Stormwater Management: Post Construction Stormwater BMP's

TEAM EJP
WATER · WASTEWATER · STORMWATER
SOLUTIONS

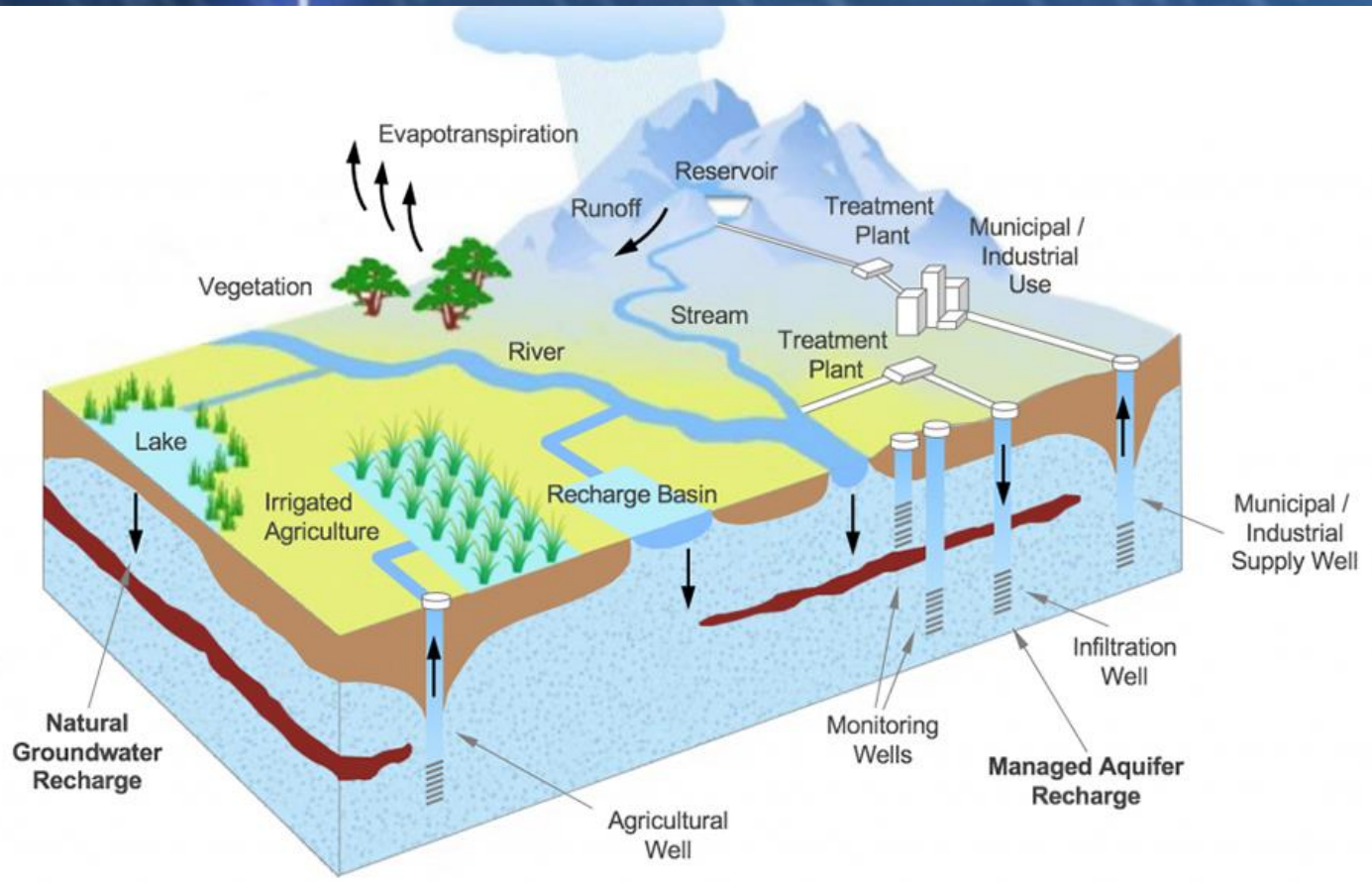
Doug McCluskey
Western Erosion Control & Stormwater Specialist
Western MA, CT, NY, OH, IN
518.764.8555
doug.mccluskey@ejprescott.com

What we need to protect

- Freshwater makes up a very small fraction of all water on the planet. Nearly 70% of the world is covered by water, only 3.0 percent of it is fresh. The rest is saline and ocean-based.
- **Just 1 percent of our freshwater is easily accessible**, with much of it trapped in glaciers and snowfields. So, only **0.007 percent** of the planet's water is **available for drinking water.**

- Info collected from www.theworldswatercrisis.weebly.com

- **Groundwater** is actually being considered the **world's most extracted raw material** at a withdrawal rate of 259 trillion gallons per year!
- **It has been estimated that households alone in the U.S. use 349 billion gallons of freshwater every day!**
- In 1990 2.2 billion gallons of groundwater was extracted and used for agricultural irrigation. Today that number is 53.5 billion gallons!

