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The Impacts of Development on Watersheds

Presented at:
Stormwater Design to Protection Watersheds
Coeur d'Alene, Idaho
March 6, 2002

Presented by:



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Impacts of Land Development

The effects of urbanization on aquatic resources can be organized into four categories:

- Hydrology
- Geomorphology
- Water Quality
- Habitat

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"After having considered that covering the ground of the city with building and pavements, which carry off most of the rain, and prevent its soaking into the Earth and renewing and purifying the Springs, whence the winter of wells must gradually grow worse and be unfit for use, as I find has happened in all old cities...I recommend at the end of the first hundred years, if not done before, the...city employ a hundred thousand pounds in bringing by pipes water so as to supply the inhabitants."

Ben Franklin, Will. Philadelphia. 1790

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Components of Impervious Cover in the Urban Landscape



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Hydrologic Effects of Urbanization

- Disruption of natural water balance
- Increased flood peaks
- Increased stormwater runoff
- More frequent flooding
- Increased bankfull flows
- Lower dry weather flows

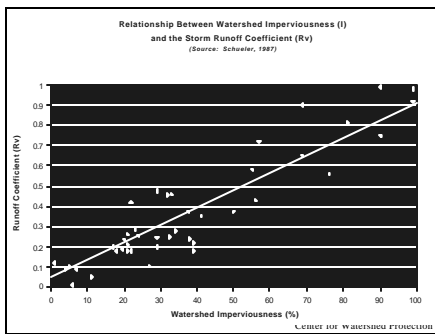
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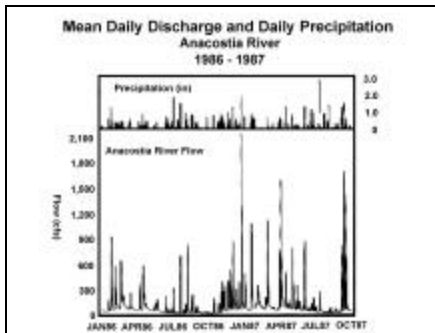
Water Balance

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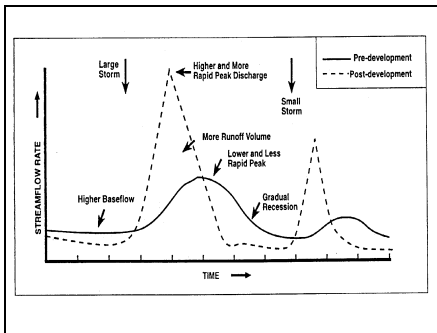
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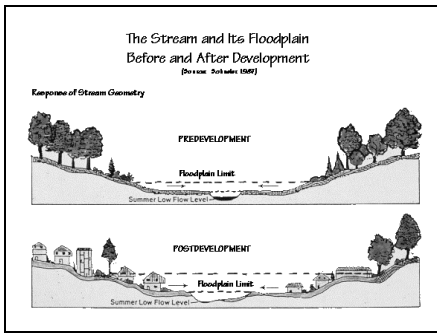


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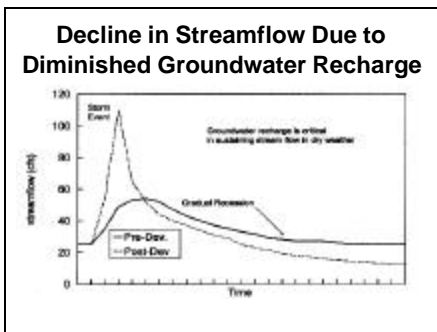
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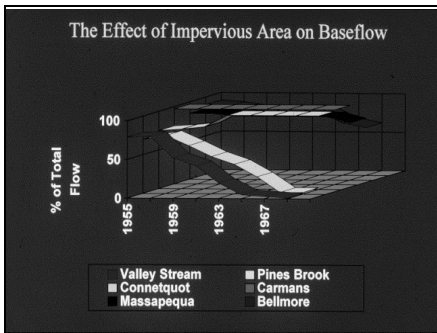
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Geomorphological Effects of Urbanization

- Stream widening & erosion
- Reduced fish passage
- Degradation of habitat structure
- Decreased channel stability
- Loss of pool-riffle structure
- Fragmentation of riparian tree canopy
- Embeddedness
- Decreased substrate quality

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less than 5% impervious cover


