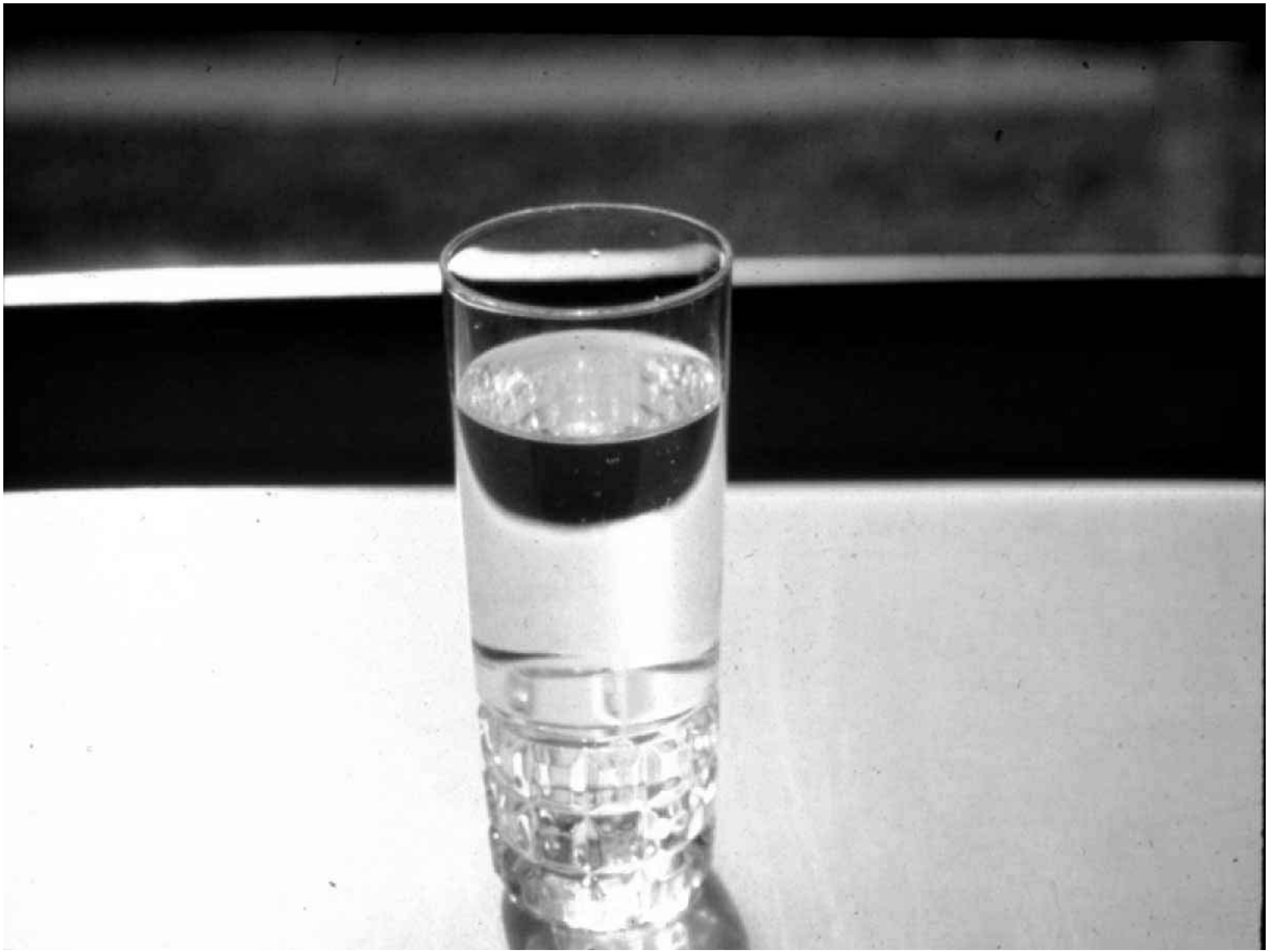
Solutions to Environmental Impacts of Roadways

Roger Bannerman
WI Dept. of Natural Resources
August 21, 2002


8 22'95

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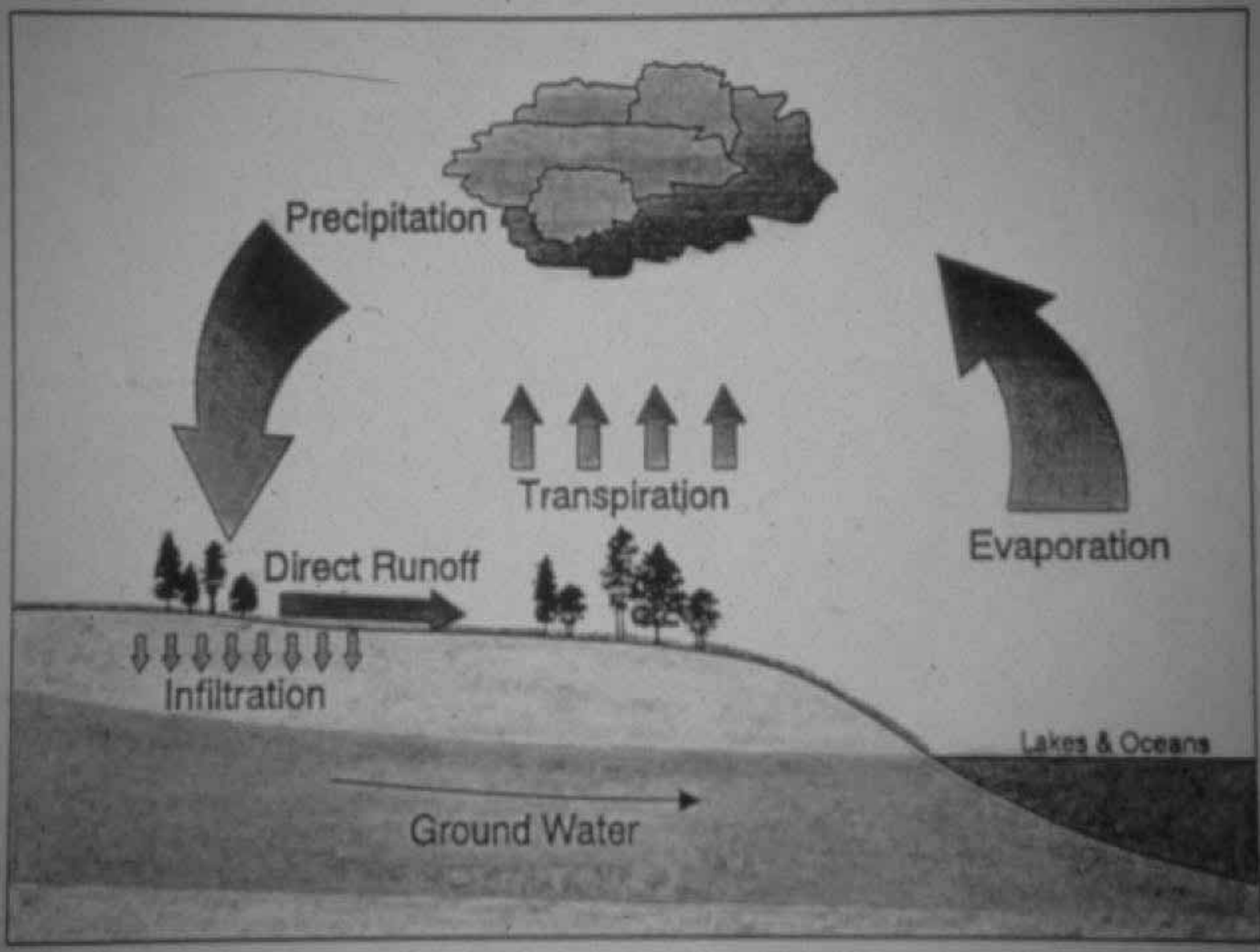
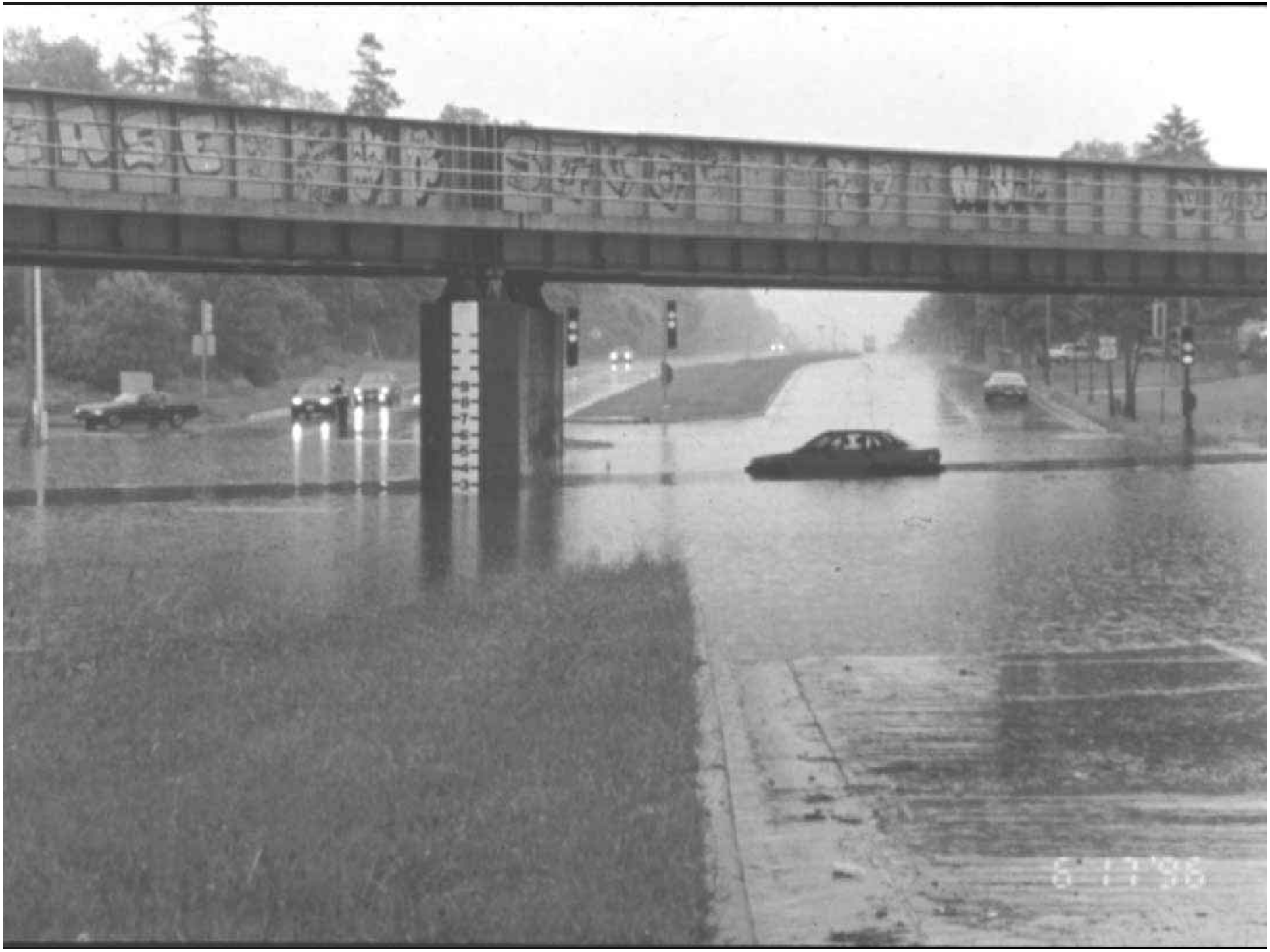
Ecological Integrity in Streams

