Impacts of land development on rural watersheds and effective local strategies to protect them.

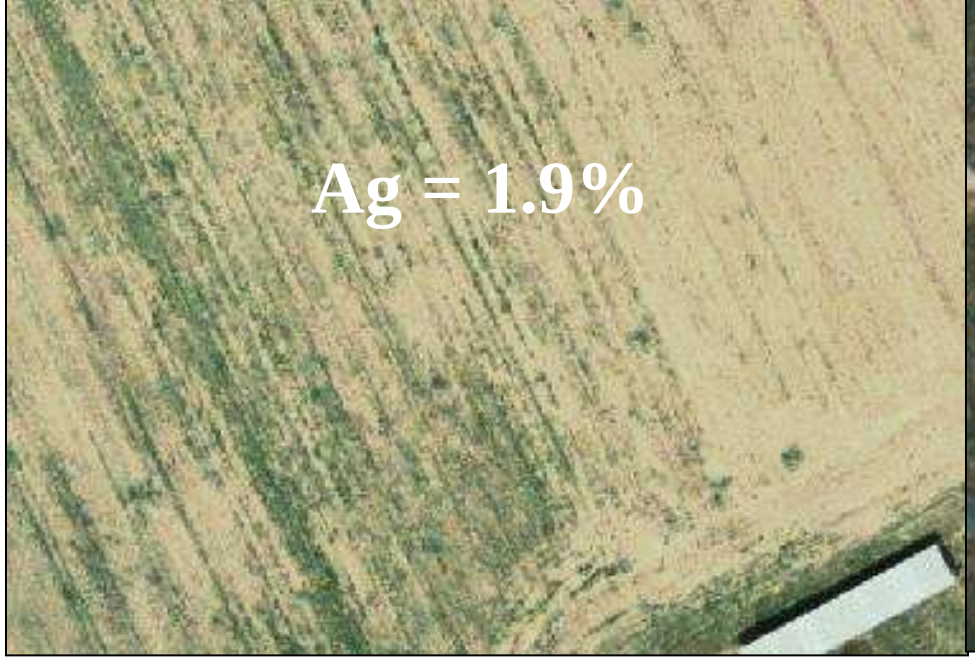
Key Questions for Today:

- What do we mean by rural watersheds?
- What are the key impacts from rural land development?
- What are the best local strategies to minimize them?
- Open Discussion

Land Cover in Rural Watersheds

Characteristics of Rural Development

- Watershed Impervious Cover (IC) ranges from 3 to 12 or 15%
- Large lot development, septic systems for wastewater treatment
.
- The “not-IC” is mostly forest, some pasture, fewer row crops, and an increasing # of CAFO’s
- Roads are major source of IC and sediment and are the primary engineered drainage system in the rural landscape
- Mostly open drainage (ditches/swales) as opposed to storm drains/catch-basins
- Most of the land development occurs outside of MS4 boundaries, and is covered by state general permits



Impervious Cover (%) for Various Land Uses

Residential Impervious Cover

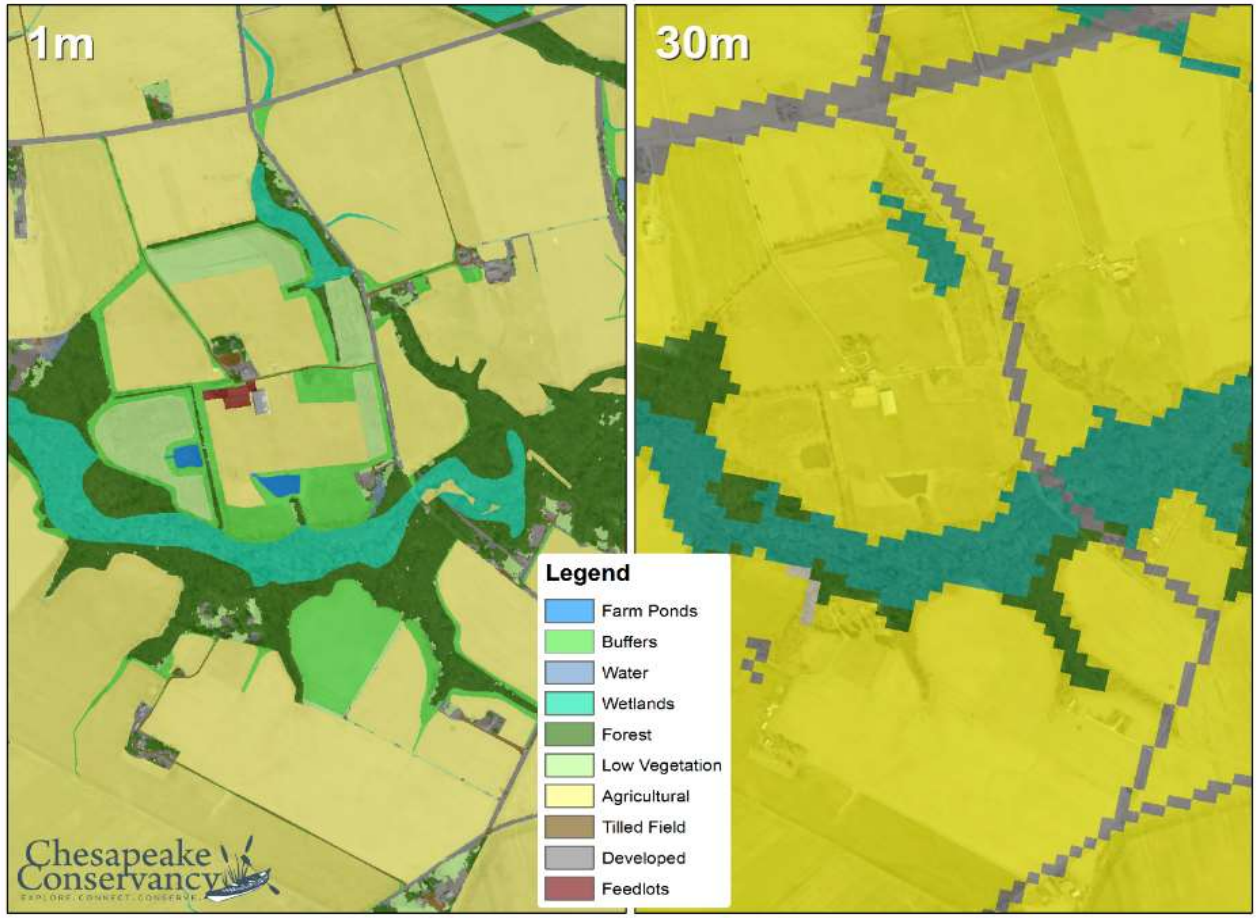
Zoning Category	Mean IC % + SE	% Car Habitat
2 acre Lots	10.6 +/- 1.3	75%
1 acre Lots	14.3 +/- 1.0	65%
½ acre lots	21.2 +/- 1.5	60%
¼ acre lots	27.8 +/- 1.2	56%
1/8 acre lots	32.6 +/- 3.1	56%
Townhomes	40.9 +/- 2.7	55%
Multi-family	44.4 +/- 3.9	61%

Source: Capiella and Brown, 2000

Progress in Measuring IC

- Incredible progress in mapping IC in last 30 years
- Cover Resolution:

  1 meter scale
- Fuzziness in defining TC an IC at the rural exurban boundary



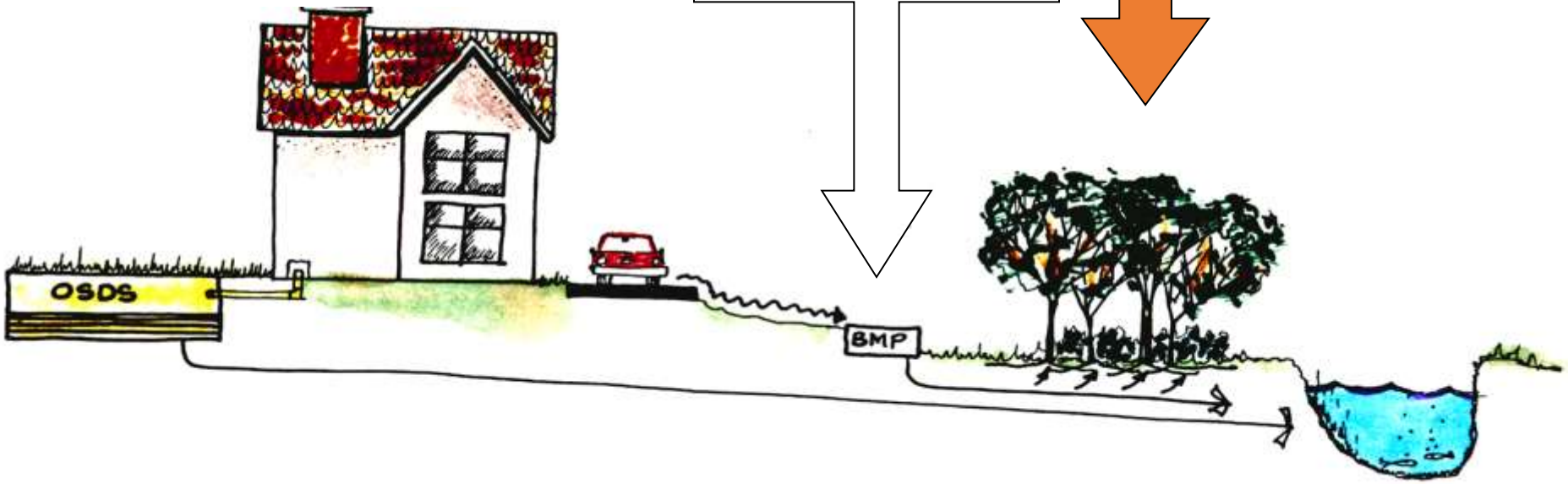
Large Lot Development, w/ a lot of Turf

Property Line to Property Line Clearing and Grubbing

Septics + residential runoff = high N

Forest Buffers

Small removal efficiencies

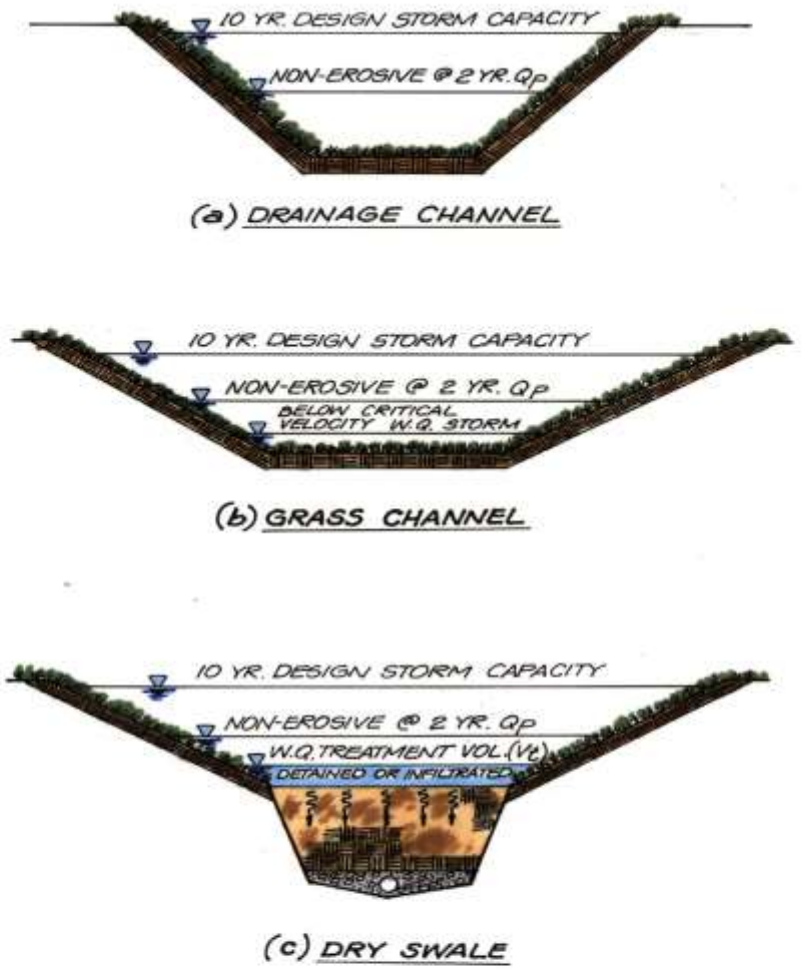


The nutrient impact is lower the further up in the watershed you are (and tighter soils)

Rural subdivisions are main target of local development and stormwater codes

Super-sized lots, wide streets & sidewalks and big cul-de-sacs

More ditches and swales than storm drain pipes



Roads are the primary drainage system connecting to the stream network

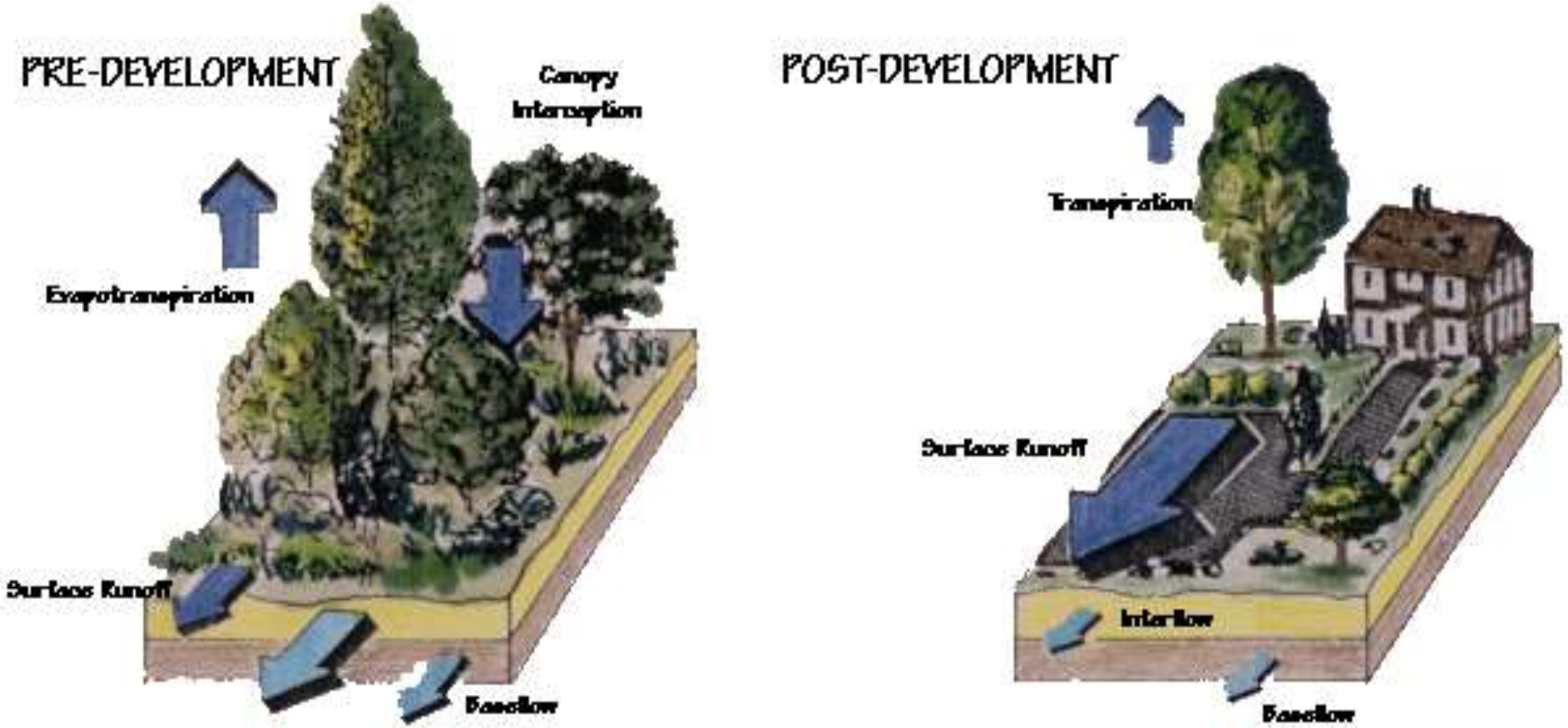
Floding causes extensive damage to public and private infrastructure

