

Stormwater



West Virginia Water Resources Training Workshops

Presented by the Interstate Commission on the
Potomac River Basin

Sponsored by the West Virginia Department of
Environmental Protection

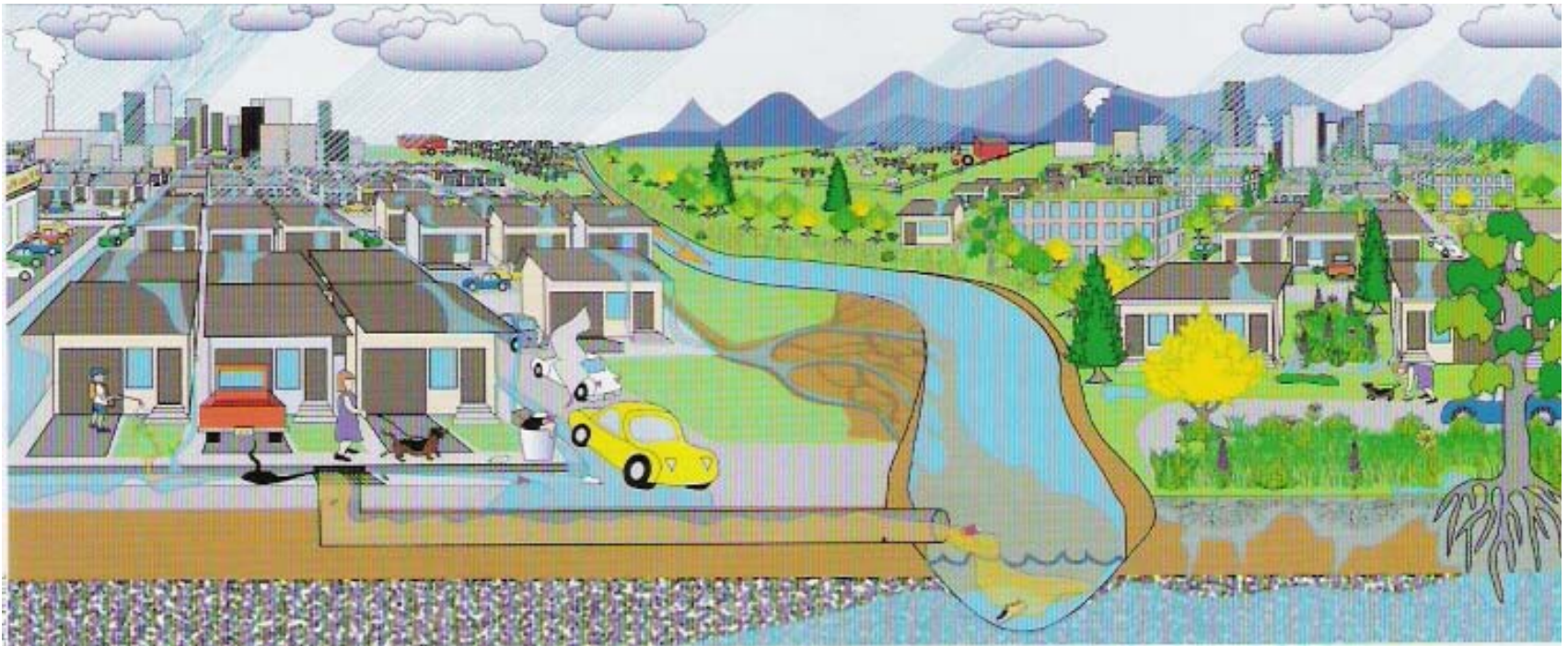
With funding from the American Reinvestment
& Recovery Act