- **Flow Regime**
- **Habitat Structure**
- **Water Quality**

The Hydrologic Cycle





Increases in Urban Runoff for Lake Mendota from 2000 to 2020

- Amounts of Urban Runoff for 2000:

5,600,000,000 gallons
or 17,000 acre-feet

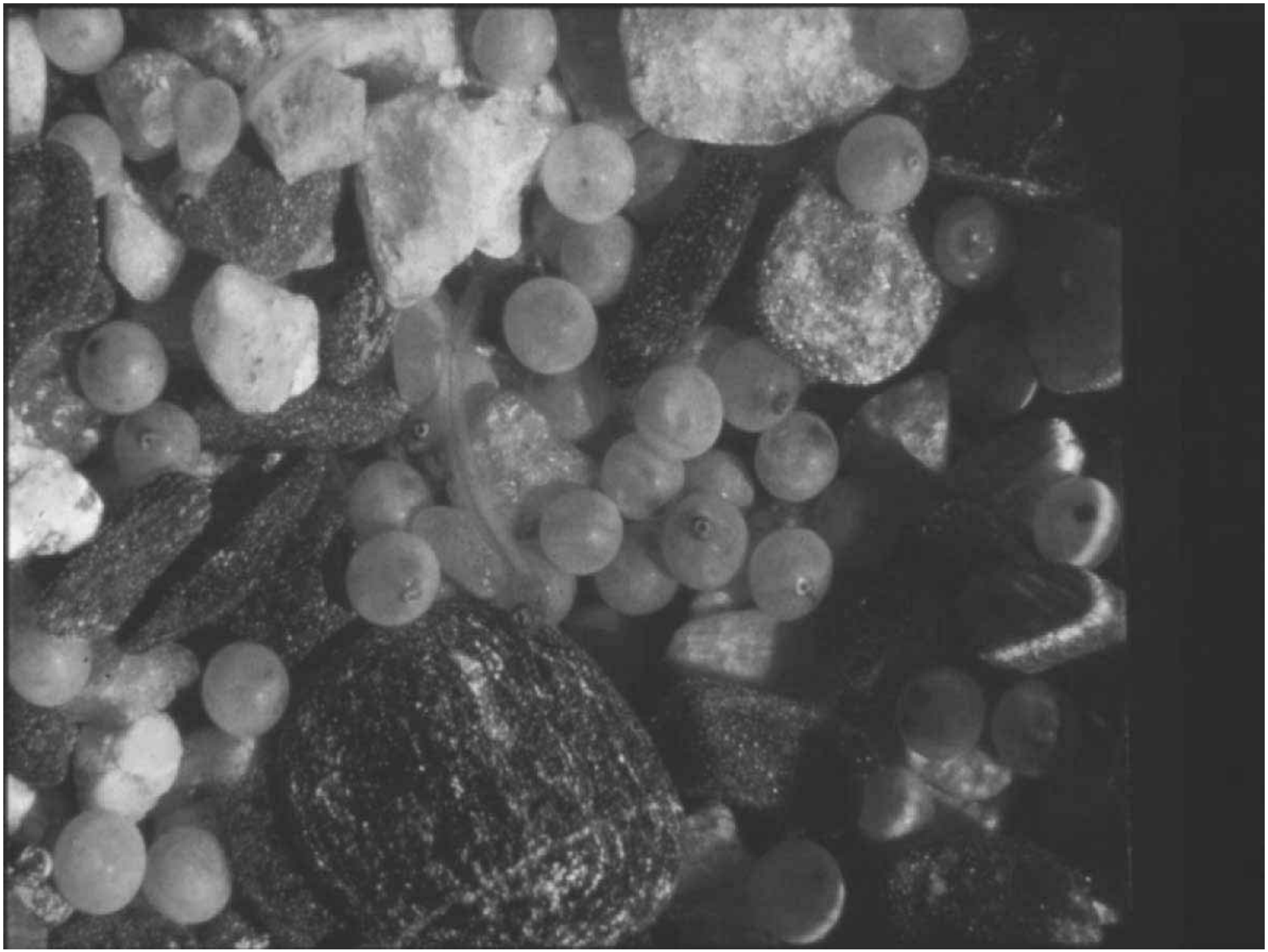
- Amounts of Urban Runoff for 2020:

8,800,000,000 gallons
or 27,500 acre-feet

(Increase of 57%)

Impacts of Changes in Flow

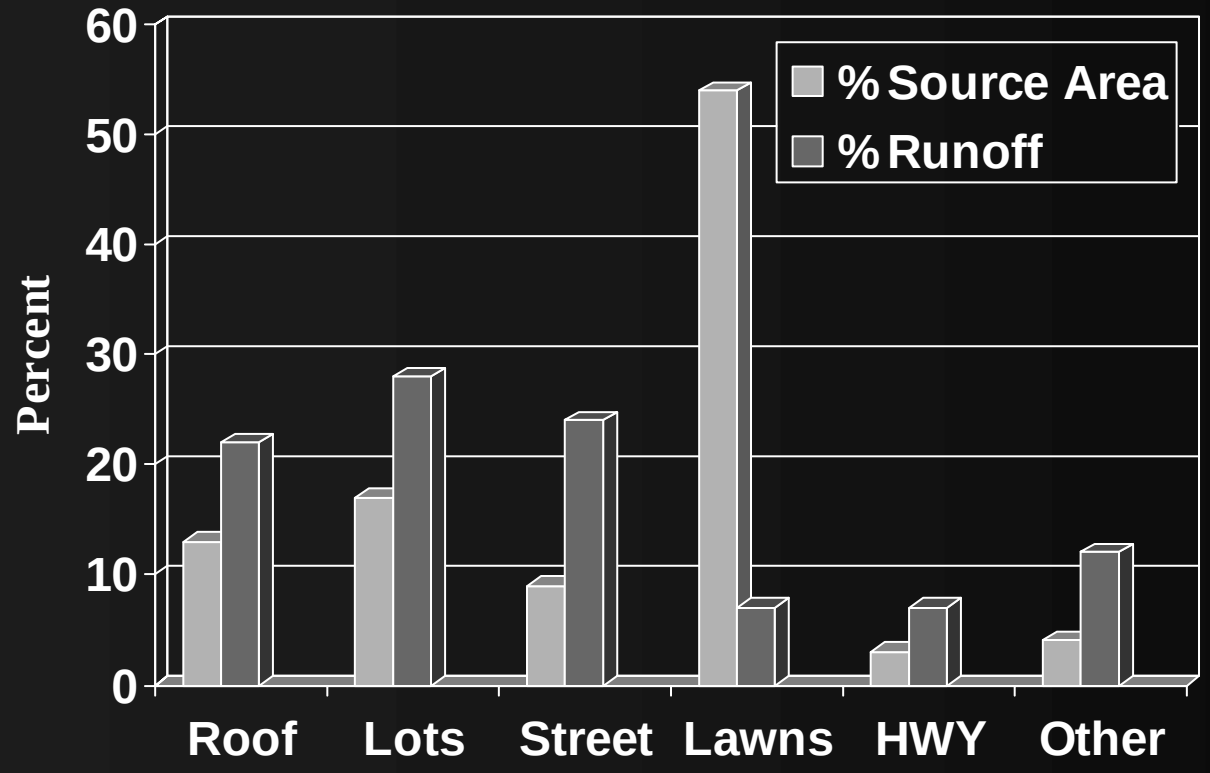
- Less Substrate Percolation
- Perennial Streams Now Intermittent
- Loss of Seasonally Flooded Spawning Areas
- Loss of Microhabitats



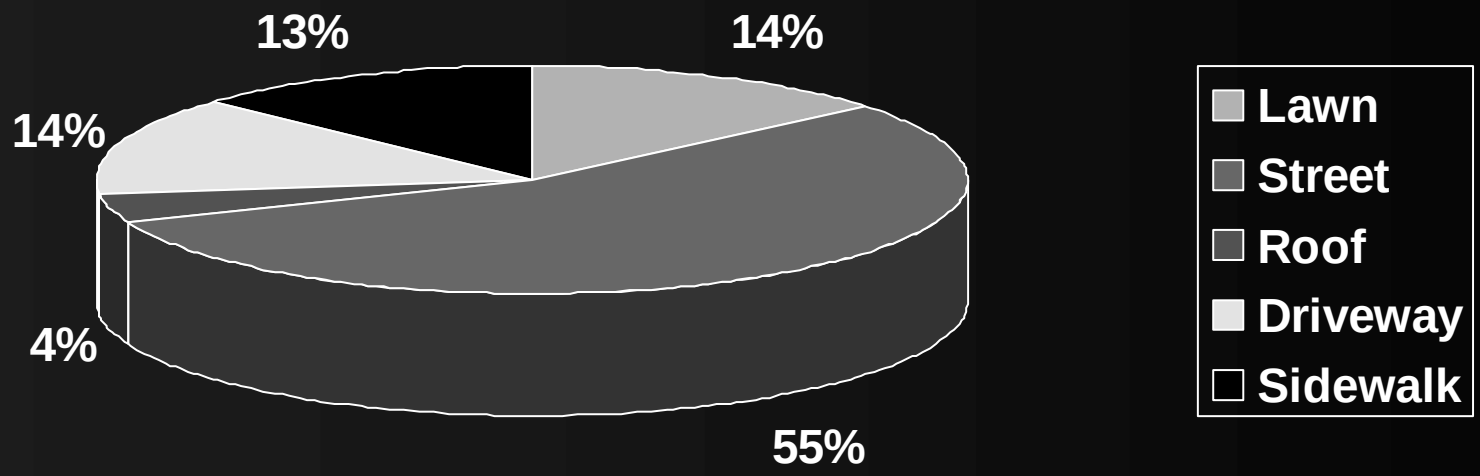
Impacts of Imperviousness on Surface Water and Groundwater Quantities

Type of Water Resource	Impervious Increase from 2% to 18%	Impervious Increase from 2% to 60%
Stream Baseflow	-20%	Dry Stream
Surface Runoff	+90%	+485%
Regional Groundwater	-10%	-55%
Spring Flow	-5%	-30%

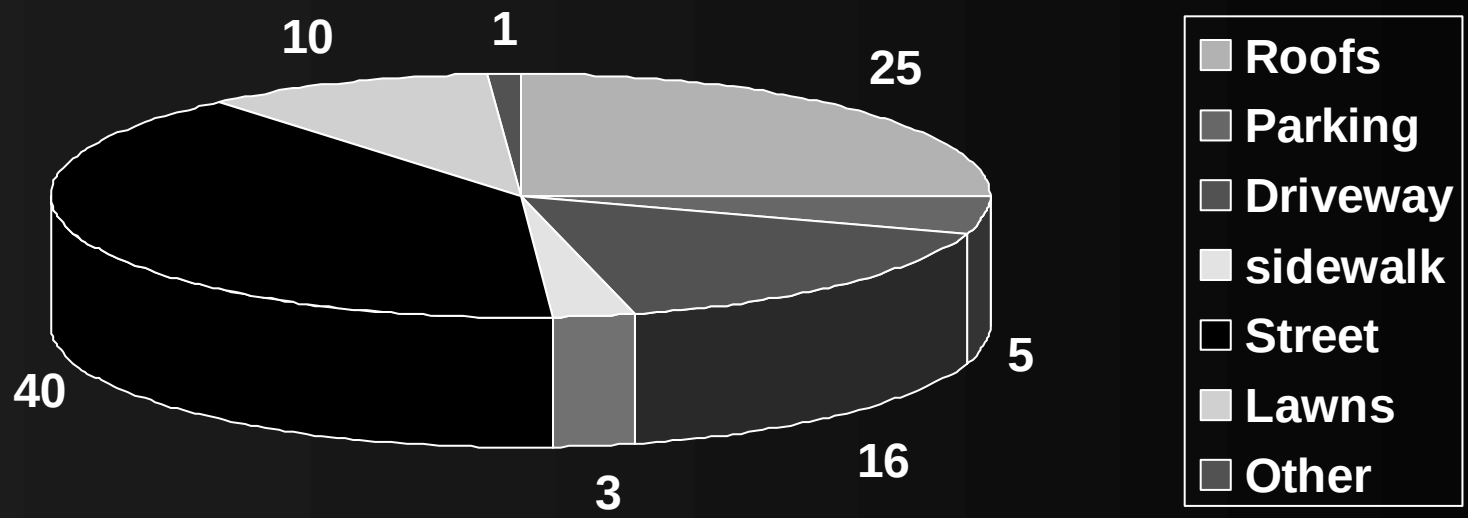
Percent Source Area and Runoff Volume for Four Subwatersheds