Both Current and Legacy Cropping Practices, Feedlots and Manure Management Continue to Influence Rural Landscape and Soils

Impacts of Rural Development

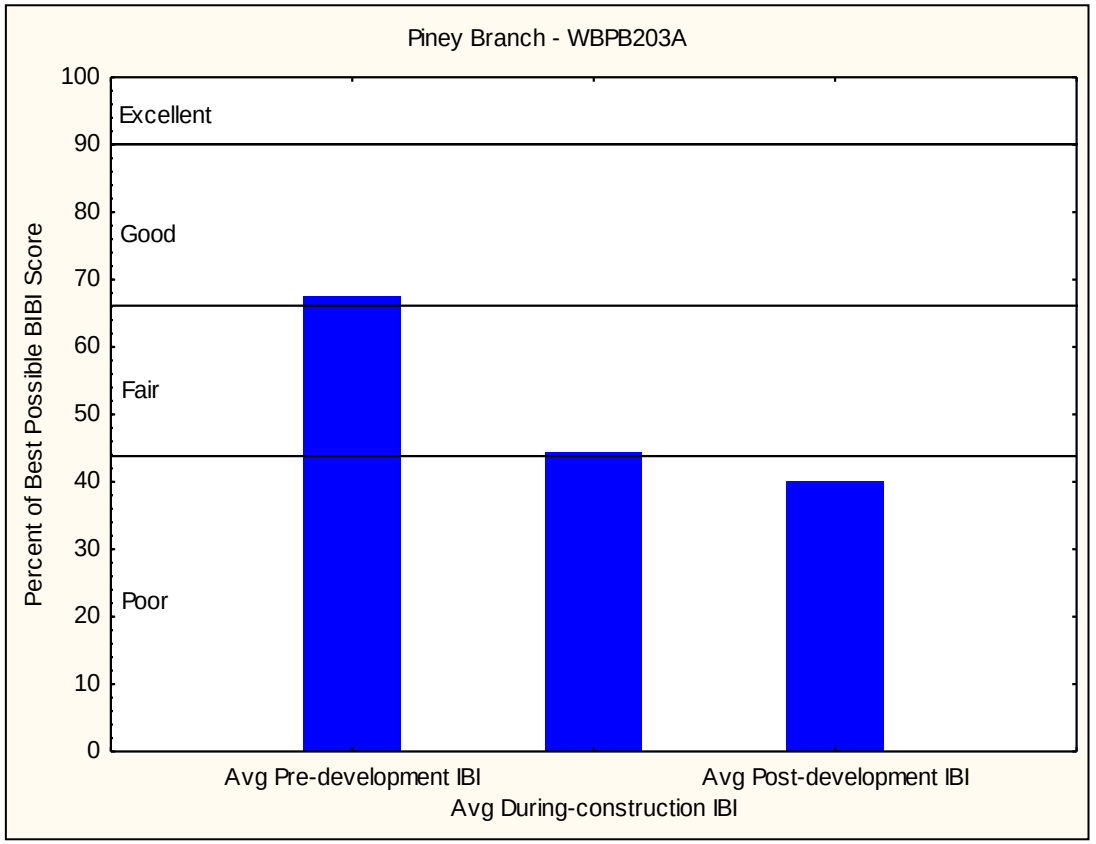
- Increased upland runoff and more flooding damage
- Stream instability and decline in instream habitat quality
- Loss of riparian forest buffer integrity (and wetlands)
- Combined w/ stream warming, decline in cold-water fishery
- Pulse of sediment, especially during construction
- Export of nutrients to the Potomac and Bay (modest)
- Toxic pollutants (salt, herbicides and insecticides)

WATER BALANCE



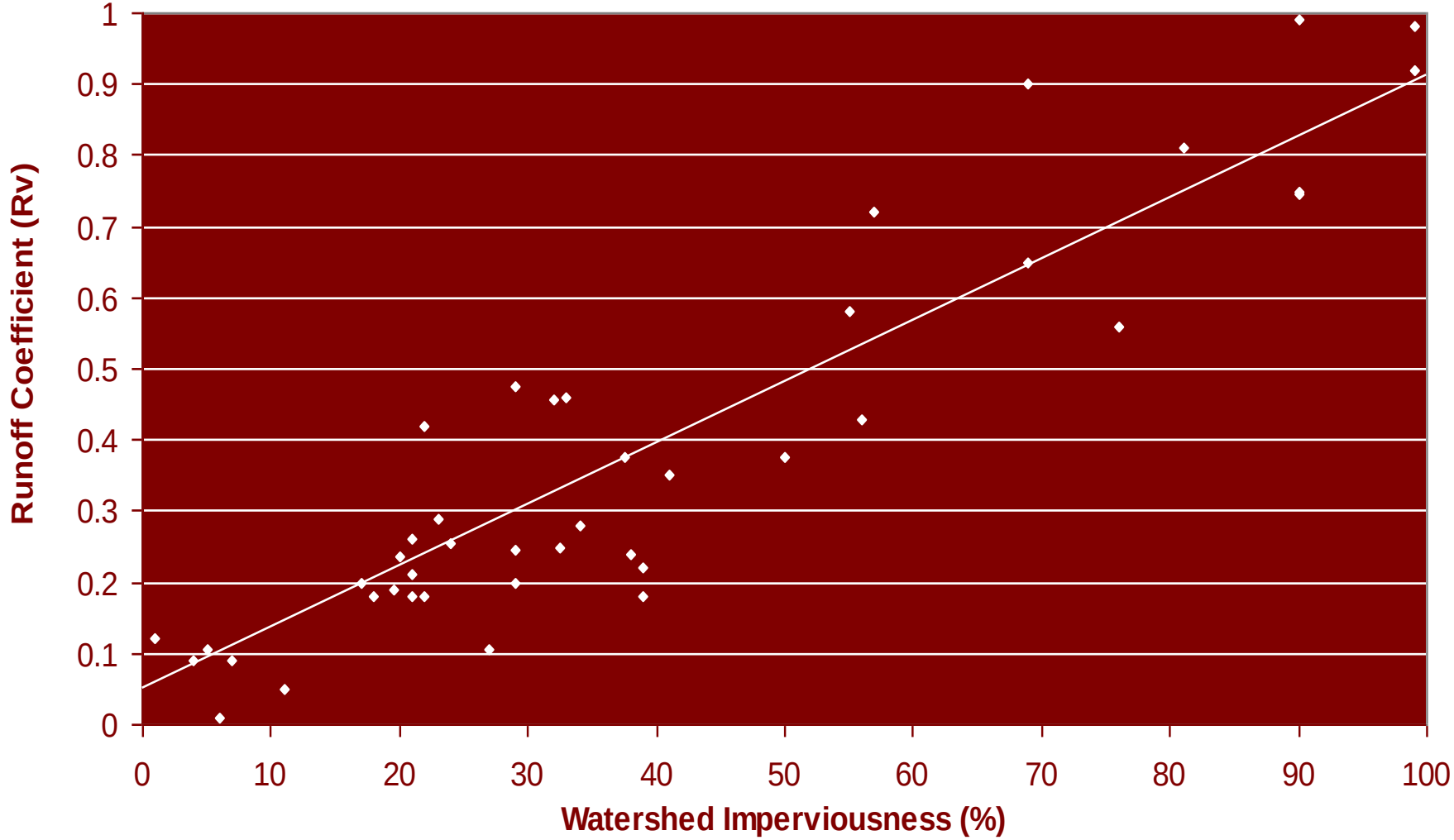
Construction Impacts

Although the construction stage of land development is short, it has long term impacts on downstream quality



