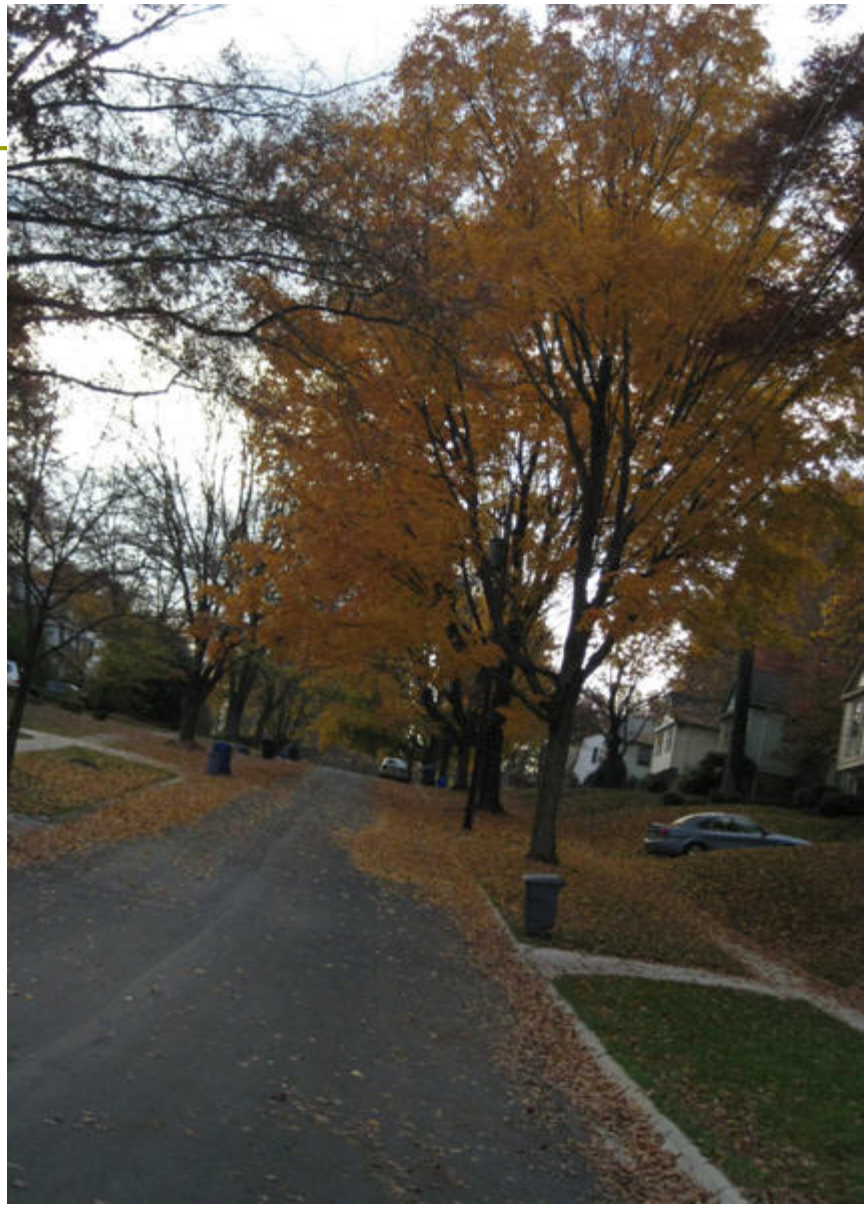
Bioretention and Permeable Pavement Maintenance

Fouad H. Jaber, PhD, PE
Associate Professor and Extension Specialist
Biological and Agricultural Engineering
Texas A&M AgriLife Extension
Dallas Research and Extension Center

