct growth to identified areas, protect sensitive areas such as wetlands and riparian areas, maintain and/or increase open space (including a dedicated funding source for open space acquisition), provide buffers along sensitive water bodies, minimize impervious surfaces, and minimize disturbance of soils and vegetation

–Policies or ordinances that encourage infill development in higher density urban areas, and areas with existing infrastructure

–Education programs for developers and the public about project designs that minimize water quality impacts

–Measures such as minimization of percent impervious area after development and minimization of directly connected impervious areas.

•*Structural BMPs* include:

–Storage practices such as wet ponds and extended-detention outlet structures;

–Filtration practices such as grassed swales, sand filters and filter strips; and

–Infiltration practices such as infiltration basins and infiltration trenches.

•EPA recommends that you ensure the appropriate implementation of the structural BMPs by considering some or all of the following: pre-construction review of BMP designs; inspections during construction to verify BMPs are built as designed; post-construction inspection and maintenance of BMPs; and penalty provisions for the noncompliance with design, construction or operation and maintenance.

What are the Elements of a Post-Construction Runoff Control Program?

- Update of general/comprehensive plan and environmental review procedures
- Development of stormwater design standards/ ordinance
- Process for review and approval of stormwater plans for new development
- Post-construction BMP maintenance, tracking and inspection
- Penalty provisions for noncompliance
- Training and education
- Proper funding and staffing for maintenance!

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Stormwater and Smart Growth

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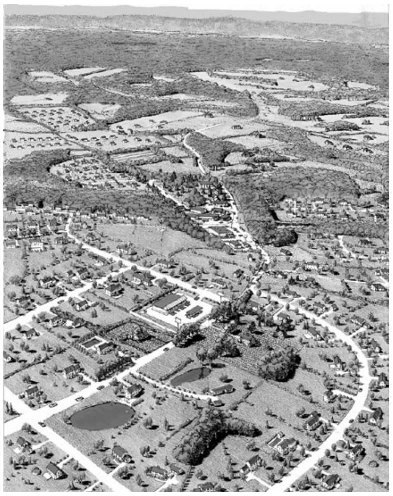
Trends in Development



Current development trends are characterized by low-density housing, farmland conversion, and dependence on cars, which:

- Consumes land at a faster rate
- Transforms farmland
- Separates houses from stores, businesses, and other land uses
- Increases time spent in cars

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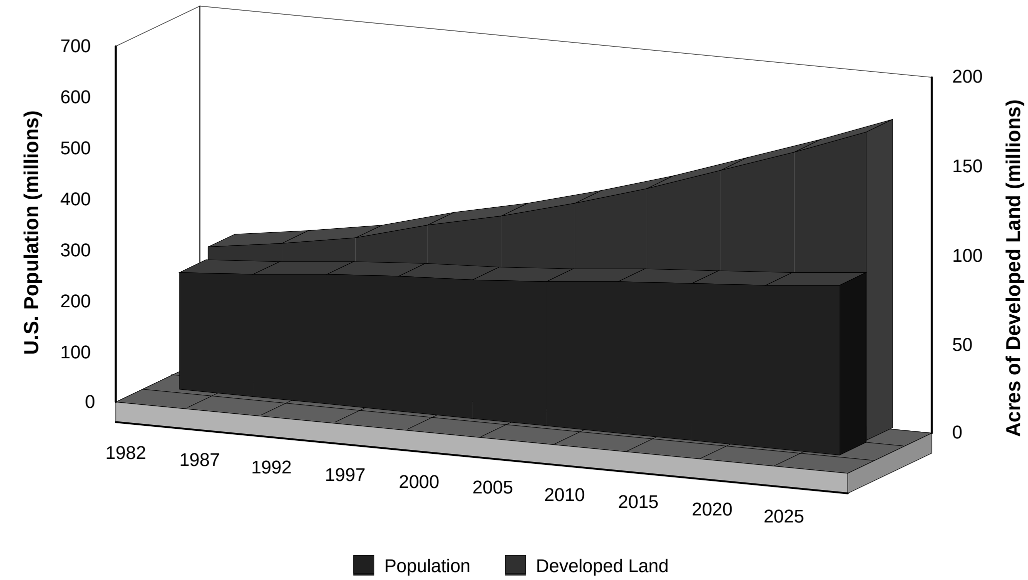
Rate of Land Development vs. Rate of Population Growth



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Which is Better for Water Quality on a Watershed Basis?

