Low Impact Development

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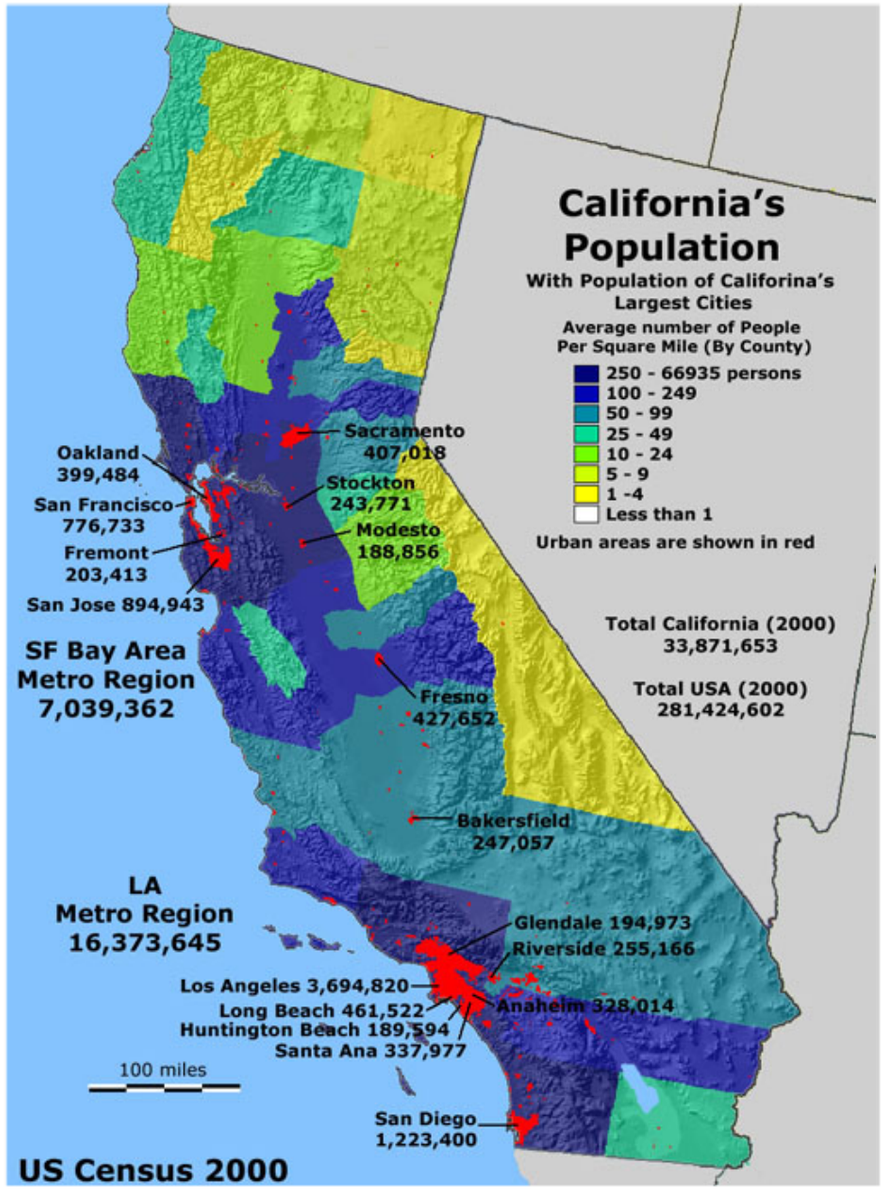
CENTER FOR WATER & LAND USE

UC DAVIS EXTENSION

PROFESSIONAL AND CONTINUING EDUCATION

California Growth

- By 2025 California will gain between 7 and 11 million new residents.
- California's population will continue to age: by 2030 the number of seniors will double and one in every six California's will be over 65.
- Most of the population increase will occur in inland counties, but 60% of the population will be in coastal areas.



Housing Needs

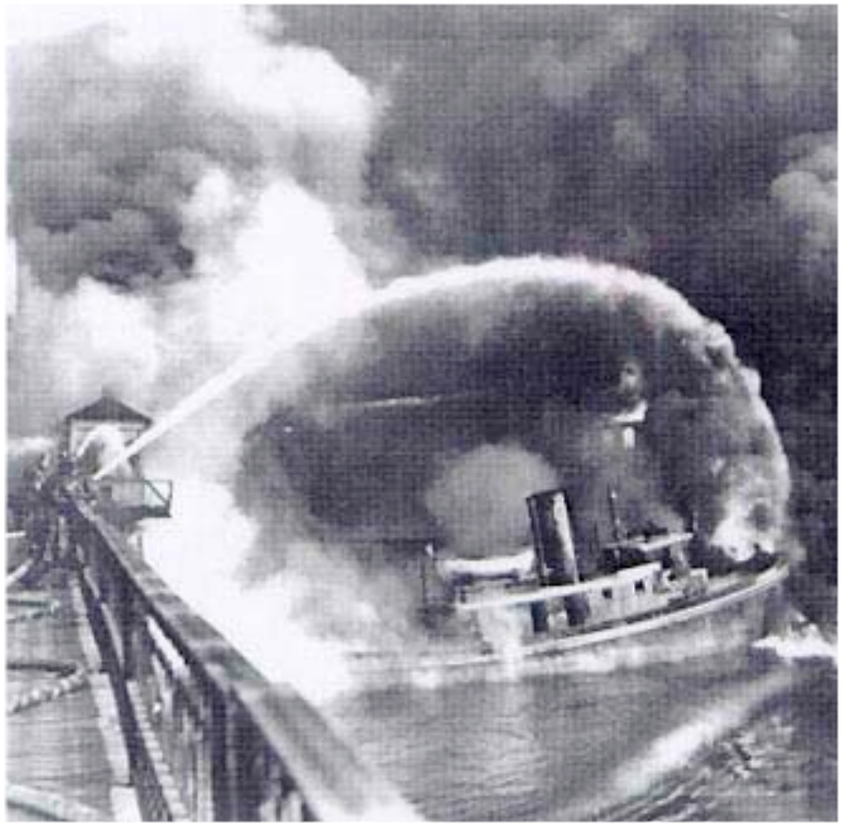
"More than half of the built environment of the United States will see in 2025 did not exist in 2000..."

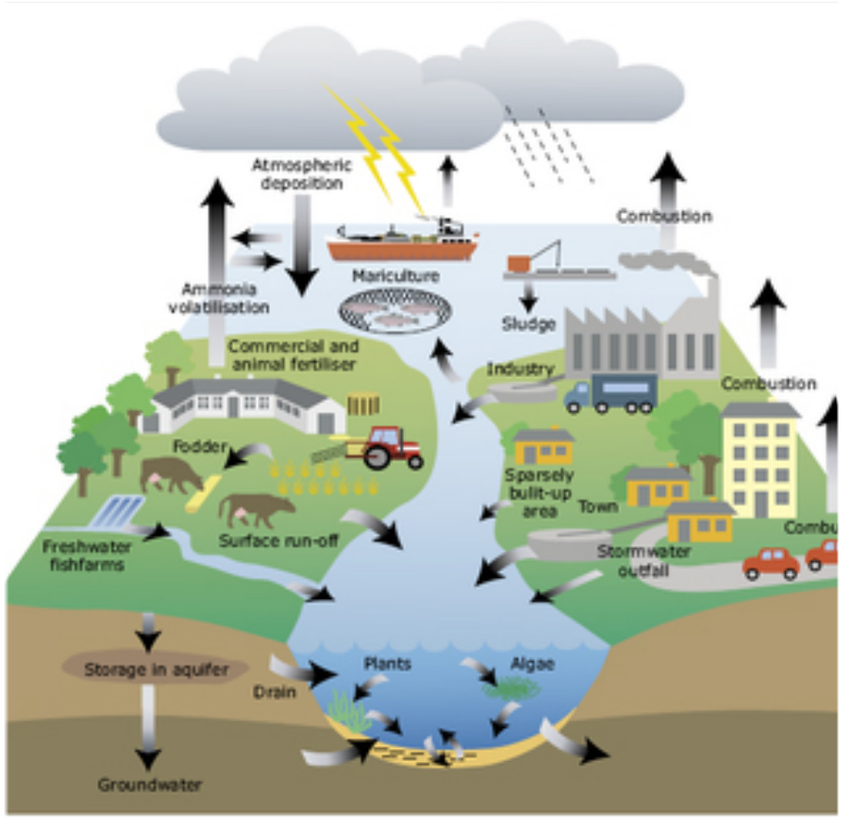
Arthur C. Nelson, Director of Urban Affairs and Planning at Virginia Tech's Alexandria Center

So What's The Problem

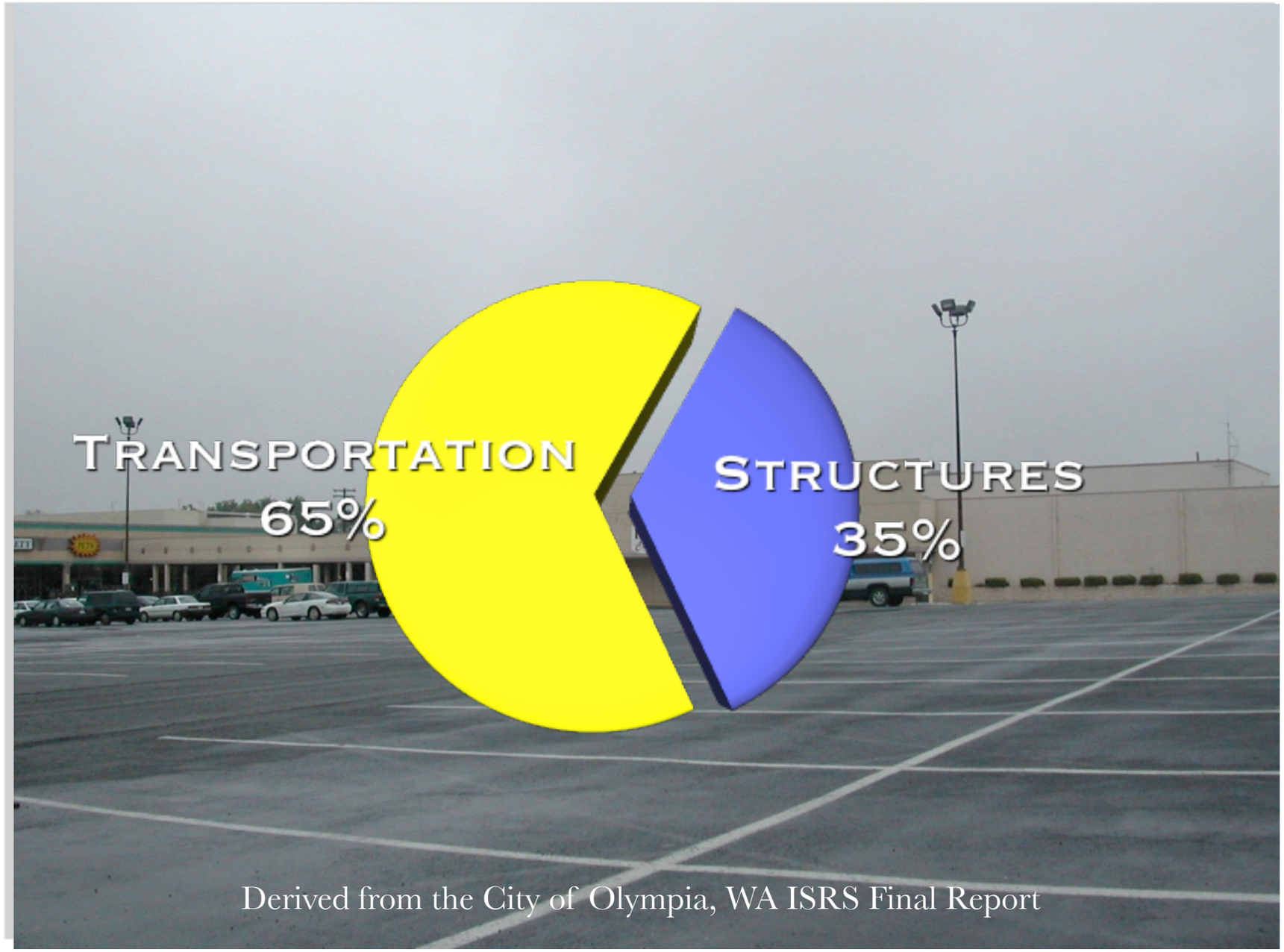
- Point Source Pollution
- Non-Point Source Pollution
  - Agricultural
  - Urban

