



GREEN INFRASTRUCTURE: WHAT'S GREEN GOT TO DO WITH IT?

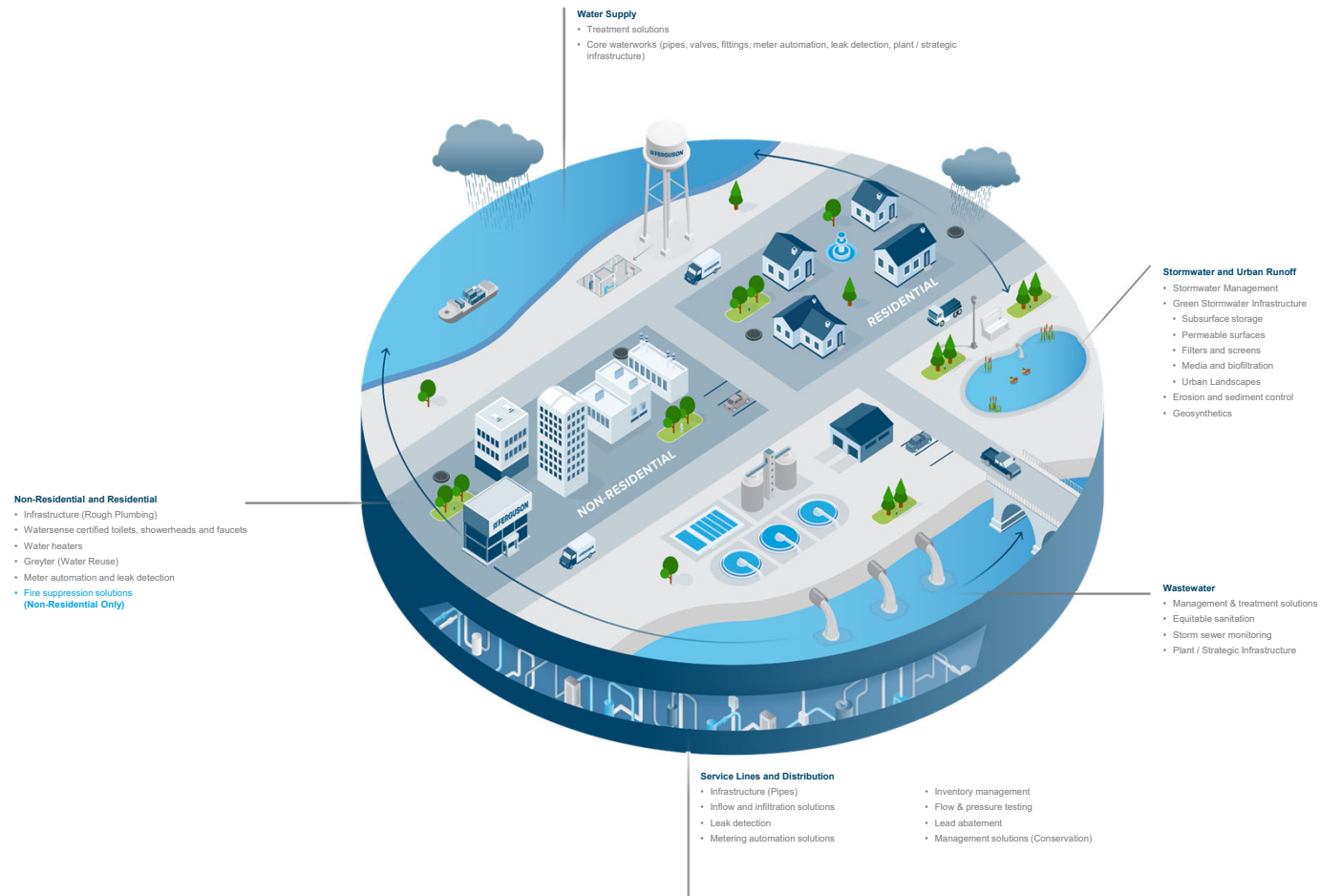
Chris Bogdan, NGICP – Urban Green Infrastructure Manager, Southeast