Image source: <http://sevenhillslake.com/stormwater.html>

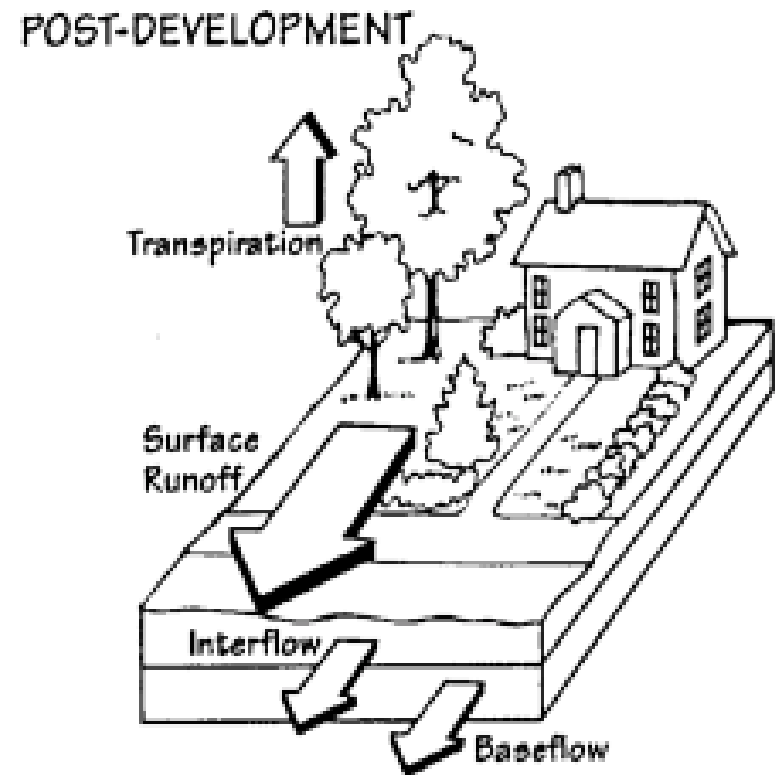
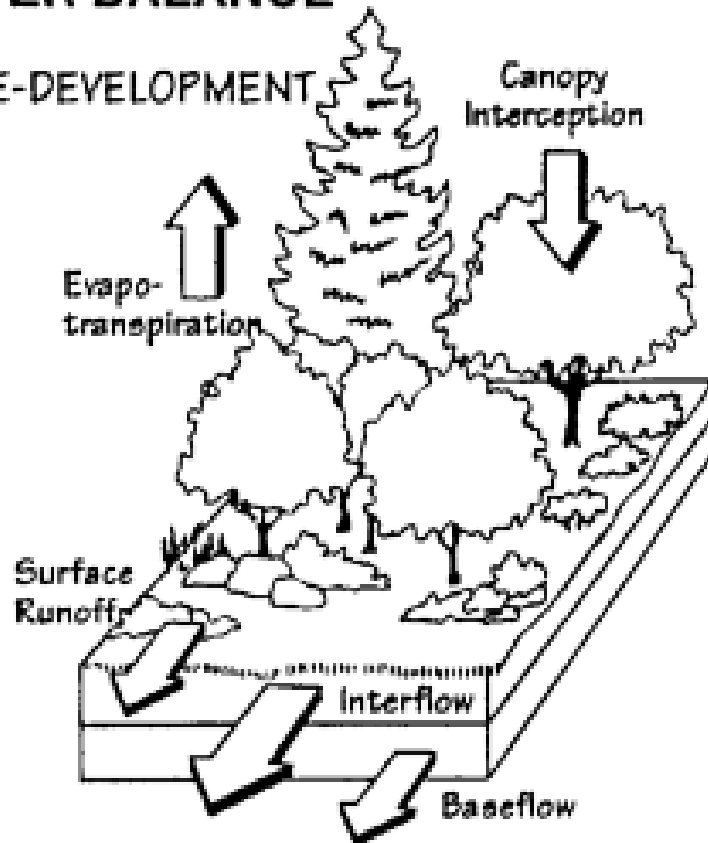


What is stormwater?