TEXAS A&M AGRILIFE RESEARCH | EXTENSION

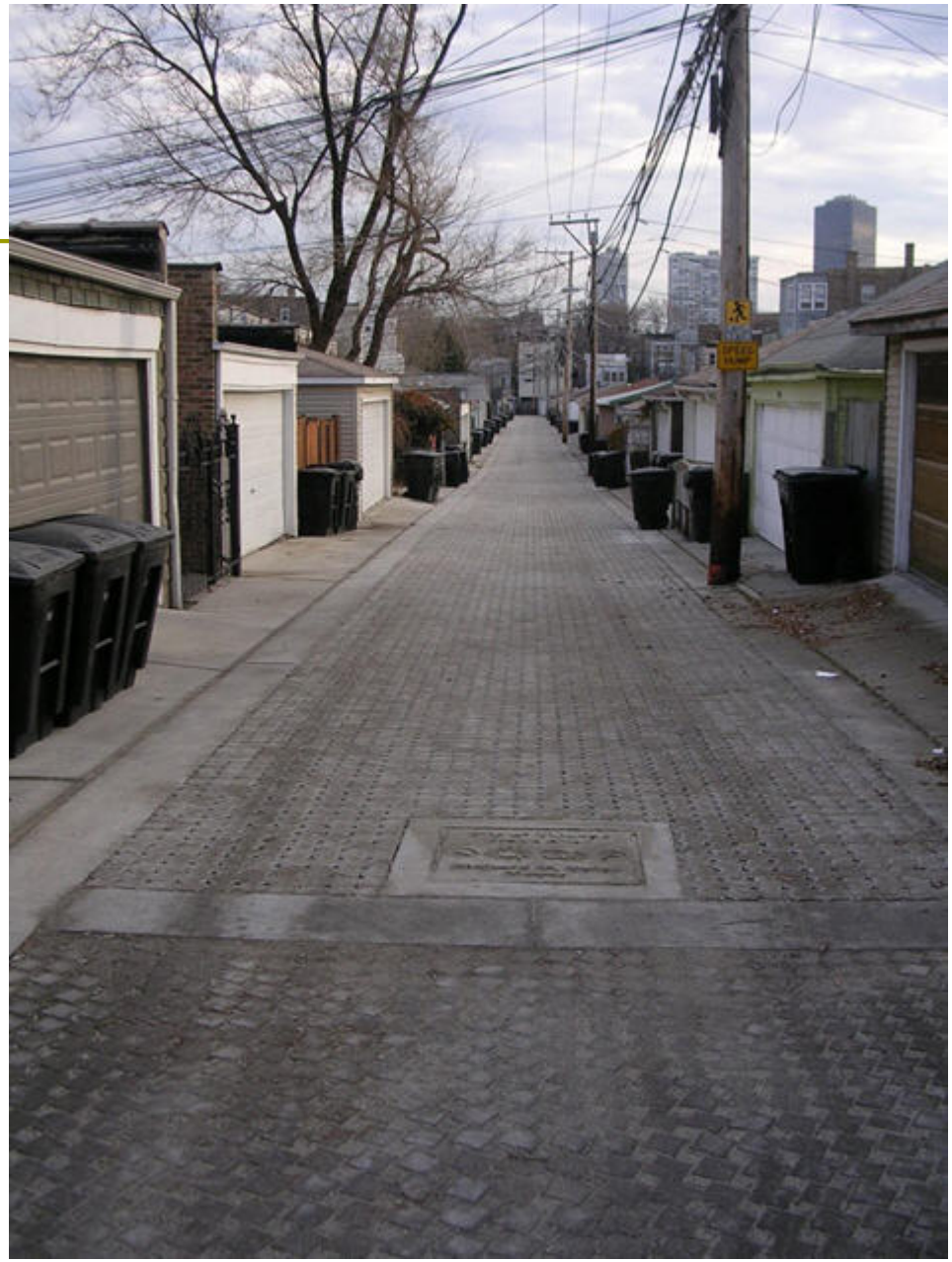
Biological & Agricultural Engineering
Plant a seed for your future at Texas A&M

- Trees are a form of LID.