 **FERGUSON**
WATERWORKS

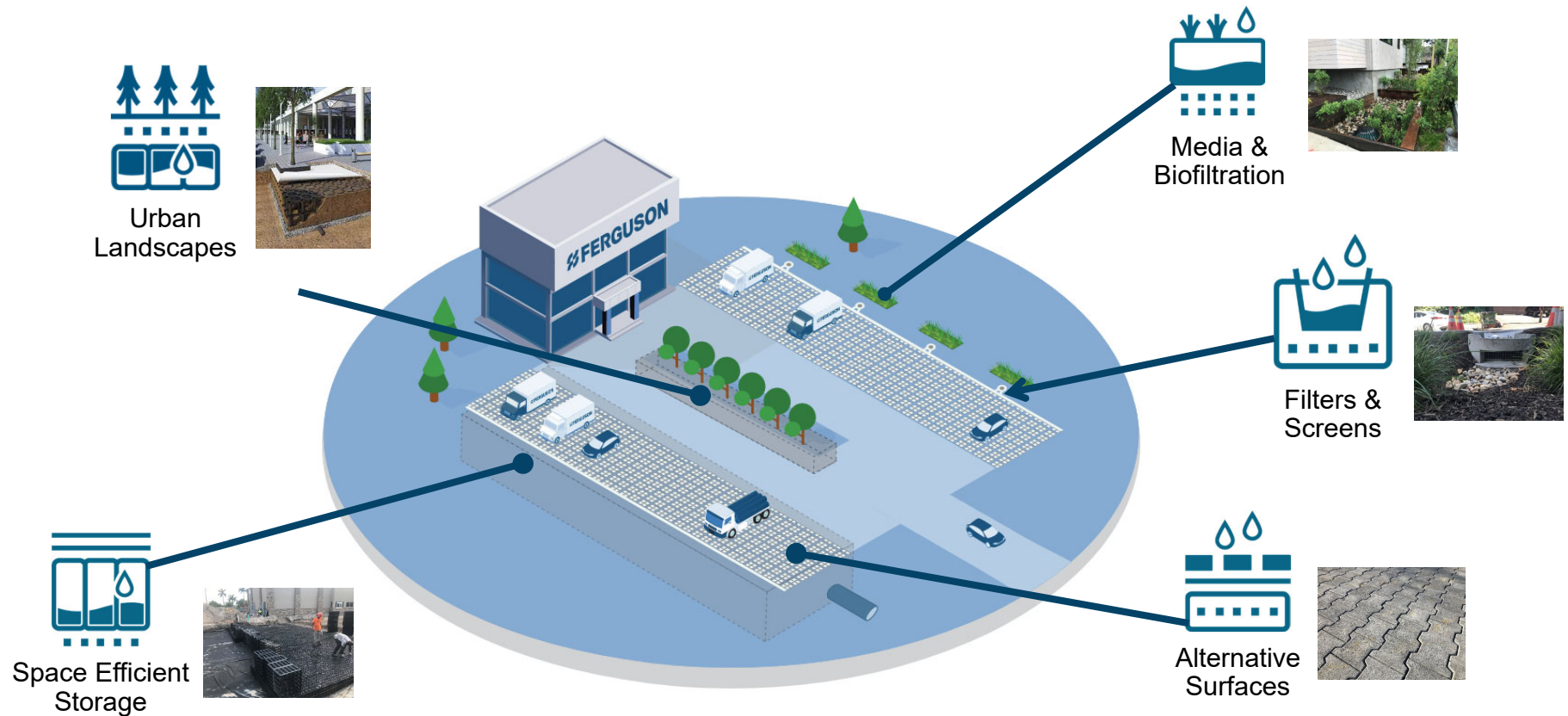
GEO & STORMWATER
SOLUTIONS



OUR WATER CAPABILITIES

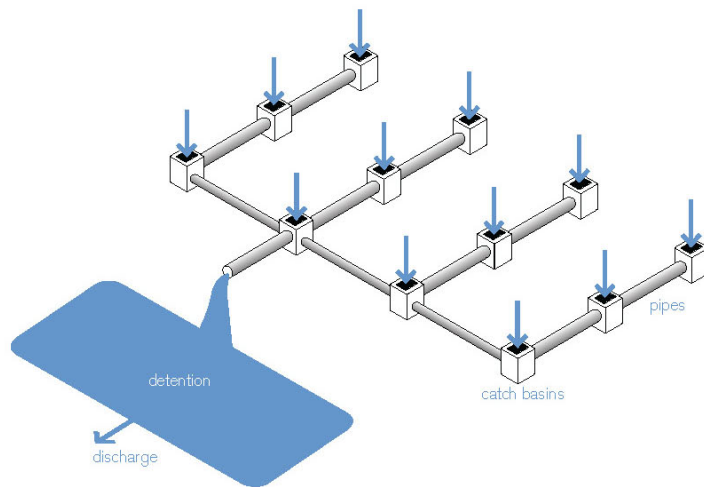


GREEN STORMWATER INFRASTRUCTURE CAPABILITIES



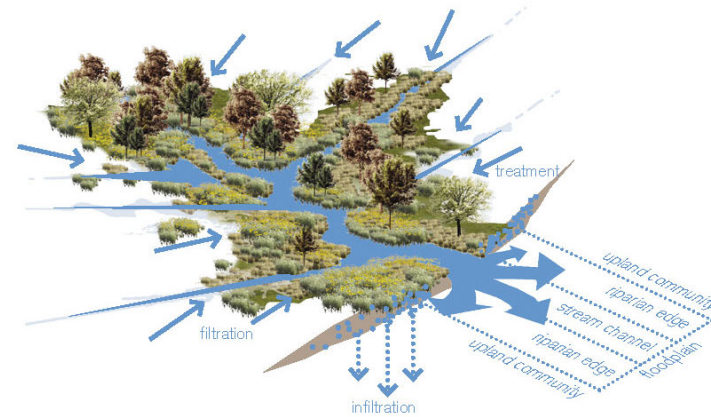
WHAT IS GREEN INFRASTRUCTURE?

hard engineering
...just transfers pollution
to another site



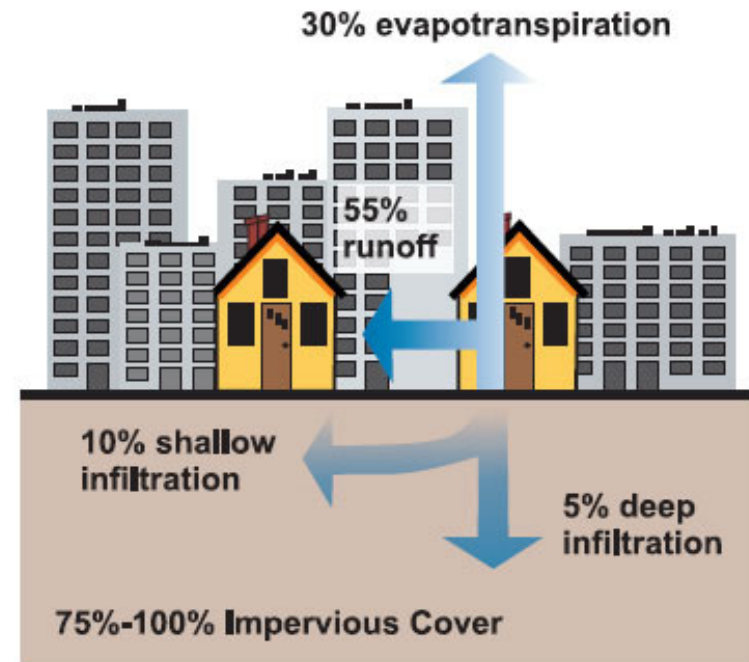
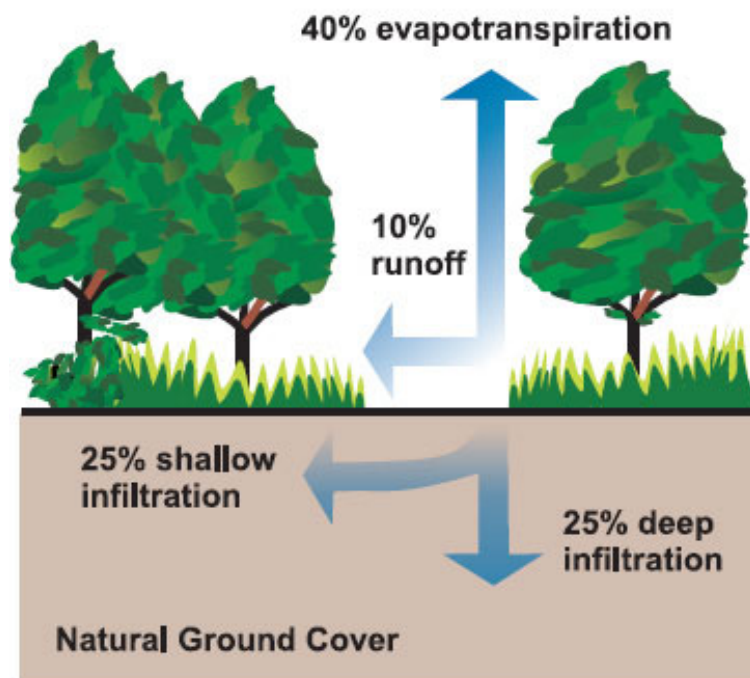
conventional management: "pipe-and-pond" infrastructure
drain, direct, dispatch

soft engineering
...metabolizes pollutants
on site—parks, not pipes!