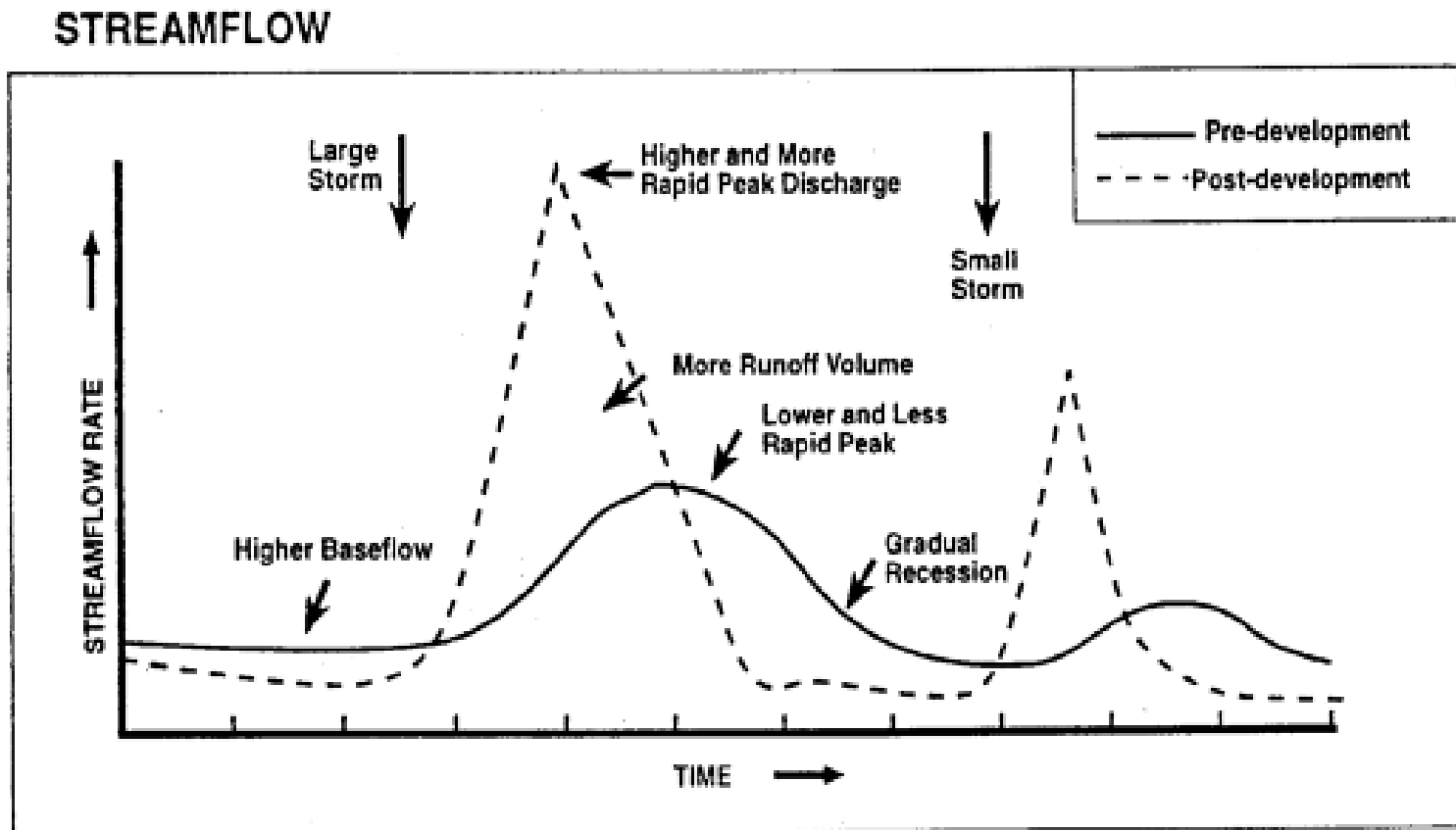


Change landscape, change flows

WATER BALANCE

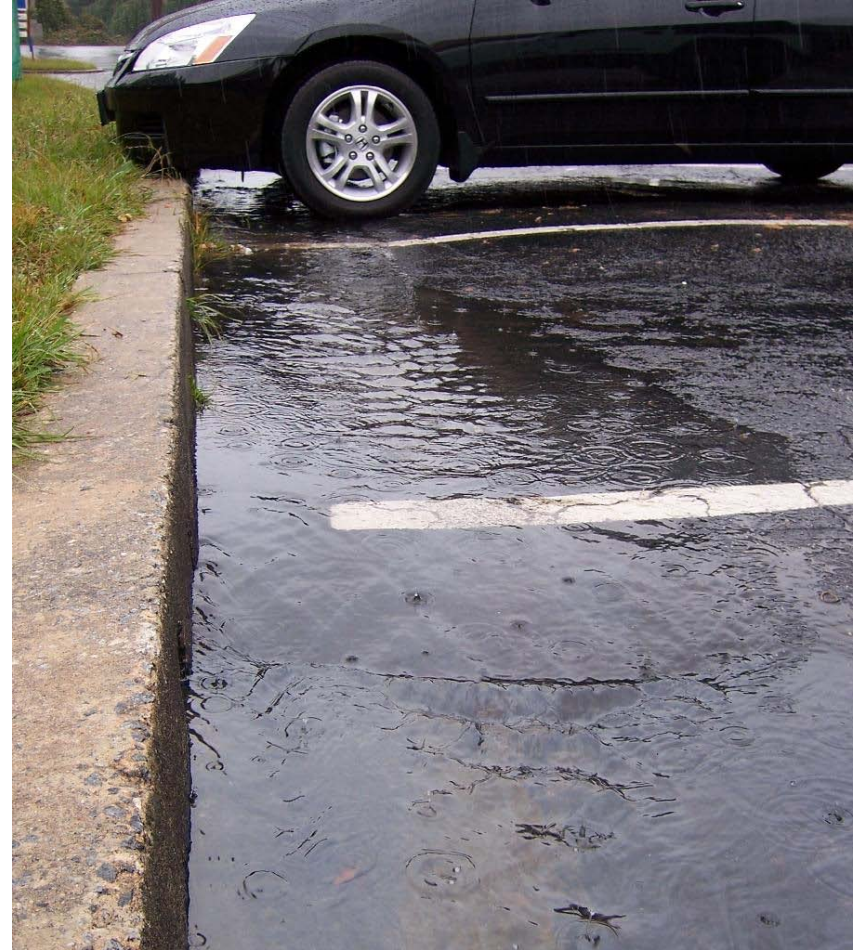


Altered hydrograph



Why do we manage stormwater?

- Flooding
- Reduces infiltration



Deteriorates Stream Channels

- Scours banks
- Deposits and carries sediments
- Habitat degradation
- Undermines roads and infrastructure



Decreases Water Quality

Stormwater runoff carries anything on the surface to our waterways:

- Pesticides, herbicides, insecticides
- Suspended solids (sediment)
- Nutrients
- Bacteria
- Hydrocarbons
- Chlorides (road salt)
- Trace metals
- Trash



General Principles

- Slow water flow
- Increase time filtering and infiltrating
- Treat the water close to the source