- TMDL
- NPDES
- Anti-degradation
- California Construction Permit





- Rooftops
- Transportation Corridors
- Parking Lots
- Sidewalks
- Recreational Facilities
- Other Compacted areas

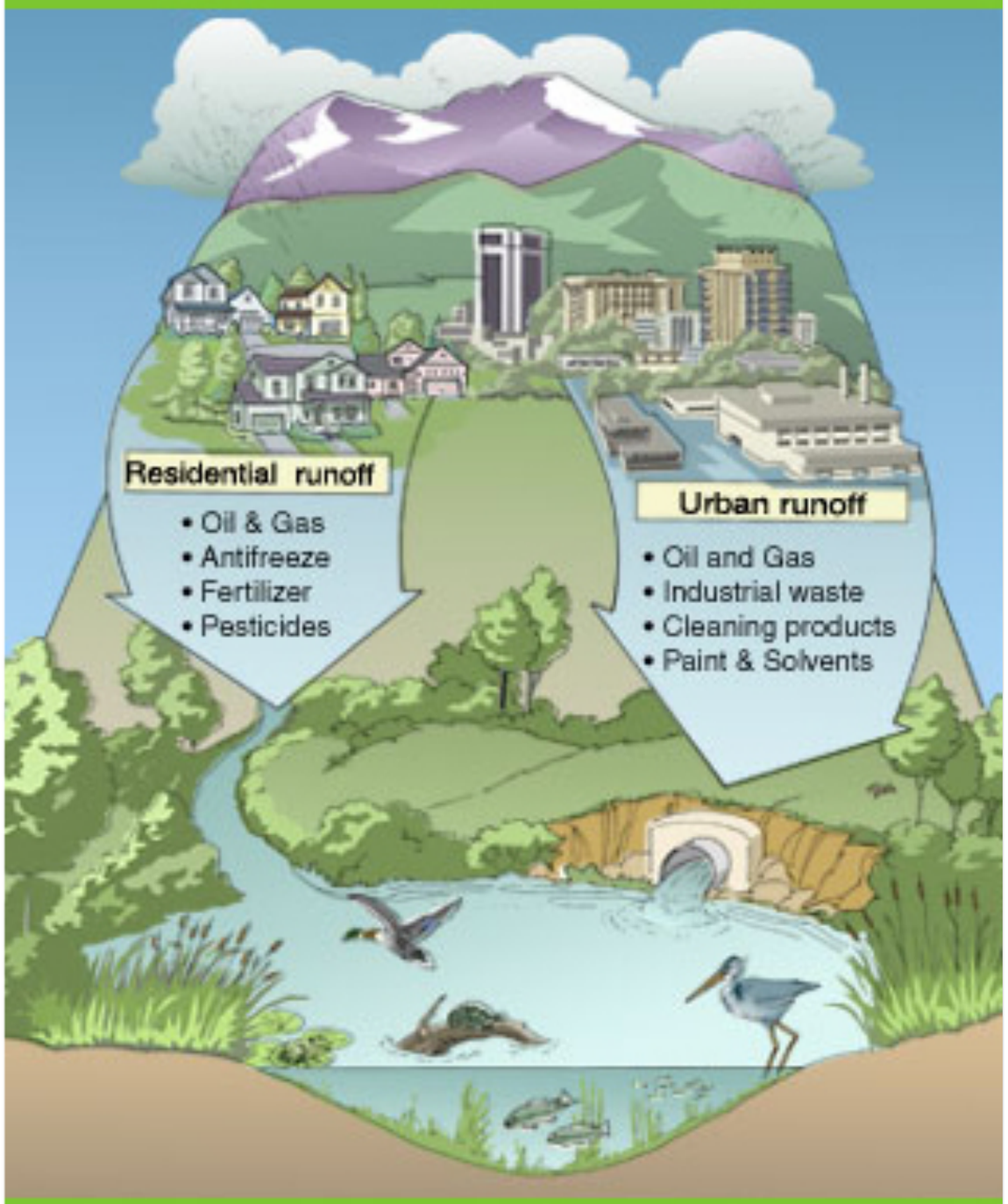


Commercial Development

Effective Impervious Area (EIA)

portion of Total Impervious Cover that is directly connected to the storm drain network

Bank Erosion

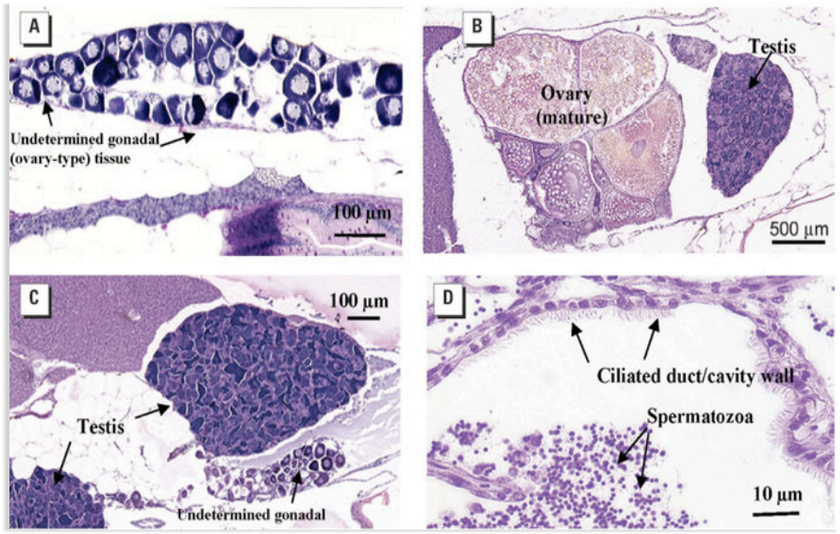


Urban Pollutants of Concern

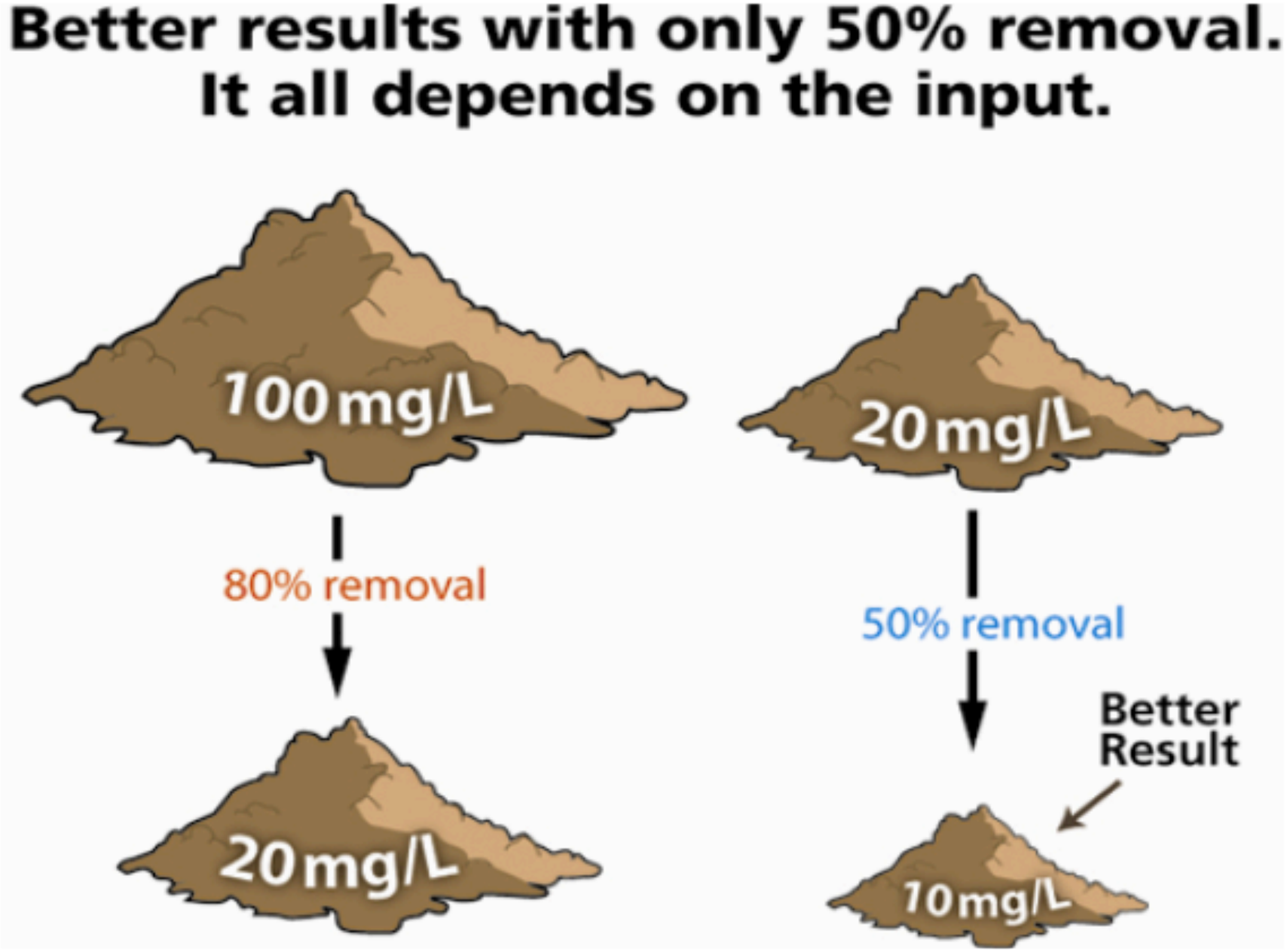
- Sediment
- Nutrients
- Pesticides
- pH (acidity)
- Pathogens
- Heavy Metals
- Temperature
- Litter and Debris
- Other Organics

Environmental Effects

May have more to do with sublethal and habitat than acute toxicity.



Of What?