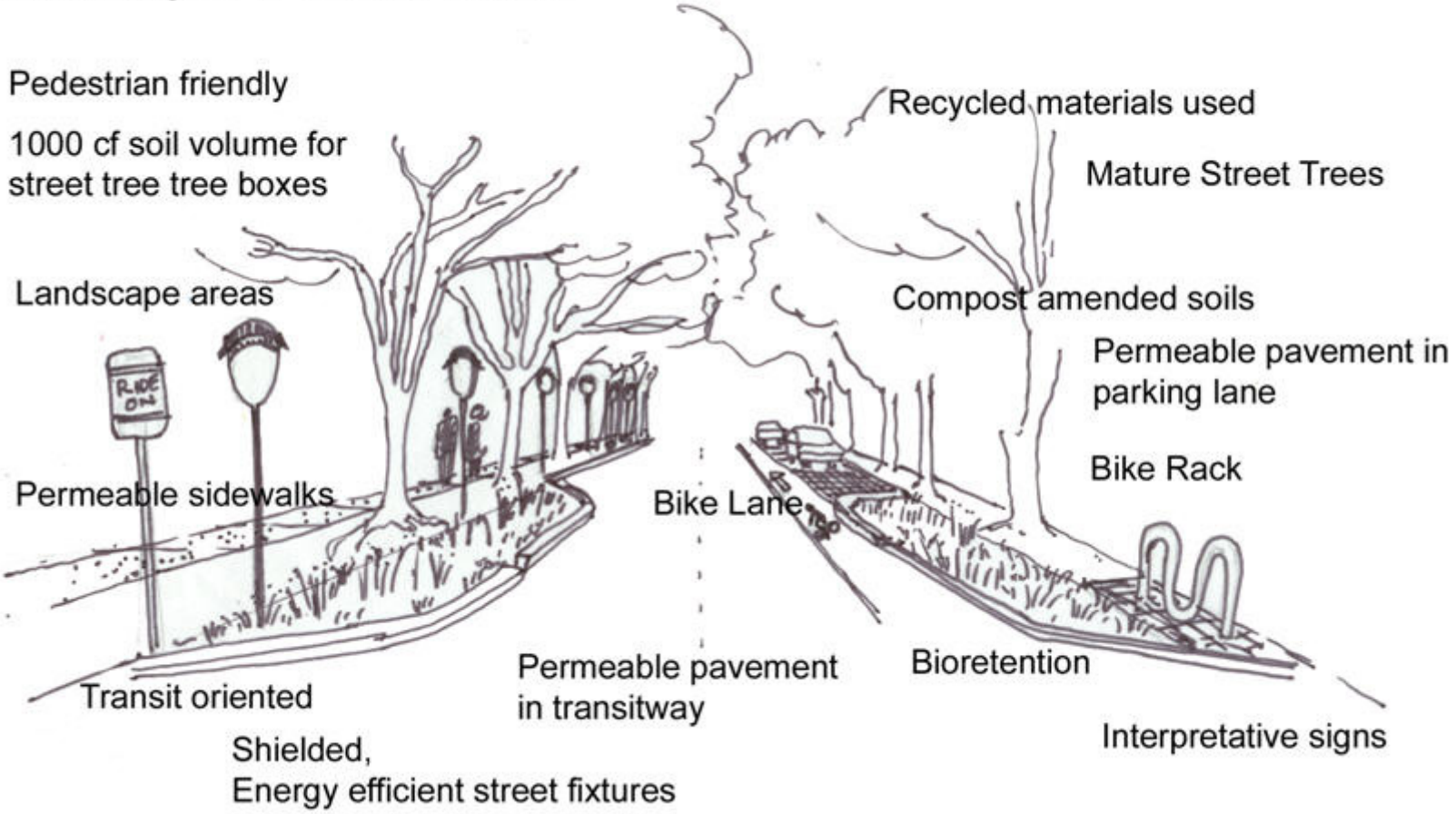



VOLVO

- Chicago Alleys Project



Anatomy of a Green Street



Prince George's County, MD

"We Bring Engineering to Life"

Bioretention is Low Maintenance…

…but not *NO* maintenance

Most common cause of bioretention failure….

I. Slow Distributed Inflow

Internal Erosion from poor water delivery

Curb cut

Rip rap

Gravel verges and grass filter strips = Treatment train

Bioretention Forebays

II. Clogging

Clogging Causes

- Berm erosion into mulch and media
- Unstable catchment
- Unmaintained forebay
- Media mix is wrong!

Asphalt Generates Sediment

Clogging

- Media chosen for **specific porosity**
- Fines occupy pore space in media
- Reduces infiltration rate significantly (**goal = 1 in/hr rainfall event**)
- Useful lifespan of bioretention found to be limited by clogging (Li and Davis, 2008)

Key Maintenance Test

- Visit site within 24 hours of 1 inch rain event (avg 11-12 /yr)
- If water is still ponded site has clogged
- Action needed
- Do this once or twice per year

Unclogging

- Excavate top 5-20 cm
- Replace with clean media
- May need deeper if severe failure occurs
- Can be expensive $$$

Remove mulch, move plants, dig out clogged soil

III. Trash Removal

- Unsightly, poor aesthetics
- Safe harbor for mosquitos
- Can clog drawdown
- Takes up volume in foreba