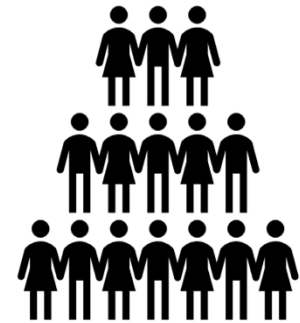
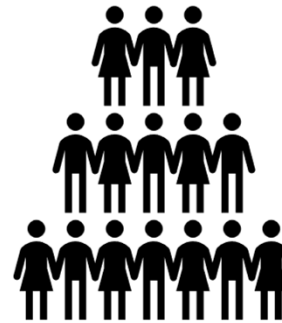
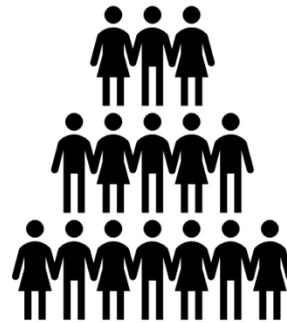
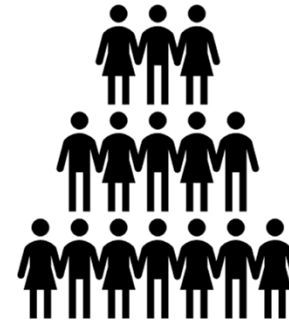


low impact management: watershed approach
slow, spread, soak

BENEFITS OF GREEN INFRASTRUCTURE



CHALLENGES WITH EXISTING INFRASTRUCTURE

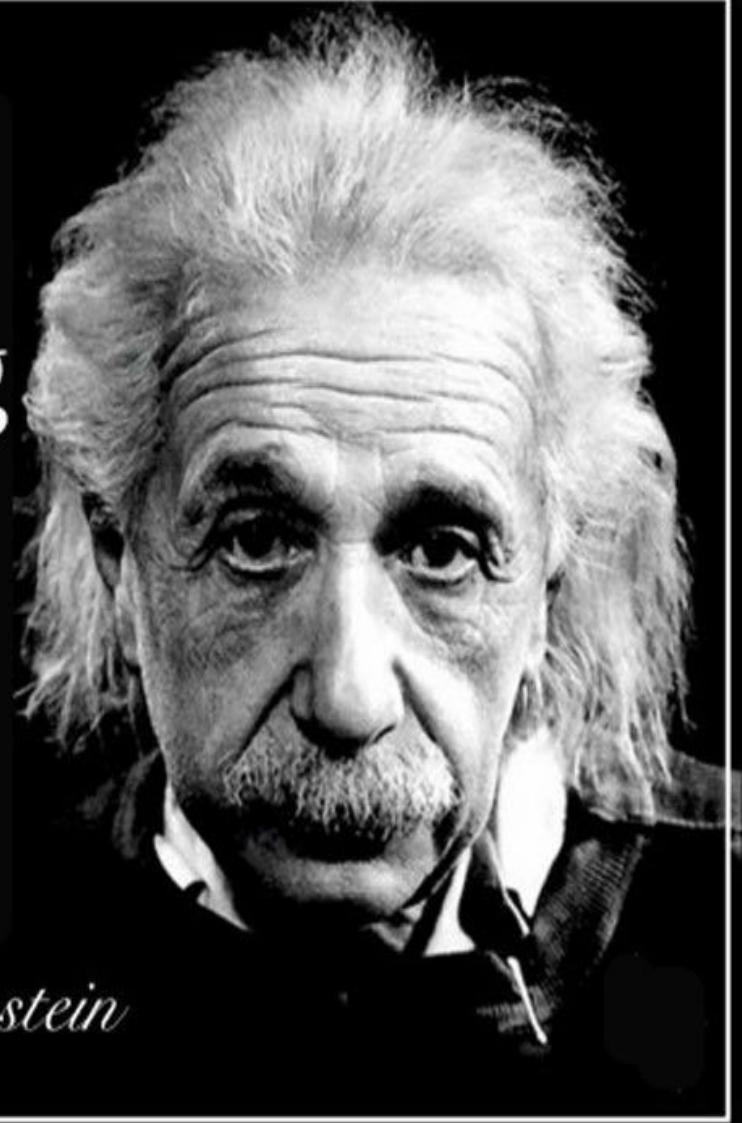


CHALLENGES WITH EXISTING INFRASTRUCTURE



Insanity:
doing the same thing
over and over again
and expecting
different results.

- Albert Einstein



GSI PRACTICES

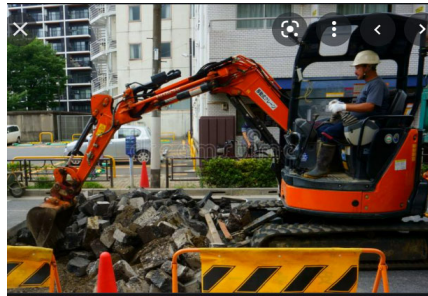
- Rain Gardens
- Bioswales
- Permeable Pavement
- Tree Box Filters
- Green Roofs
- Urban Tree Canopy
- Constructed Wetlands
- Vegetated Filter Strip
- Rainwater Harvesting