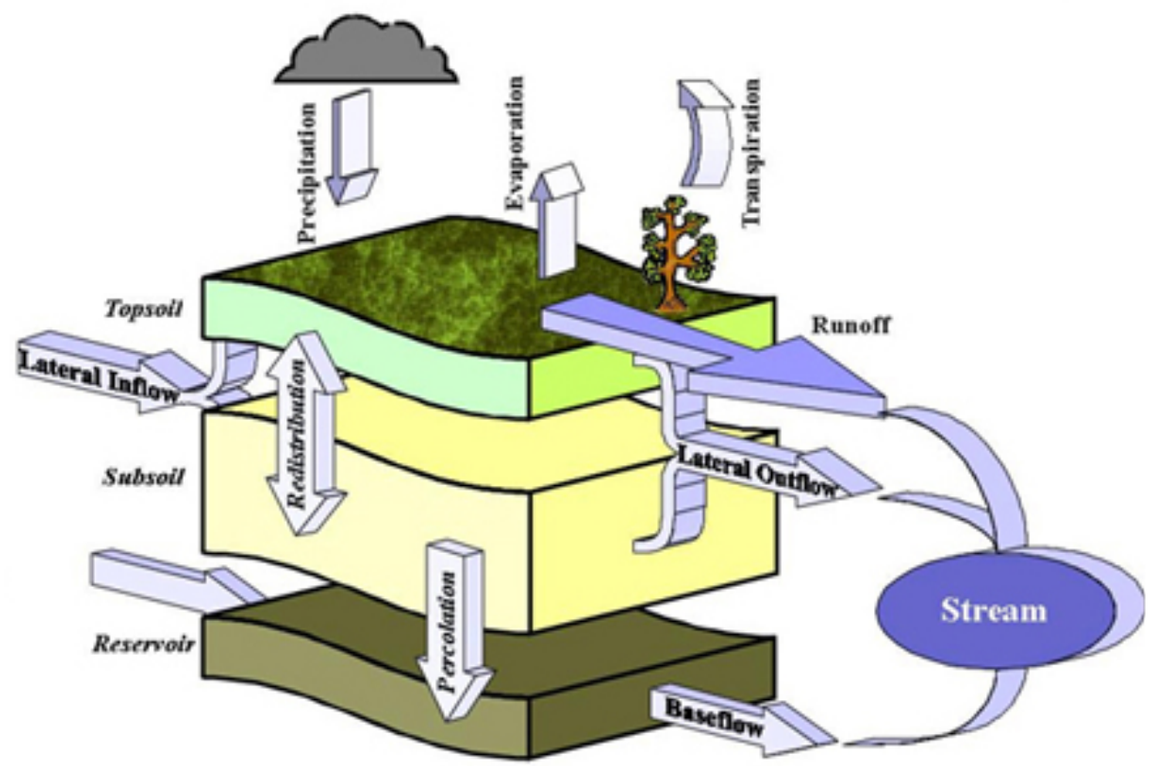


Percent Removal

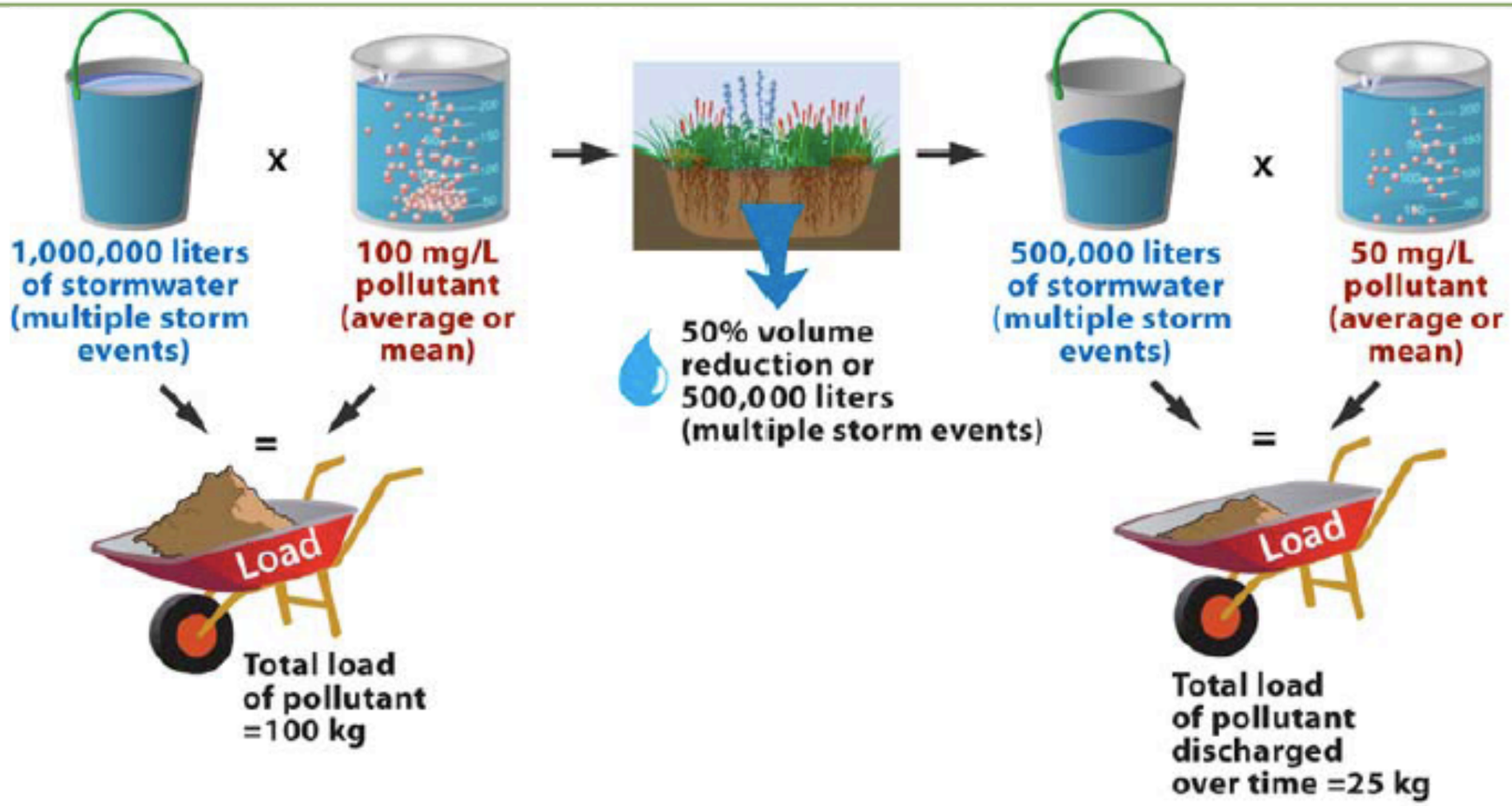
Challenge to Think, Design, & Build Differently

Maintaining the Water Balance

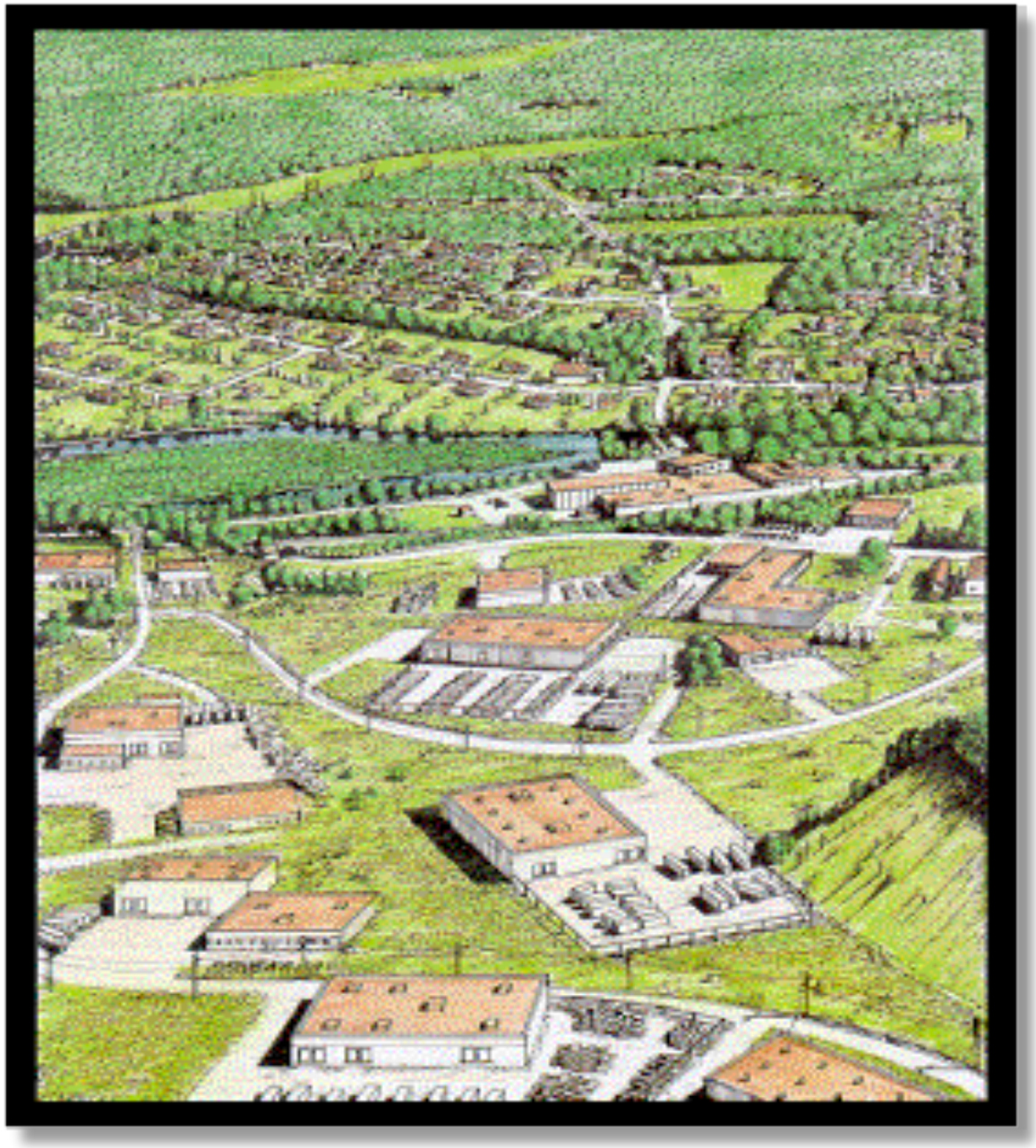
- Runoff reduction
  - Pre and post volume and rate of runoff need to be the same.
  - Preservation of drainage basin if over 50 acres).
  - Time of concentration needs to be equal or greater than before the project.



Impact of Volume Reduction on Total Load



In this example, the BMP removes 75 kg or 75% of the "total load" of this pollutant. The "true" performance of this BMP is only apparent when we factor in the impact of volume reduction and calculate the total load of the pollutant.



Conventional vs Cluster Development

One Solution

Low Impact Development

LID

Try It - You'll Like It!