OR

Low Density

Higher Density

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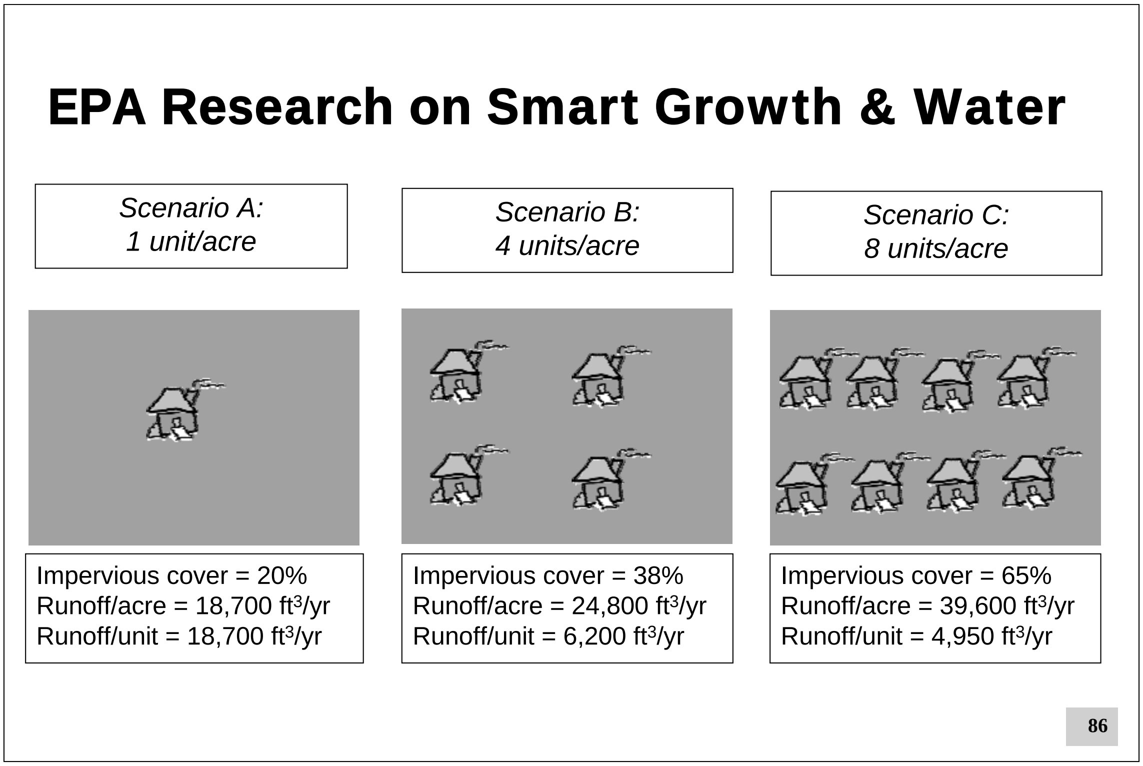
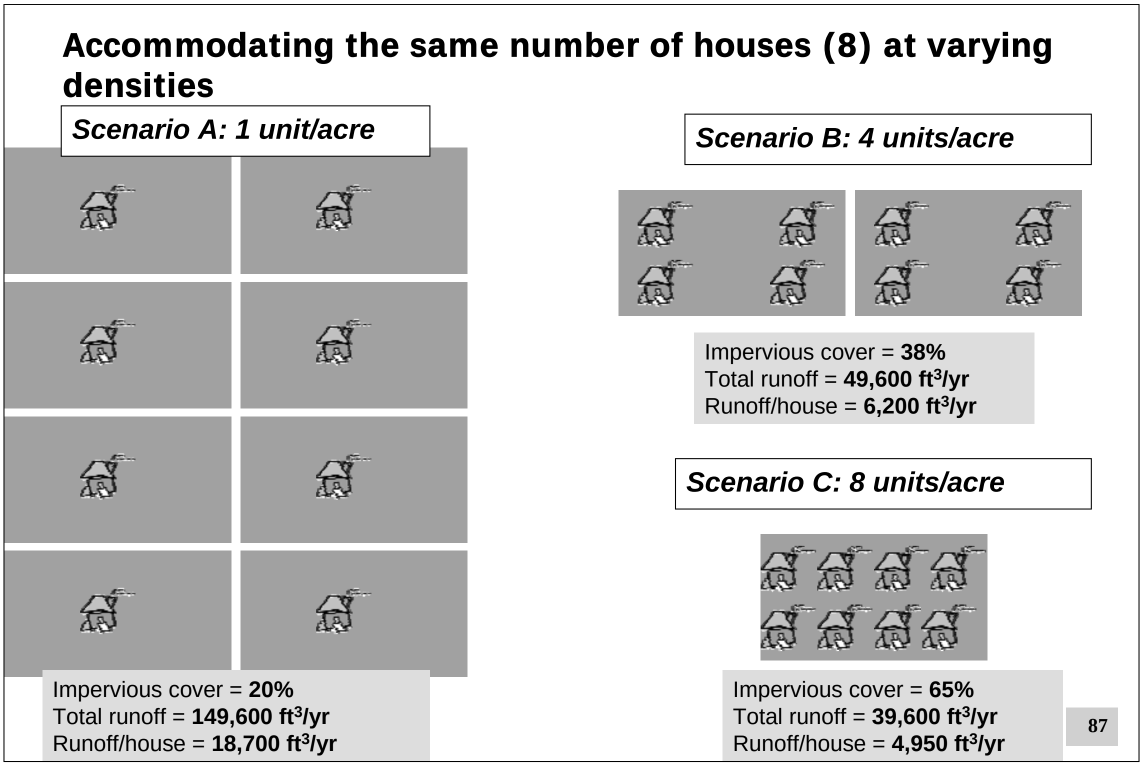