Fort Bragg, NC

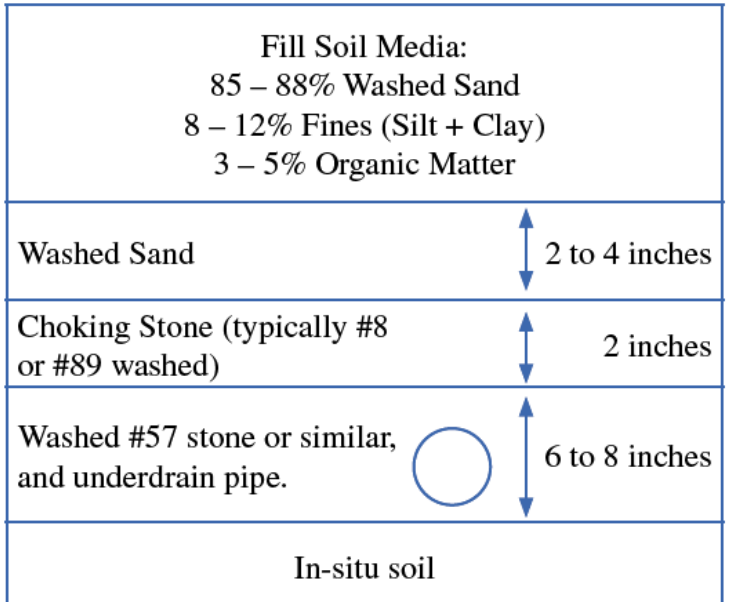
IV. Overflow Structure Maintenance

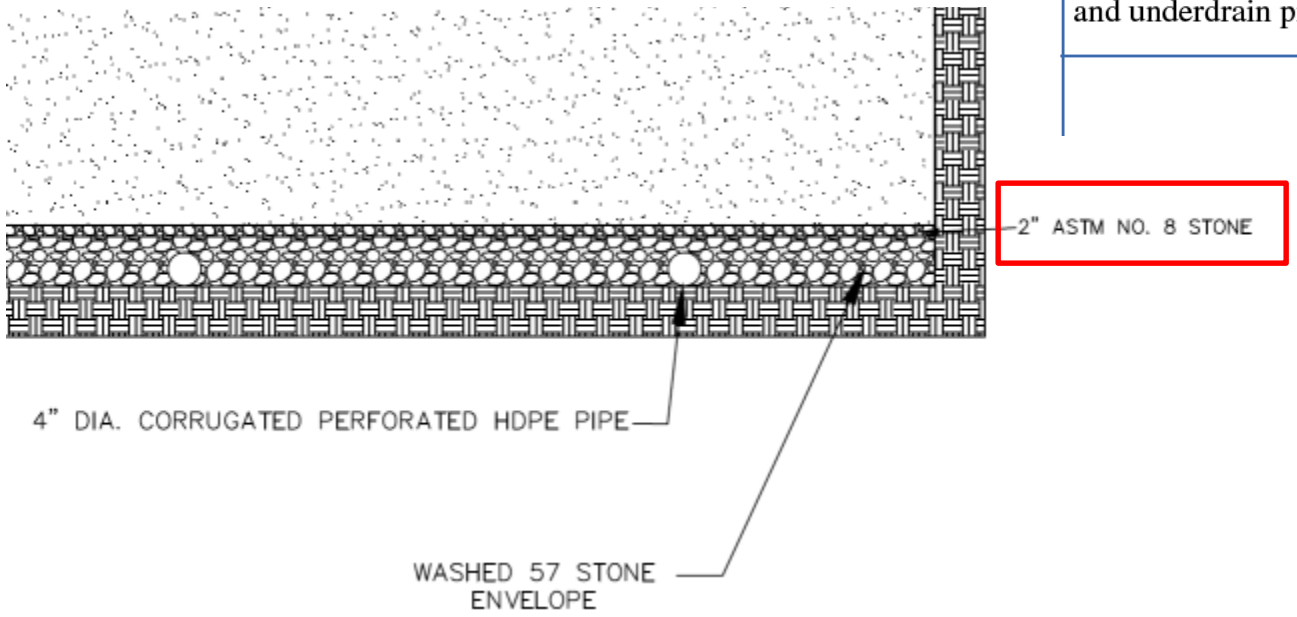
- Urban areas, overflow structure *can* be matter of **public safety**
- Certain outlets more apt to clog than others
- Private firms specialize in outlet maintenance on SCMs

Clogged outlet

V. Underdrain Maintenance?

- Surprisingly uncommon
- Clogging potential: filter fabric vs choking stone
- Cleanouts make it easy





Underdrain Cleanouts

Bad

Better

VI. Plant Selection

- Plant palette has grown as BR soils have improved
- Natives are good
- Avoid invasives and ‘spreaders’

Plant Density

Keep it open!