Annual Runoff for Each Source in Monroe Basin



Sources of Runoff from Residential Areas



Impacts of Sediment on Streams

- Turbidity
- Warming
- Abrasion
- Scouring
- Infilling
- Soft, Shifting Substrate

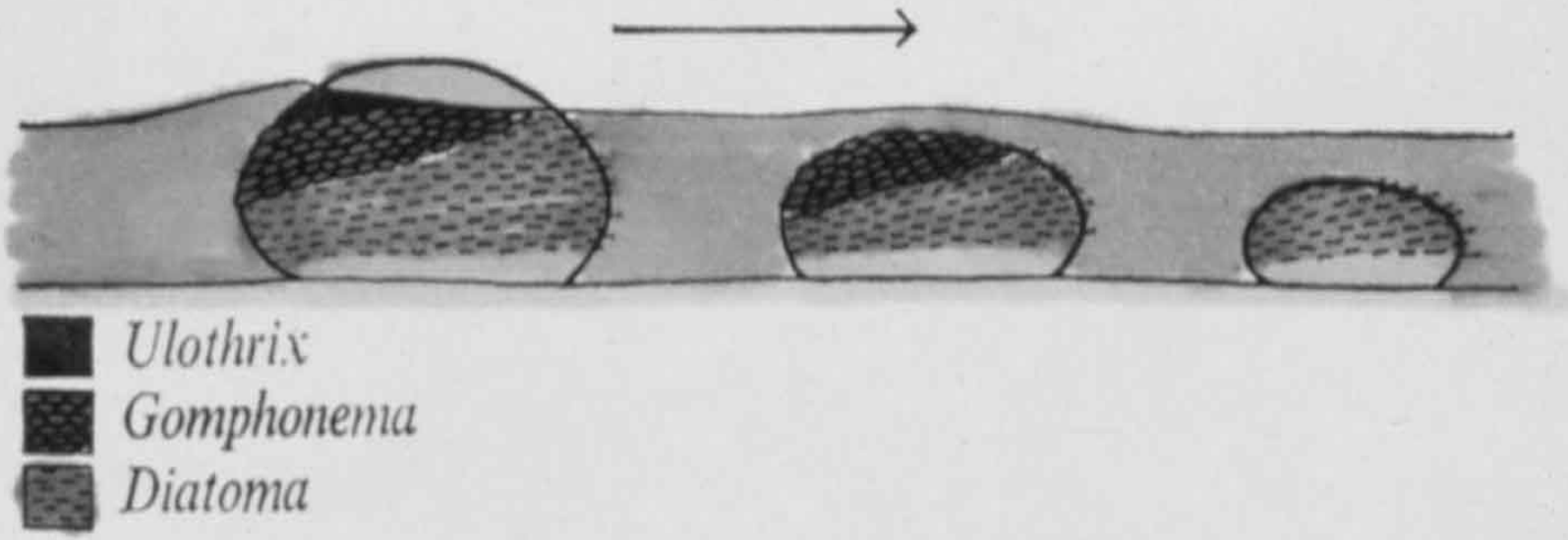
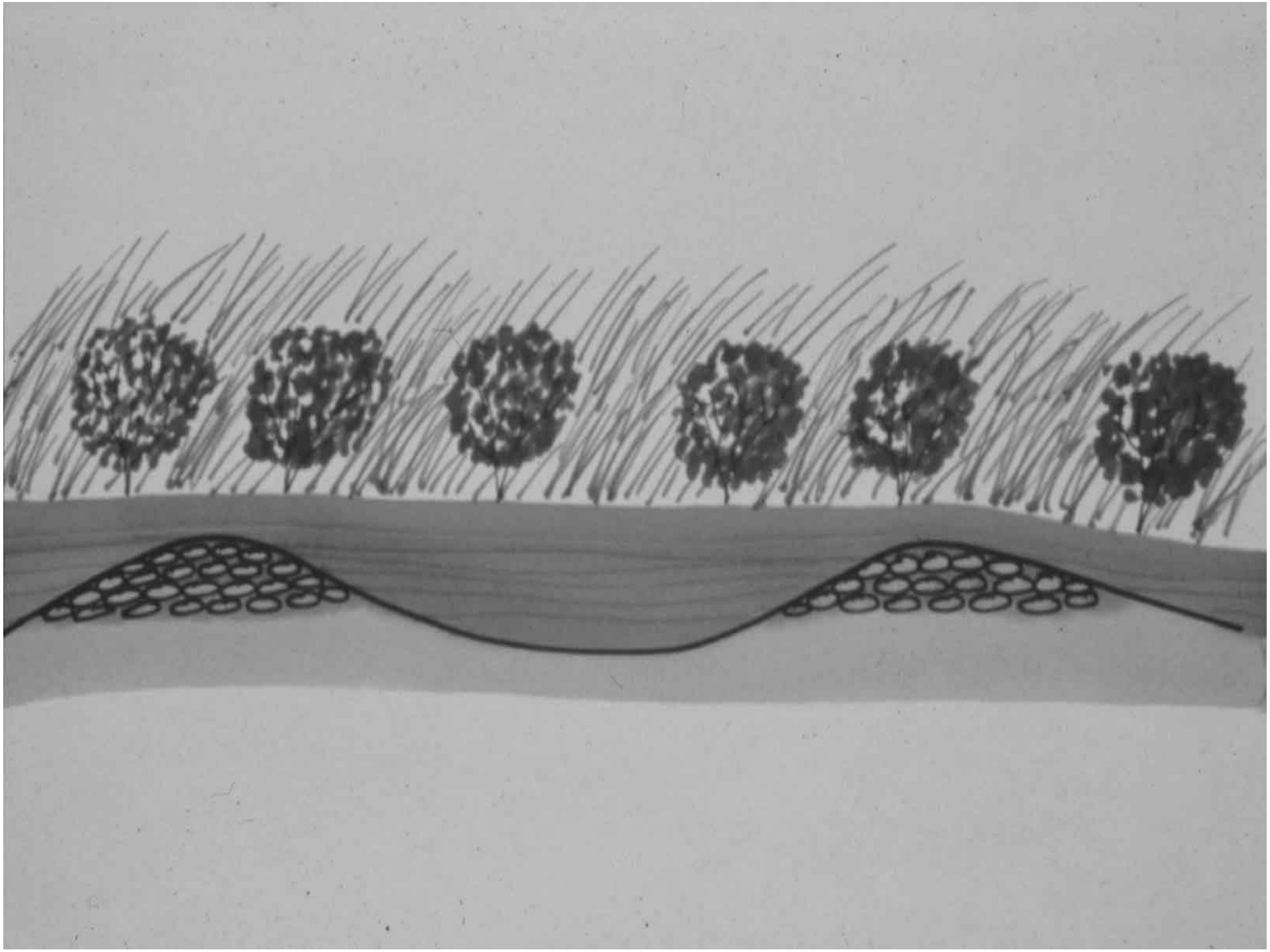
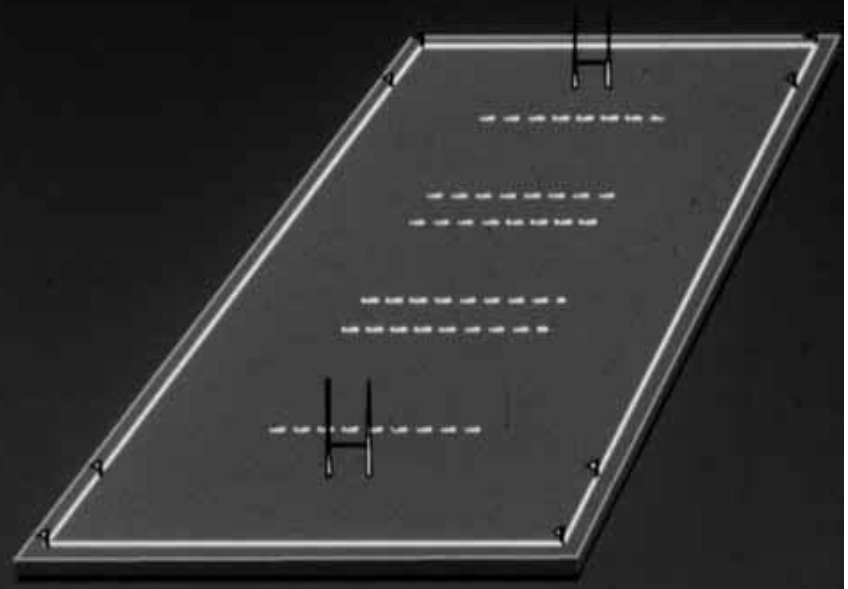


FIG. IV, 4. Diagrammatic illustration of the distribution of algal species on variously submerged stones in the Saline River, Michigan. Redrawn from Blum (1960).