GSI MISCONCEPTIONS

- Too Expensive to Build
- Too Expensive to Maintain
- Too Expensive to Repair

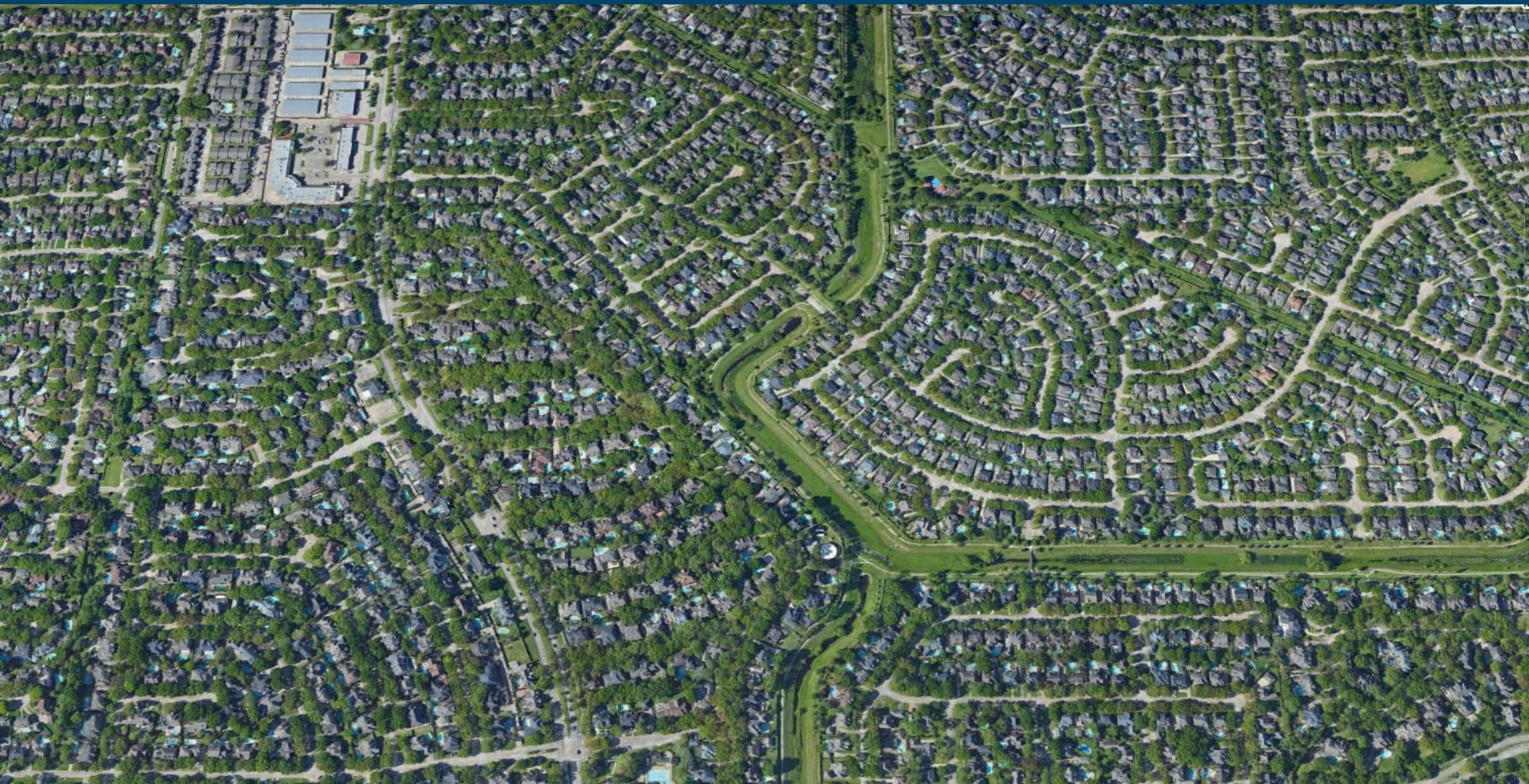




STORMWATER INFRASTRUCTURE: A BRIEF HISTORY











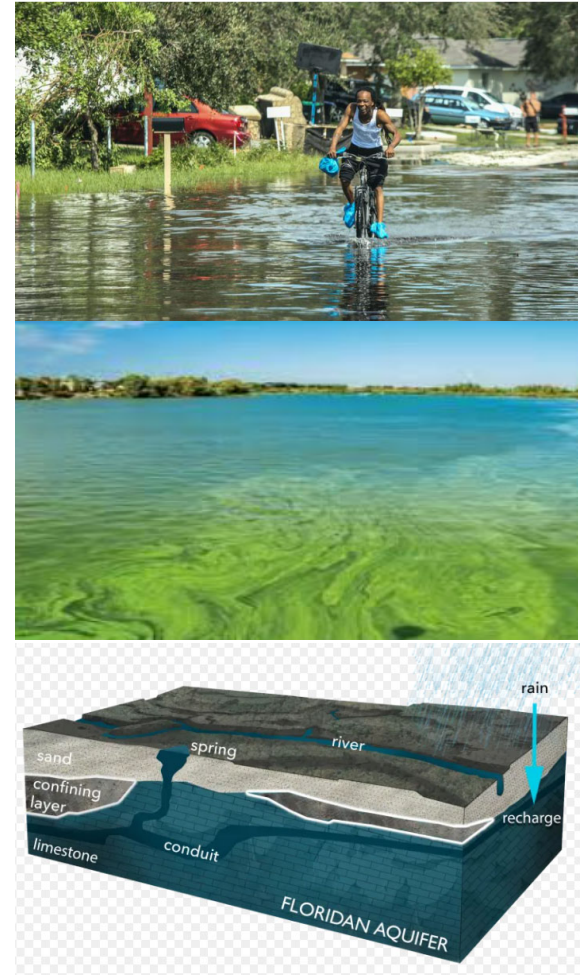




WHAT'S DRIVING GREEN INFRASTRUCTURE?

THE WHY FOR MUNICIPALITIES

- Mitigates Flash Flooding
- Reduce Nutrient Discharges
- Recharge Aquifers to Combat Sea Level Rise
- Reduce Pressure to Clean Other People's Runoff
- Adds Tax Revenue for Municipalities
 - Ponds Don't Generate Revenue
 - Revitalized Areas Bring New Businesses



BUT
DO DEVELOPERS
CARE???

THE WHY FOR DEVELOPERS

- Increased Nutrient Reduction Requirements
- Revised Stormwater Manuals Requiring GSI
- Public Perception is Changing
- Building on the Worst Sites
- Provide More Buildable Land- **ROI**





GREEN PRACTICES

GOALS FOR GREEN ASSETS

- Look amazing (aesthetics)
- Filter Pollutants (water quality)
- Be Maintenance Free (good luck 😊)
- Be able to handle a layer of trash and sediment

That's pretty much impossible – but using pretreatment devices gets us much closer!

- Energy Dissipation
- Collection of sediment/debris

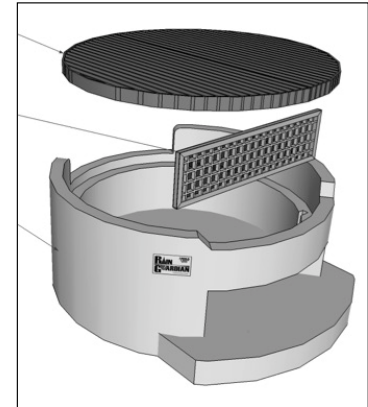






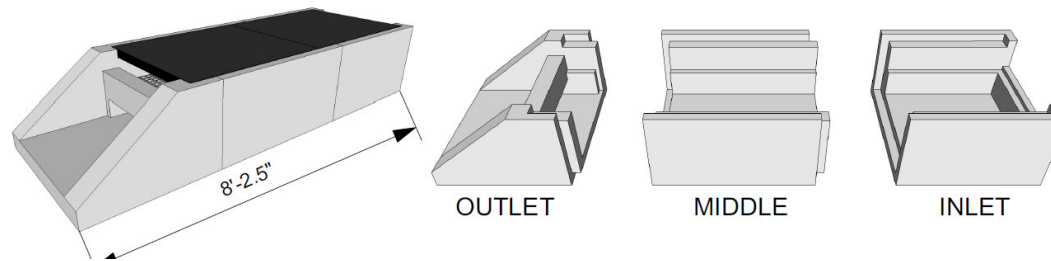
CURBLINE PRETREATMENT

- Extend Effective Bioretention Cell Life
- Maximize Capacity
- Easy Installation
- Simplify Maintenance



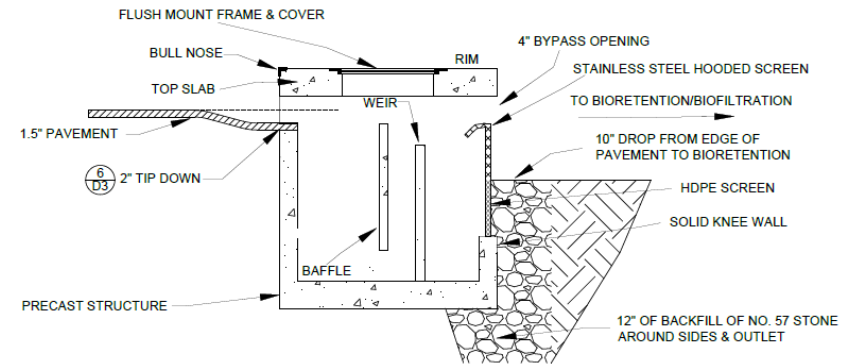
CURBLINE PRETREATMENT

- When BMP is behind sidewalk
- Modular based on sidewalk width
- Solid cover on top



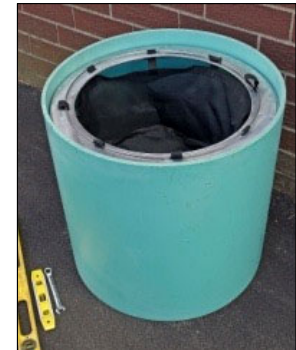
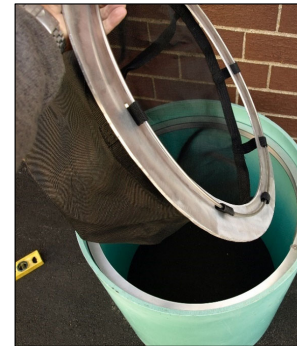
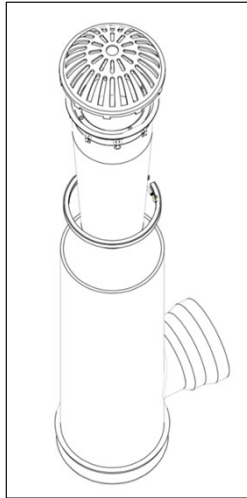
CURBLINE PRETREATMENT