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8-10% impervious cover

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10% impervious cover

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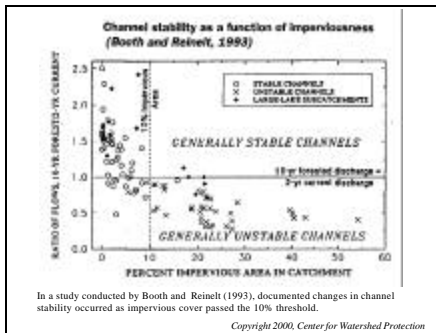
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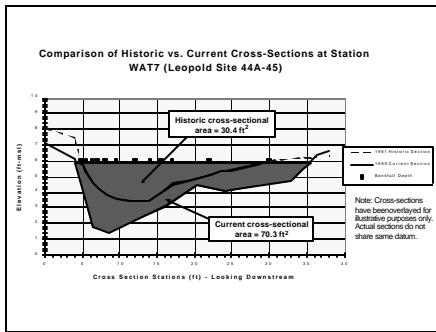


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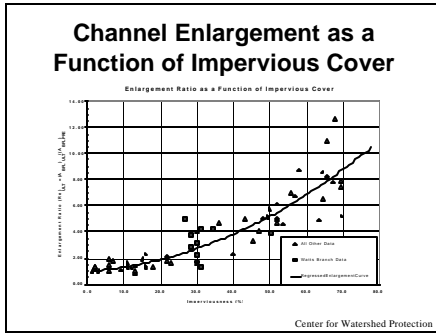
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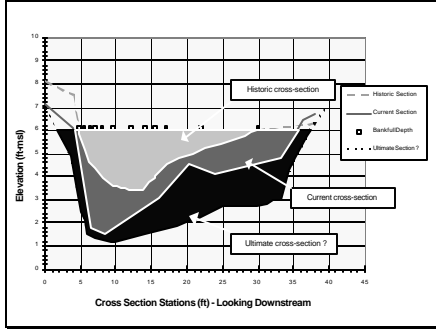


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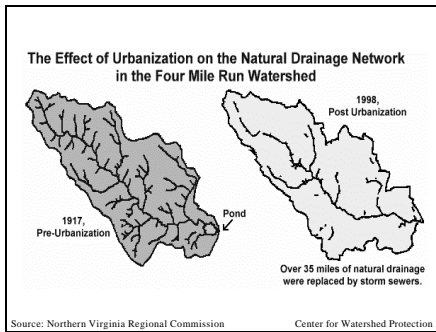
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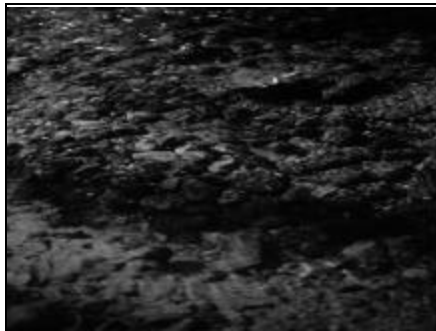
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Effects of Urbanization on Water Quality

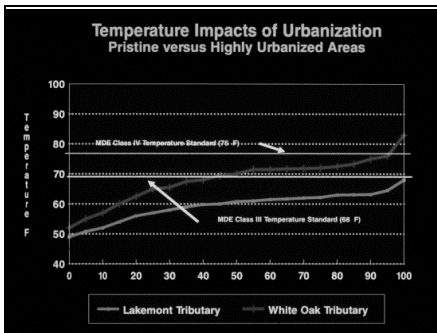
- Increased stream temperature
- Increased pollutants
- Increased risk of shellfish bed/beach closure

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**Urban and Industrial Stormwater:
Typical Pollutants**

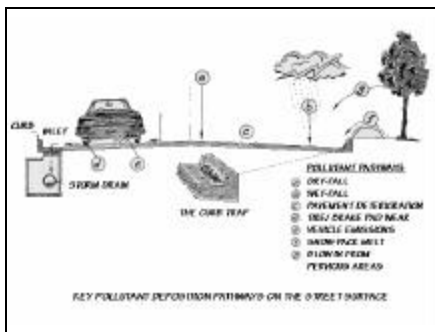
- Suspended solids/sediments
- Nutrients (nitrogen & phosphorus)
- Metals (copper, zinc, lead, and cadmium)
- Oil & greases (PAHs)
- Bacteria
- Pesticides & herbicides
- Temperature

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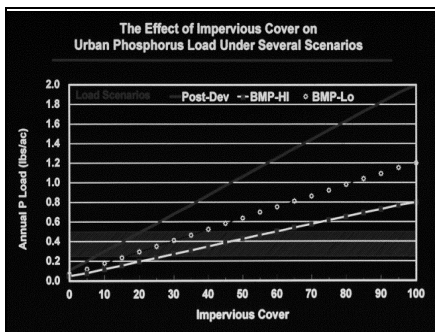
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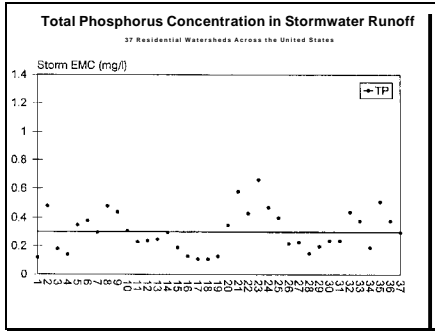