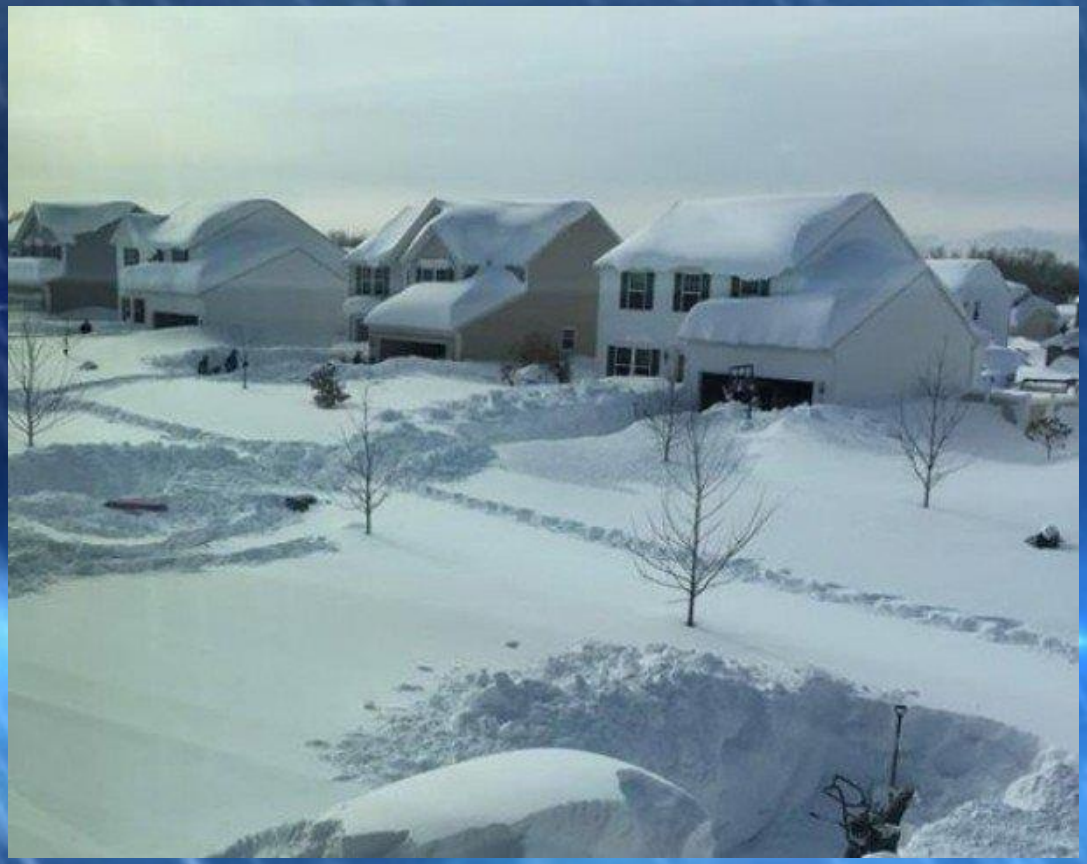


- **How are we replenishing our aquifers?**
- **Are we managing Stormwater?**
- **Could we be handling our Snowmelt better?**

StormWater Runoff

1” rain event on 1 acre of ground.....27,154 gallons

1” of snow on 1 acre of ground.....2,715 gallons



The city of Buffalo NY covers 33,610 acres. In November 2014 they received 7’ of snow. How many gallons of runoff could have been infiltrated using the right practices?

- **THANKSGIVING 2014 BUFFALO NY**
- **Received over 7’ of snow**
- **Snowfall rates estimated as high as 6” per hour**

7,665,096,600 Gallons

Erie County NY Math Equation

Per Erie County Water Authority:

Customers use 230 gallons of fresh water daily

111,000 Households in the City of Buffalo

111,000 x 230 gal = 31,080,000 gal per day

7,665,096,600 ÷ 31,080,000 = 246.6 days

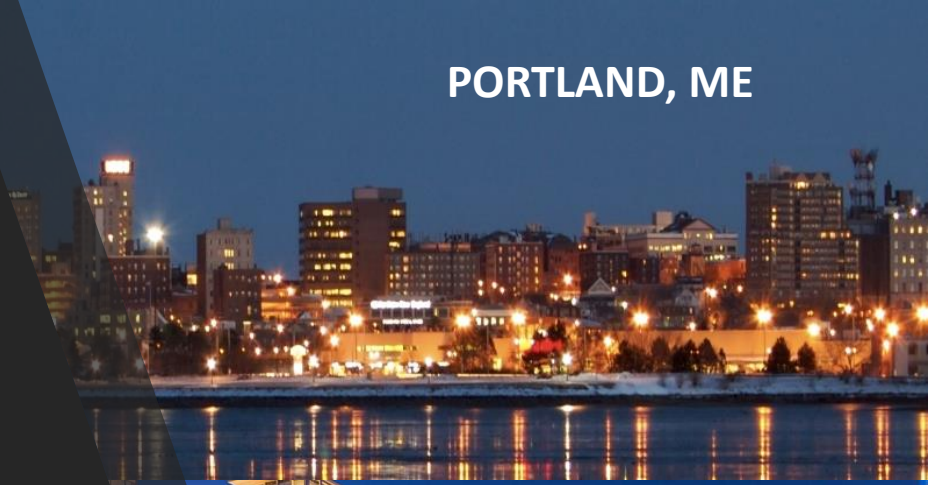
Some interesting facts provided by Kevin Meindl, Green Infrastructure Program Manager for the Buffalo Sewer Authority:

– Buffalo has large amounts of impervious surfaces (where water does not get absorbed) with over 56% of the city being identified as impervious, much higher than peer cities such as Syracuse (41%), Pittsburgh (34%), and Scranton, PA (23%).

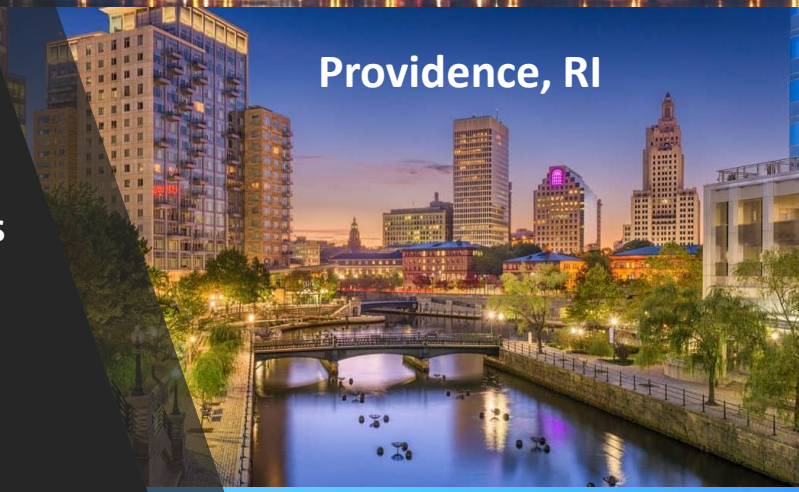
4,292,454,096 gal of stormwater

138 days of available water

Portland covers 44,441 Acres



Providence covers 22,387 Acres



Boston covers 57,363 Acres

Severe Storms increasing

August 2011: Hurricane Irene

October 2012: Hurricane Sandy

June 2013: Tropical Storm Andrea

June 2015: Tropical Storm Bill

May 2016: Tropical Storm Bonnie

October 2016: Hurricane Matthew

September 2017: Hurricane Irma

September 2018: Hurricane Florence

October 2018: Hurricane Michael

August 2020: Hurricane Laura


1.Syracuse
2.NYC
3.Syracuse
4.Ithaca
5.Albany
6.rye

- **Where are we sending Stormwater?**
- **What are the impacts of sending it off site?**
- **Can we do Better?**