- Reduce impervious cover
- Reduce runoff

- Use the water

Filter Strip



Swale



Rain Garden



Bioretention



Landscape Infiltration

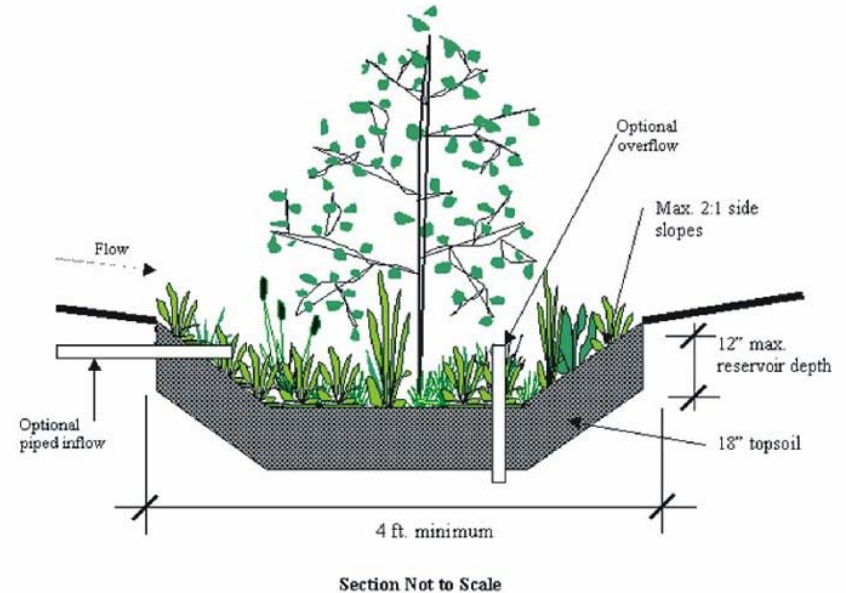


Image source: <http://www.buffalorising.com/2009/02/pushing-green-at-canal-side.html> (left)

Image source: http://www.epa.gov/oaintn/stormwater/cells_infiltration.htm (right)

Green Roof

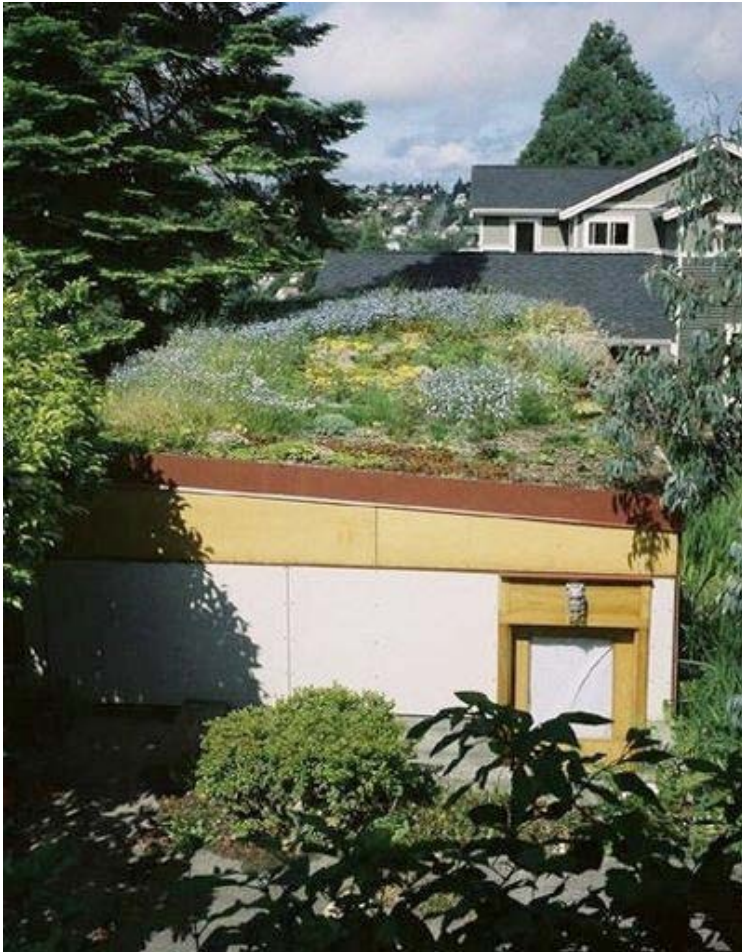


Image source: Green Roofs Australia, greenroofs.wordpress.com/ (left)

Image source: http://demakerealestate.blogspot.com/2008_06_01_archive.html (right)