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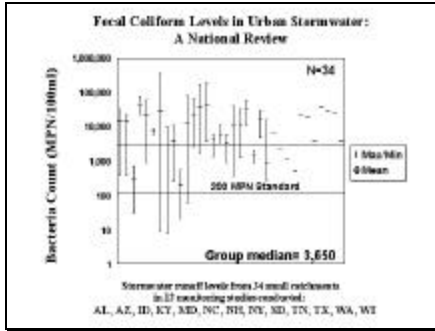
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Stormwater Hotspots

Definition: A land use or activity that produces higher concentrations of trace metals, hydrocarbons or priority pollutants than normally found in urban runoff.

- Auto recycling
- Commercial parking lots
- Fleet storage areas
- Industrial rooftops
- Landscaping/nursery
- Industrial (outdoor storage or unloading)
- Public work areas
- Vehicle service & maintenance
- Vehicle washing/steam cleaning

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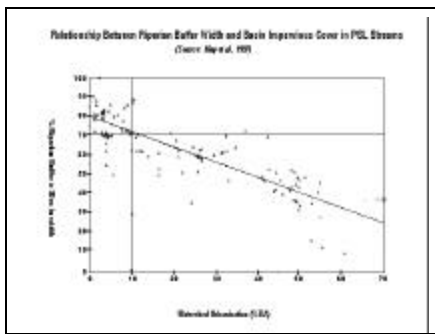
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Effects of Urbanization on Habitat

- Decline in habitat value of streams
- Loss of buffer zones
- Loss of large woody debris
- Creation of fish barriers
- A shift in the energy source that drives streams
- Increased algae growth

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Loss of Large Woody Debris

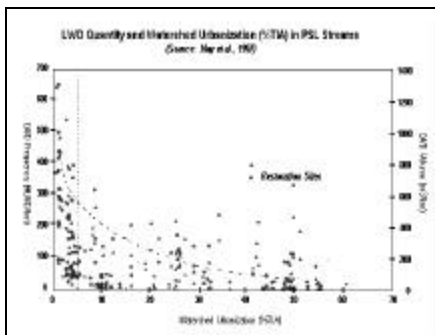
- The loss of large woody debris is important because it performs essential functions:
- Allows the stream to retain sediments, nutrients, and carbon more effectively
- Provides habitat structure

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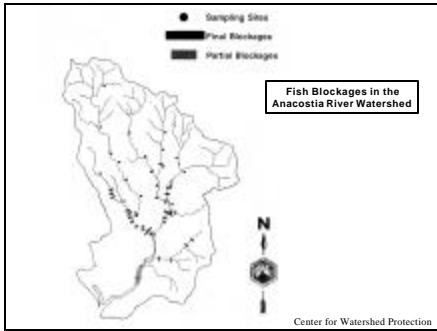


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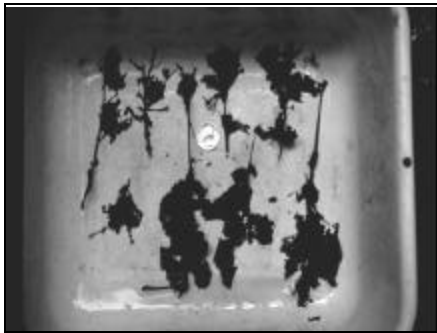
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Consequences of Habitat Decline

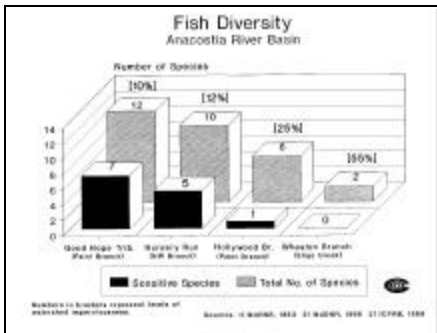
- Decline in aquatic insect diversity
- Decline in fish habitat quality
- Decline in fish diversity
- Loss of sensitive coldwater species & salmonoids
- Reduced spawning of anadromous & resident fish
- Decline in wetland plant & animal community diversity