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

(Source: Schueler, 1987)



Additional Data from NSQD (2004) validate the slope and intercept

Rural Site Runoff Coefficients (Rv)

Cover	HSG A	HSG B	HSG C	HSG D
Forest	0.02	0.03	0.04	0.05
Managed Turf / Disturbed Soil	0.15	0.20	0.22	0.25
Impervious Cover	0.95	0.95	0.95	0.95

Some NC Studies on Construction Site Runoff and Sediment Loss

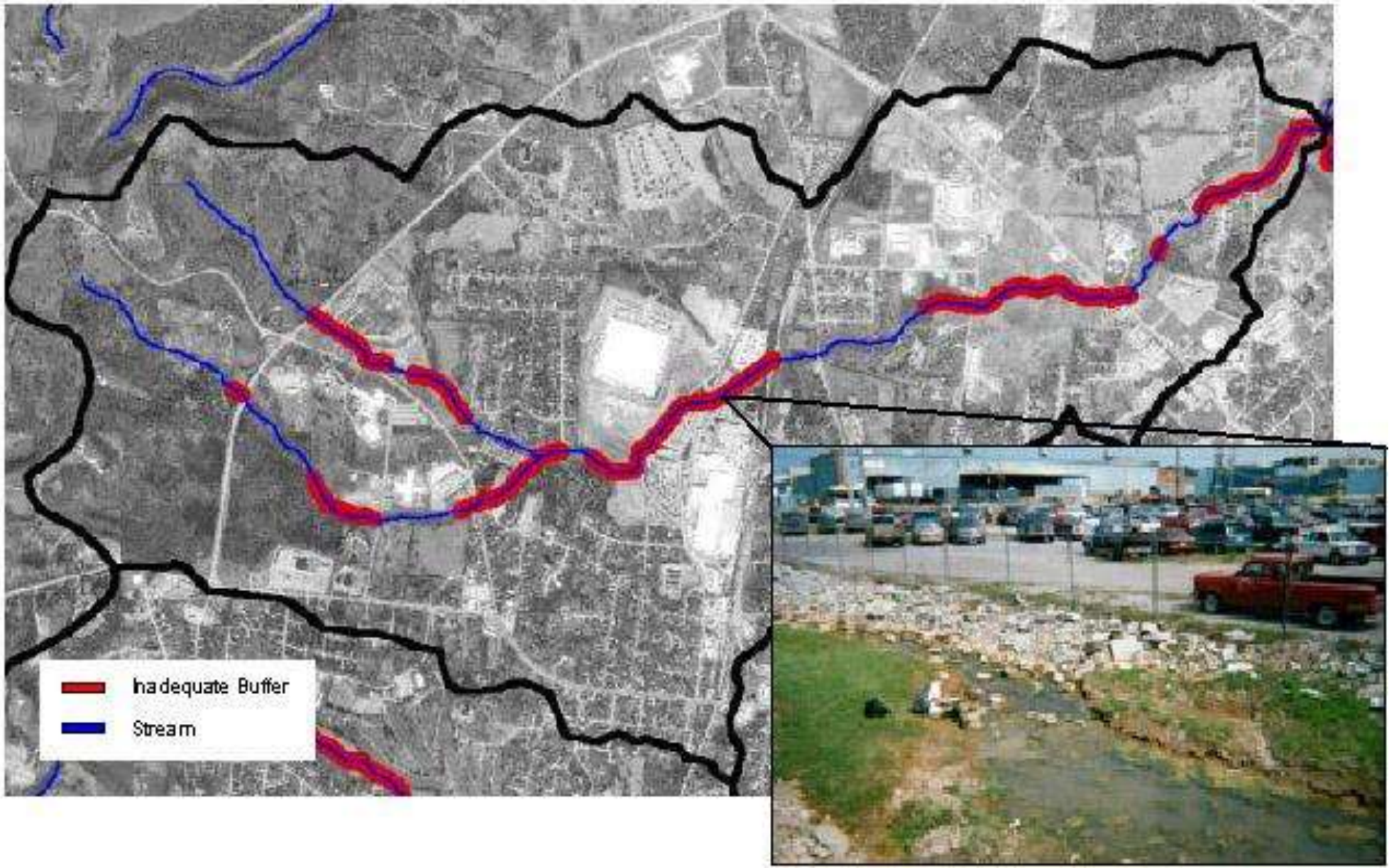
106 storms by Line and White (2007) NC Piedmont [5]		
STAGE	Runoff Coefficient	TSS (tons/acre)
Construction [1]	**0.50**	13
Establishment [2]	**0.60**	2.8
Post Construction [3]	**0.55**	0.9
Undeveloped [4]	0.21	0.16

[1] from initial clearing , grading, installation of infrastructure and seeding (0.7 years)
[2] Most homes constructed, and lawns and landscaping are becoming established (1.4 years)
[3] After home build out (3.6 years)
[4] Undeveloped reference watershed
[5] 6 years of sampling during and after construction at a 10 acre residential subdivision, compared to an undeveloped reference forest catchment less than a mile away (also sampled for same 5.6 years)

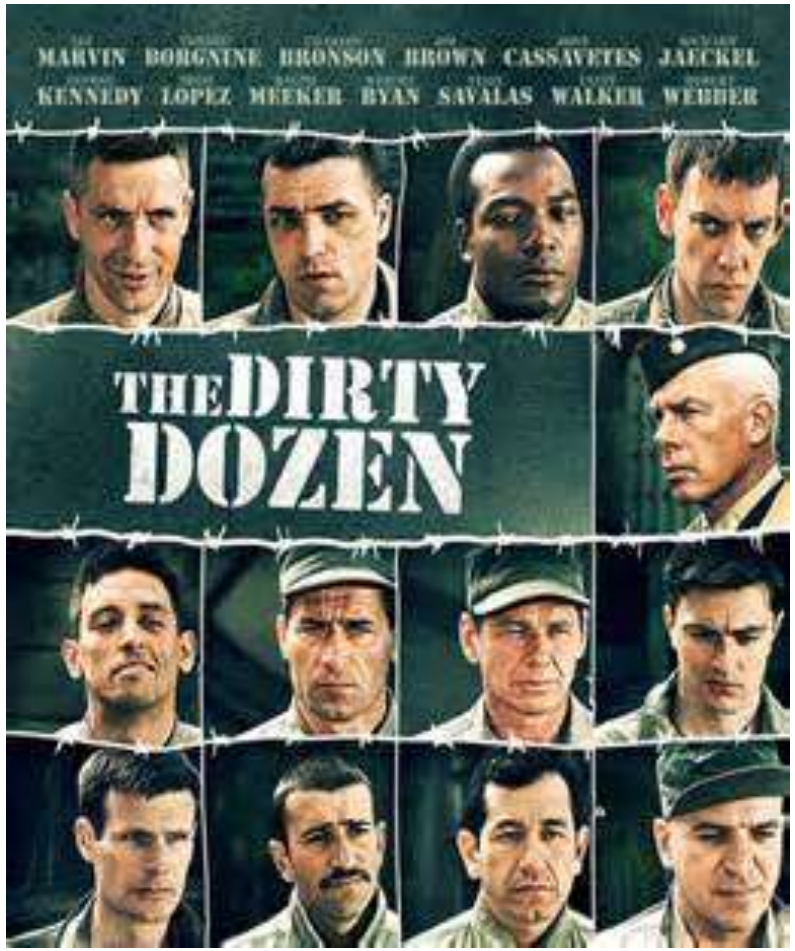
Flooding, stream erosion, lower dry weather flows and disconnected floodplains