Image of LID

Hidden Creek
Pleasant Hill, CA

What LID Can Be

The Face of LID

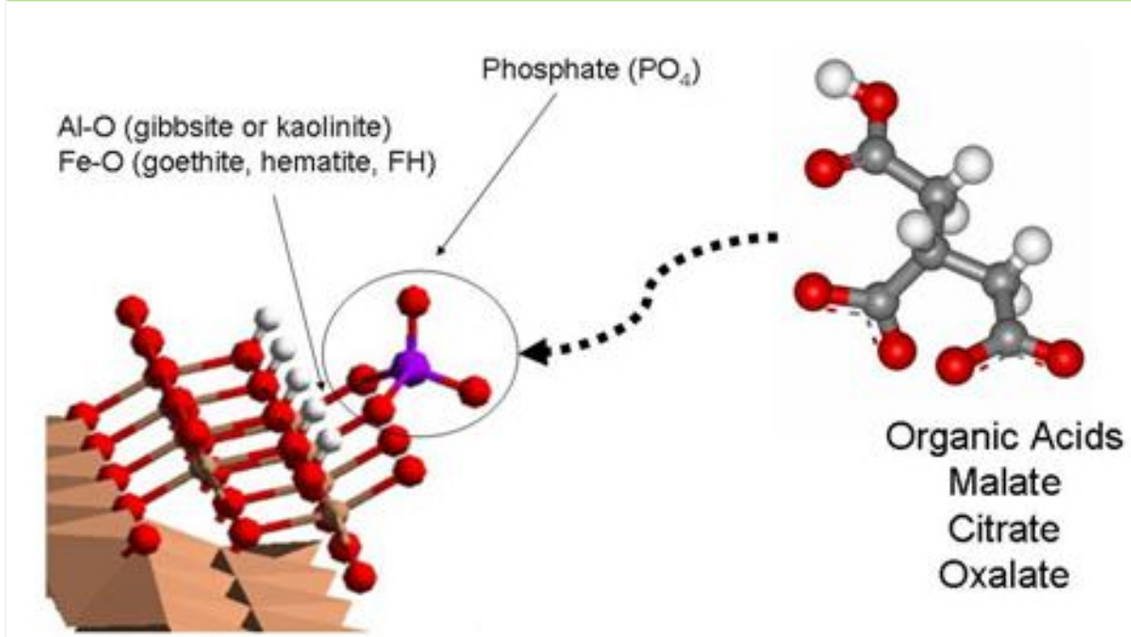
Factors Influencing BMP Performance

BMP Performance is not consistent and will vary base on the:

- Design
- Soil type
- Depth of soil
- Historical land uses
- Rainfall patterns
- Land uses in the drainage area
- Age of the system
- Upkeep and maintenance

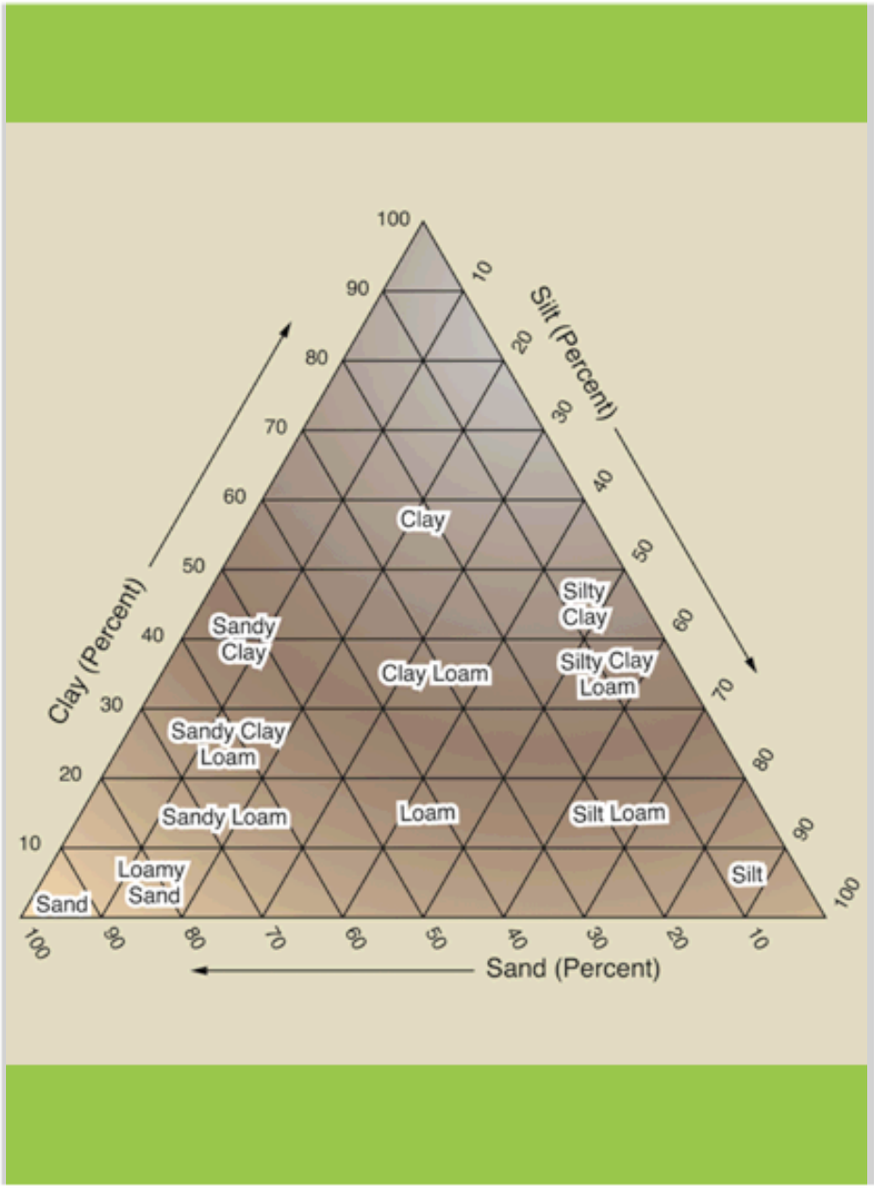
Finding a Balance

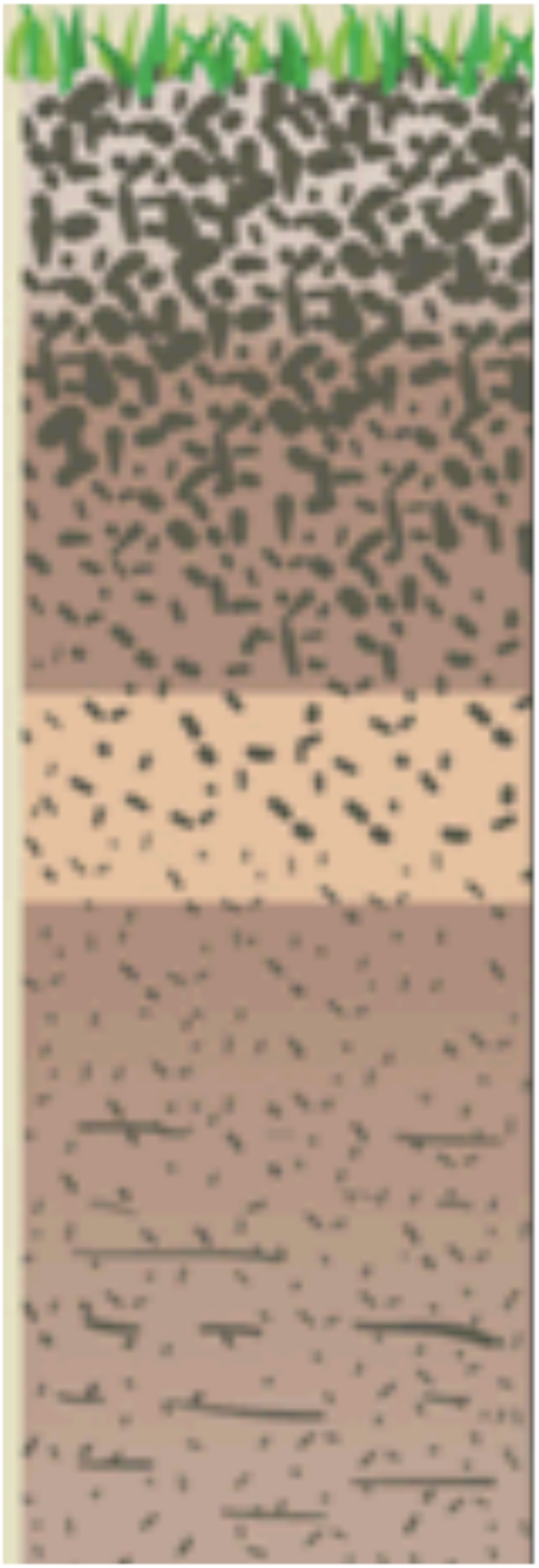
- Infiltrate urban runoff at an acceptable rate
- Allow sufficient residency time for sorption of constituent pollutants
- Design for the long term sustainability with a minimum of maintenance.



Clay Soils

- Low Impact Development can work on most types of soil.
- Low infiltration rates before - low infiltration rates after
- Need to provide reservoir to accommodate percolation rates.
- May need to provide an under-drain.
- Need a bypass system for high water events.





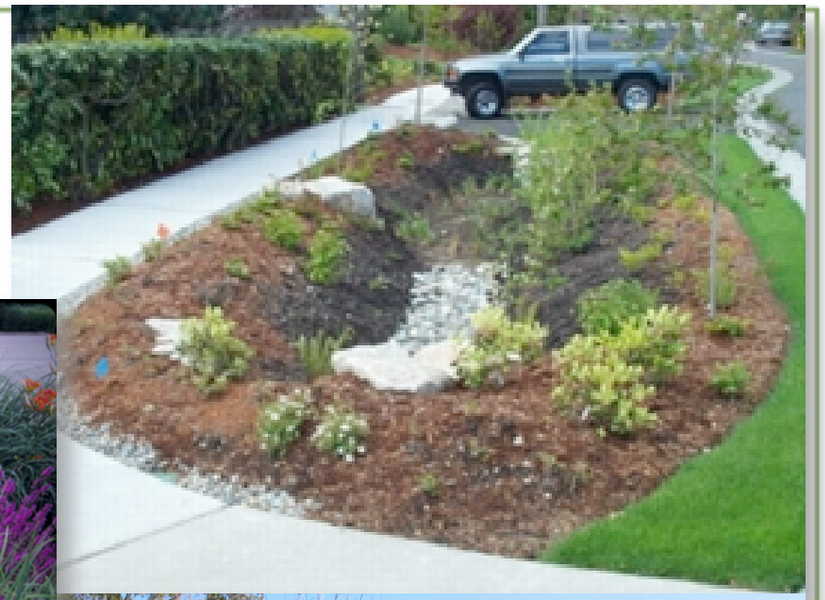
Soil Type	Infiltration Rates inches/hour	Infiltration Rates inches/day	Infiltration Rates meters/day
Sand	8.27	198.5	5.04
Loamy Sand	2.40	57.6	1.47
Sandy Loam	1.02	24.5	0.62
Loam	0.52	12.46	0.32
Silt Loam	0.27	6.5	0.17
Sandy Clay Loam	0.17	4.1	0.10
Silt	0.10	2.4	0.06
Clay Loam	0.09	2.2	<0.06
Silty Clay Loam	0.06	1.4	0.04
Sandy Clay	0.05	1.2	0.03
Silty Clay	0.04	1.0	0.02
Clay	0.02	0.5	0.01