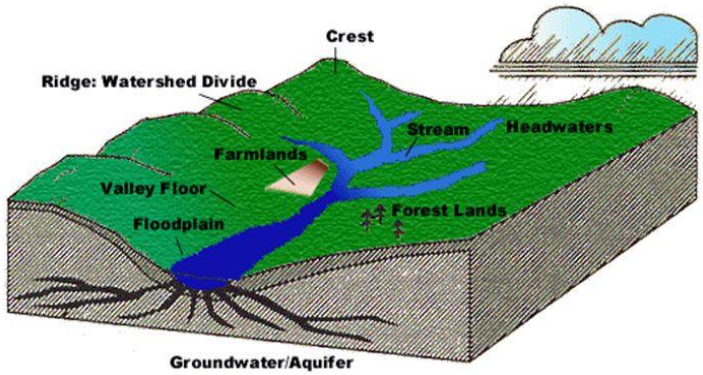
Impacts of Urbanization

Impacts of Urbanization

- **The impacts of urbanization include:**
- **1.** Increased **stream bank erosion** and sediment transport
- **2.** Increased deposition of sediments (and associated contaminants) in estuaries and harbors. **After flowing over hot asphalt the runoff is typically warmer when entering water bodies**, causing additional damage to habitat
- **3. Increased local flood risk for urban flood plains**
- **4.** Increased overflow frequency and volumes from sanitary sewers, particularly in areas with combined stormwater and wastewater sewers
- **5.** Contamination of receiving environments, either acute (following storm events), chronic (due to accumulation over time), or both
- **6.** The EPA estimates that American households improperly dump about 193 million gallons of used oil every year.