IC and Stream Habitat

Loss of Riparian Buffer Continuity

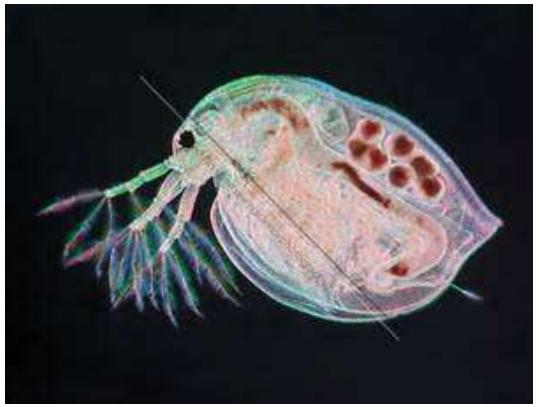


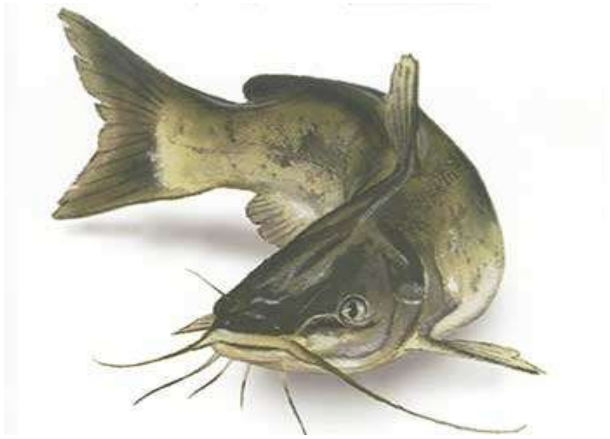
Rural areas don't have as many toxics due to urban runoff, but there are some pervasive impacts all the same

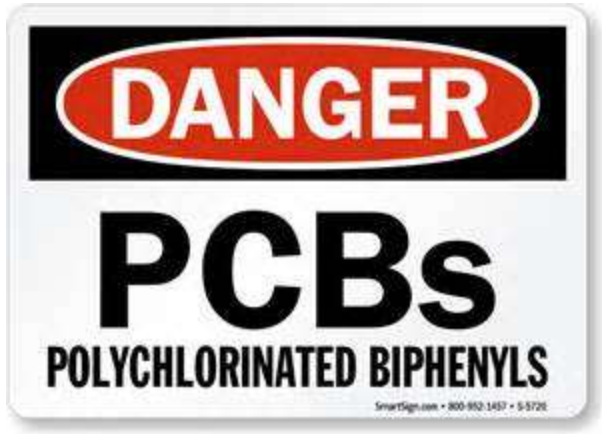


- PCBs
- **PAH**
- TPH
- **Mercury**
- **Cd, Cu, Pb, Zn**
- As, Cr, Fe, Ni
- **Pyrethroid Pesticides**
- Legacy Pesticides: DDT/DDE
- Legacy Pesticides: Diazinon
- Plasticizers
- Flame Retardants
- Dioxins

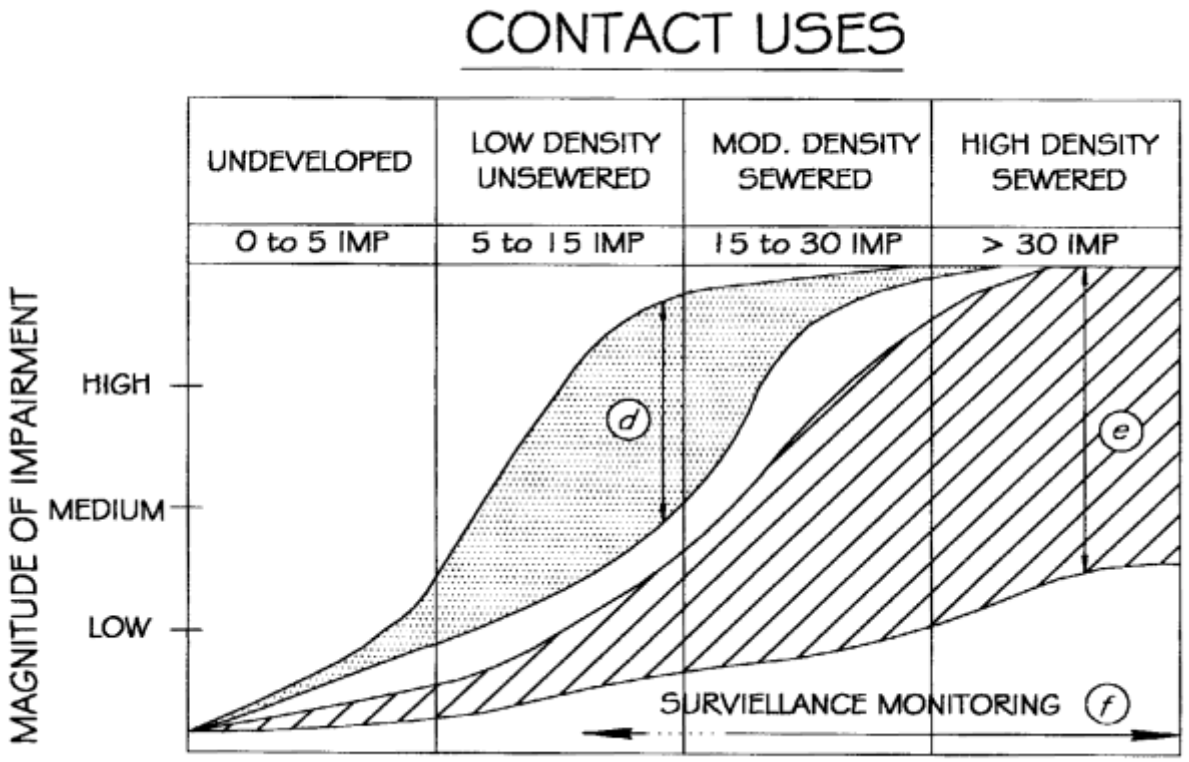
Due to atmospheric deposition and pesticide application, rural resources are impacted by current and legacy toxics