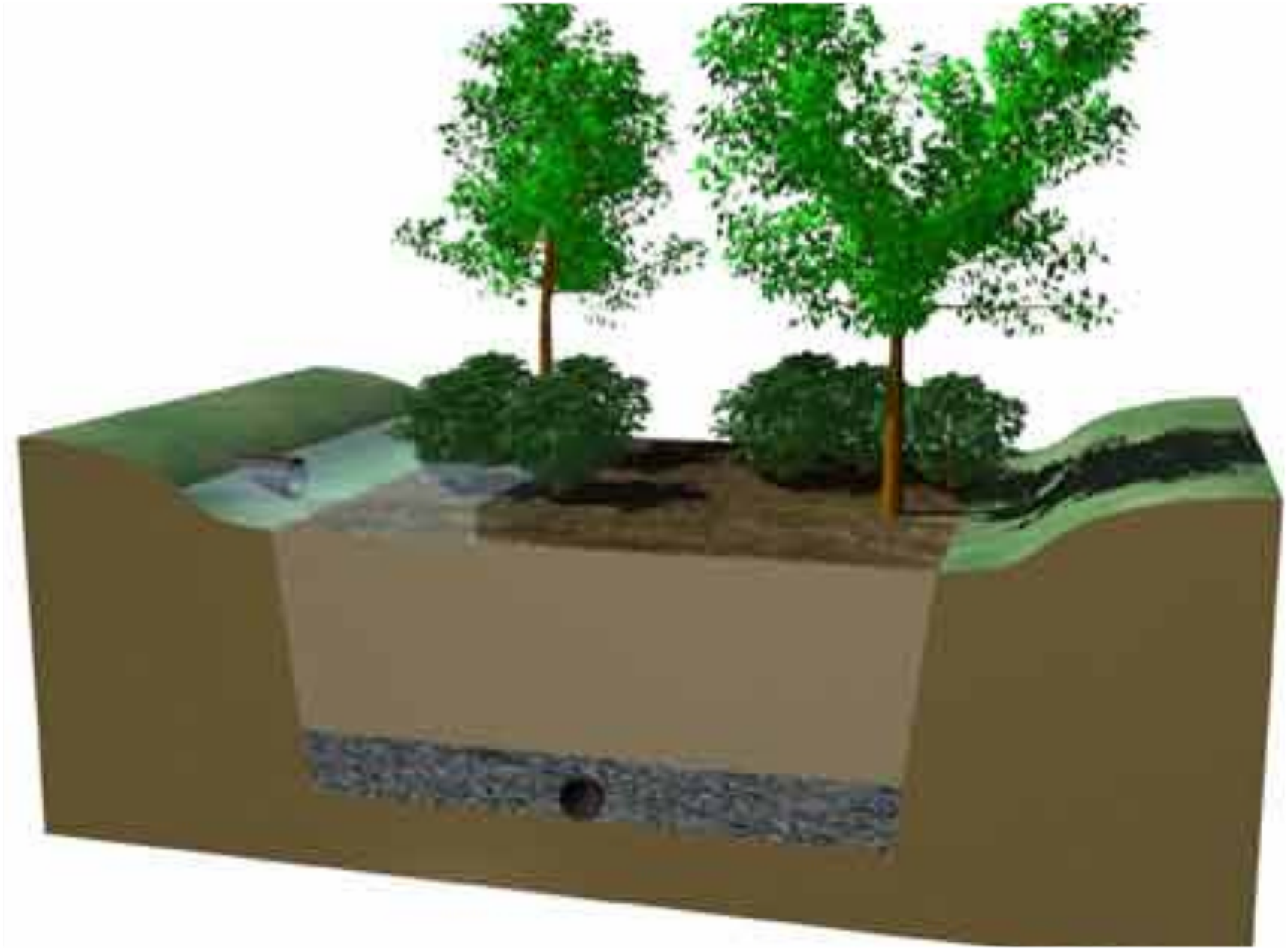
Infiltration Rates By Soil Type Under Saturated Soil Conditions

Target Pollutant	Minimum Fill Media Depth	Target Infiltration Rate	Other Design Guidance
TSS	No minimum fill depth required	Any rate is sufficient. 2 to 6 inches per hour recommended	If high TSS influent, frequent maintenance required.
Pathogens	No minimum fill depth required	Any rate is sufficient. 2 to 6 inches per hour recommended	Limiting plant coverage allows more direct sunlight to kill pathogens.
Metals	18 inches	Any rate is sufficient. 2 to 6 inches per hour recommended	Must keep top layer of cell from being saturated for extended periods.
Temperature	To be determined. Conservatively, at least 36 inches	To be determined. Slower rates may be preferable (less than 2 inches per hour)	Introduction of IWS volume at the bottom of the cell may reduce effluent temperature.
Total Nitrogen (TN)	At least 30 inches (36 inches preferred)	1-2 inches per hour. Slower rates are better.	Introduction of IWS volume may reduce TN concentrations.
Total Phosphorus (TP)	24 inches	2 inches per hour	A low P-Index is essential. Recommended range is from 10 to 30.