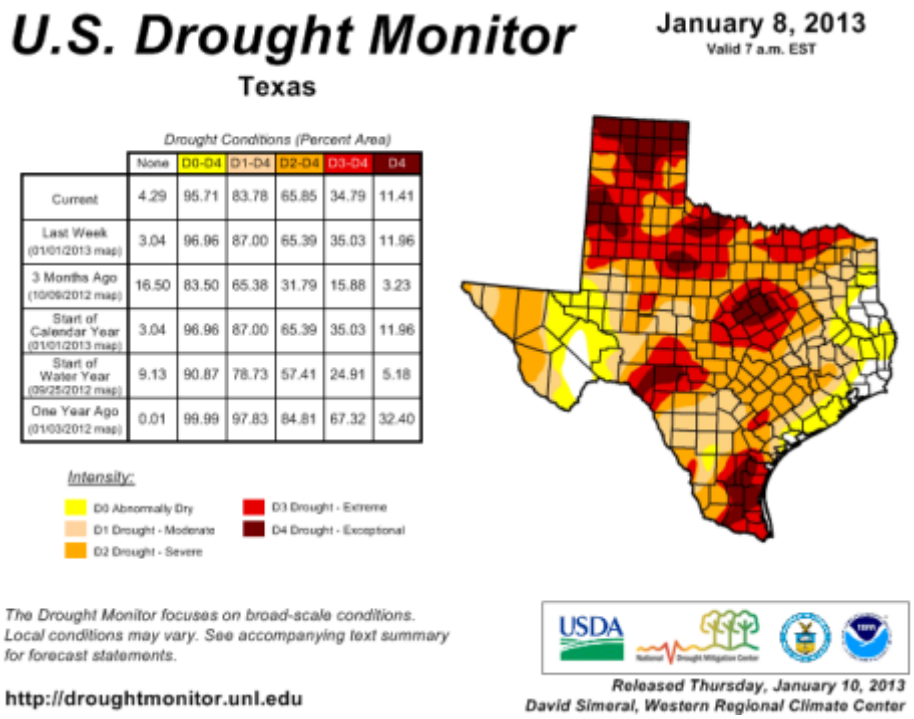
Maintenance Trigger: Plant replacement

- Replace dead plants ASAP with more tolerant plants or plant new plants on higher ground in the bioretention bed

Vegetation Maintenance

Vegetation Maintenance

- **Irrigate**
  - 2 to 3 days for first few months
- Once established, shoul sustain themselves
- Vegetation selection is key here
- Droughts



Importantly…

Think *clean water,* **not** *lush*

Vegetation Maintenance

1 to 2 times/yr

VII. Mulching: Benefits

- Prevents weeds from sprouting
- Adds organiz matter, active zone for microorganisms
- Conserves moisture during dry periods
- Cools soil
- Attractive

Mulching

- Use double or triple-shredded hardwood
- Renew if needed due to oxidation or discoloration
- Do not over-mulch and fill water storage pool with mulch
- “Hot Spots”

Bioretention Maintenance Task Schedule

Task	Frequency	Maintenance Notes
PRUNING	1 – 2 times/yr	Nutrients in runoff often cause bioretention vegetation to flourish
MOWING	2 – 12 times/yr	Frequency depends upon location and desired aesthetic appeal
MULCH REMOVAL	Once every 2 – 3yrs	Mulch accumulation reduces available water storage volume. Removal of mulch also increases infil. rate
WATERING	Once every 2 -3 days for first few months. Seldom after establishment	During droughts, watering after initial year may be needed
FERTILIZATION	Once initially	
REMOVE AND REPLACE DEAD PLANTS	Once per year	>10% of plants may die, survival rates increase over time
MISCELLANEOUS	Monthly	Trash collection, spot weeding, removing mulch from overflow

Permeable Pavement Design Steps

- 1. Siting and feasibility
- 2. Pavement course
- 3. Discuss PP with owner
- 4. Layout site drainage system
- 5. In-situ soil testing
- 6. Infiltration vs. detention system
- 7. Subgrade grading design
- 8. Depth of aggregate base
- 9. Safe conveyance of 10-yr storm
- 10. Observation wells
- 11. Membranes
- 12. Edge restraints

Step 1: Siting and Feasibility

- Constraints with:
  - Seasonal high water table
  - Site slope
  - Buffers and setbacks
  - Stormwater hotspots
  - Redevelopment sites
  - Proximity to water supply wells