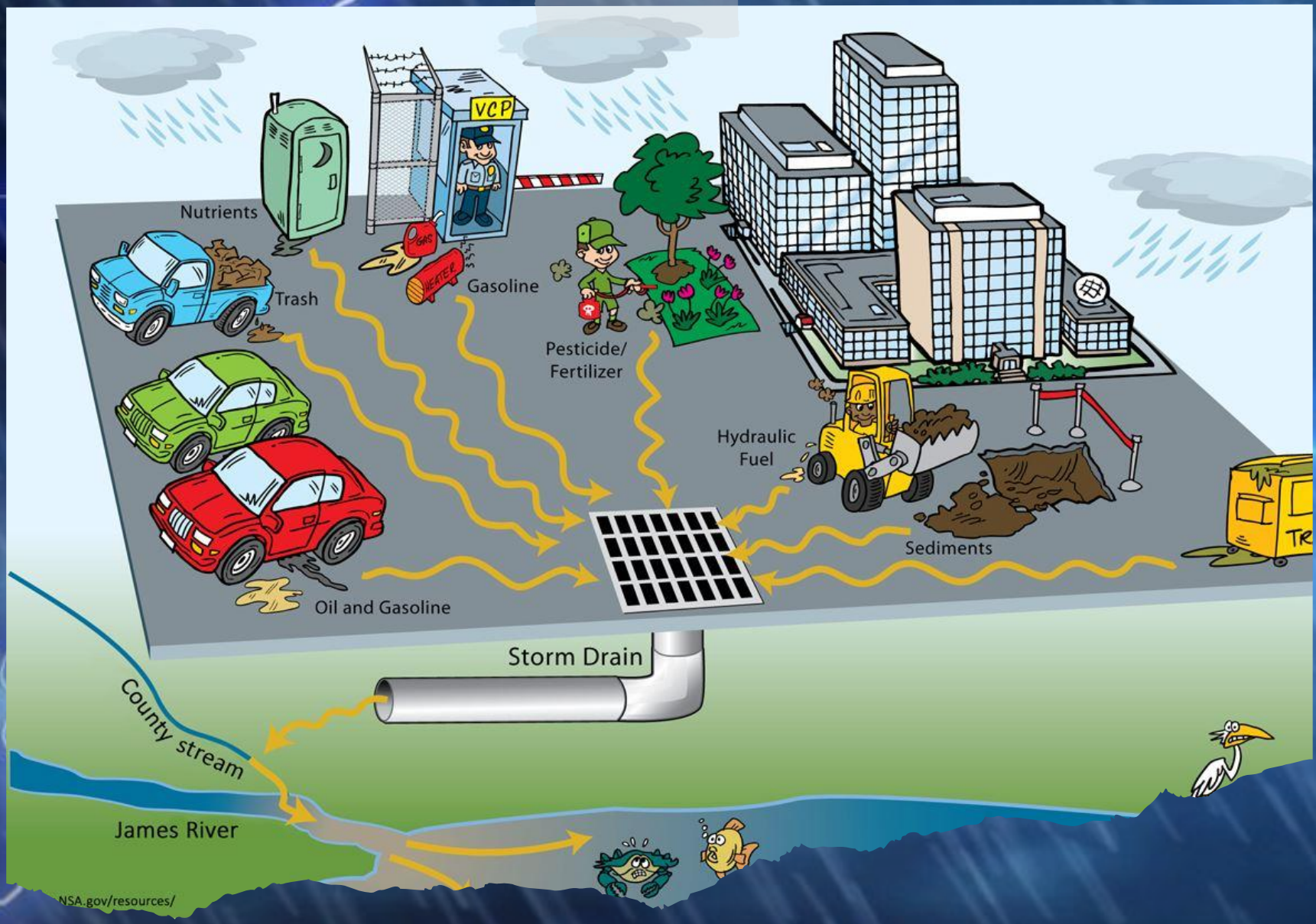
What are we putting in our waterways

Protecting our Watershed

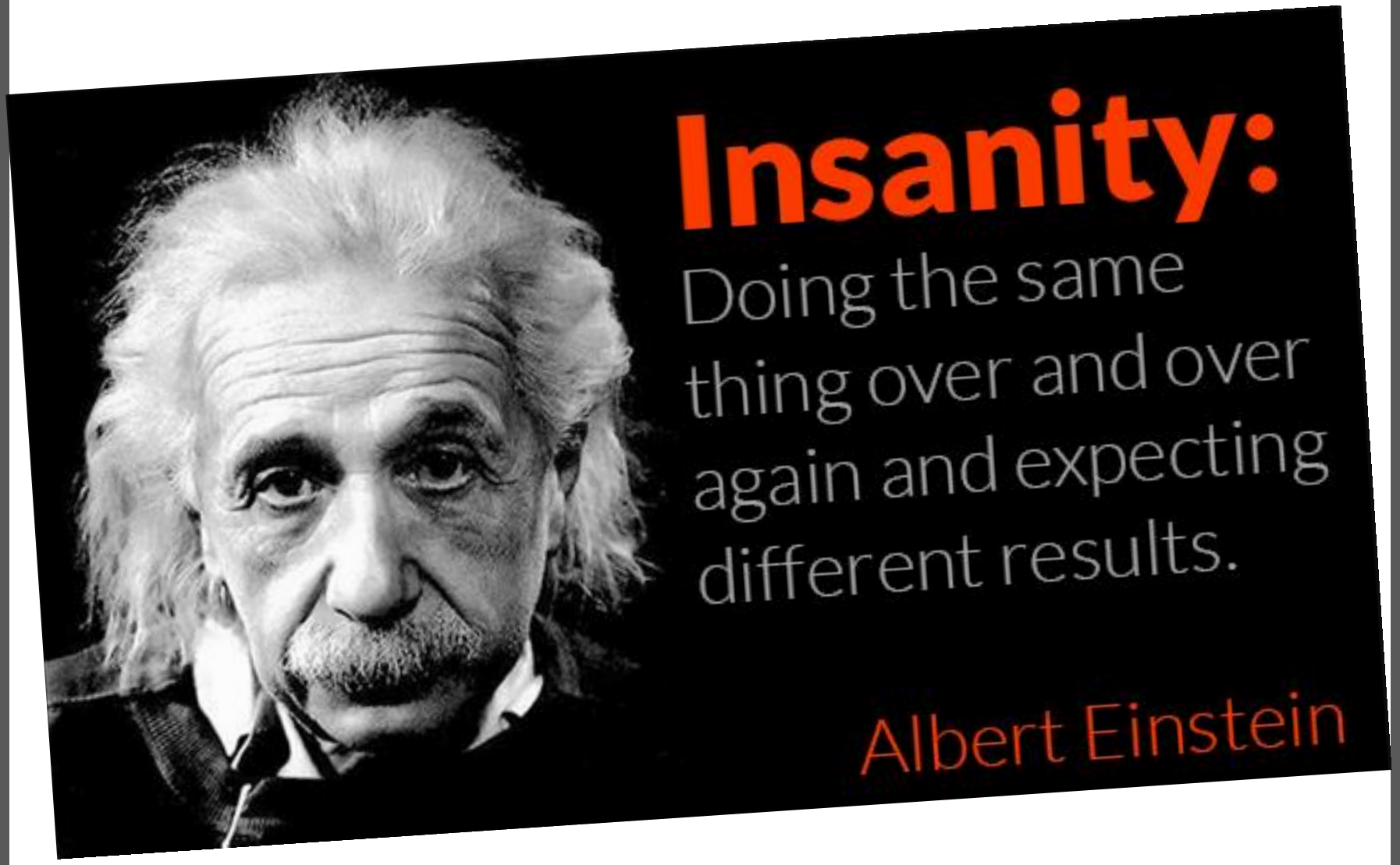


Some Human impacts on Watersheds

- Nutrient overloading
- Sediment runoff
- Toxic Chemicals
- Organic loading
- Thermal loading
- Stream Channel Alteration
- Altered Hydrology


VCP
Nutrients
Trash
Gasoline
Pesticide/
Fertilizer
Hydraulic
Fuel
Sediments
Oil and Gasoline
Storm Drain
County stream
James River
NSA.gov/resources/

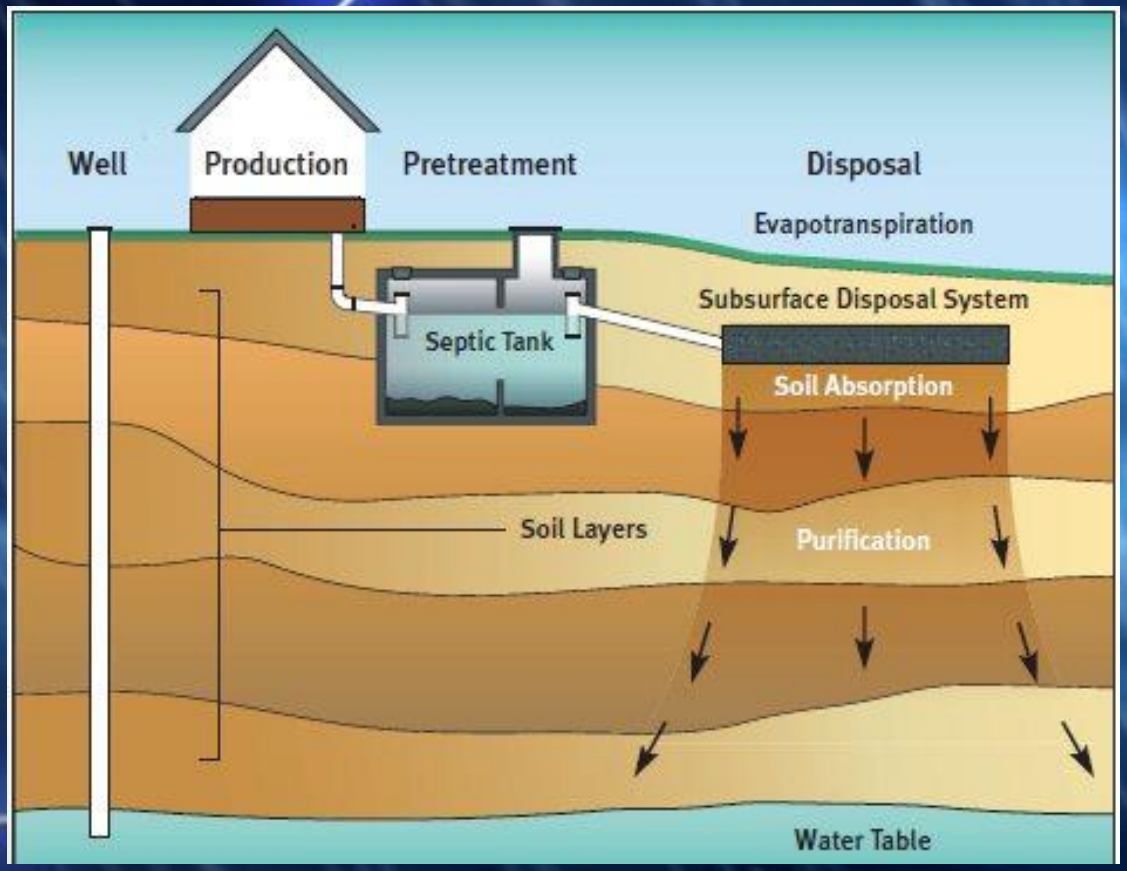

Open
stormwater
drain


Insanity:
Doing the same thing over and over again and expecting different results.
Albert Einstein