- Larger watersheds
- Higher volumes of sediment
- Formal sump and storage
- Baffles, weirs and screens



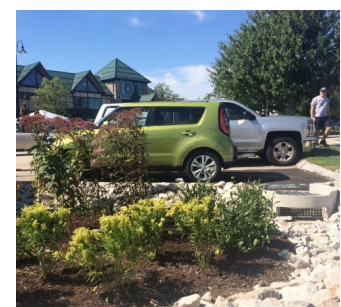
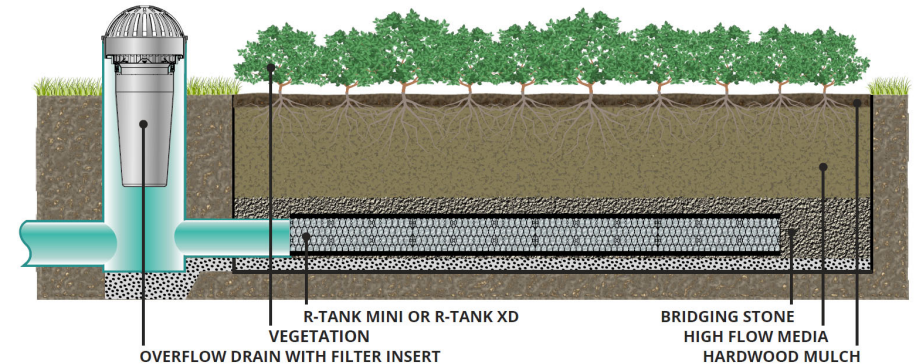
OVERFLOW STRUCTURE

- Conveyance of larger storms
- Collection of floatables, mulch, debris
- Expanding ring mount
- No screws or fasteners
- Low cost
- Easy to clean



MICRO BIOFILTRATION

- Space efficient
- 100 in/hr innovative media
- Provides treatment for a variety of pollutants
- Engineered system



- Smaller footprint = less disturbance
- Smaller footprint = smaller maintenance footprint
- Smaller footprint = feasibility in tight spaces previously overlooked

MICRO BIOFILTRATION

Vegetated System:

Plants process pollutants removed from run-off and root system maintains drainage and aeration of media.

3" Layer of Shredded Hardwood Mulch:

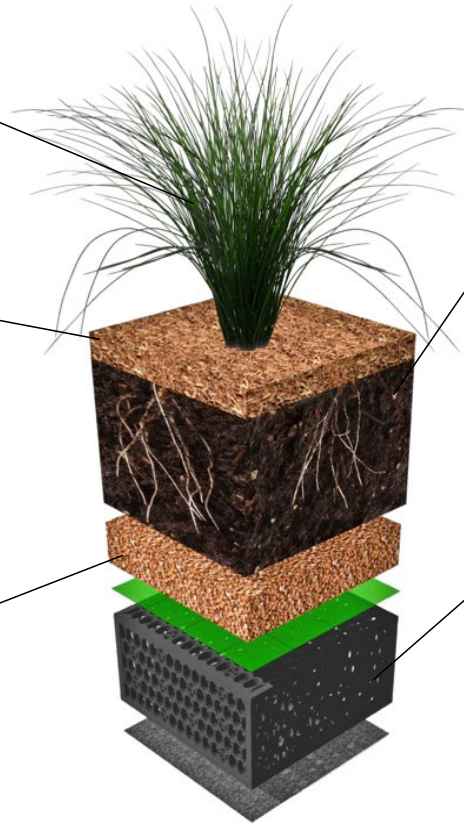
Pre-treatment mechanism.

Removal and Replacement of Mulch Represents the Bulk of System Maintenance!

6" Bridging Stone & Separation Layer:

Clog-Proof Clean Stone & Micro-Grid Replace Traditional Geotextile Layer

No geotextile = no clogging



18" High Performance Media:

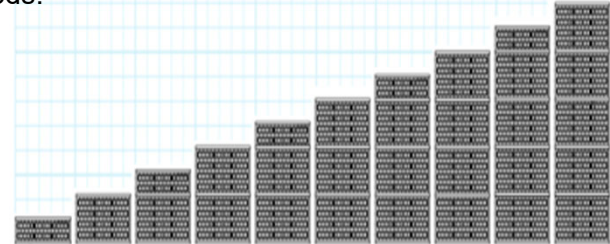
Flows at 100" Per Hour / 200 ft per day
Resistant to Clogging

High Performance Underdrain:

9.45" Modular Tank, or "Flat Pipe" w/95% Open Surface Collects Water Efficiently.

Optional 2" Low-Profile Panel Addresses Shallow Applications.

Expand into Modular Tanks for Larger Storage Needs.



EXAMPLES- TIGHT URBAN SITES



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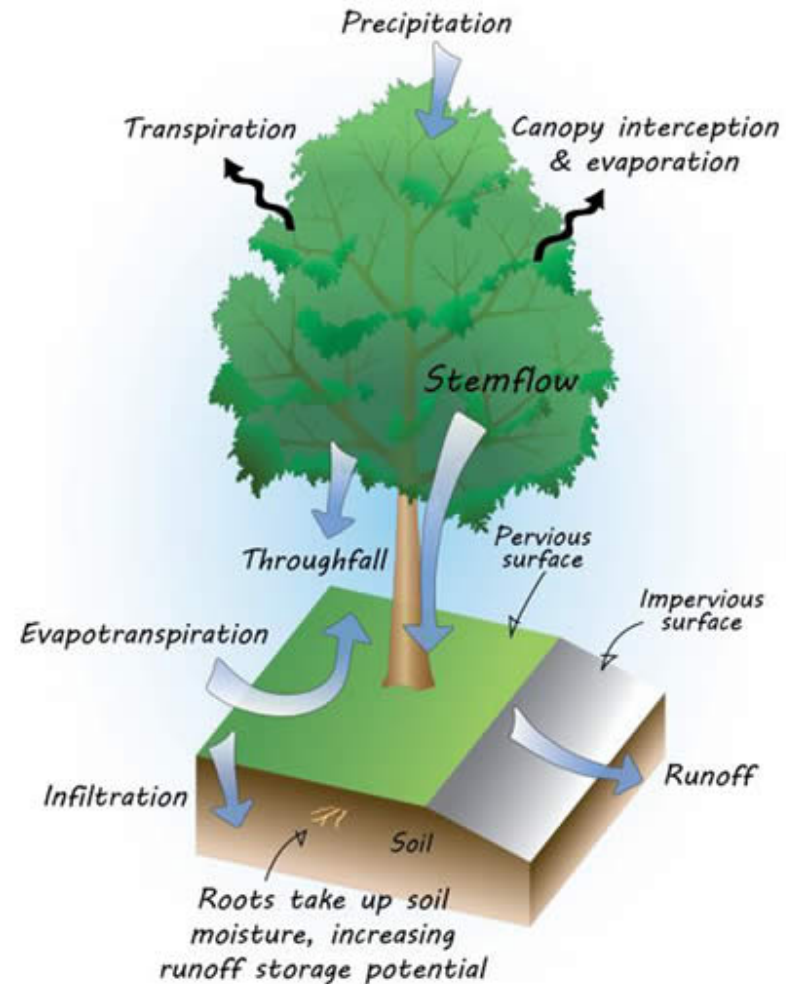