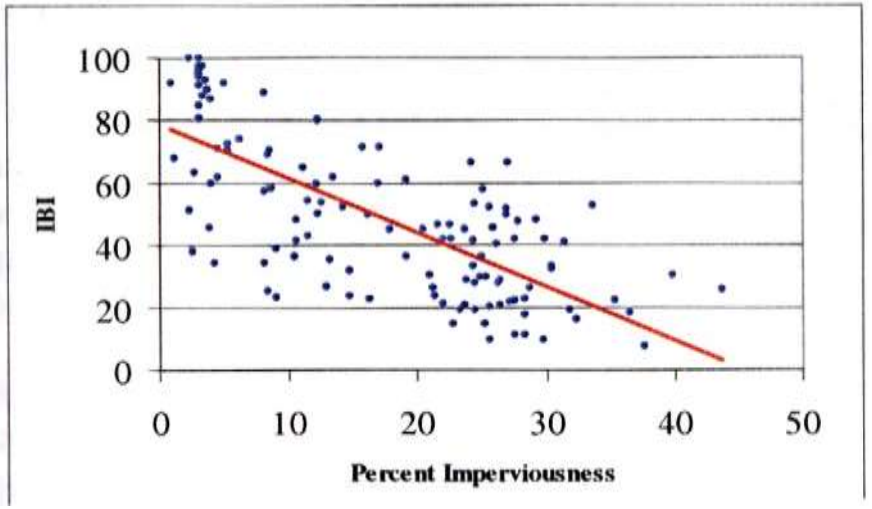




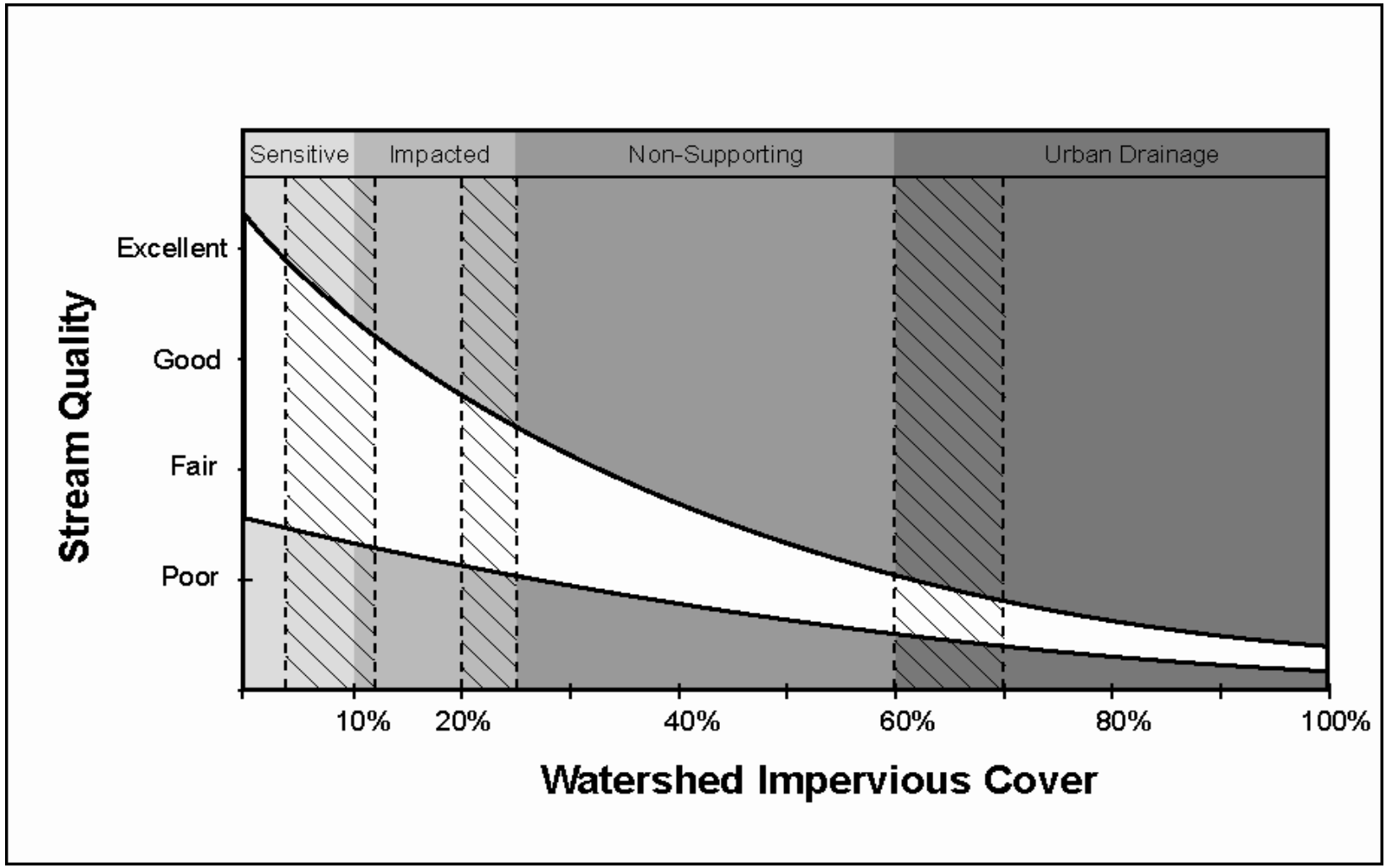
Bacteria levels in rural areas are not as great compared to urban watersheds, but the receiving waters are more sensitive to impairments