The table shows total SW Runoff PER ACRE for two communities

Community B, with more housing units, has a greater amount of IC and generates more SW runoff than Community A

The table shows total SW Runoff PER HOUSING UNIT for two communities

When examined at the individual housing unit, each house in Community B produces 33 percent less runoff than housing units in Community A.



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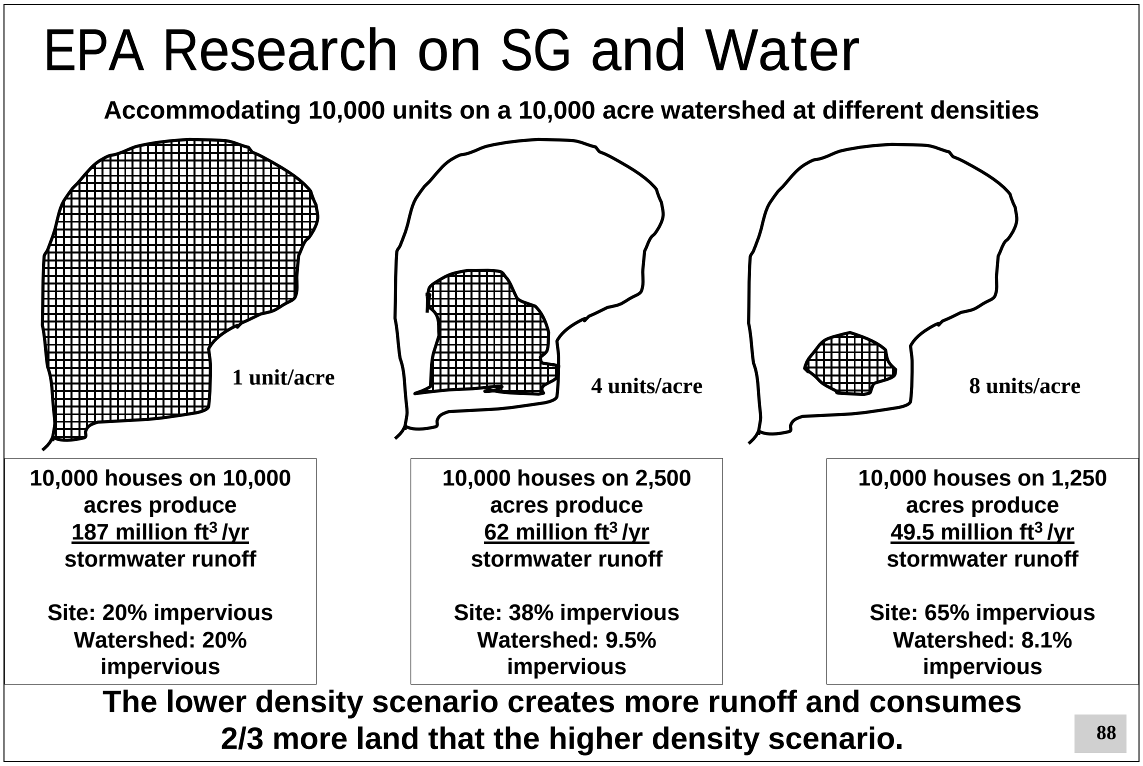