Pre-Treatment

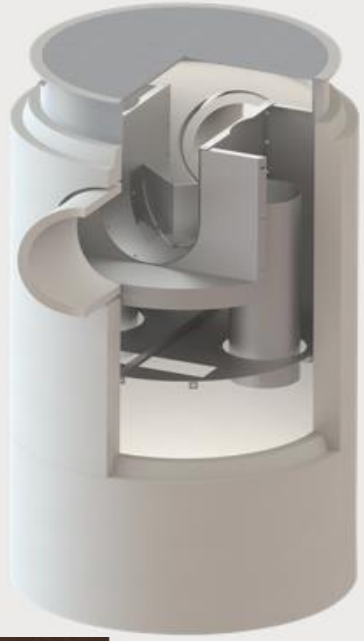
Pre-Treatment

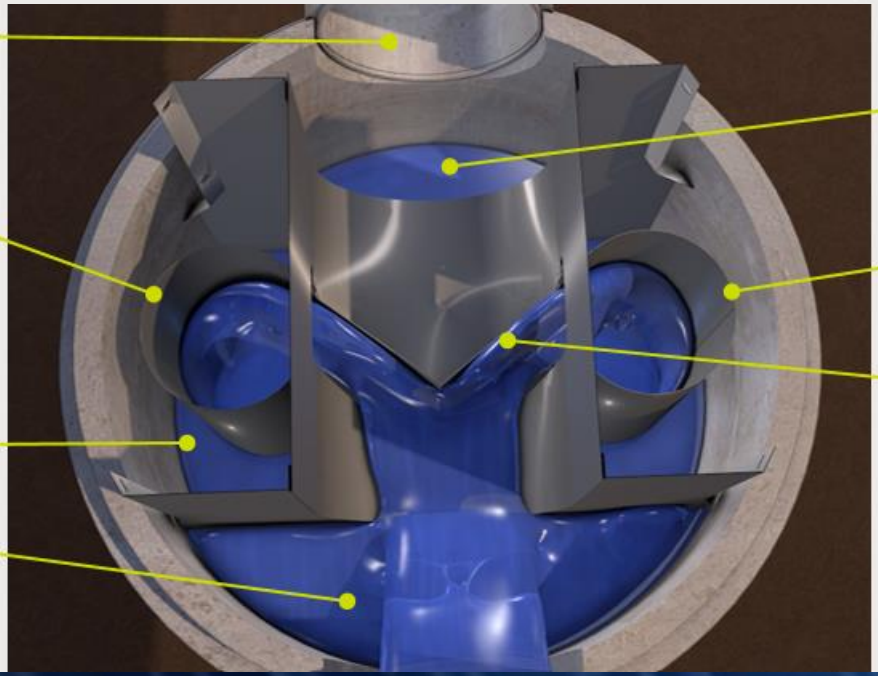
Not a New Concept



- Pretreatment
- Detention
- Deep and Shallow
- Permeability

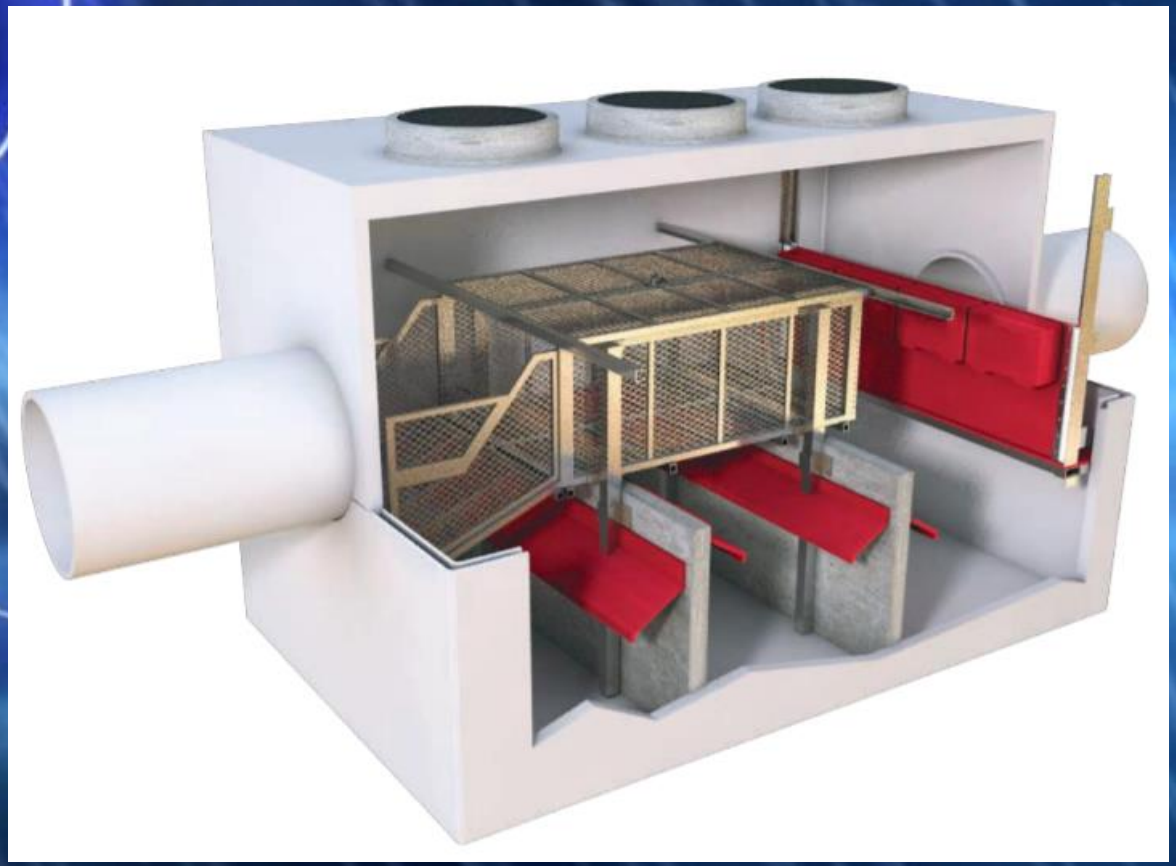
- Hydrodynamic Separation System (**HDS**)
- **Pretreatment** system to remove TSS, gross solids, trash and debris
- **Compact design** accommodates wide range of pipe orientations with **Round** or **Square** Configurations