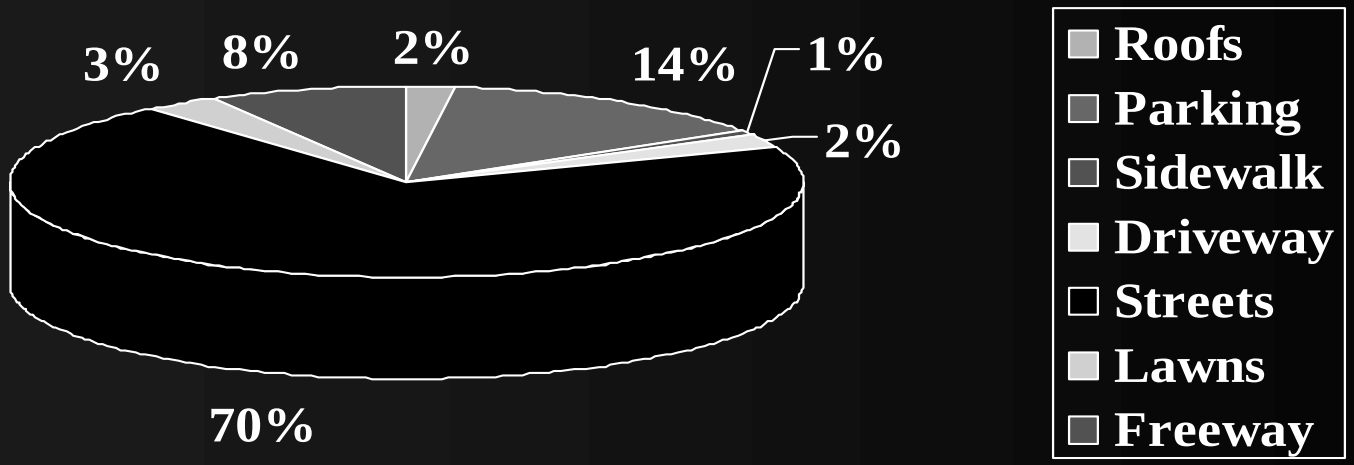


Sediment Deposited in Lake Wingra at Stormsewer Outfall

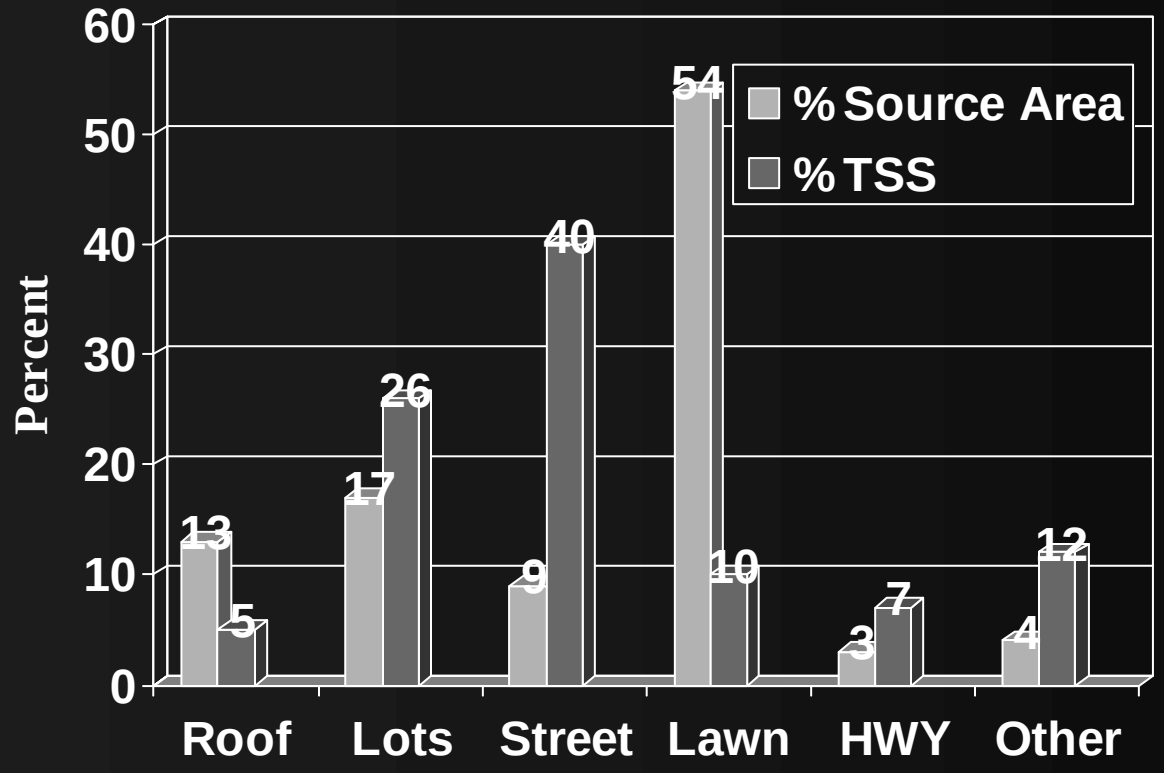
- Sediment Covers Football Field to Depth of 6 Inches
- 800 cubic yards of Sediment = 200 City Sand Trucks
- Sediment Occupies 0.05% of Lake Volume



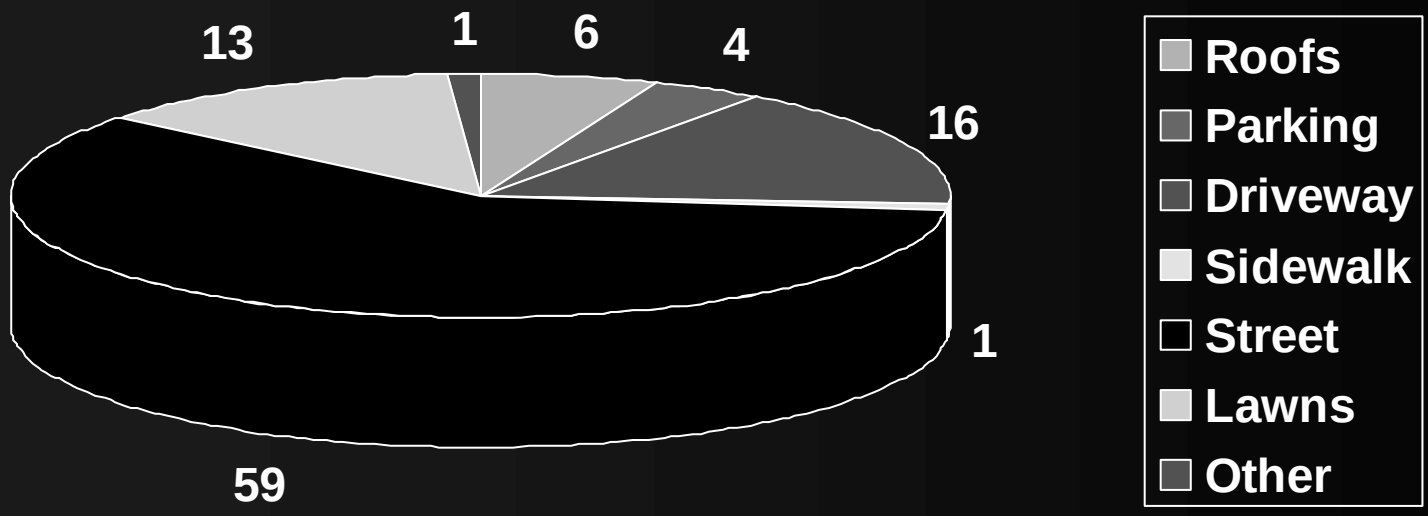
Suspended Solids Sources in Madison, WI by Source Area



Percent Source Area and TSS Loads for the Four Subwatersheds



Sources of TSS Loads in Residential Area



Post Construction Infiltration Performance Standards

By design, infiltrate sufficient runoff volume so that the post-development average annual infiltration volume shall be a portion of pre-development infiltration volume.

Residential	**Non-residential**
90% (1% Cap)	60% (2% Cap)

Post-Construction Performance Standards - Peak Runoff

- Reduce peak runoff discharge rates, MEP, as compared to pre-development conditions for the 2 year, 24 hour design storm.

- Pre-development conditions shall assume "good hydrologic conditions"' for land covers as identified in TR55.

Post-Construction Performance Standards – Suspended Solids

- Reduce Average Annual Total Suspended Solids Load for New Development by 80% as Compared to No Controls.

- Reduce Average Annual Total Suspended Solids Load by 40% for Existing and Redevelopment.

Developed Area Performance Standards – Stage 1& 2

- Stage 1: Reduce Total Suspended Solids by 20% as Compared to No Controls (by 2008).
- Stage 2: Reduce Total Suspended Solids by 40% as Compared to No Controls (by 2013).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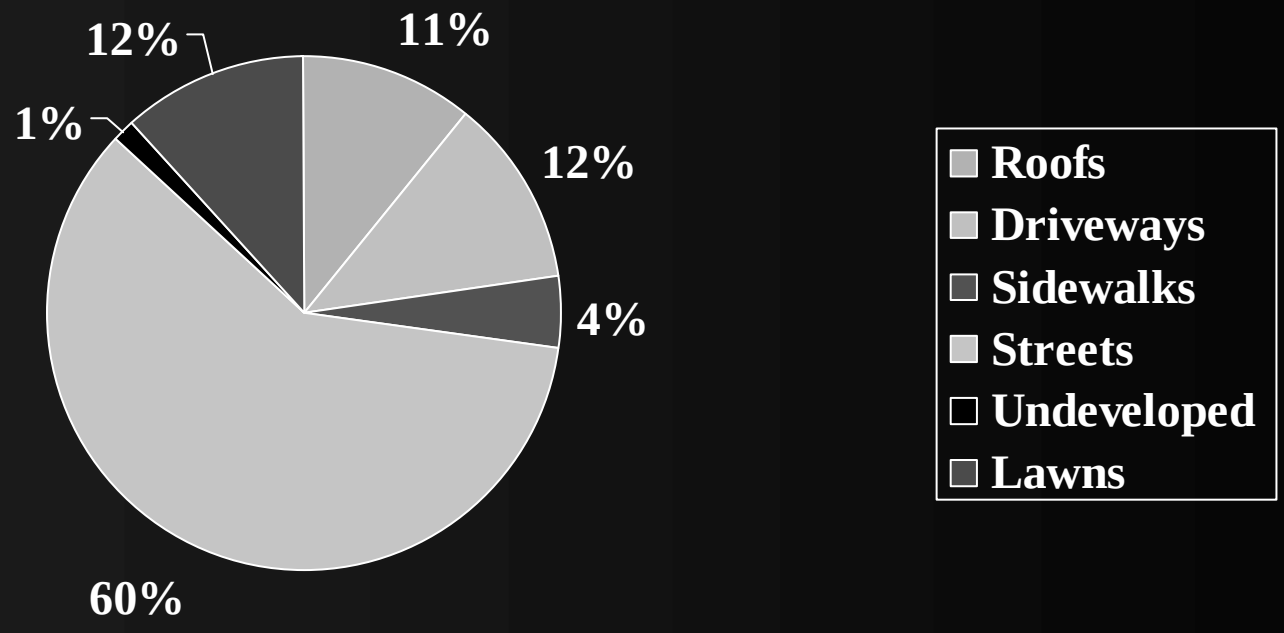
Cedar Hills
% Runoff Volume per Source Area



Elements of Low Impact Design for Cedar Hills Development

- Grass Swales
- Detention Pond
- Infiltration Basin
- Reduce Street Width


Cedar Hill Site Design,
Crossplains WI
Explanation
Wetpond
Infiltrations Basin
Swales
Sidewalk
Driveway
Houses
Lawns
Roadway
Woodlot
N
500 0 500 1000 Feet


Neighborhoods are often designed using a "cookie cutter" approach, which does nothing to provide a sense of place and community.