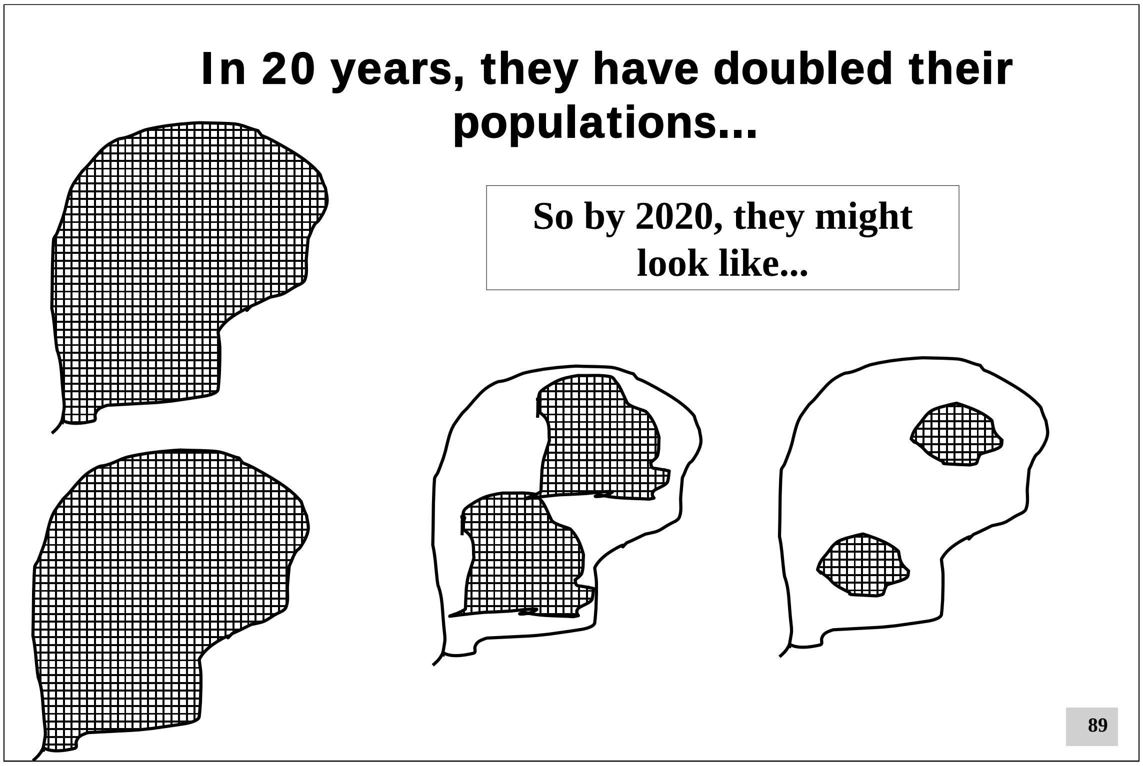


We have found that higher density developments can be more protective of regional water quality. I'd be happy to send anyone this research if you are interested.



In 20 years, they have doubled their populations...
So by 2020, they might look like...
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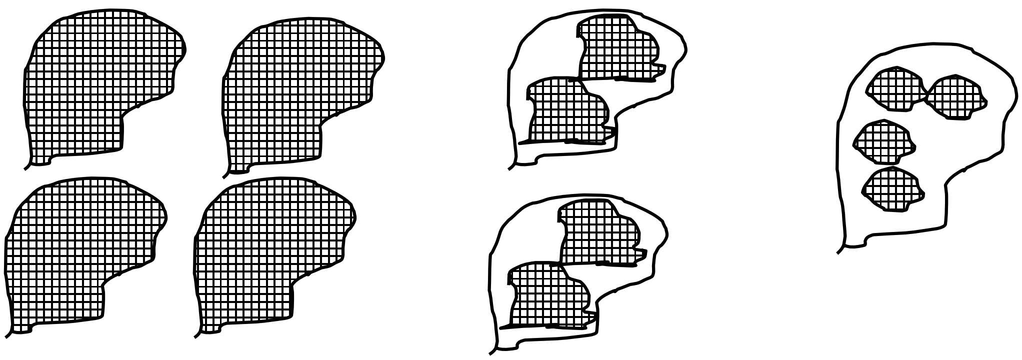
In another 20 years, they have doubled their populations, again...