Porous Pavement



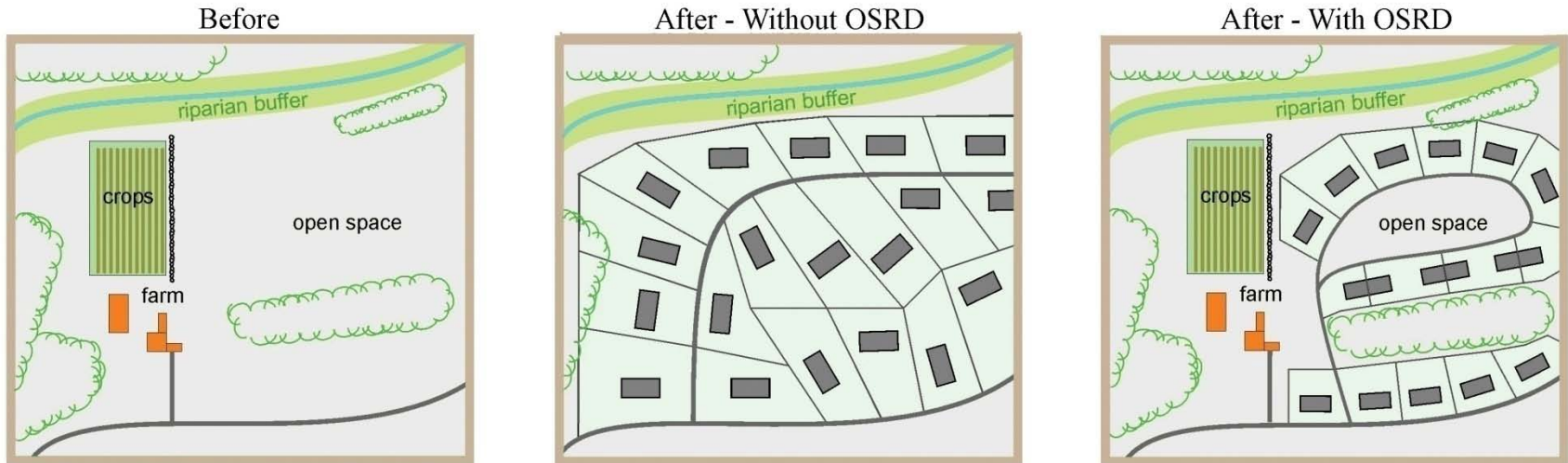
Image source: Wyandotte County Government, http://www.wycokck.org/Dept.aspx?id=22980&menu_id=1022&banner=15284 (Left)
Image source: Spence Brothers, www.spencebrothers.com/general.asp?ID=24 (right)

Selecting Management Techniques

- What problem are you trying to address?
- Area characteristics
- Maintenance requirements
- Funding
- Aesthetics

Practice	Runoff Reduction (%)	Total Phosphorus Removal (%)
Green Roof	45 – 60	0
Rooftop Disconnection	25 – 50	0
Raintanks/cisterns	40	0
Permeable Pavement	45 – 75	25
Grass Channel	10 – 20	15
Bioretention	40 – 80	25 – 50
Dry Swale	40 – 60	20 – 40
Wet Swale	0	20 – 40
Infiltration	50 – 90	25
Sheetflow to Open Space	50 – 75	0
Filtering Practice	0	60 – 65
Constructed Wetland	0	50 – 75
Wet Pond	0	50 – 75

Open Space Residential Design



Planning opportunities

- **Zoning** – land use type; low density v. high density
(WV Code §8A-7 Zoning Ordinance)
- **Subdivision codes** – how parcels are developed
(WV Code §8A-4 Subdivision and Land Development Ordinance)
- **Street standards and road design guidelines**
- **Parking requirements** – set maximum number
- **Minimum setback requirements** – build closer to the street so driveways and walkways are shorter
- **Site coverage limits** – make higher so houses can be closer and therefore less street coverage
- **Height limitations** – increase so there is less sprawling development
- **Open Space requirements**

Monitoring and Maintenance

- Meeting goals
 - Continued functionality
 - Save money
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- Inspection and enforcement
 - Maintenance requirements in permits