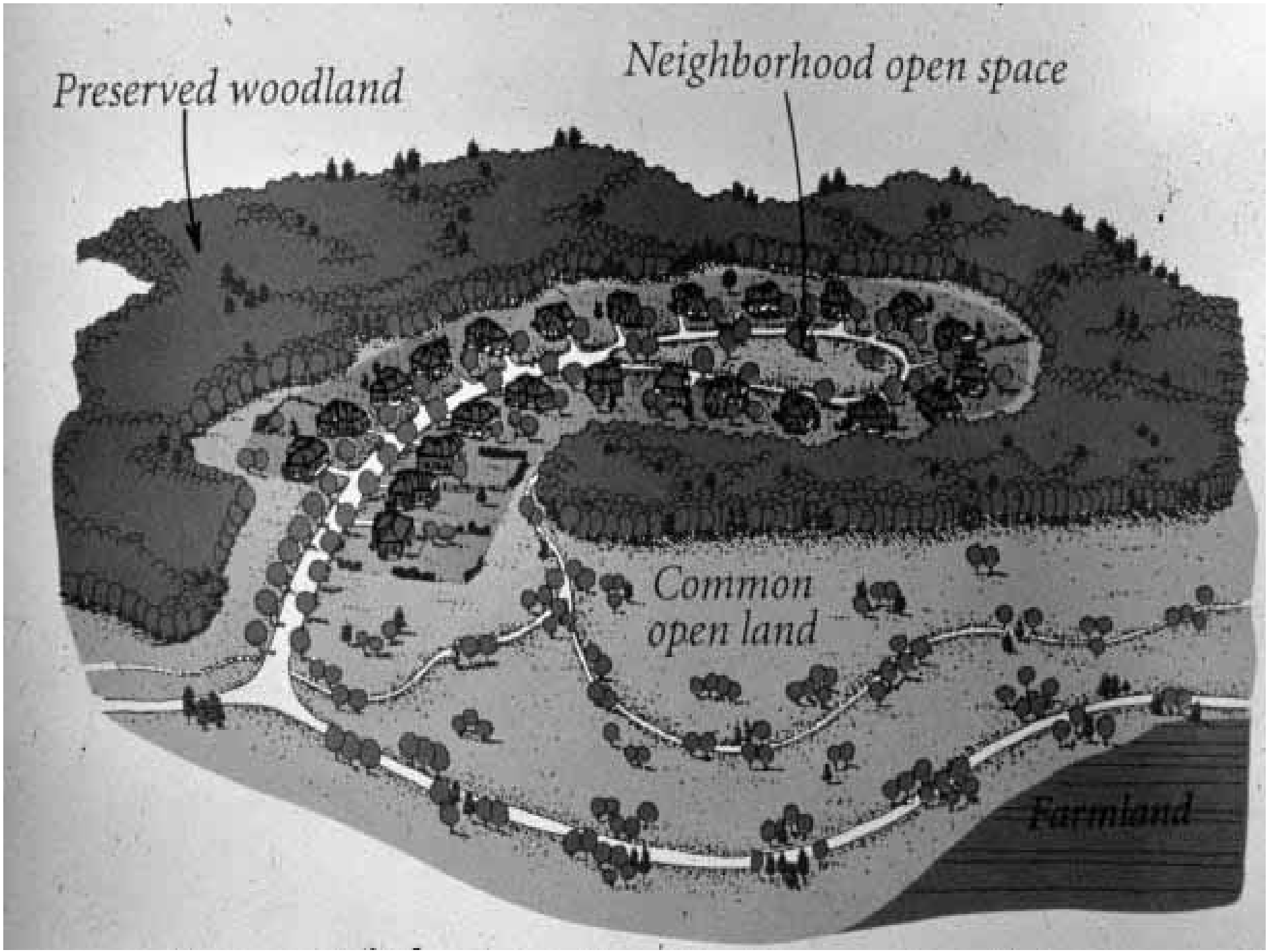

Preserved woodland
Neighborhood open space
Common open land
Farmland

Figure 5-6
Conventional Development Layout and Stormwater Plan

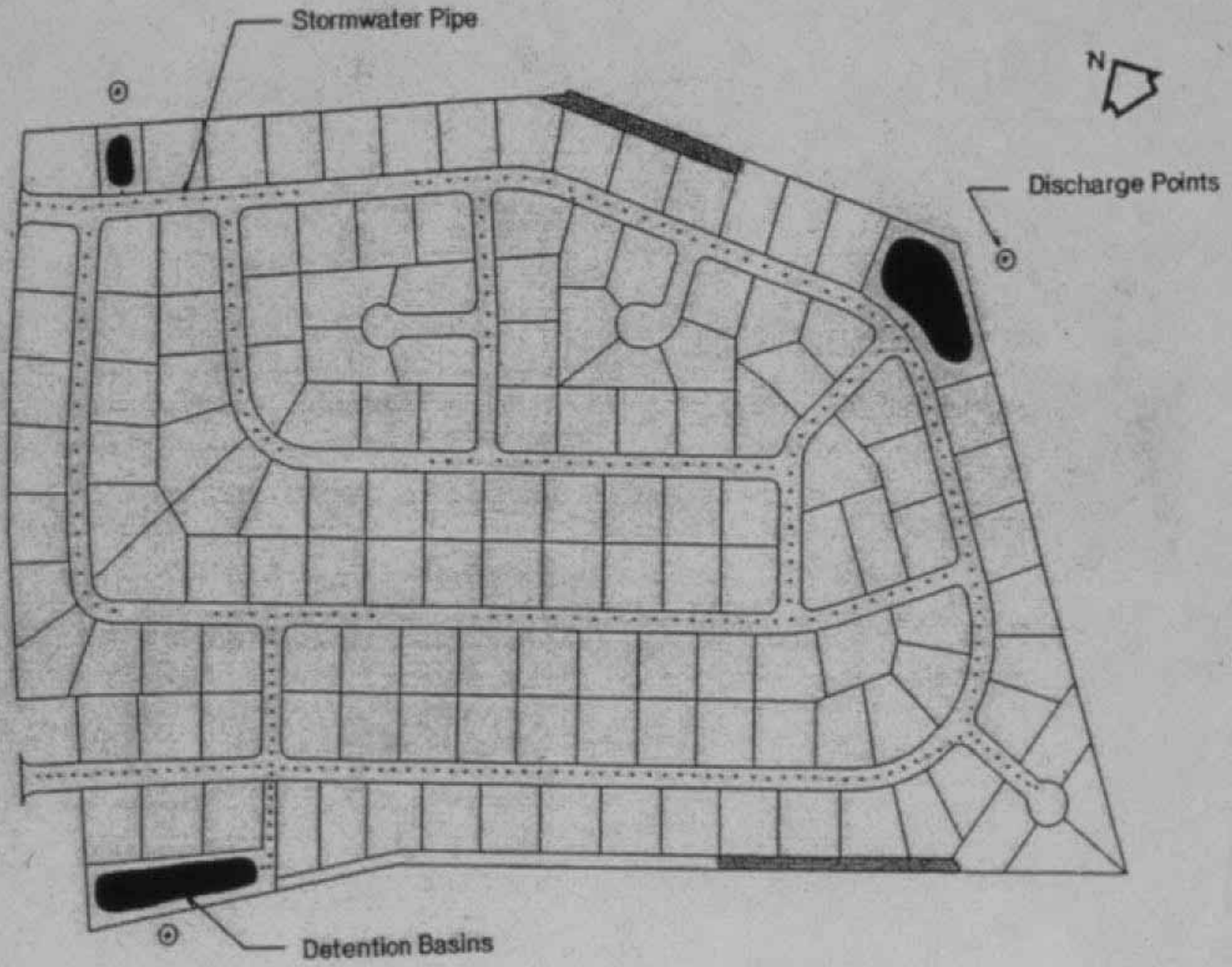
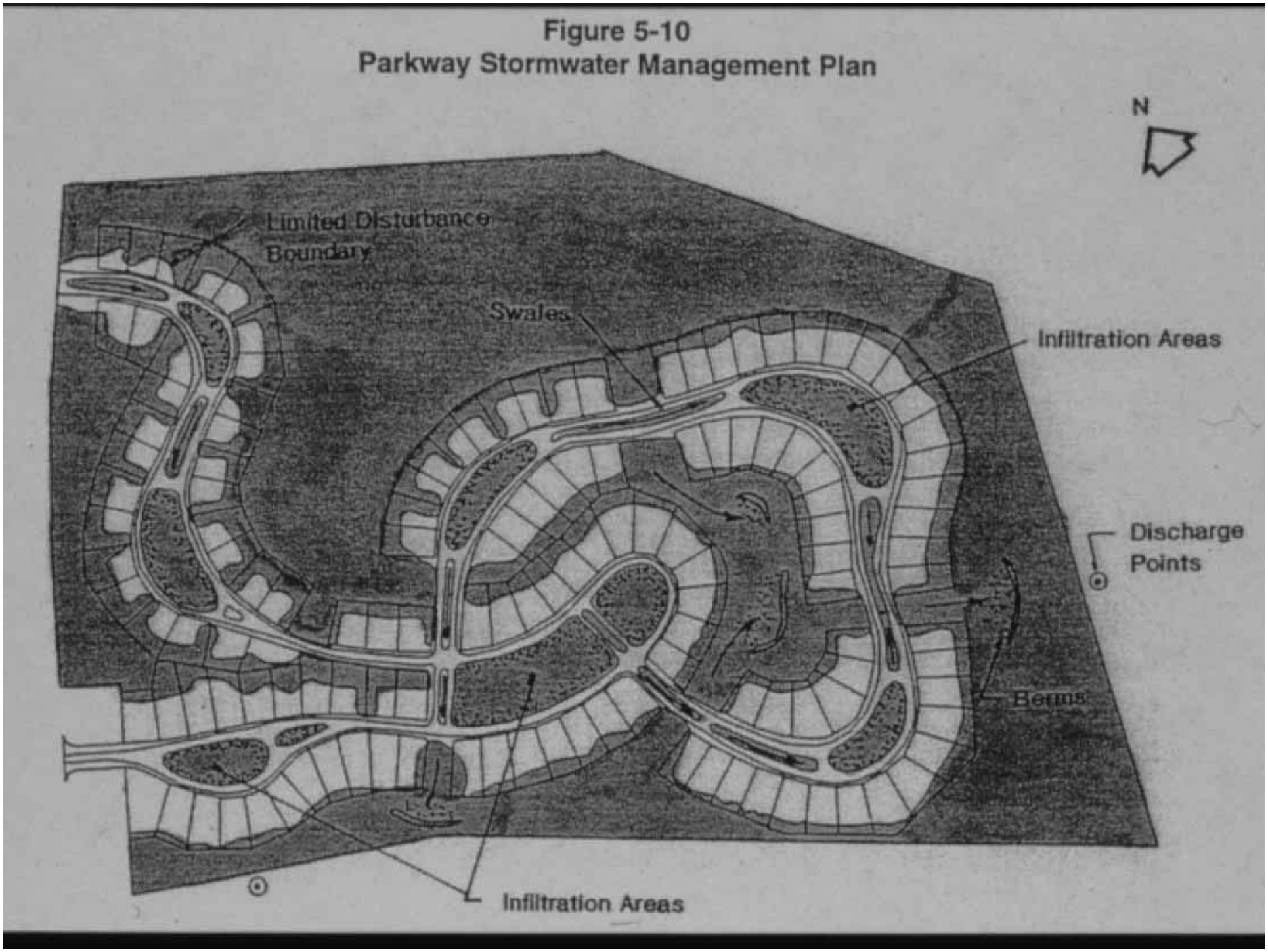
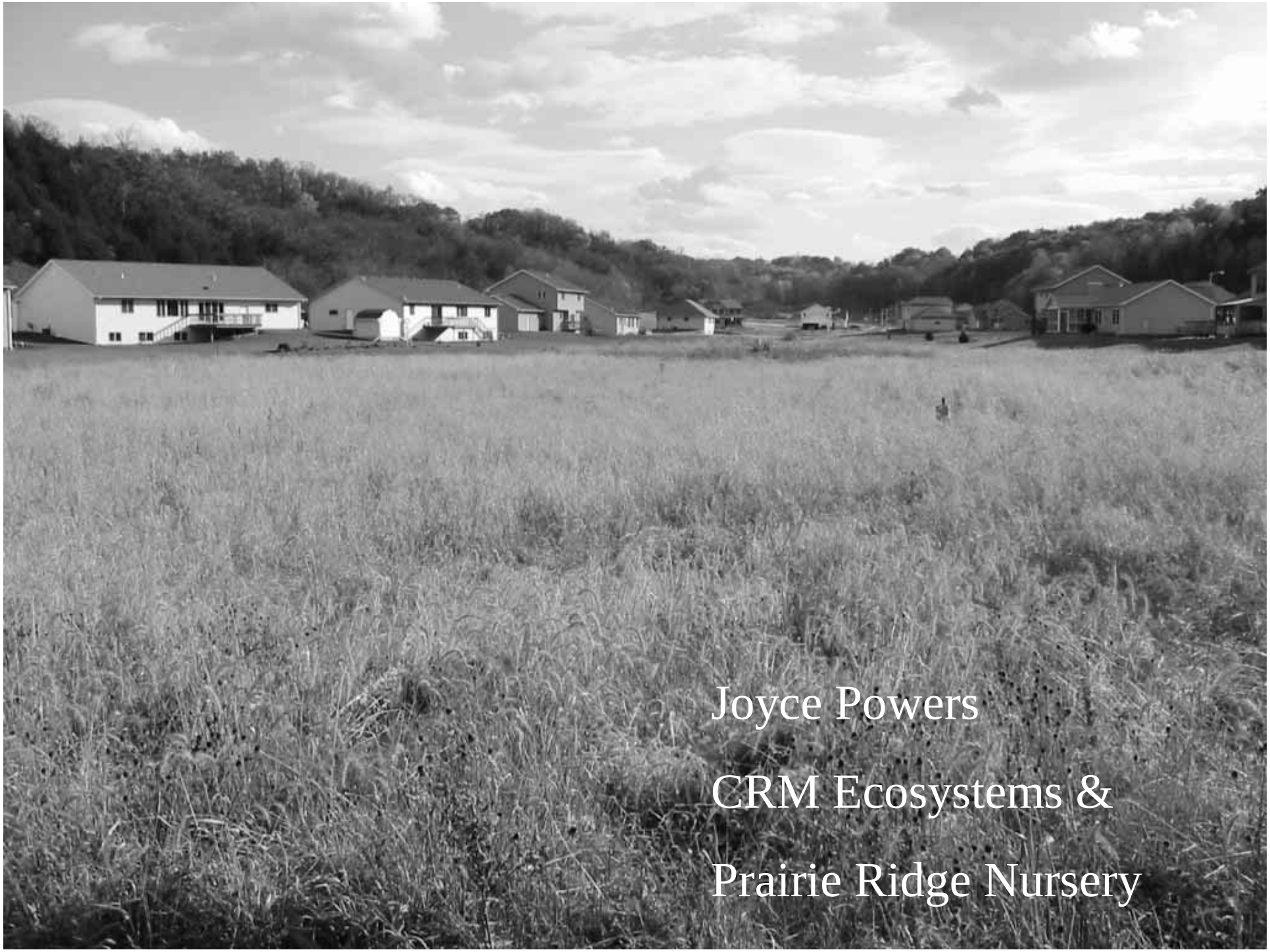