LINEAR EXAMPLES



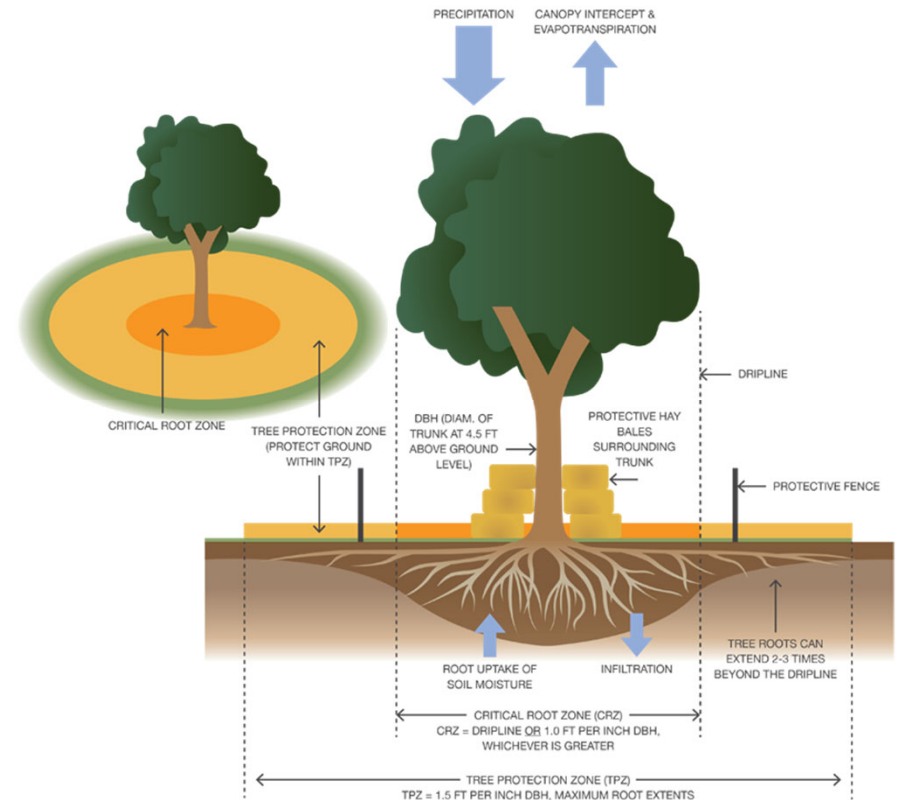
TREES- THE ULTIMATE BMP

- Flood Reduction
- Improved Water Quality
- Soil and Ground Stabilization
- Increased Property Values
- Lowered Utility Costs
- Temperature Moderation
- Oxygen Production
- Promotion of Physical Activity
- Increased Mental Well Being
- Absorption of Pollutants from Soil & Water



TREE HEALTH

- Tree's roots:
 - Anchor the tree in the soil
 - Water and mineral uptake
 - Absorb oxygen, necessary for their own respiration and growth
- The typical North American tree's root structure grows more outward than downward
- Up to 80% of a tree's feeder roots are concentrated in the top few inches of soil

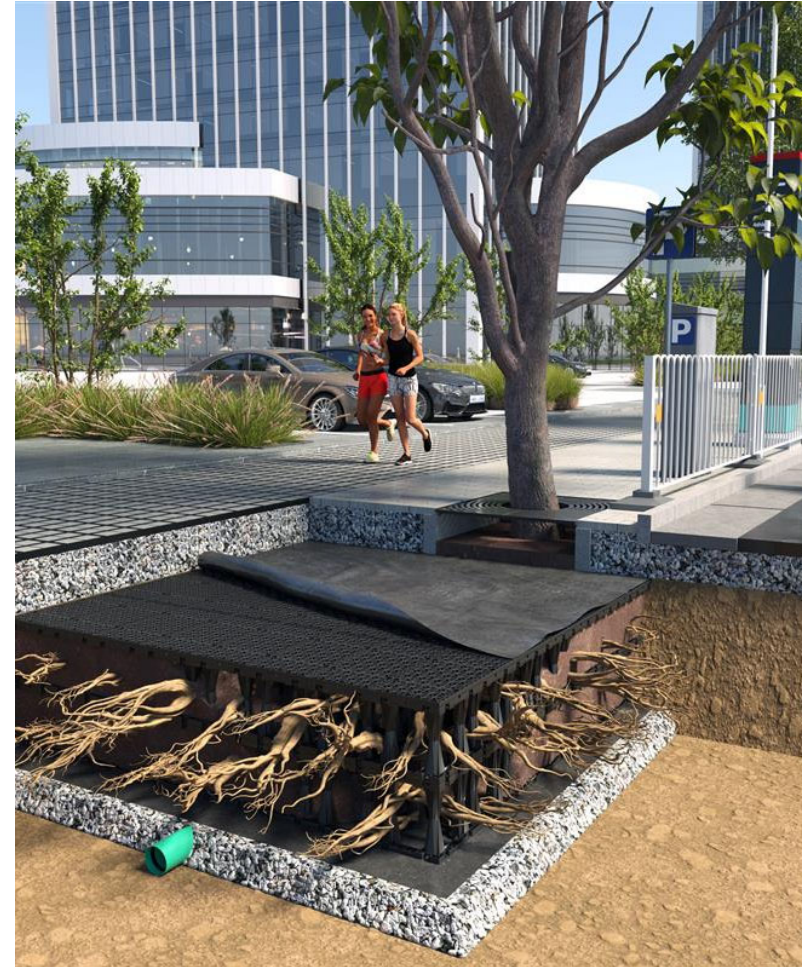


THRIVING URBAN TREES????



SOIL / TREE CELLS

- Utilizes a modular plastic frame to hold up the surface and that void is filled soil
 - The finished surface places a load on the structural framework of the plastic system.
 - Soil provides air, nutrients, and retains water.
- Provides a modular system that works around existing utilities, tight spaces, complex shapes, etc.
- Able to be used in pedestrian and vehicular applications



SOIL / TREE CELLS

High Strength and Capacity

- 95% void internal area
- Cone-based module (55 psi unfilled)
- Structural side panel for lateral strength (12 psi unfilled)
- Supports traffic loading (HS-20 rating)

DIMENSIONS			
Module (Segments)	Height (Inches)	Capacity (CF)	Weight (Lbs.)
Single (1)	16.93	4.28	19.72
Double (2)	32.68	8.26	35.58
Triple (3)	48.43	12.23	51.44



SOIL / TREE CELLS





ALTERNATIVE SURFACES

PERMEABLE PAVERS



Why Fill the Joints?