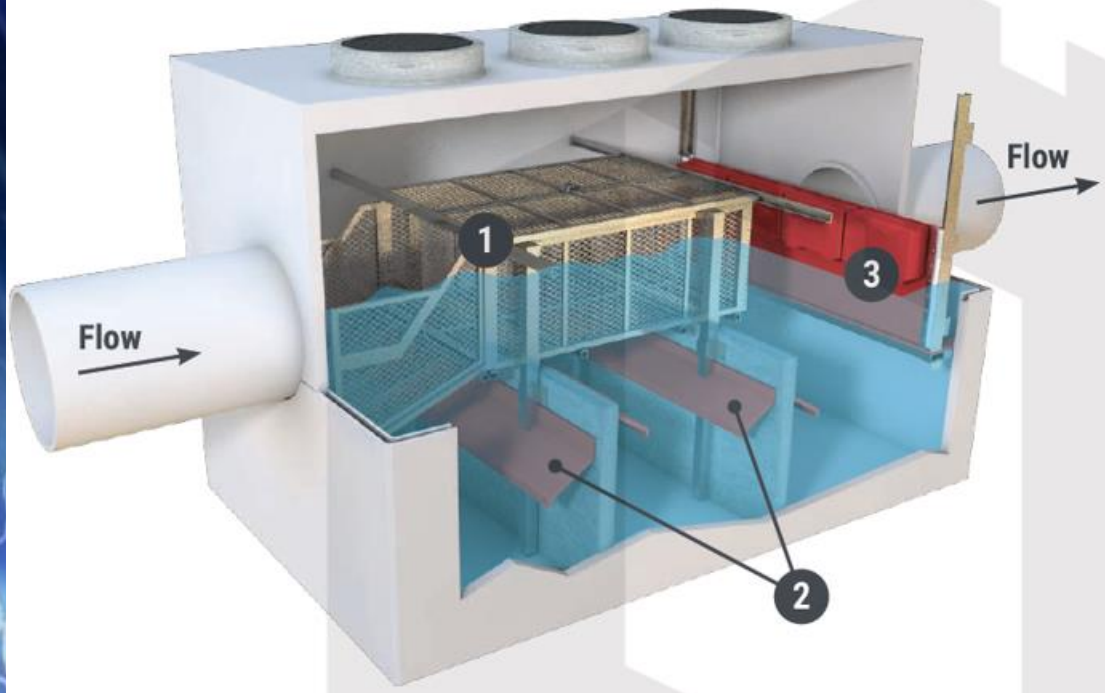
Hydrodynamic Separator

Nutrient Separating Baffle Box (NSBB)



During Storm Event

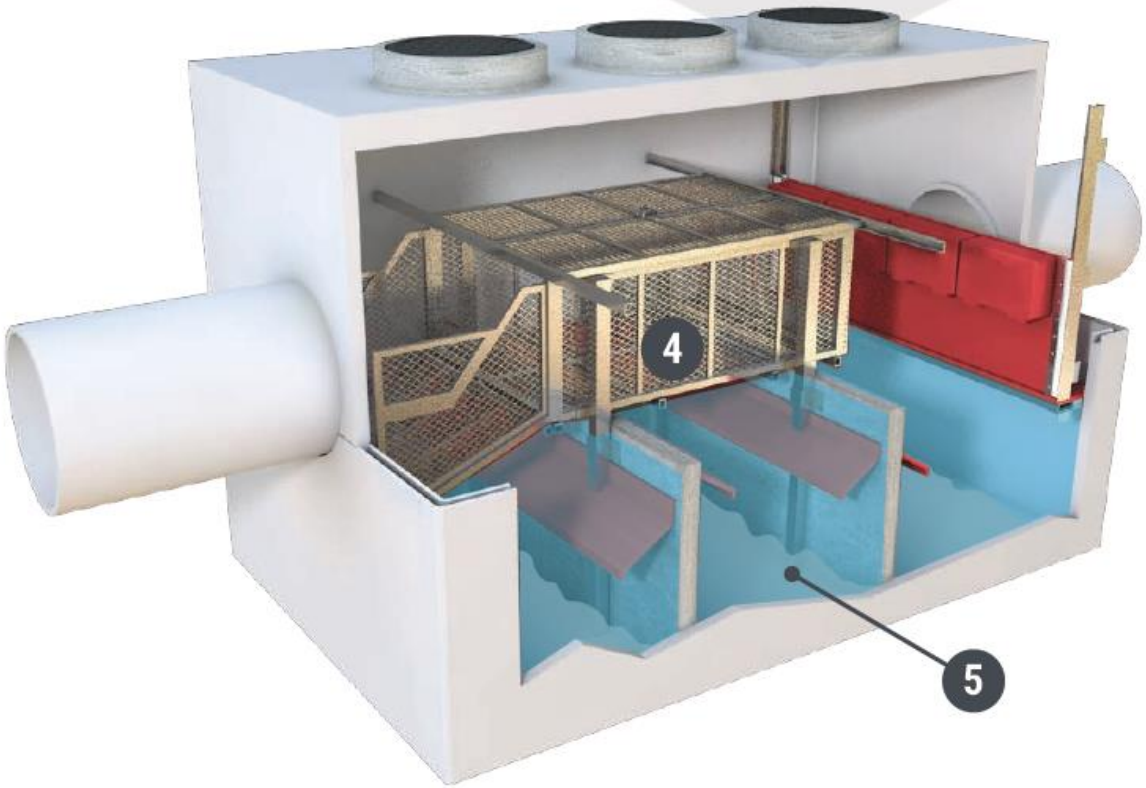
Nutrient rich organics and litter are captured in the screen system.



1. Runoff filters through the screen and skimmer leaving pollutants behind. Left over runoff evaporates over time.
2. Turbulence defectors prevent captured sediment from becoming resuspended.
3. Hydrocarbons and other floating debris are trapped upstream of the floating skimmer.

After Storm Event

Debris dry out between storm events while pollutants are stored above the static water. As a result, the system does not turn septic.