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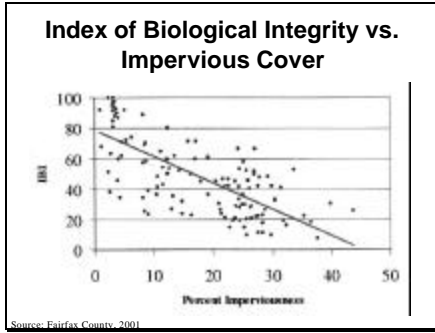
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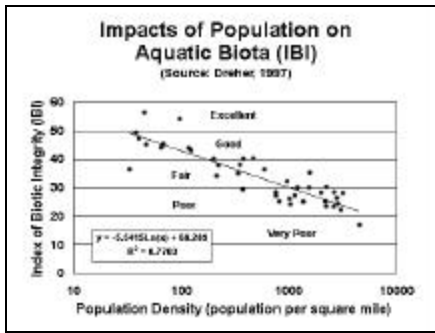
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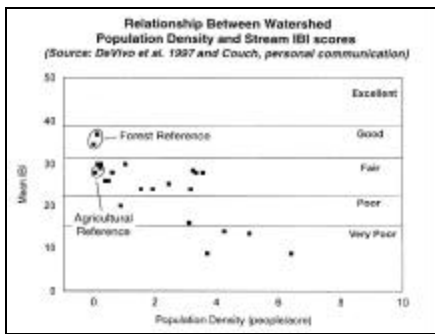
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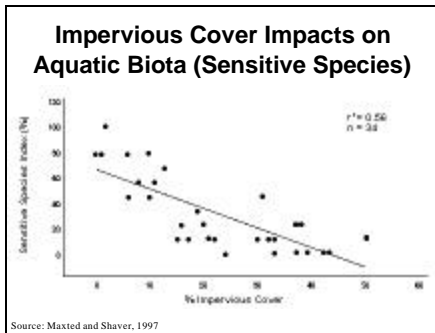
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Caveats of Stream Classification

- Should only be applied to first to third order streams and not to larger rivers or lakes
- Streams with good riparian cover tend to score higher than streams where this cover is absent
- Streams with less than 10% impervious cover are not necessarily high quality streams

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Factors Impacting ICM

| Parameter | Mitigation Effect |
|---------------------|-------------------|
| % Forest Cover | 😊 |
| Age of Development | 😞 |
| Riparian Continuity | 😊 |
| Stormwater STPs | 😐 |
| Wetlands/Beaverdams | 😊 |
| Curb and Gutter | 😞 |
| Better Site Design | 😊 |
| % Turf Cover | 😞 |

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Sensitive Stream




Description:
Subwatershed has less than 10% impervious cover. Stream is rated highest quality according to fish, macroinvertebrates, or habitat indicators.

Planning Objectives:
Maintain/enhance predevelopment stream habitat, recharge, hydrology, stream temperature, channel stability, or riparian condition.

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Impacted Stream




Description:
Subwatershed has 10-25% impervious cover and monitoring indicates a decline in physical, biological or water quality indicators.

Planning Objectives:
Reduce the frequency of post-development bankfull and subbankfull flooding, maintain channel stability, provide maximum removal of pollutants of concern (especially bacteria).

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Non-Supporting Stream




Description:
Subwatershed has more than 25-30% impervious cover, is not a candidate for restoration, and cannot support a full range of designated uses.

Planning Objectives:
Reduce stormwater and sanitary sources of bacteria to meet dry weather water contact standards, maintain water elevation of existing 100 year floodplain, target pollutant reduction for new development and redevelopment.

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Restorable Stream



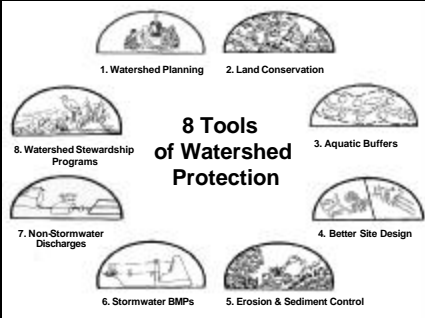
Description:
Subwatershed classified as impacted or non-supporting with enough retrofit potential for meaningful improvements in the hydrologic regime and pollutant loading of the stream.

Planning Objectives:
Control hydrologic regime, remove urban pollutants, restore stream habitat, stabilize channel morphology, augment riparian cover, protect stream substrate, and enable recolonization of native aquatic community.

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8 Tools of Watershed Protection



- 1. Watershed Planning
- 2. Land Conservation
- 3. Aquatic Buffers
- 4. Better Site Design
- 5. Erosion & Sediment Control
- 6. Stormwater BMPs
- 7. Non-Stormwater Discharges
- 8. Watershed Stewardship Programs