Infiltration Rates

Bioretention Areas





Bioretention Areas

Sand - 50-88%
.02-.04 grain size

Fines - 8-30%
Clay <5%

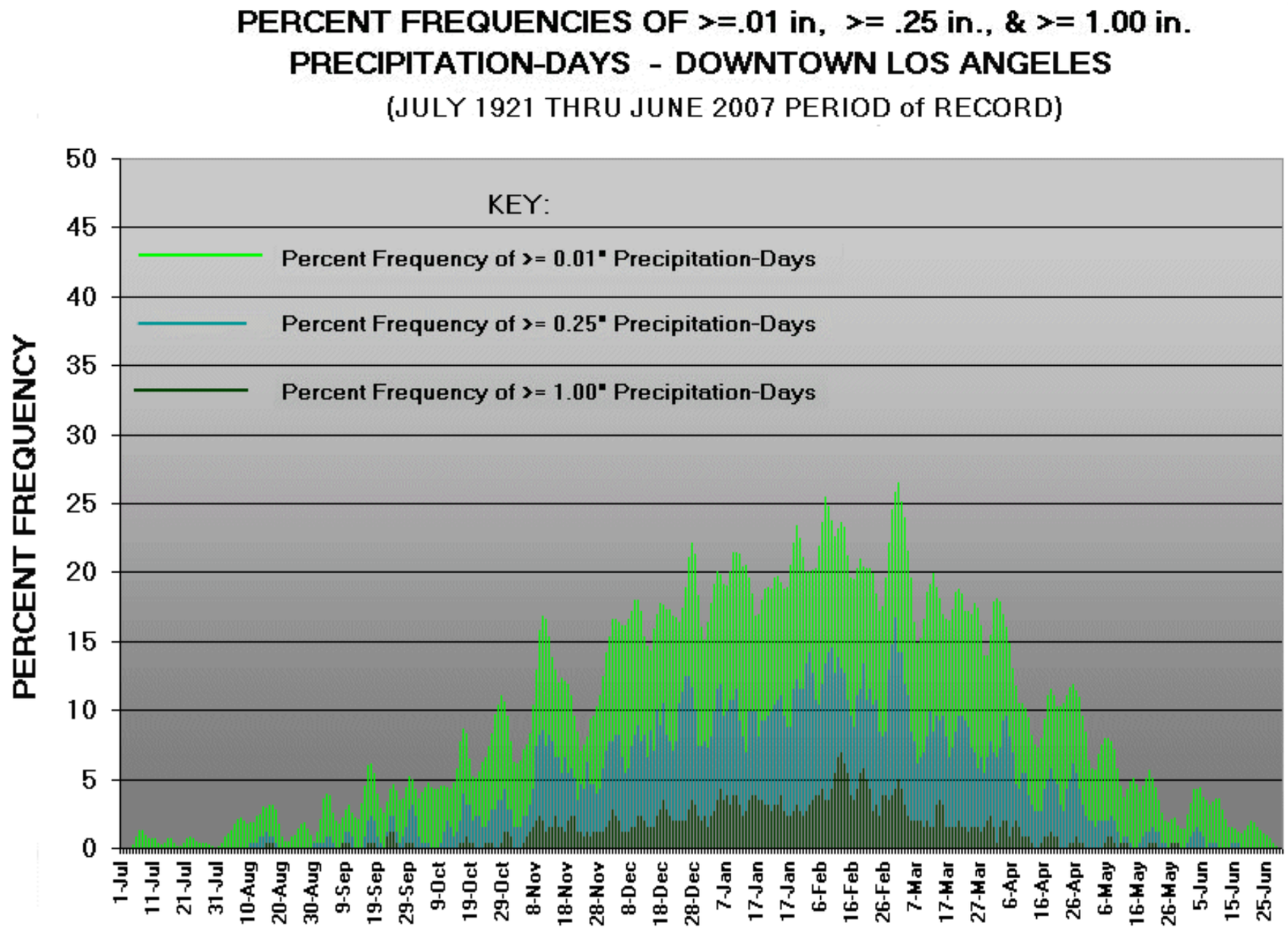
Organic - 8-30%

Designed for an Infiltration Rate of 1.5 in/hr or 36 in/day

Depth of at Least 24 inches

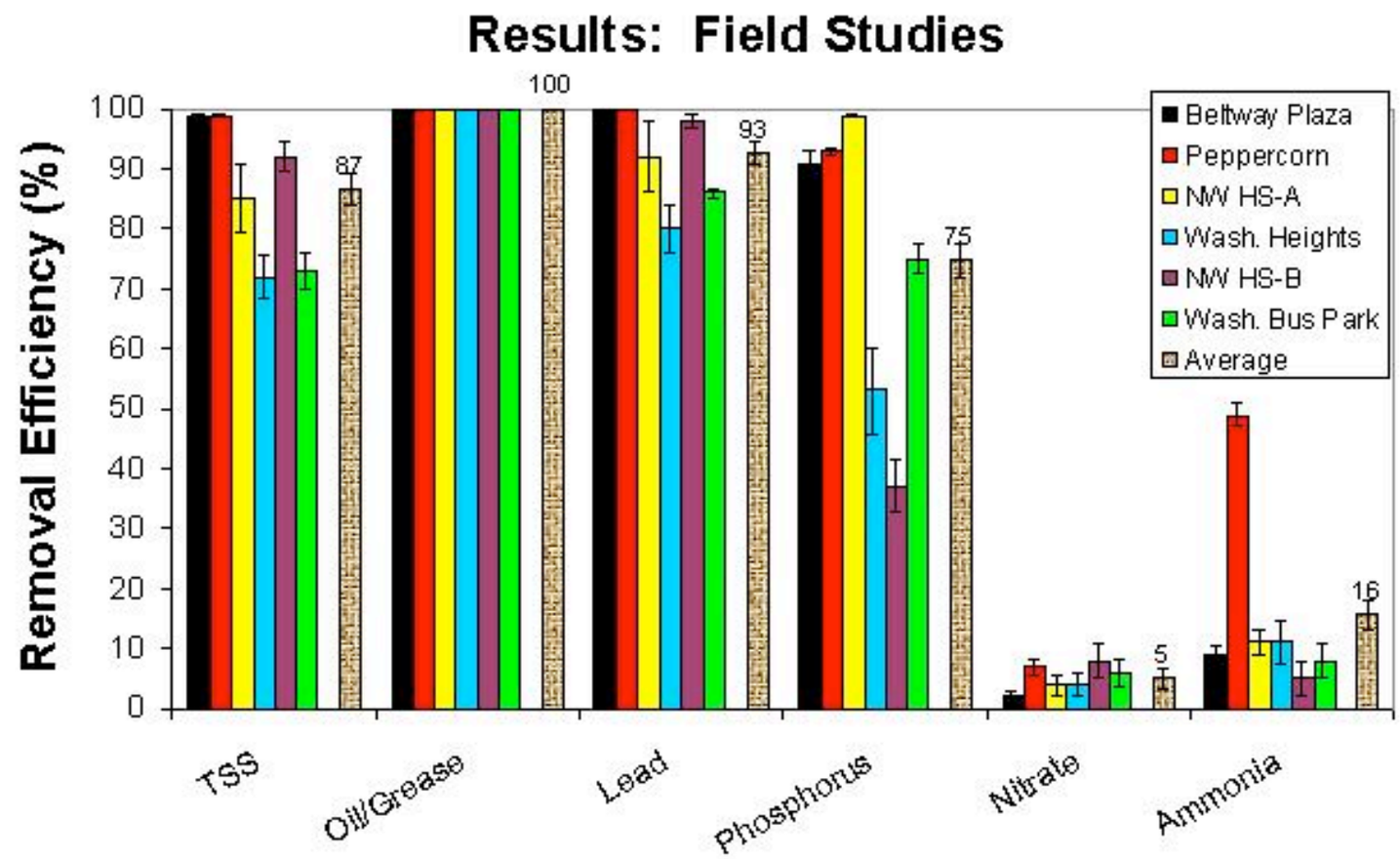
Microbial Inoculation

Engineered Soil



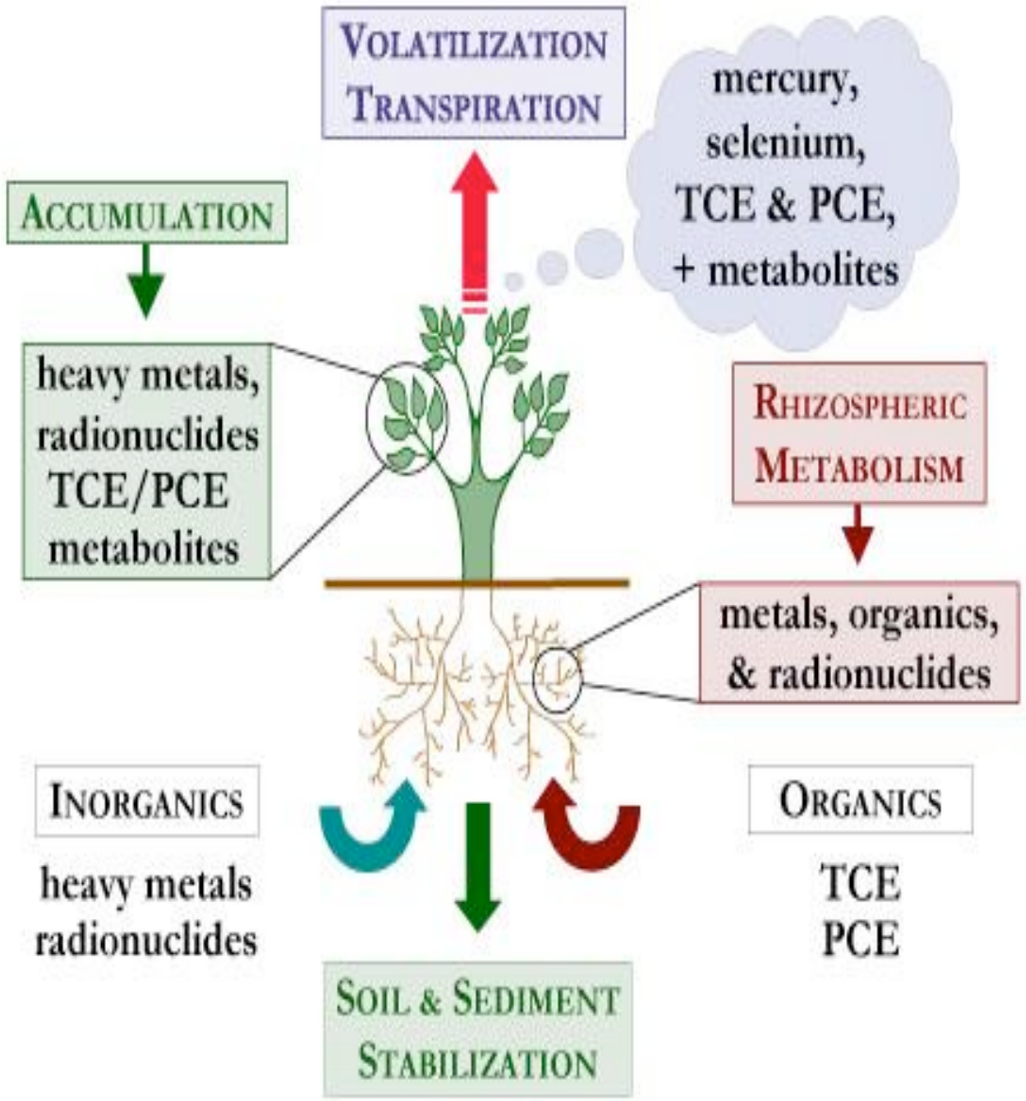
Rain Fall Events

Bioretention

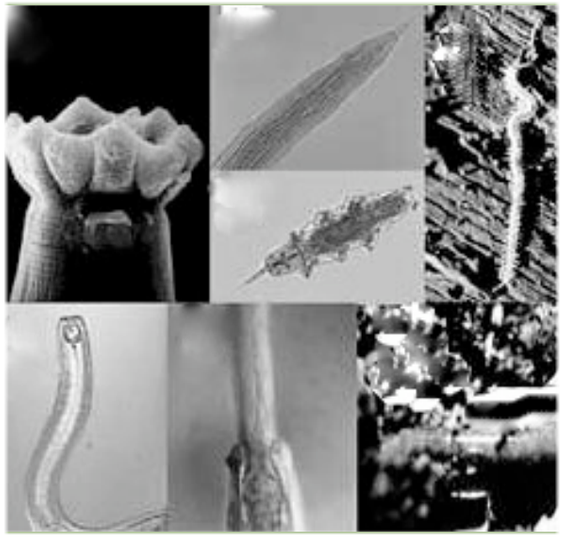


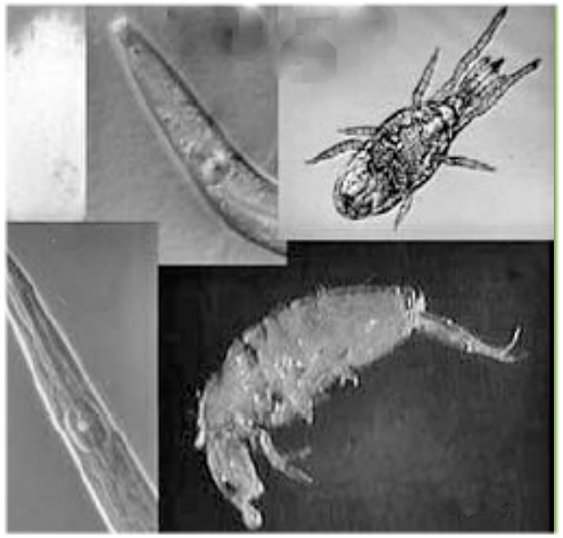
University Of Maryland

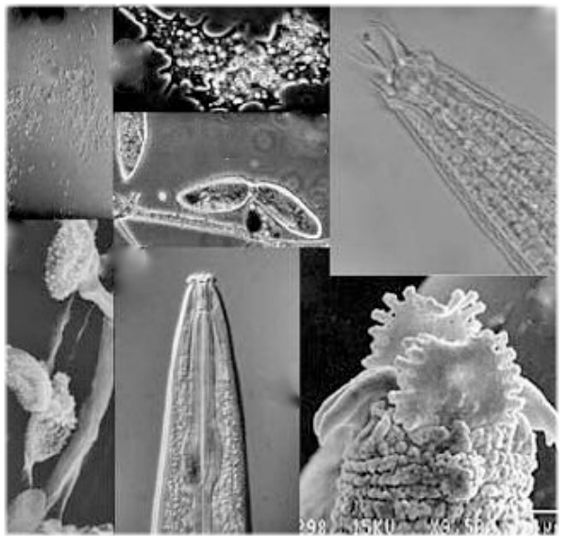
Pollutant Removal



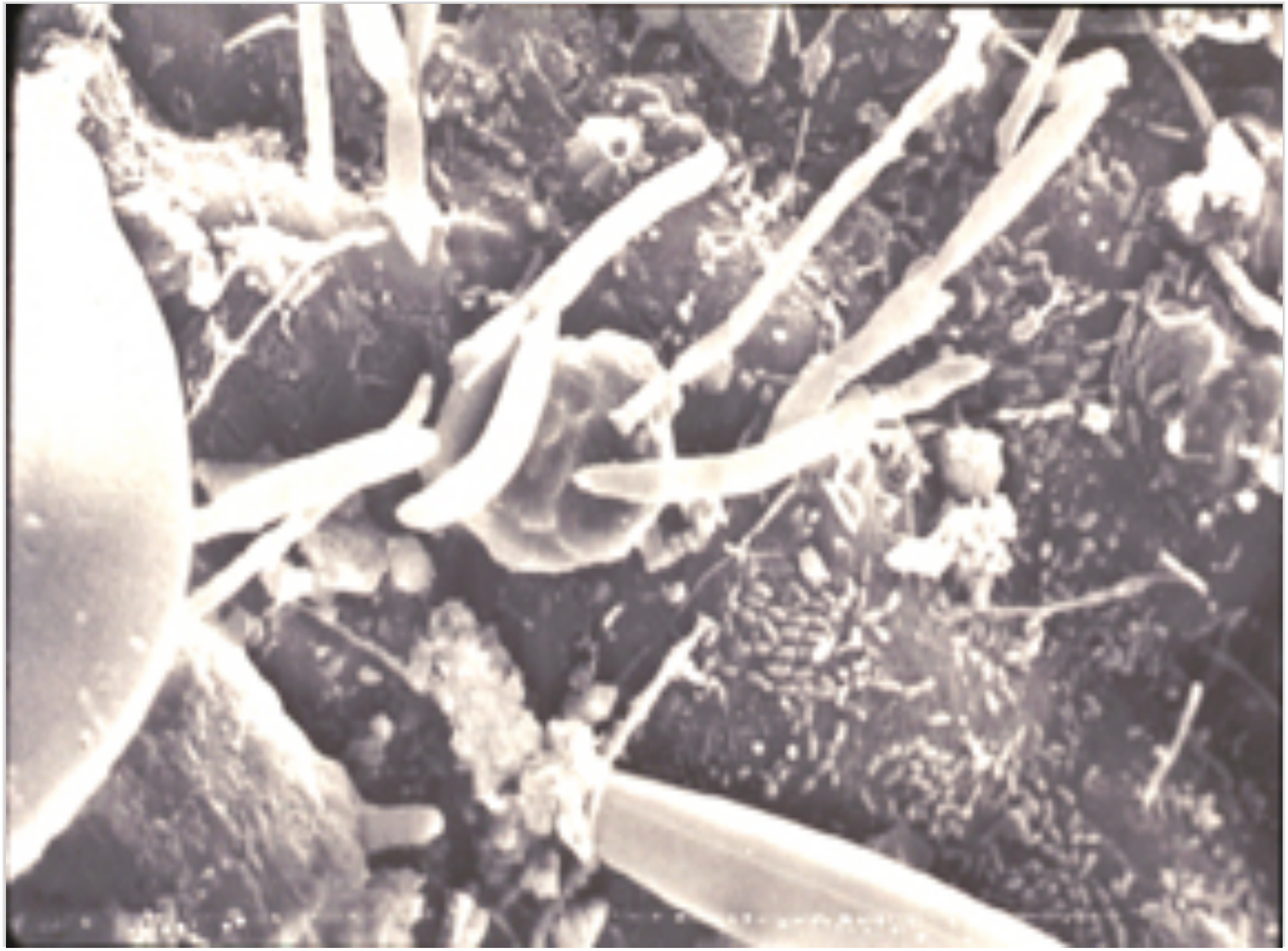
Phytoremediation







It's Alive!