Figure 5-10
Parkway Stormwater Management Plan




Joyce Powers
CRM Ecosystems &
Prairie Ridge Nursery

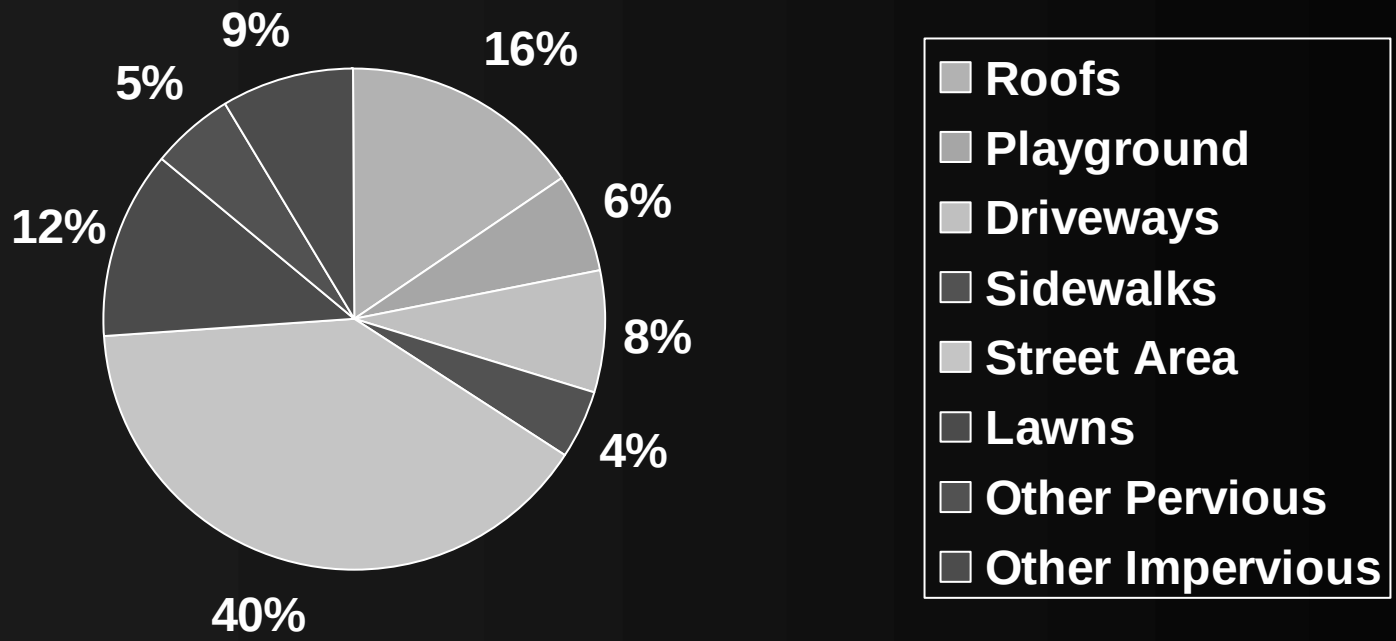
Effectiveness of BMPs at Cedar Hills

Type of Control	*Infiltration Volume, in.*	*% of Pre-development*
Pre-development	30.8	
90% Goal	27.7	90%
No Controls	25.4	82%
Grass Swales	26.3	85%
Swales + Pond + Basin	30.6	99%

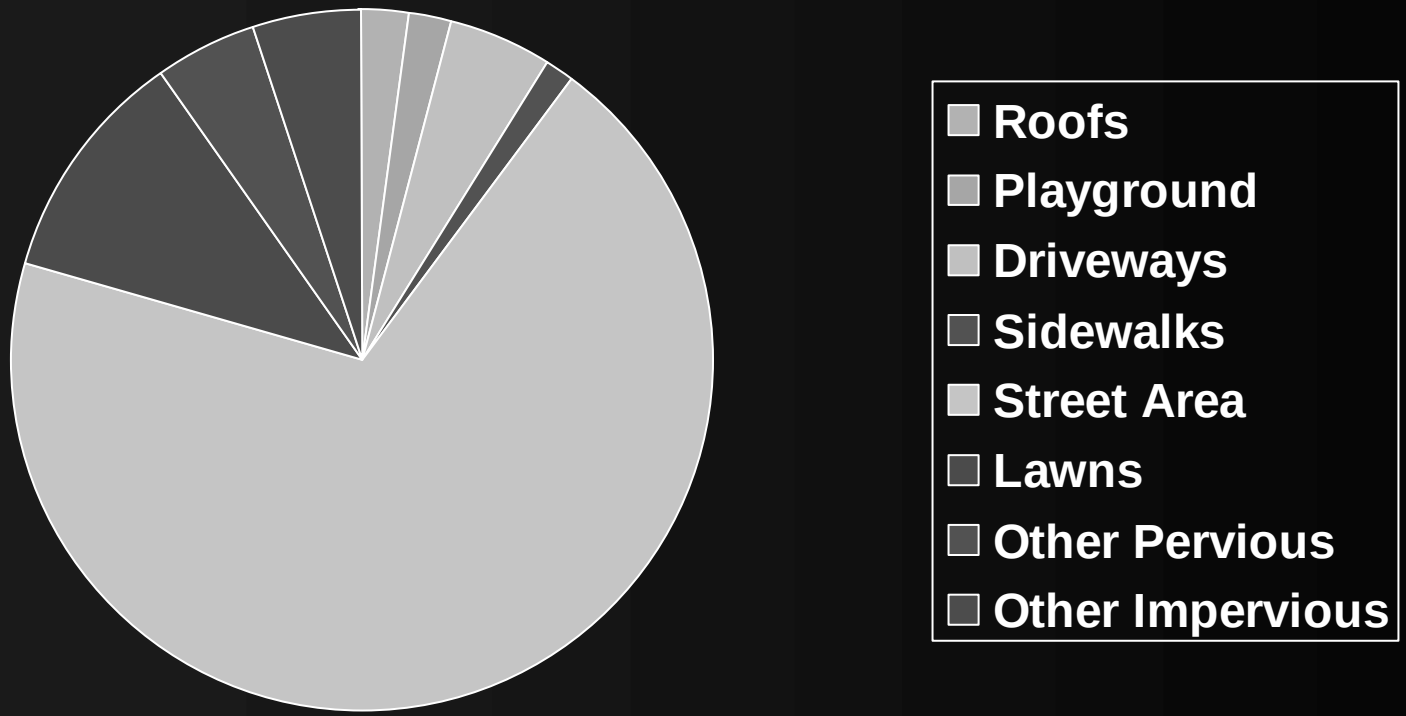
Reductions in Runoff Volume for Cedar Hills

Type of Control	Runoff Volume, inches	Reduction in Post Runoff Volume
Pre-development	1.3	
No Controls	6.7	80%
Grass Swales	5.8	13%
Swales + Pond + Basin	1.5	78%