BENEFITS

- Reduce Impervious Area
- Meet Local Regulations
- Create New Inlets
 - Reduce the size of pipes or remove pipes altogether
- Offer detention opportunity
 - Reduce size of pond
- Add Aesthetics
- Differentiate Travel Lanes from Parking

WHY FILL THE JOINTS?



- Provide Stability for Traffic Loads
- Prevent Pavers from Shifting
- Filter Sediments and Trash
- CHALLENGE

Open-Joint Pavers Help Maximize Conveyance Rates and Reduce Maintenance

TO FILL OR NOT TO FILL- THAT IS THE QUESTION

100" / Hour

VS

1,000" / Hour

50% Clogged – 50"/hr

75% Clogged – 25"/hr

90% Clogged – 10"/hr

50% Clogged – 500"/hr

75% Clogged – 250"/hr

90% Clogged – 100"/hr

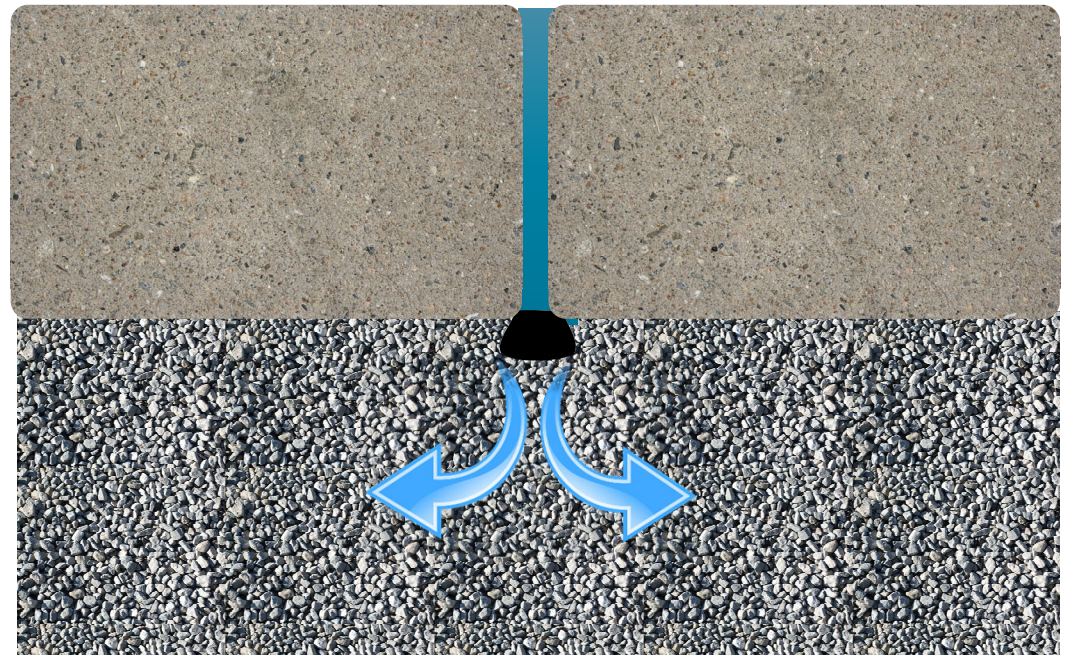
Higher Conveyance Rates (> 1000 inches/hour) Can
Minimize Owner Pain By Extending Maintenance
Cycles

PAVER COMPARISON

Typical Paver



Open-Joint Paver



Where Does Clogging Occur?

Initiating clogging at the BOTTOM of the joint creates several inches of head pressure to drive water into the base.

...of course, that's only good if you can still remove the sediment!

MAINTENANCE



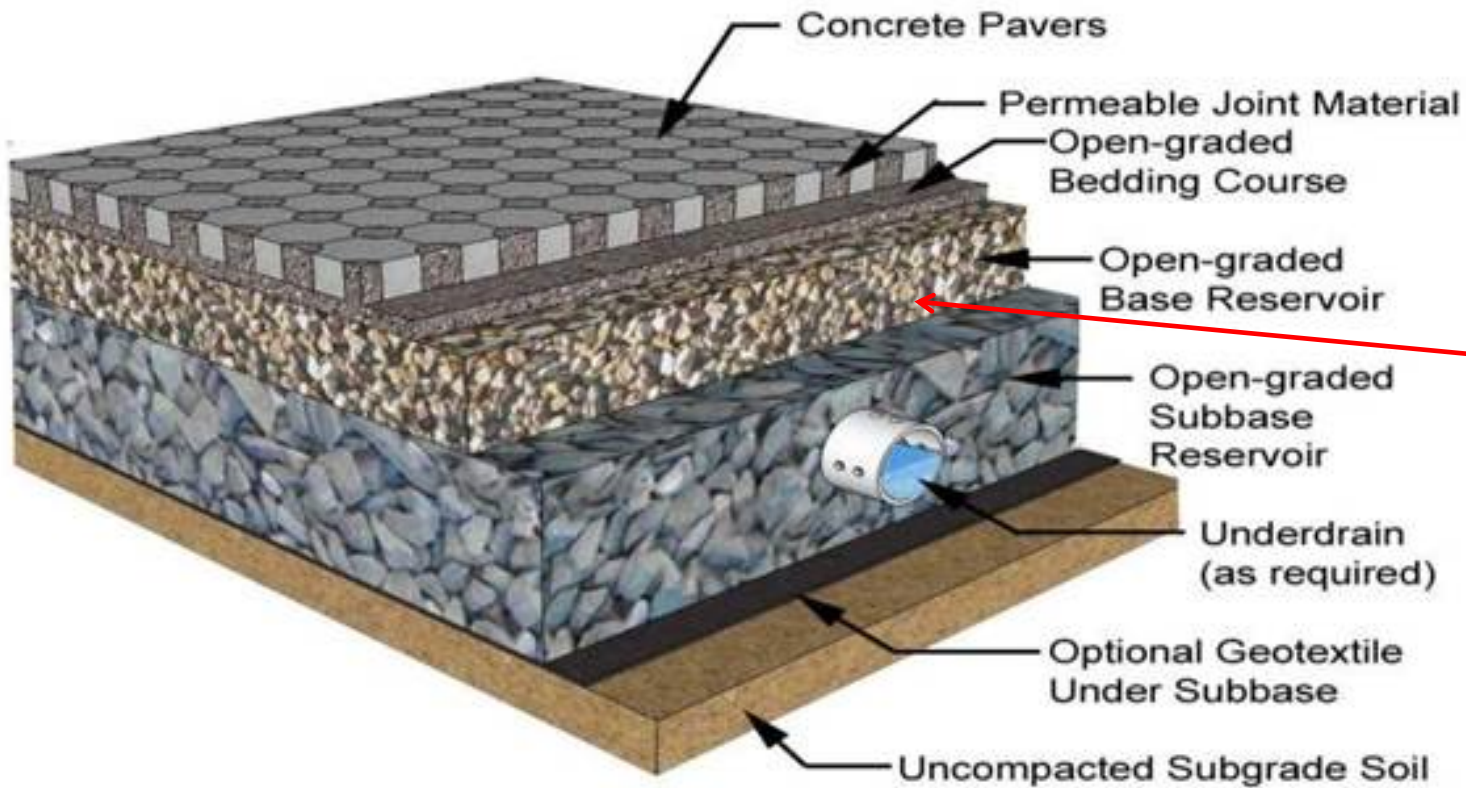
- Cost to Vacuum
- Cost of Replacement Rock
- Labor to Install
- Loss of Lot During Maintenance
- When Can Lot be Closed and How Long Must it Be Closed?
- What is the Maintenance Schedule?