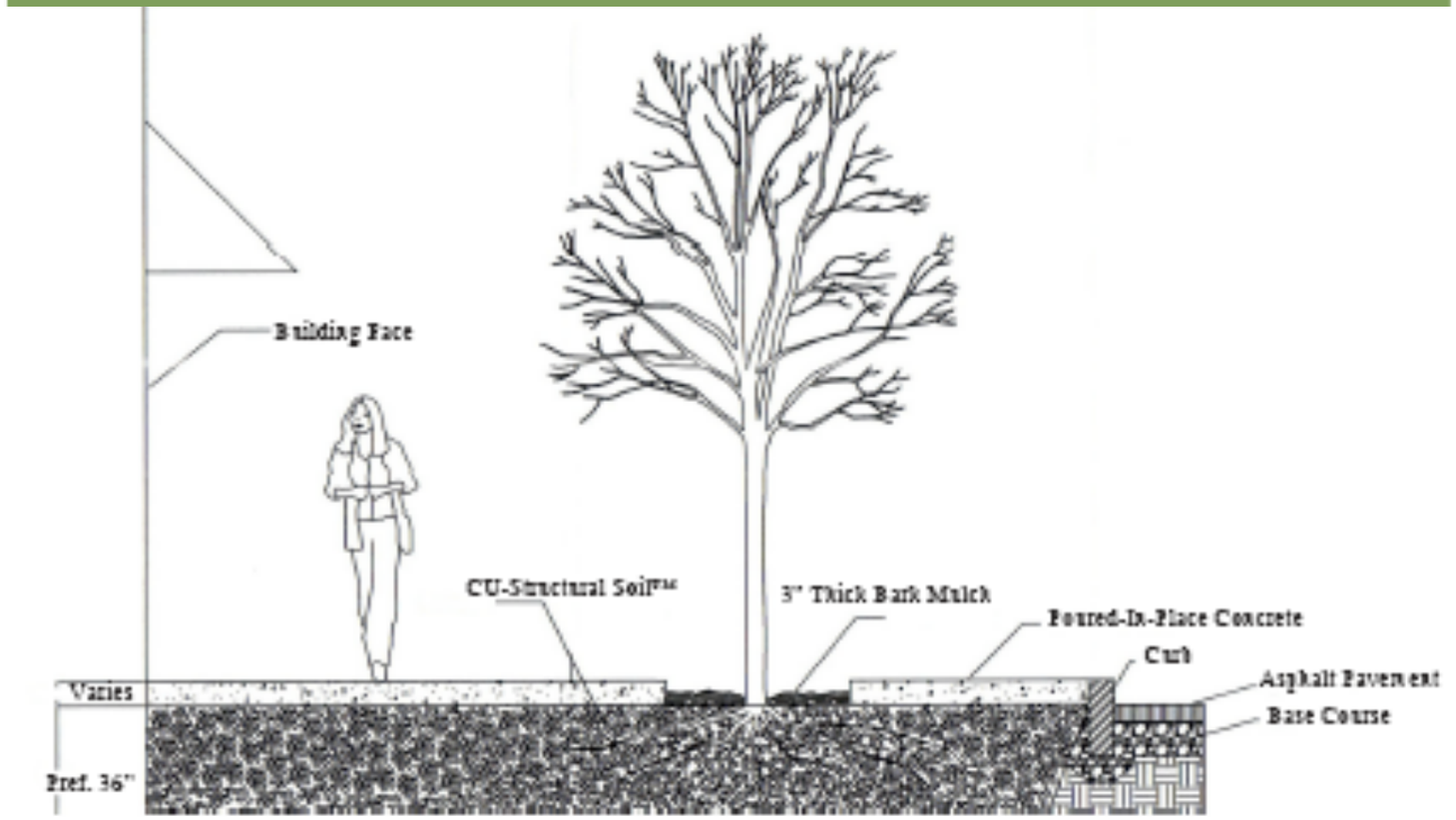
Degradation
Decomposition

Bioretention Areas

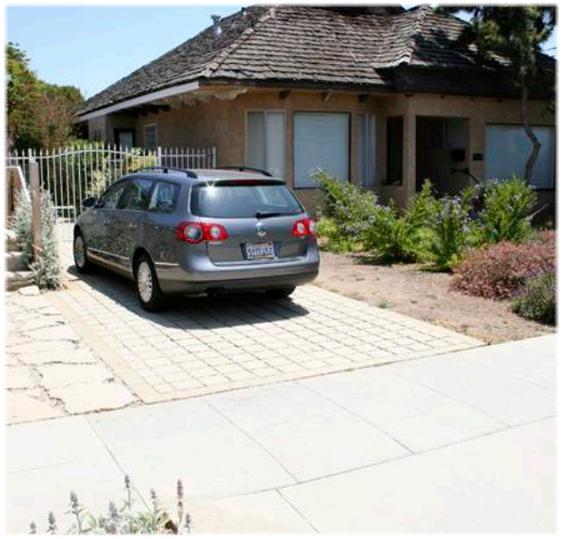
Street Trees

- Urban areas in 2003 had 21% less tree canopy than they did in 1993.
- Average life expectancy for urban trees is 7 years.
- Causes for tree death:
  - Poor Soil
  - Compaction
  - Inadequate drainage
  - Utility trenches
  - Tree Grates
  - Excessive paving