Impacts on fisheries and stream biodiversity



The ICM and Rural Watershed Management

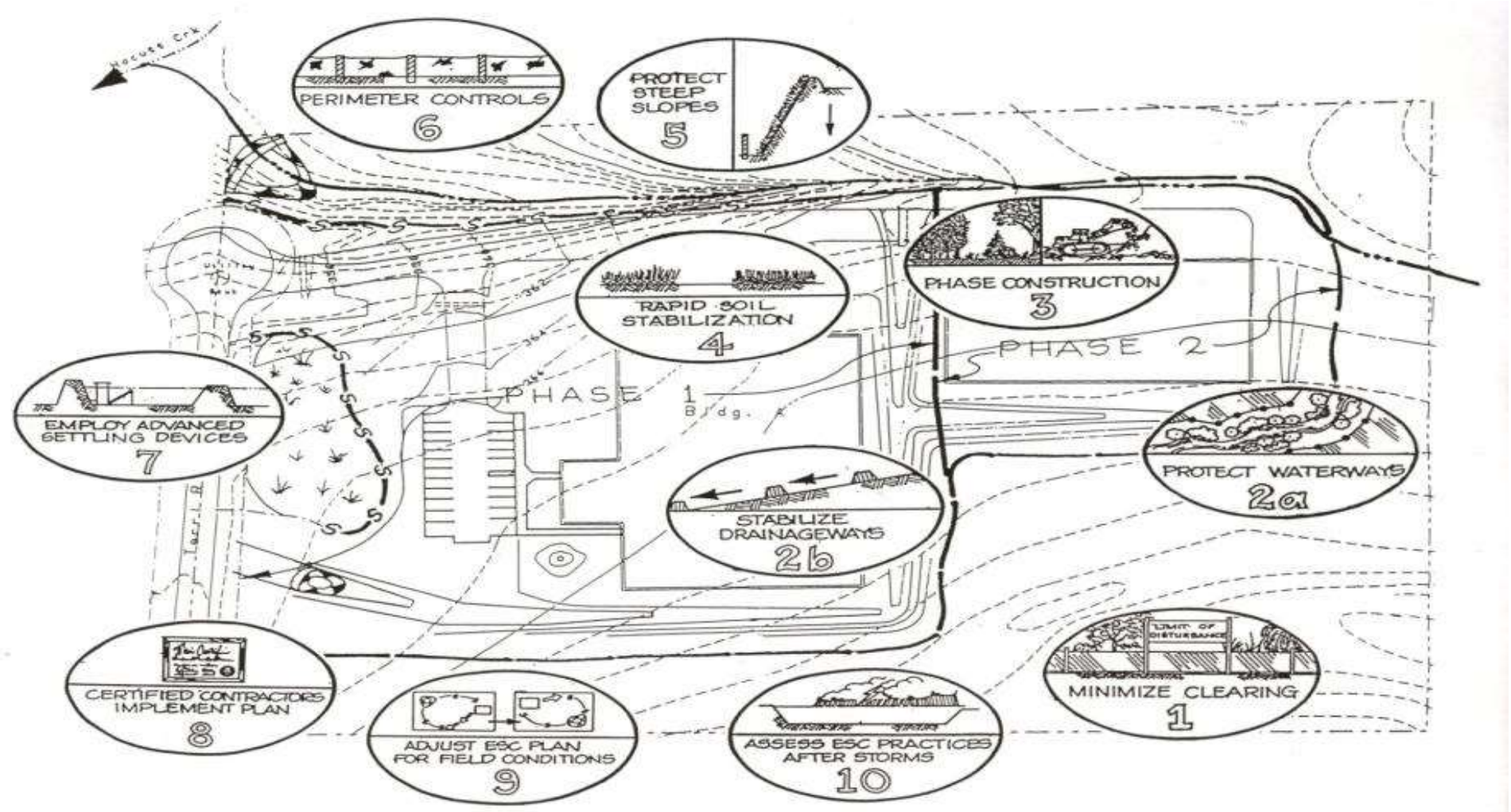


Strategies for Managing Rural Development

- Better Site Design and Environmental Assessment
- Enhanced Erosion and Sediment Control
- IDDE Programs focused on spills and septic failures
- New Stormwater BMPs (the WV Manual)
- Riparian forest buffers and habitat-oriented stream restoration projects
- Collaborate with farming, livestock and rural partners

Better Site Design is a Cost-Effective Tool

Defining Erosion and Sediment Control Practices



CBP Expert Panel Findings

Current Level 2 WV ESC Practices Provide a High Level of Sediment Removal From Construction Sites

ESC Scenario	Discharged Load	Effective Removal Rate *
ESC Sites Operating at Level 1	3.1 t/ac/yr	74%
ESC Sites Operating at Level 2	**1.8 t/ac/yr**	**85%**
ESC Sites Operating at Level 3	1.25 t/ac/yr	90%
ESC Sites Operating at Level 4	No estimate	No estimate

* Relative to panel's estimate of 12 ton/ac/yr for sites without ESC practices

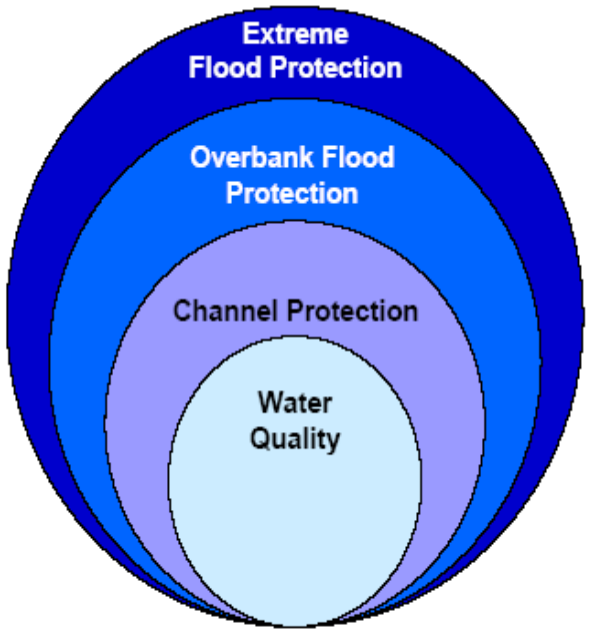
Improving Nutrient Management at Construction Sites

Careless Hydro-seeding Without Regard to Soil Needs Creates a Very High Risk for Nutrient Export

Recommended adding PAM to hydro-seed mix to minimize fertilizer wash-off during the 3 to 4 week “hi risk window” for grass to germinate and achieve desired density.

Consider sub-soiling and compost amendments to improve soil quality in starter lawns