OPEN JOINT PAVERS



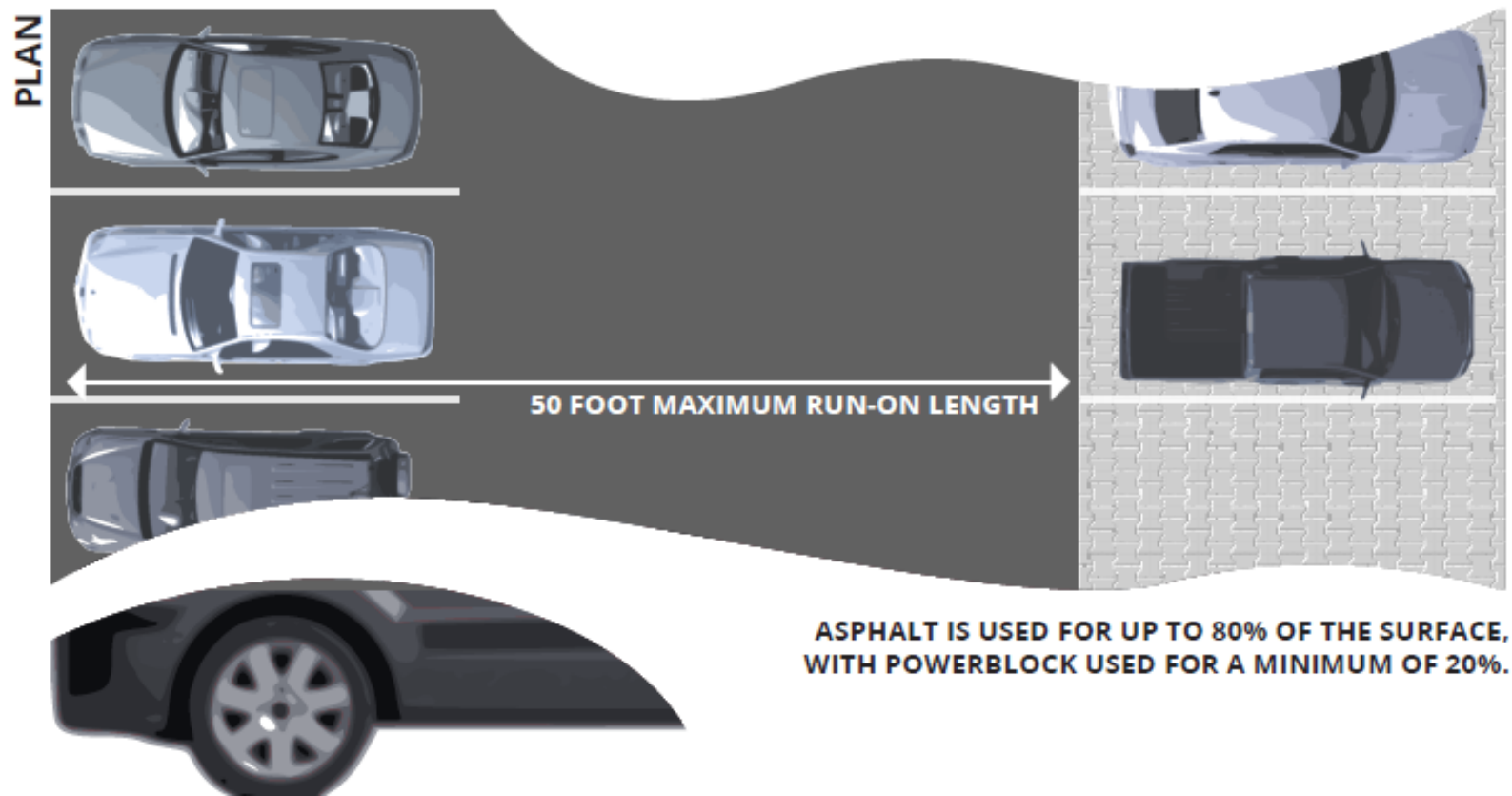
- Pavement – Handles Traffic Loads with 6000 psi Concrete
- Drains – Open Joints Move Water Without Inlets
- Stores & Infiltrates – Stores 1" of Water

TYPICAL CROSS-SECTION



Increase rock base or add void space for additional water storage

DESIGN OPPORTUNITIES

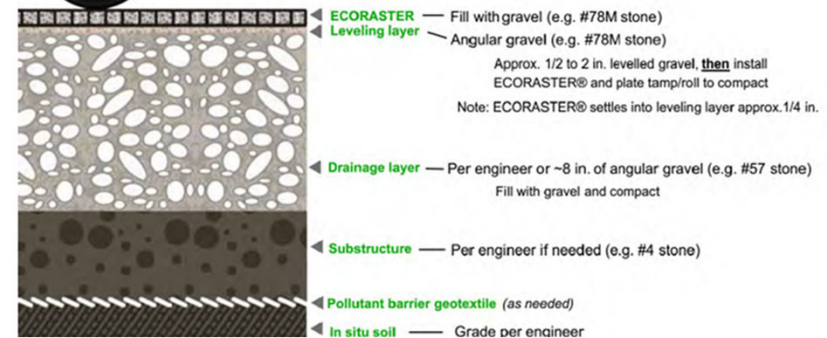


DESIGN EXAMPLES



PERMEABLE GRID SYSTEMS

- LDPE
- Cold climate tested
- Locking joint
- Expansion and flex elements
- UV Stability
- **Filled Strength > 21,740 PSI**



DESIGN EXAMPLES



DESIGN EXAMPLES



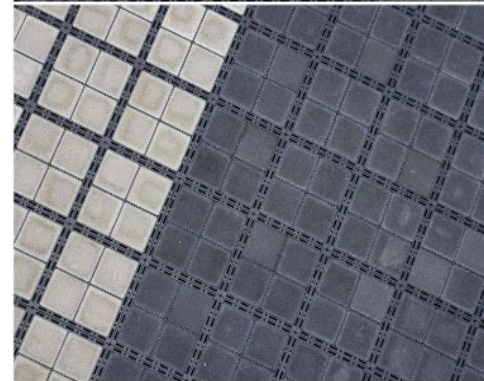
DESIGN EXAMPLES



DESIGN EXAMPLES



PERMEABLE PAVER OPTION





RECAP

THOUGHTS ON DESIGN GOALS



- Developers and municipalities have different goals
 - Use GSI designs to provide developers with more ROI
 - Use GSI designs to reduce flooding or nutrient loads for municipalities
- Maintenance must be included in the cost discussion
- **There must be a value proposition**
 - Revitalize an old part of town to attract more businesses
 - Remove or reduce a pond size to add more buildable land

DESIGN CONSIDERATIONS



GREEN ASSETS

- Use pretreatment
- Micro bioretention might make GSI possible
- Consider suspended pavement systems for urban trees

PERMEABLE SURFACES

- Pervious surfaces are more than DCIA reduction
 - Provide new inlets
 - Provide detention
- Where are your sediment contributors?
- Use in light traffic areas to promote longevity

THANK YOU FOR YOUR TIME!



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