So by 2040, they might look like...

4 watersheds totally built out

2 watersheds partially built out

1 watershed partially built out



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Smart Growth Principles

- Mix land uses
- Take advantage of compact building design
- Create a range of housing opportunities and choices
- Create walkable neighborhoods
- Foster distinctive, attractive communities with a strong sense of place
- Preserve open space, farmland, natural beauty, and critical environmental areas
- Strengthen and direct development towards existing communities
- Provide a variety of transportation choices
- Make development decisions predictable, fair, and cost-effective
- Encourage community and stakeholder collaboration in development decisions

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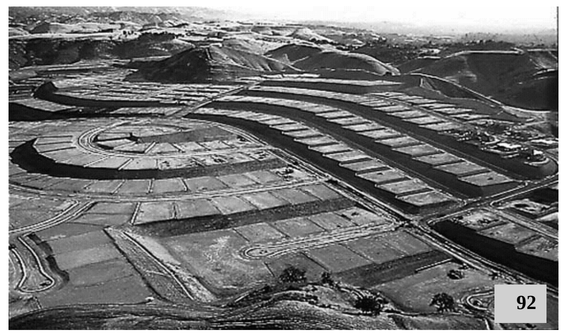
Water Quality & Smart Growth

- Density and imperviousness are not equivalent
- Lawns do not equal undisturbed land, such as forests or meadows
- Low-density developments have more impervious infrastructure
- Growth is coming to the region—limiting density on a site doesn't eliminate that growth



I know I was invited to speak about the social and economic benefits of smart growth strategies, I did want to take a few minutes to discuss EPA's perspective on smart growth and water quality– because this is a watershed conference. Some local governments think that higher density developments are worse for water quality because of the increase in IC. So our office set out to see if that was true. These are the critical assumptions we used for that research.

I know I was invited to speak about the social and economic benefits of smart growth strategies, I did want to take a few minutes to discuss EPA's perspective on smart growth and water quality.

Which is Better for Water Quality on a Watershed Basis?

Housing like this....

...is, by design, served by retail and roads like this

Low Impact Development

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Site design is arguably the most critical aspect of stormwater management.

Site Design

- Traditional stormwater management that focuses on moving water off the landscape often exacerbates the stormwater problem.

- Techniques that manage stormwater on-site and promote infiltration result in:
  - **Pollution reduction**
  - **Volume reduction**

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Basic Premise of Low Impact Development

- Design site to minimize pollutant loadings and runoff volumes and velocities
- Use distributed small scale treatment systems
- Maximize infiltration/ground water recharge
- Reduce infrastructure costs
- Protect ecosystem functions and values

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Low Impact Development

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Low Impact Development

- Smaller-scale, distributed BMPs
- Focused on retention and infiltration
- Multiple benefits in addition to stormwater control

Residential bioretention system

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Minimize Development Impacts

- Reduce storm pipes, curbs and gutters
- Reduce building footprints
- Preserve sensitive soils
- Reduce road widths
- Minimize grading
- Limit lot disturbance
- Reduce impervious surfaces

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LID design requires the planner and designer to carefully evaluate the physical and ecological characteristics of the site and consider how to minimize development impacts. The goal is to work with the site characteristics to maintain hydrologic functions and processes rather than attempt to mitigate impacts. For example, avoiding the disturbance and grading of vegetated areas can significantly reduce the need for stormwater controls and will help to recharge ground water. Reducing impervious surfaces by reducing road widths, clustering buildings and using permeable surfaces for parking reduces surface runoff and improves infiltration.