Structured Soils for Urban Trees

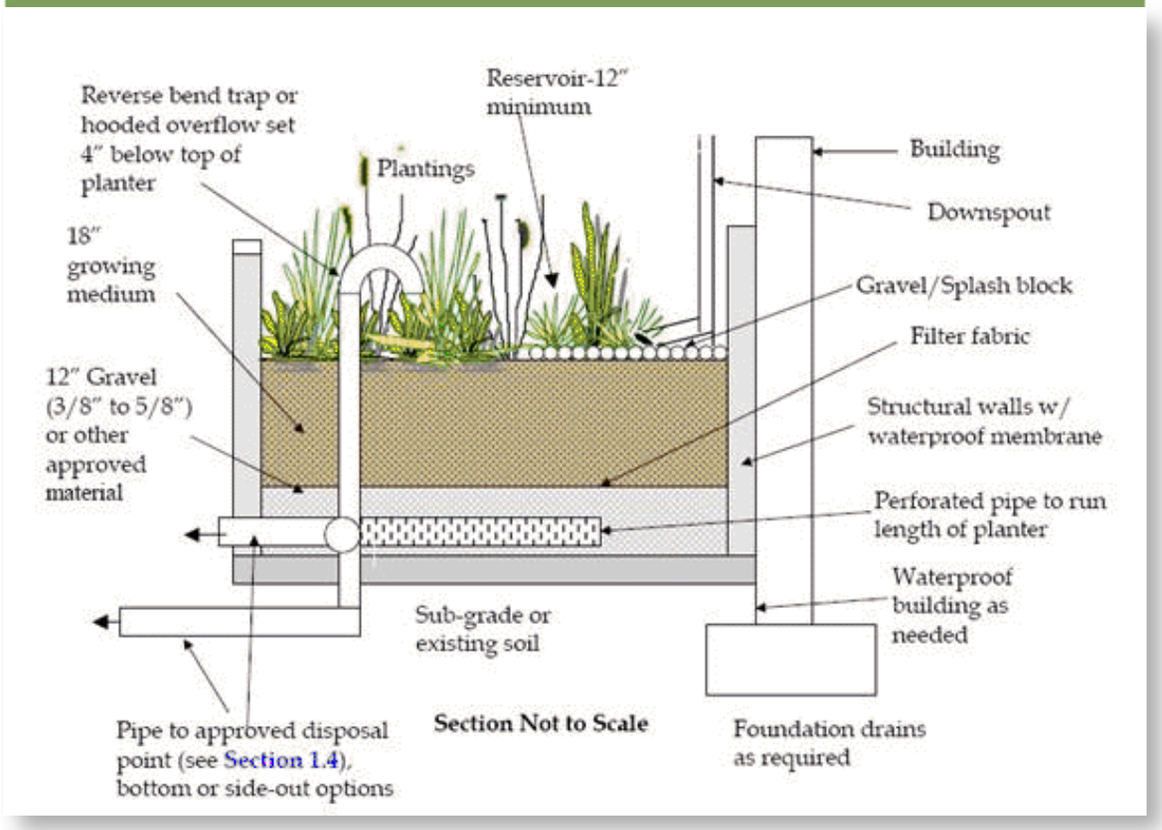


Site Design: Porous Surfaces

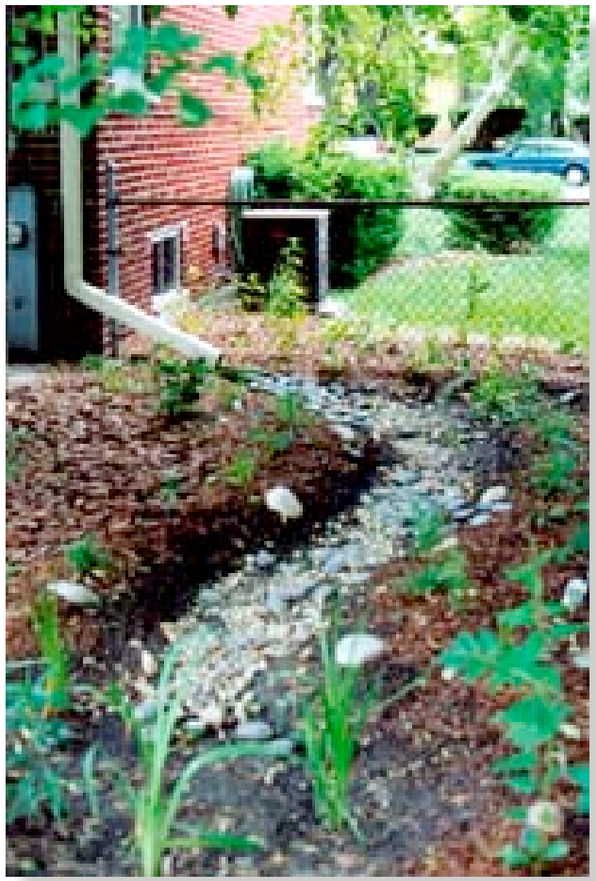


Site Design: Porous Pavers

Storm Water Planters



Rain Gardens



Reduced Runoff

Reduced Energy Cost

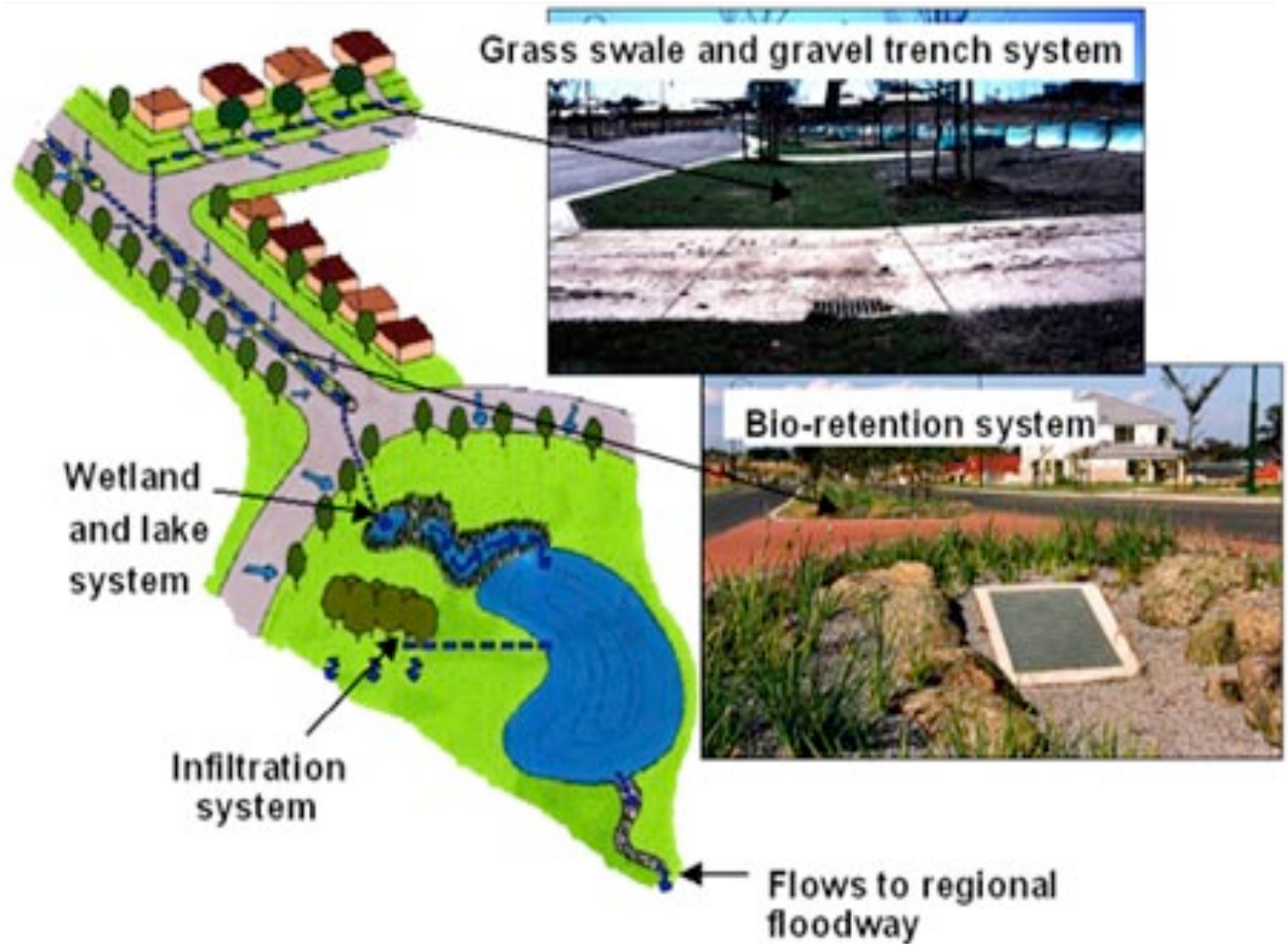
Reduced Renovation Cost

Reduced Noise

Extensive Green Roofs

Water Collection

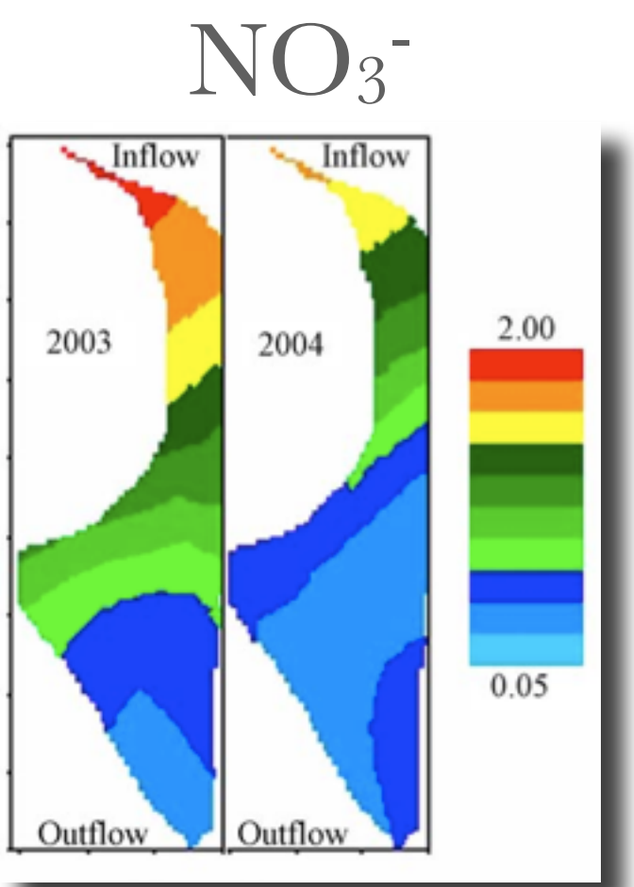
Santa Monica Library

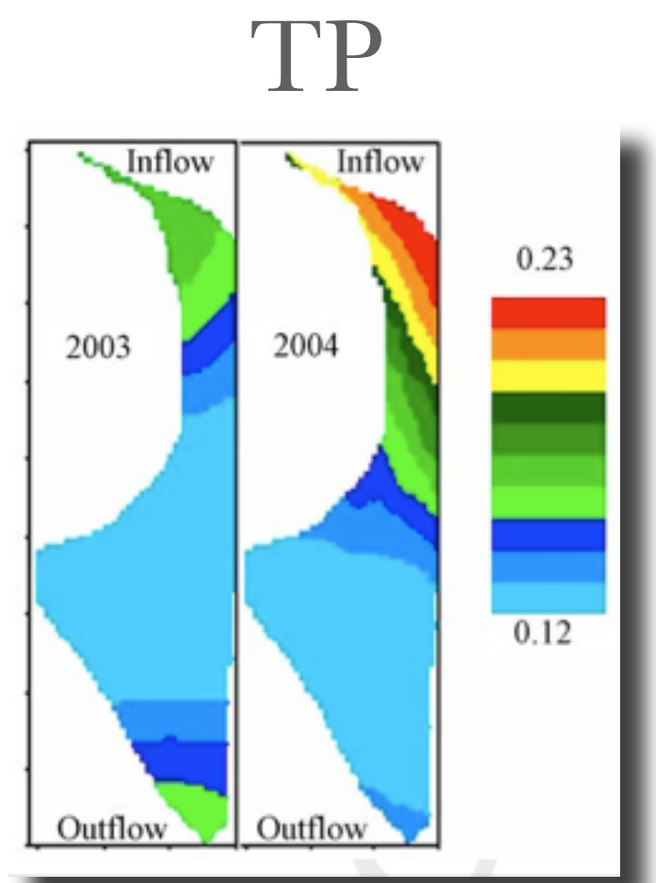


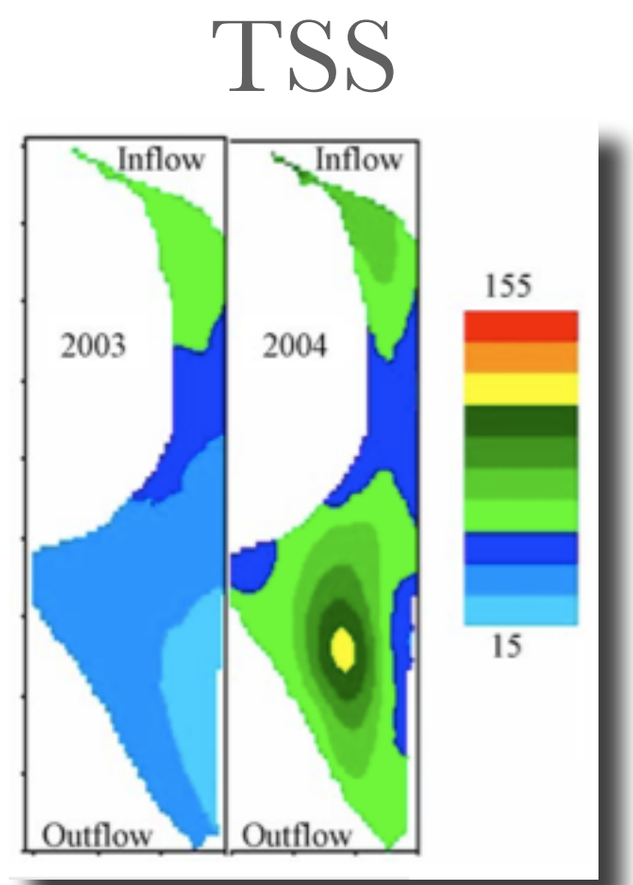
Regional Approach

Flood Plains and Wetlands

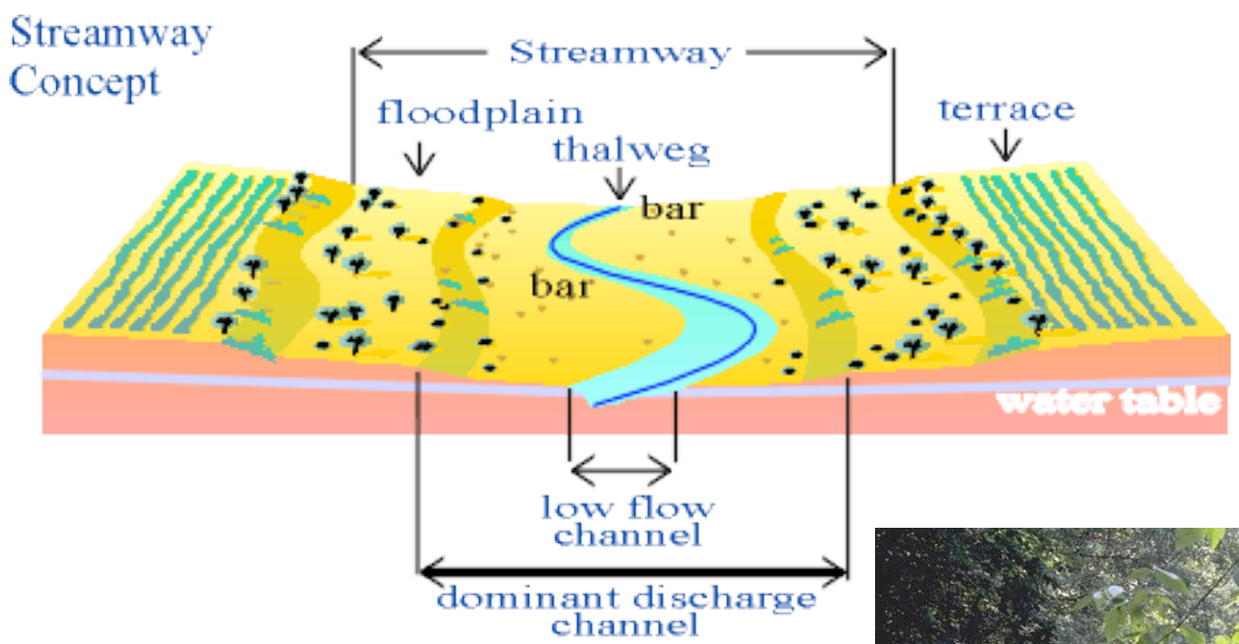
Nutrient Removal

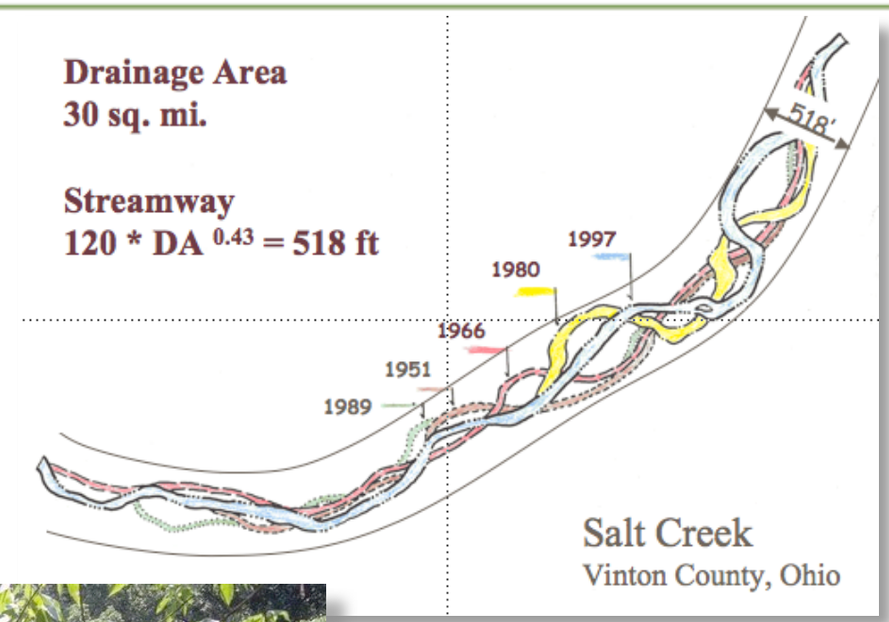






Using Natural Systems





Finding the Balance

- Protecting the Environment
- Using Natural Resources to Meet Water Quality Requirements
- Allowing for Growth and Development
- Ensuring Natural Resources for Future Generations
- Increasing the Current Value of Your Community

Thank

You!