Stormwater hotspots

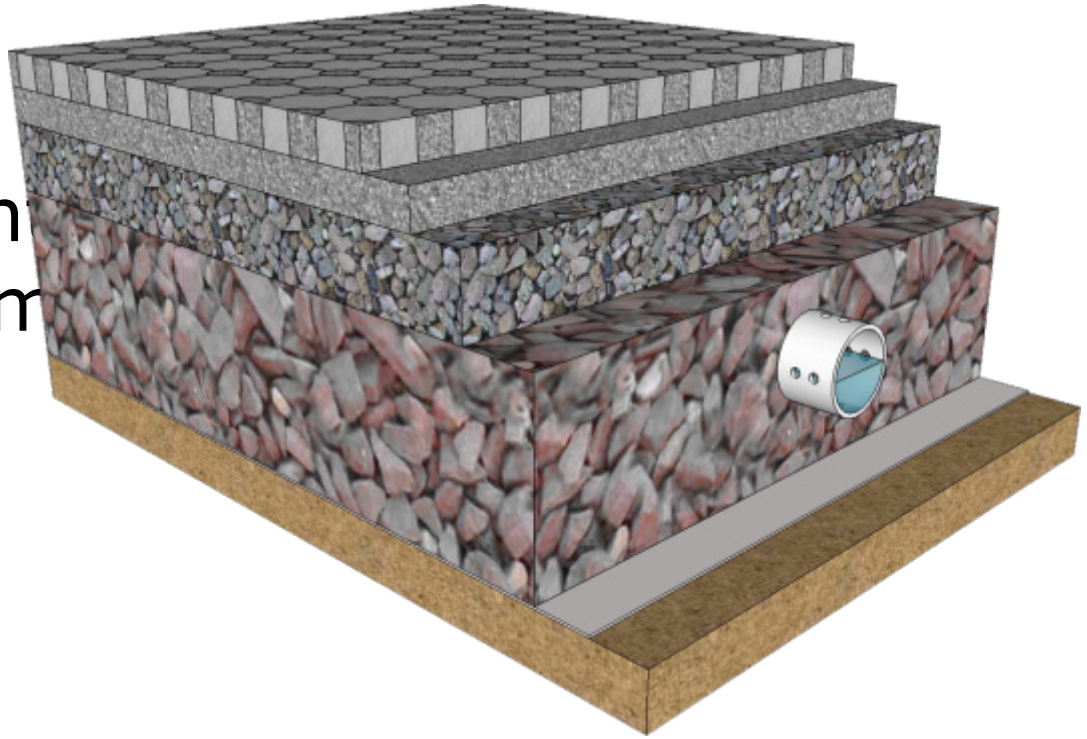
Vehicle maintenance/fueling areas
Public works yards
Trucking & distribution centers
“Heavy” industries
Airport maintenance areas
Railroads and bulk shipping
Solid waste facilities
Wastewater treatment plants
Scrap yards

Structural Calculations

- 2 main functions
  - Support Expected Weight of Vehicles (Structural)
  - Store & Infiltrate a design volume of water (Hydrologic)

Factor 2: Design Precip Depth

- 90% Rainfall Volume?
  - ~1 inch
- Pre-Developmen Infiltration Volum
  - 0.33-1 inch
- Moderate ARI storm (e.g., 2-, 10-yr)
- Infrequent ARI storm (25-, 50- yr)



If not maintained, "permeable" pavement can become Impervious

Permeable Pavement Maintenance:

Clean the Catchment - Street Sweeper

Permeable Pavement - Clean the Catchment: Blowing

Permeable Pavement Maintenance: Sweeper/Vacuum Truck

- Different Types of Sweepers for Different Types of Permeable Pavements:
- Mechanical Sweeper vs. Regenerative Air Sweeper vs. Vacuum Sweeper

Permeable pavement weed control

- Systemic herbicides like Roundup - Preferred
- Flame weed killers – LP gas fueled – Be careful. Could ignite Concrete!

Grassed Permeable Pavement

You might have to mow it!

Permeable Pavement Maintenance Tasks an Schedule

TASK	SCHEDULE
Inspect Lot for Clogging	Semi-annual to Quarterly
Street sweeping and vacuuming	Per inspection results
Gravel replacement	Post-Vacuuming
Oil and grease cleaning	As needed per clientele
Avoidance of landscape debris (grass clippings, leaves)	Each landscape maintenance
Spray/$_{\text{Flame}}$ Weeds and Moss with Herbicides	Monthly during growing season
Adjoining land and watershed stabilization	Keep watch


Questions?