Maintain Site Runoff Rate

- Maintain natural flow paths
- Decentralize and micromanage stormwater at its source
- Use open drainage
- Flatten slopes
- Disperse drainage
- Lengthen flow paths
- Save headwater areas
- Maximize sheet flow

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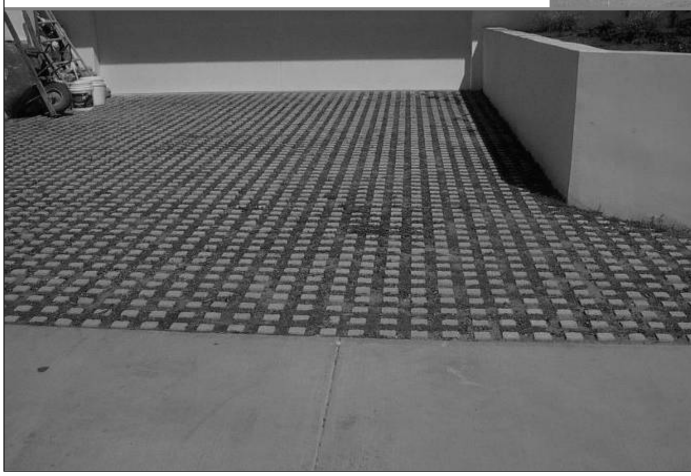
Maintaining the natural runoff rate from a site protects receiving waters, such as streams and wetlands, stream channels, and fish and wildlife habitat. The goal is to maintain the historic, pre-developed volume, rate, frequency and duration of stormwater discharges so that discharges are not excessively high during wet, winter months or excessively low during dry, summer months. A number of techniques are available to achieve this. In this example, runoff is directed to this vegetated swale, which slows down flows and allows for infiltration.

Design standards should encourage alternatives to curb and gutter where practical



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Common LID Management Practices

- Disconnectivity
- Bioretention (Rain Gardens, Infiltration Trenches)
- Permeable and Porous Pavements
- Green Roofs
- Planter Boxes
- Soil Amendment
- Open Swales
- Rain Barrels

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These are some of the more common integrated management practices used in low impact development. Several research organizations throughout Puget Sound, including the University of Washington and the Washington State Department of Transportation, are gathering information and conducting research on these techniques.

Disconnectivity

Disconnectivity means disconnecting impervious surface areas, and directing stormwater to vegetated areas. This slide shows how the drains from a parking garage or building can be directed to a vegetated area to reduce runoff volume and provide treatment. A conventional system would have just piped the runoff into the downstream system.

Open Swales

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Bioretention

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Parking Lot Infiltration

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Rain Gardens

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Permeable and Porous Pavements

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Green Roofs

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Rain Barrels, Cisterns and Storage Tanks

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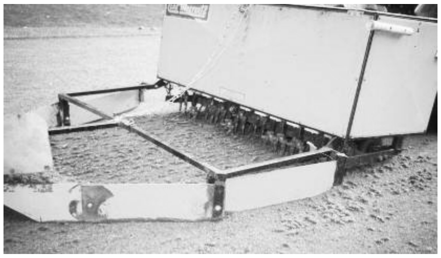
Soil Amendment



Soil aeration

Soils amended to a depth of 12 inches

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Planter Boxes

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LID designs move away from a “collect, convey and discharge” strategy to one that creates a hydrologically functional landscape. Narrower streets, open road sections and landscape practices that store and filter runoff are all typical practices.

Construction Cost Comparison

	Conventional	Low Impact
Grading/Roads	$569,698	$426,575
Storm Drains	$225,721	$132,558
SWM Pond/Fees	$260,858	$ 10,530
Bioretention/Micro	—	$175,000
Total	$1,086,277	$744,663
Unit Cost	$14,679	$9,193
Lot Yield	74	81

Prince George's County, Maryland

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This cost estimate shows that the price to develop each lot is more than 30 percent less for the LID subdivision. Key reasons for this include the elimination of stormwater ponds, roadway curbs and gutters, and much of the storm drainage infrastructure. The elimination of the ponds also allows for more developable area, which increases the lot yield and further reduces the development costs for each lot.

Post-Construction
Smart Growth
Low Impact Development

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How Can Watershed Groups Help?

- Post-Construction Runoff Control
  - **Facilitate high quality watershed planning**
  - **Ensure that smart growth and low impact development ideas are incorporated into master plans, ordinances, design manuals, etc.**
  - **Educate decision makers and developers**
  - **Sponsor voluntary projects, such as rain gardens, disconnecting downspouts, using pervious pavement, and rain barrels**

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Smart Growth and Low Impact Development Resources

See "Links to Additional Resources" associated with this Webcast:

www.clu-in.org/conf/tio/owswphase2/resource.cfm

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Questions??

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