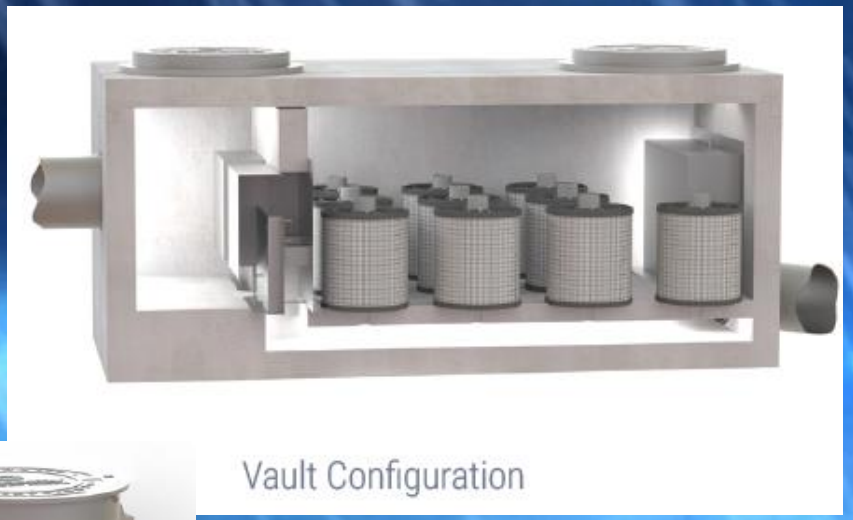


4. Nutrient pollutant load is not lost to static water and will not be flushed out during the next storm event.

5. Separating organic matter from the static water prevents bacterial buildup.

Cartridge Filtration

Concrete Catch Basin



Vault Configuration

Manhole Configuration

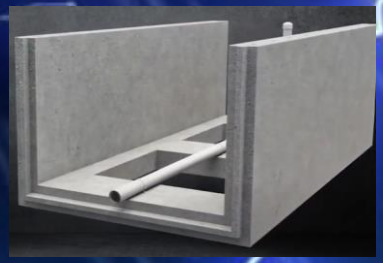
Table 1. PerkFilter Performance Summary

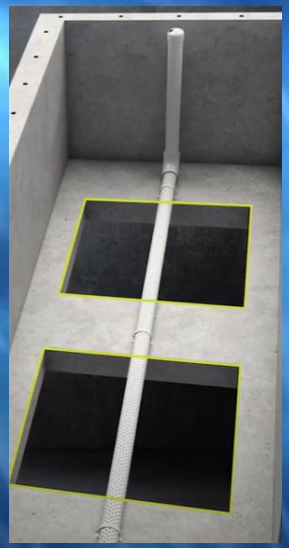
Parameter	Influent Concentration Range	Effluent Concentration Range	Average Removal Efficiency
TSS	20 - 200 mg/L	3 - 36 mg/L	82%
TSS	100 - 200 mg/L	8 - 36 mg/L	85%
Total Phosphorus	0.1 - 0.5 mg/L	0.02 - 0.2 mg/L	62%
Total Zinc	0.04 - 0.25 mg/L	0.009 - 0.098 mg/L	62%
Total Copper	0.005 - 0.035 mg/L	0.002 - 0.015 mg/L	50%
Aluminum	0.34 - 9.3 mg/L	0.07 - 1.7 mg/L	76%

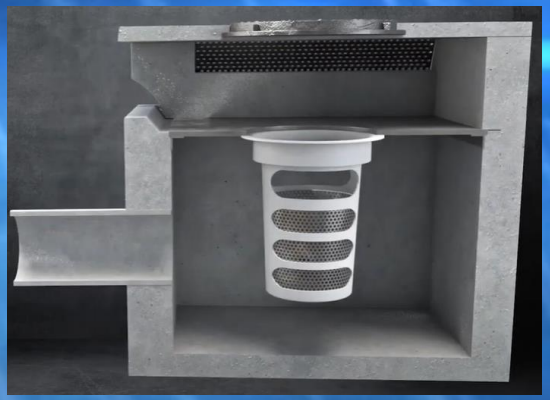

NO
PARKING
WELCOME TO OUR
Tobacco-Free Beach

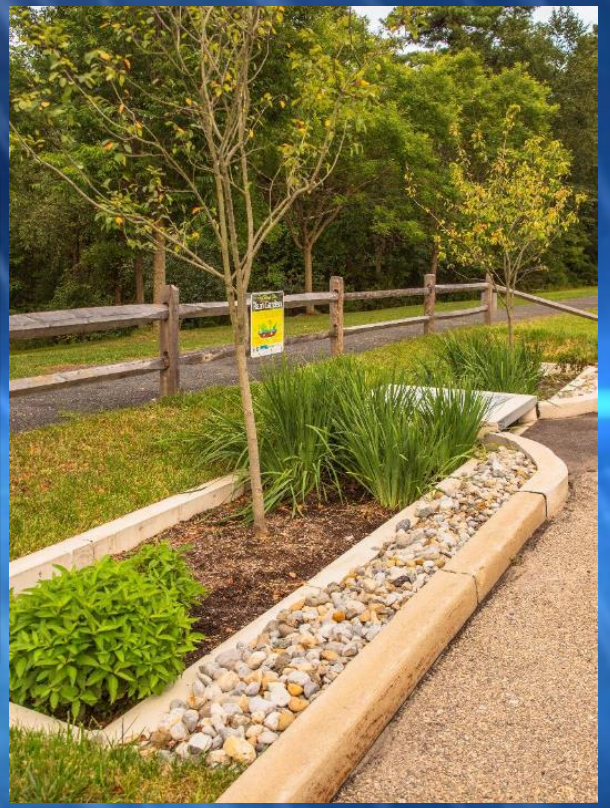
Biofiltration

Biofiltration: Terramod









Biofiltration: BioPod

- High-Flow Bypass
- Flexible Design
- Water Quality
- LEED Potential
- Treatment Train
- Optional integrated bypass reduces construction costs by eliminating the need for a separate bypass structure.
- Available in multiple sizes to meet your site-specific requirements.
- Proprietary media engineered to remove fine sediment, nutrients, petroleum hydrocarbons as well as dissolved metals.
- Can contribute towards earning LEED points for your project.
- Ability to stand-alone or be incorporated into a stormwater ‘treatment train.’