St. Francis
% Runoff Volume per Landuse

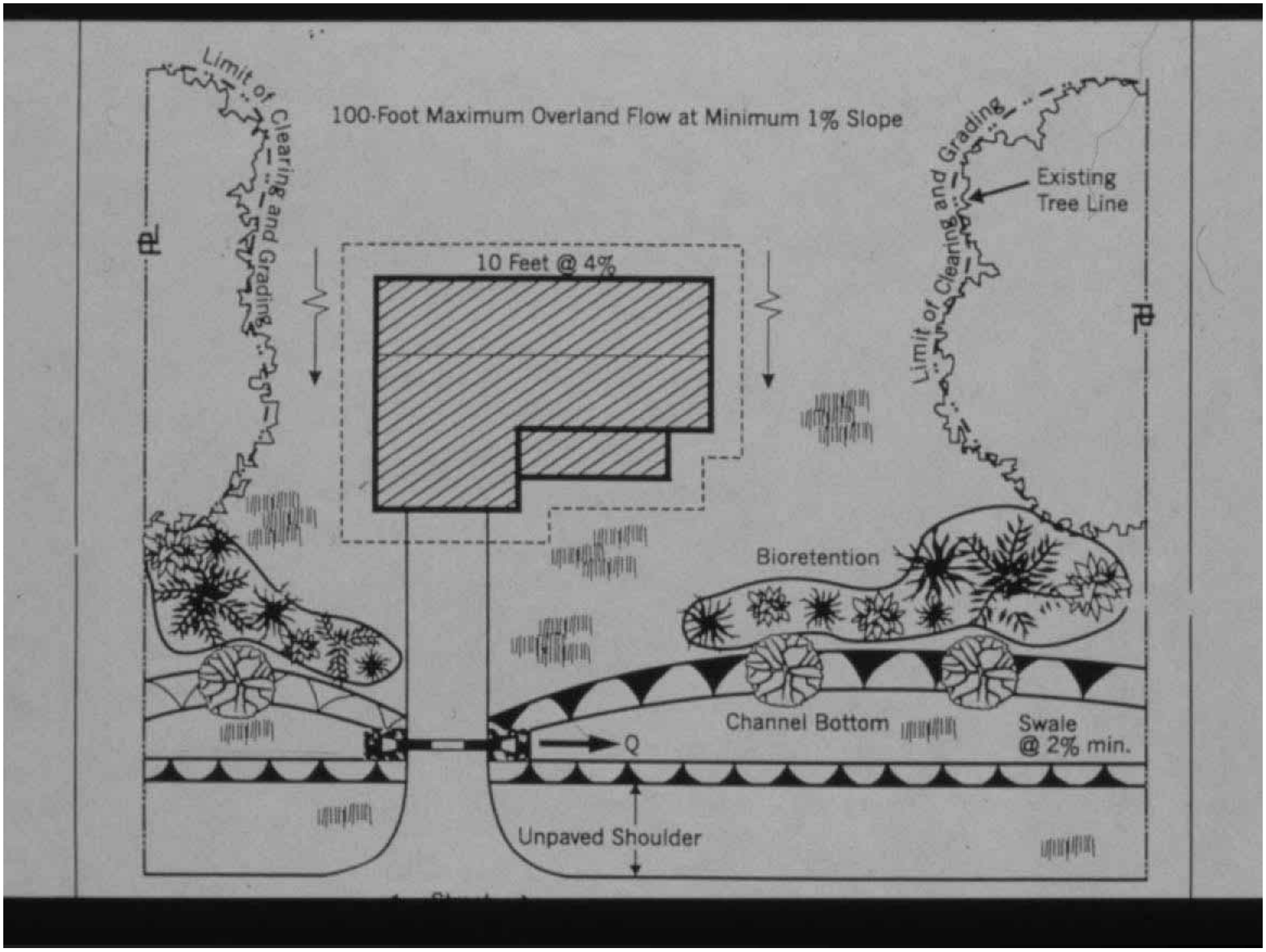


St. Francis
% Total Suspended Solids per Landuse



Description of St. Francis Development

- 72 acres
- Lot sizes from 1/4 to 2 acres
- 101 homes
- Pre-development landuse is cropland
- 16% connected imperviousness
- Adjacent resource: Brewery Creek


100-Foot Maximum Overland Flow at Minimum 1% Slope
Limit of Clearing and Grading
Limit of Clearing and Grading
Existing Tree Line
10 Feet @ 4%
Bioretention
Channel Bottom
Swale @ 2% min.
Q
Unpaved Shoulder

Effectiveness of BMPs at St. Francis

Type of Control	*Infil.Volume, inches*	*% of Pre-development*
Pre – development	30.8	
90% Goal	27.7	90%
No Control (Area 4)	27.1	88%
Rain Gardens (Area 4)	27.7	90%
(Area4) Garden +Trenches	30.5	99%
(4) Garden + Trench + Basin	31.7	100%
All 4 Areas	***30.8***	***100%***

Reductions in Runoff Volume for St. Francis

Type of Control	*Runoff Volume, inches*	*Reduction in Runoff*
Pre-development	1.3	
No controls (Area 4)	5.0	74%
Rain Gardens (Area 4)	4.4	14%
(Area 4) Gardens + Trenches	1.6	69%
Gardens + Trenches + Basins (Area 4)	0.4	92%
All 4 Areas	***1.3***	***74%***

Reductions in Runoff Volume and Suspended Solids for St. Francis

Type of Control	***Suspended Solids, lbs.***	***Reduction in Suspended Solids***
Pre-development		
No controls (Area 4)	12,670	
Rain Gardens (Area 4)	12495	1%
(Area 4) Gardens + Trenches	5019	60%
Gardens + Trenches + Basins (Area 4)	0	100%
All 4 Areas	***3517***	***83%***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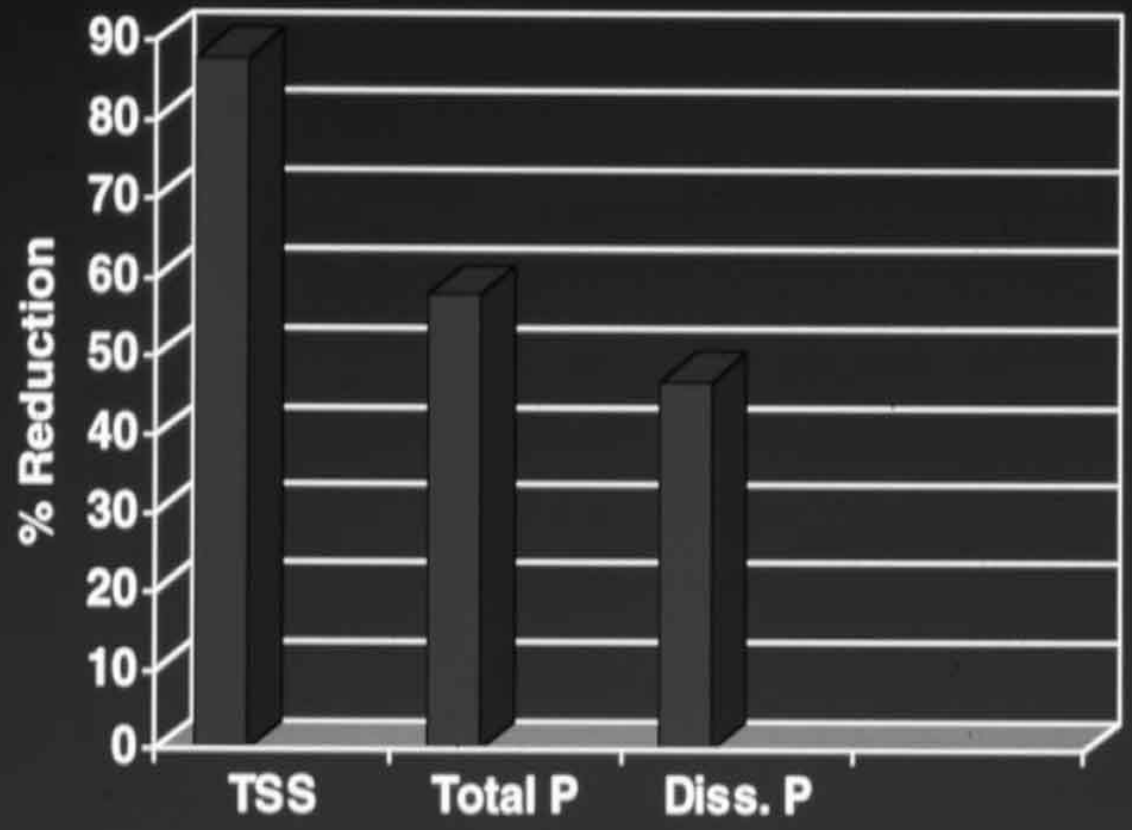
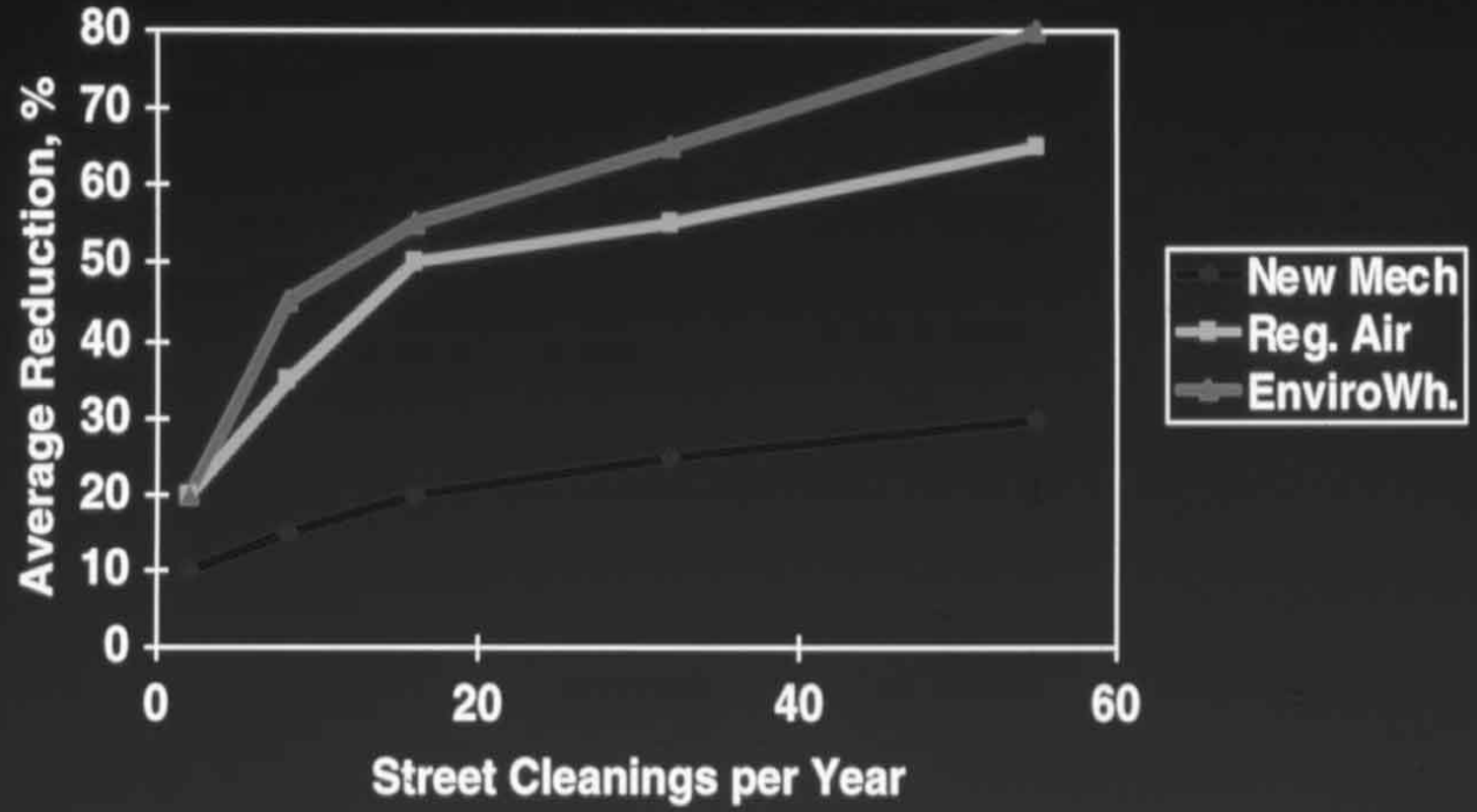
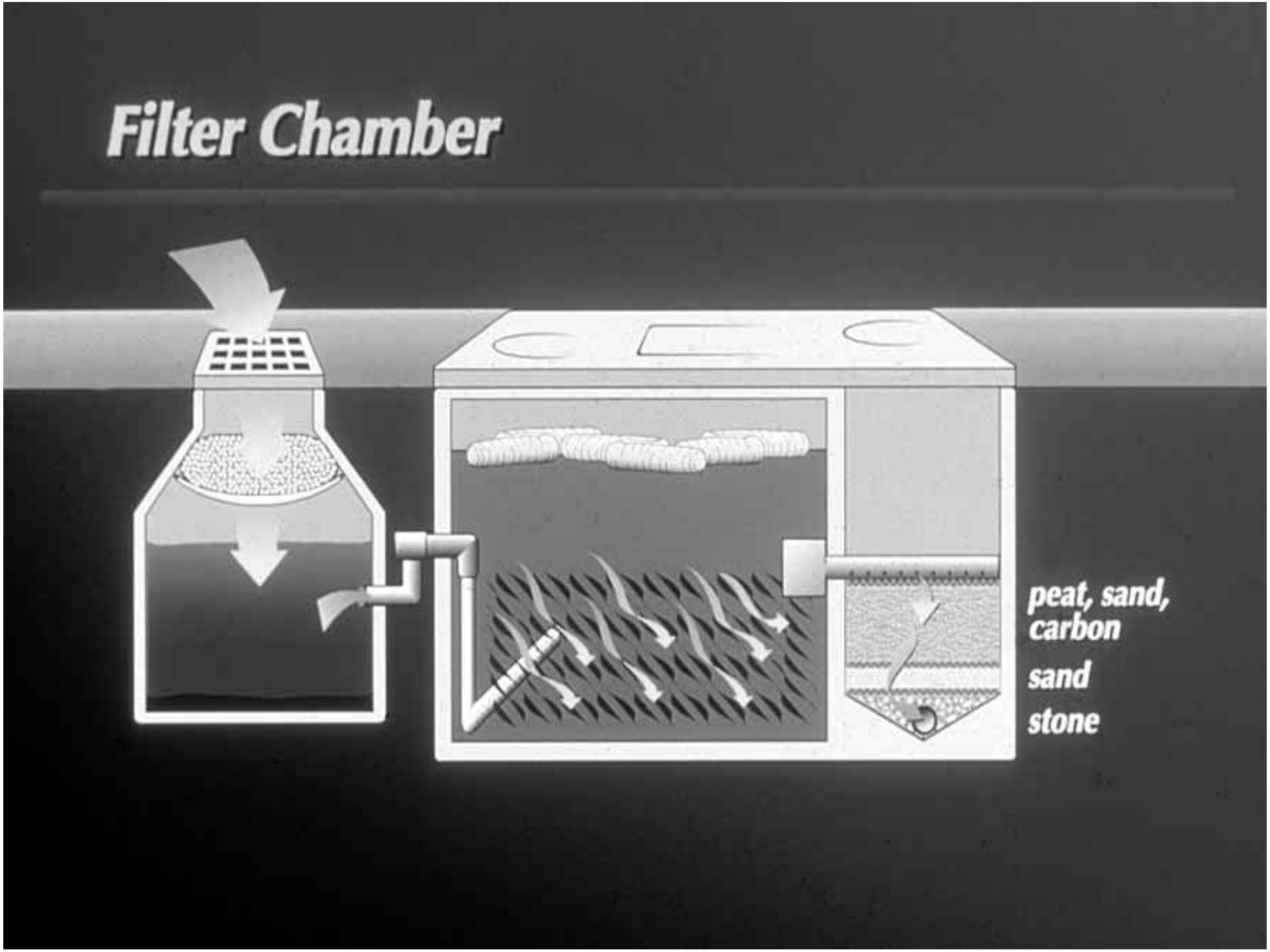
Total Load Reduction Achieved by Monroe Pond