WV Stormwater Manual Practices



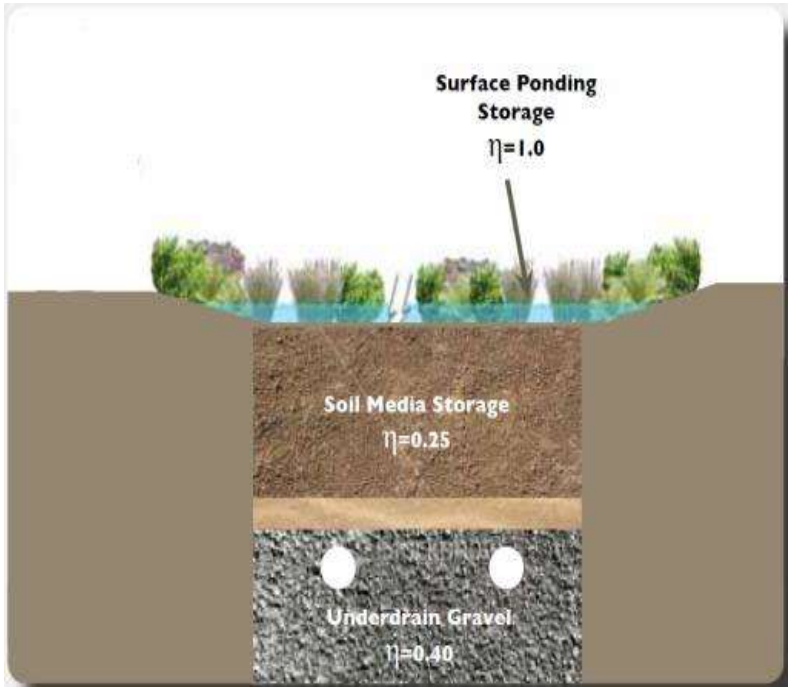
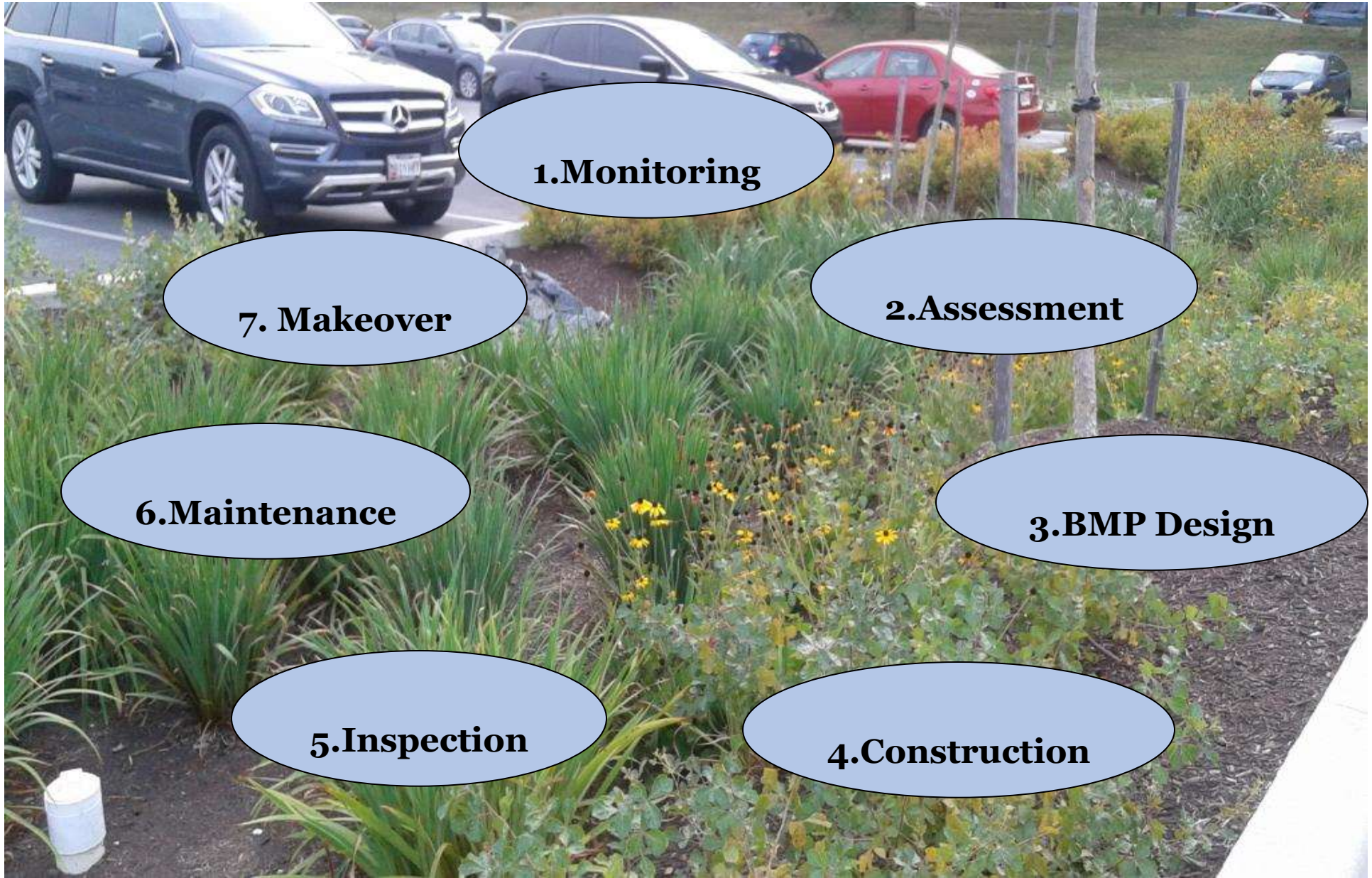
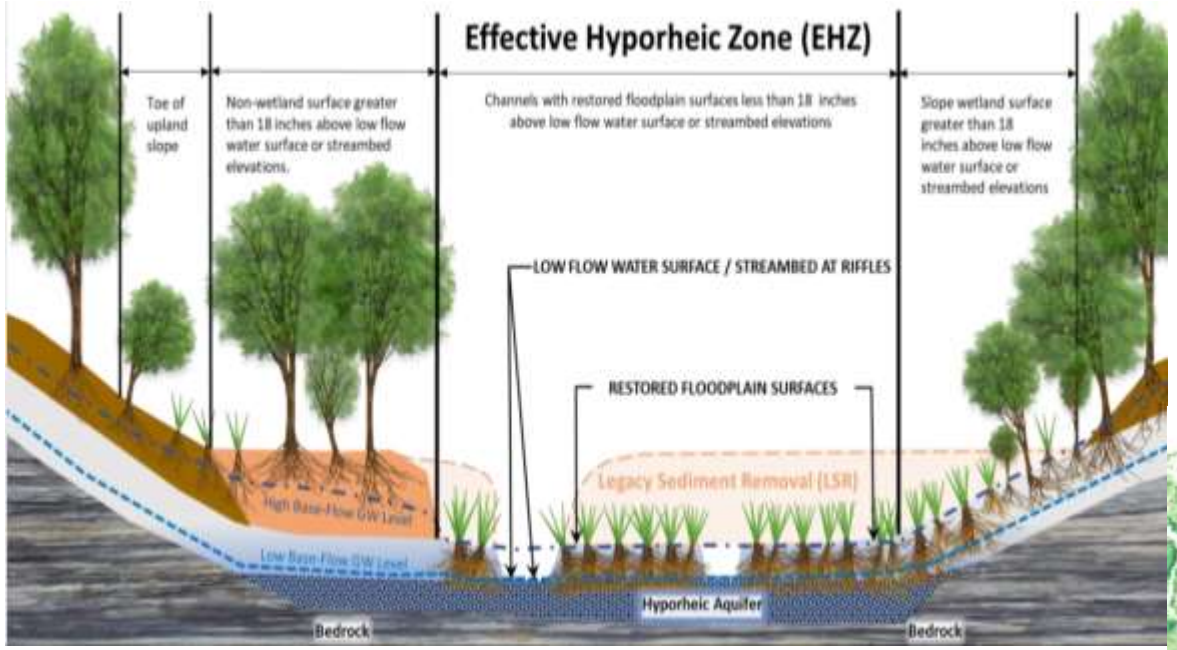


Figure 4.4-1 Representation of the Unified Stormwater Sizing Criteria

Shifting to Full Cycle Stormwater Design

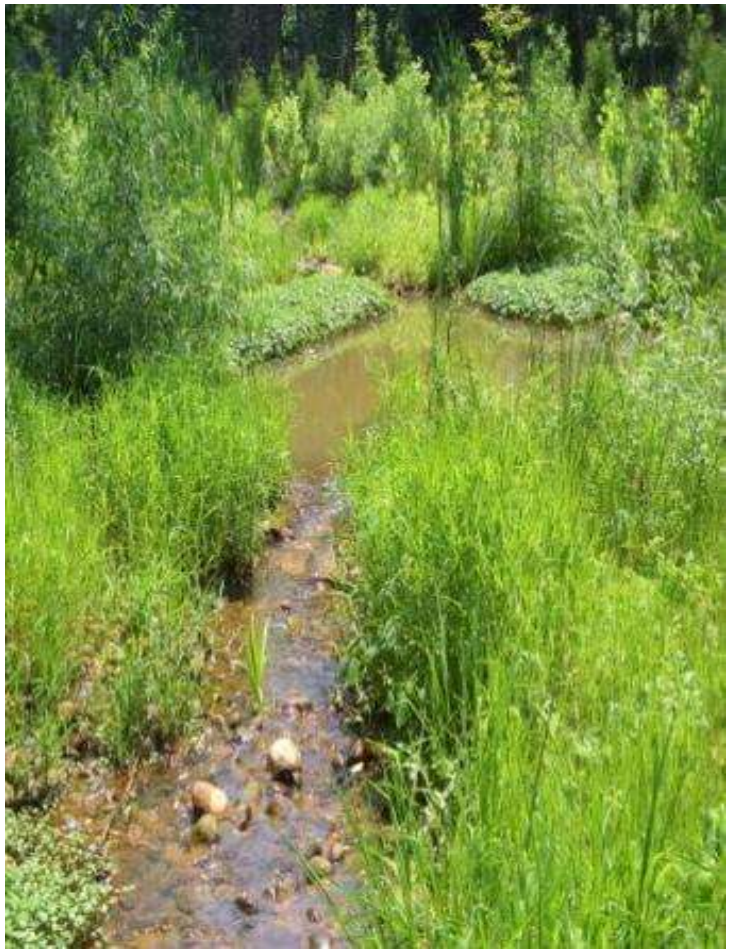


Stream and Floodplain Restoration in Rural Areas



Forest Planting and Stream Buffers

- Tree planting projects are effective where they establish forest ecosystem processes and function



Urban BMP Expert Panels Completed Since 2013

Major BMPs

- BMPs for New and Redevelopment Projects
- Rural Stream Restoration
- Stormwater Retrofits
- Urban Nutrient Management
- Street Cleaning?
- Nutrient Discharges from Grey Infrastructure
- Residential Stewardship Practices

Contributing BMPs

- Enhanced Erosion and Sediment Control
- Floating Treatment Wetlands
- Septic System Upgrades
- Impervious Cover Disconnection
- Urban Tree Planting
- Urban Canopy Expansion
- Shoreline Management Practices
- Filter Strips

Red Font: Useful for Bay TMDL

Open Discussion on Rural Watershed Management