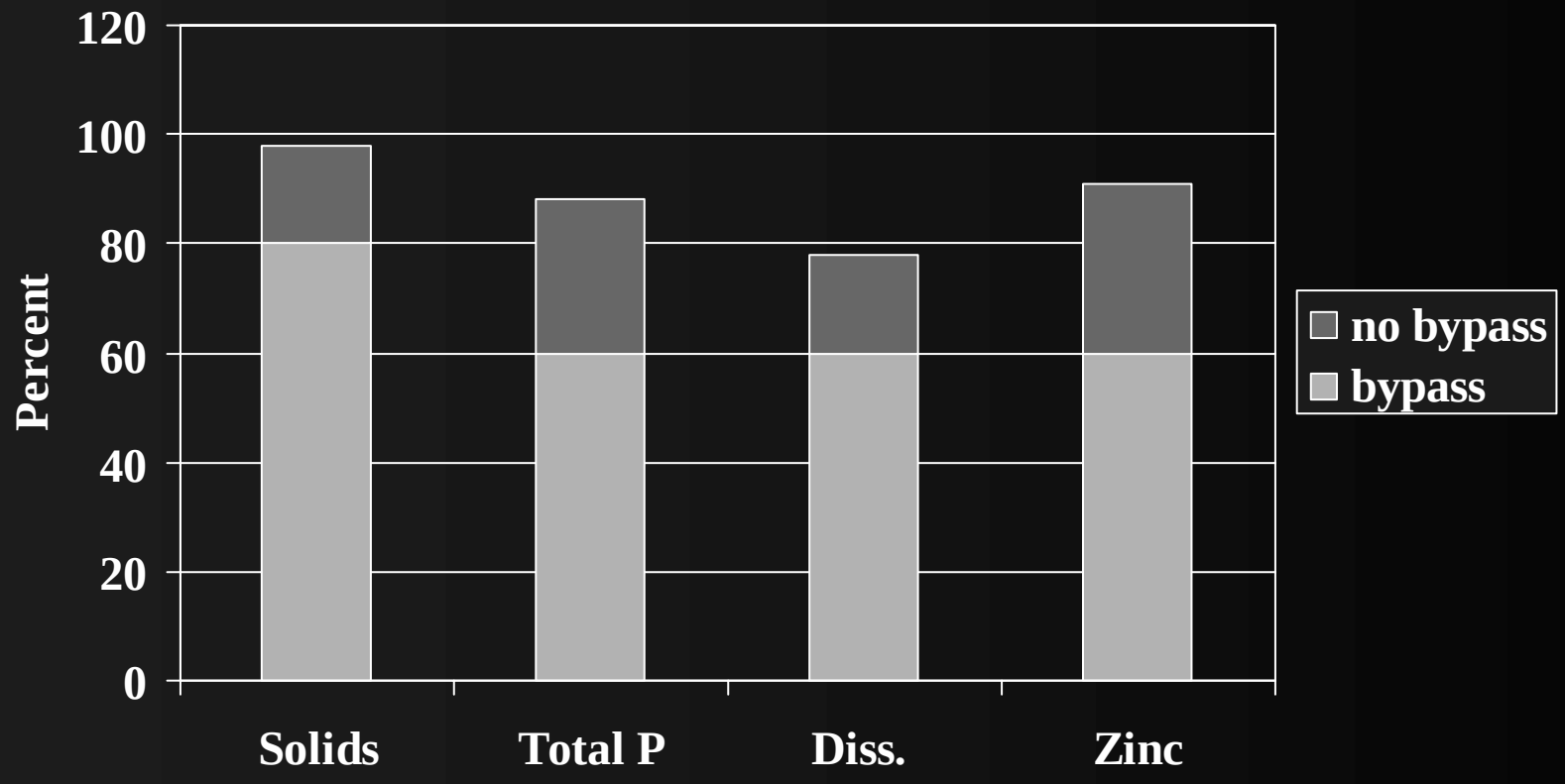

Enviro Whirl II

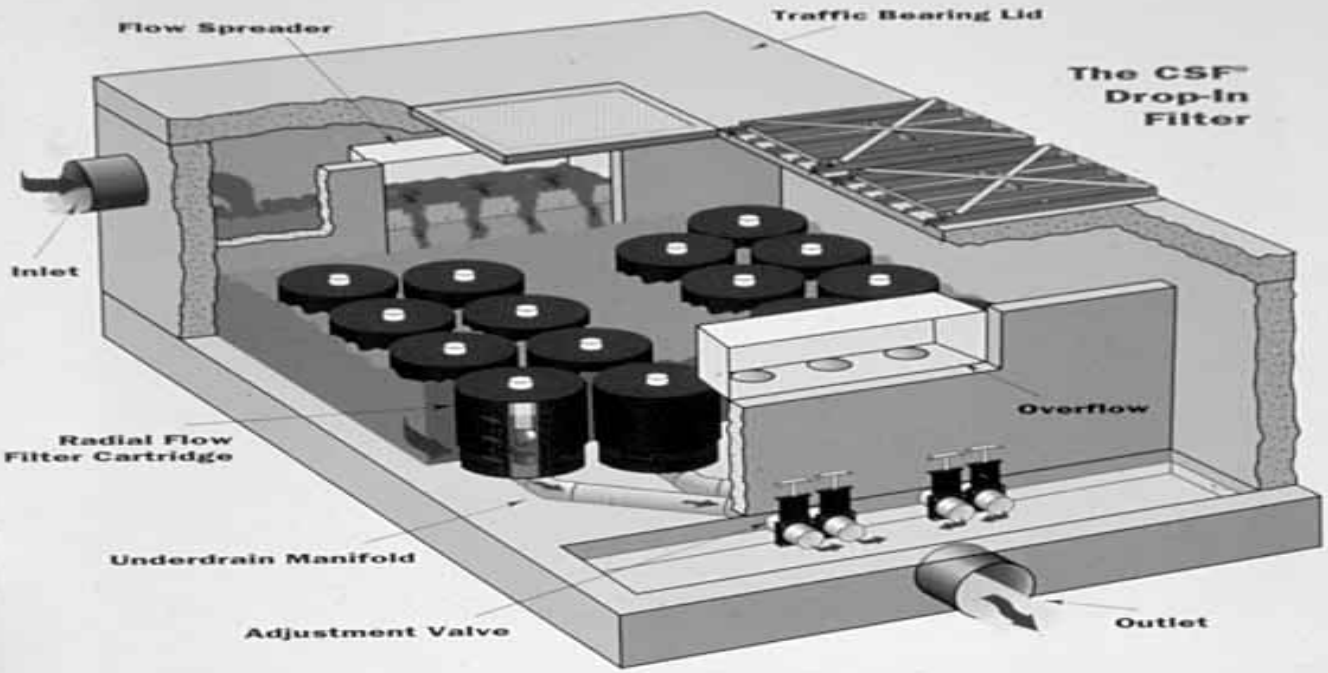
TSS Reduction with Different Street Sweepers (SIMPTM)



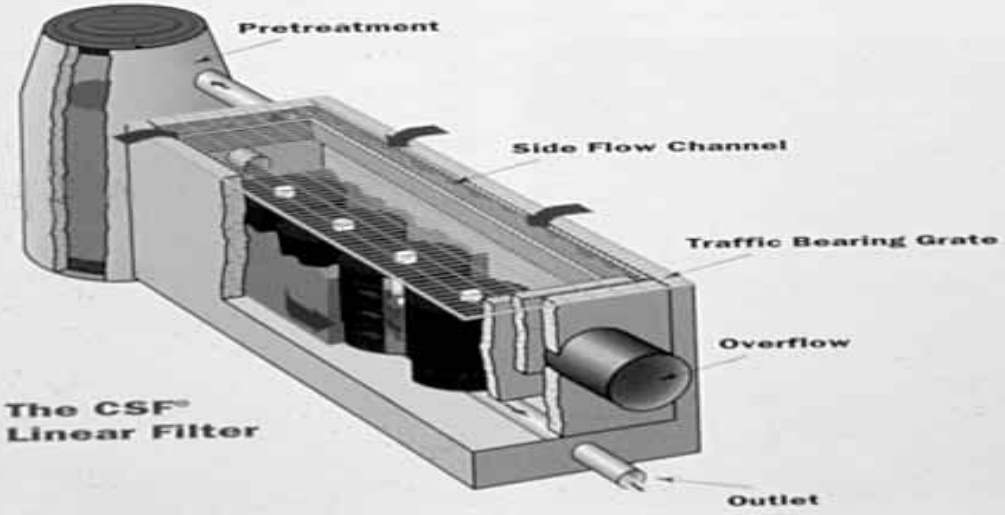

Filter Chamber
peat, sand, carbon
sand
stone

Removal Efficiencies of the MCTT





The CSF™ Drop-In Filter



The CSF™ Linear Filter


16ST-6

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