™ Module With StormMix™ Media

Biofiltration BioPod

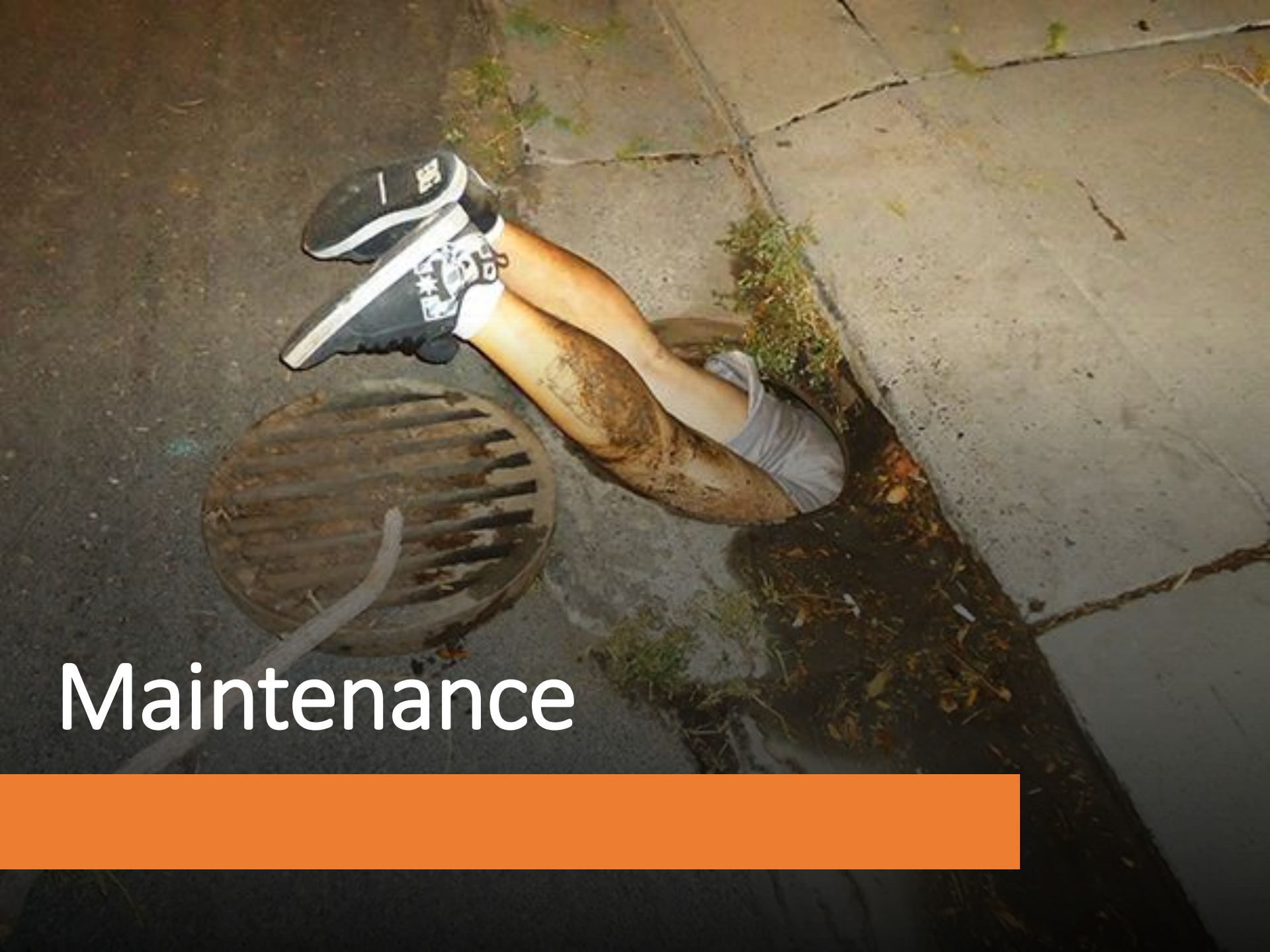
Flow Rate[a] (gallons/minute)
25
38
51
57
76
95
115
204

Expected Treatment Capabilities

Based on laboratory testing (Herrera 2016a), the **TreePod™ is capable of removing 97, 94, and 97 percent of influent total phosphorus, dissolved copper, and dissolved zinc, respectively**. In addition, **it is expected to reduce total suspended solids by at least 80 percent** when influent concentrations are 100 to 200 mg/L and exhibit effluent concentrations below 20 mg/L when influent concentrations are between 20 and 100 mg/L. Table 3 presents a summary of the water quality results from the PULD application.

Table 3. Summary Results from PULD Lab Testing.

Parameter		Dissolved Copper	Dissolved Zinc	Total Suspended Solids	Nitrate + Nitrite	Total Phosphorus
Units		ug/L	ug/L	mg/L	mg-N/L	mg-P/L
TAPE Goal		>30%	>60%	≤20 mg/L		≥50%
Mean Influent Concentration		10.6	117.4	45.7	116	2.406
Media	**Column No.**	**Average Percent Removal**	**Average Percent Removal**	**Effluent Concentration**	**Average Percent Removal**	**Average Percent Removal**
TreePod™ Media Mix	62	94%	97%	9.8	39%	97%



Maintenance

Stormwater Detention & Reuse

Definitions

- Detention – stormwater is stored temporarily
- Retention – stormwater is stored permanently
- Infiltration – stormwater flows downward to recharge groundwater aquifer
- Harvesting – stormwater is treated and used again for non-potable purposes, such as irrigation

Box Store = 63,067 sf footprint or 1.45 acres

3" of rain = 118,605 gallons of stormwater

Parking is at least twice the size of store

237,210 gallons

HURRICANE IRMA, 2017

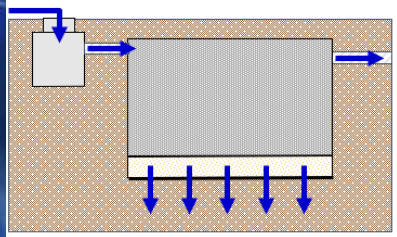
Section of RT 9 in Westborough, MA
Lots of Roof and Pavement

Zoomed in on one plaza

Westborough, MA

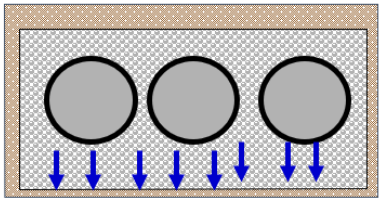
Where is this Stormwater Going?

Evolution of Drain Field Designs



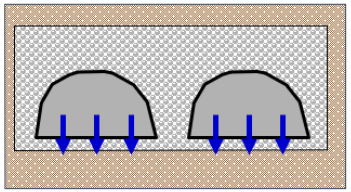
Drainage Stone Bed

- Excavation filled with Drainage Stone
- 40% Void Space for Water Storage
- Inefficient – But It Worked



Pipe & Stone Filled Bed

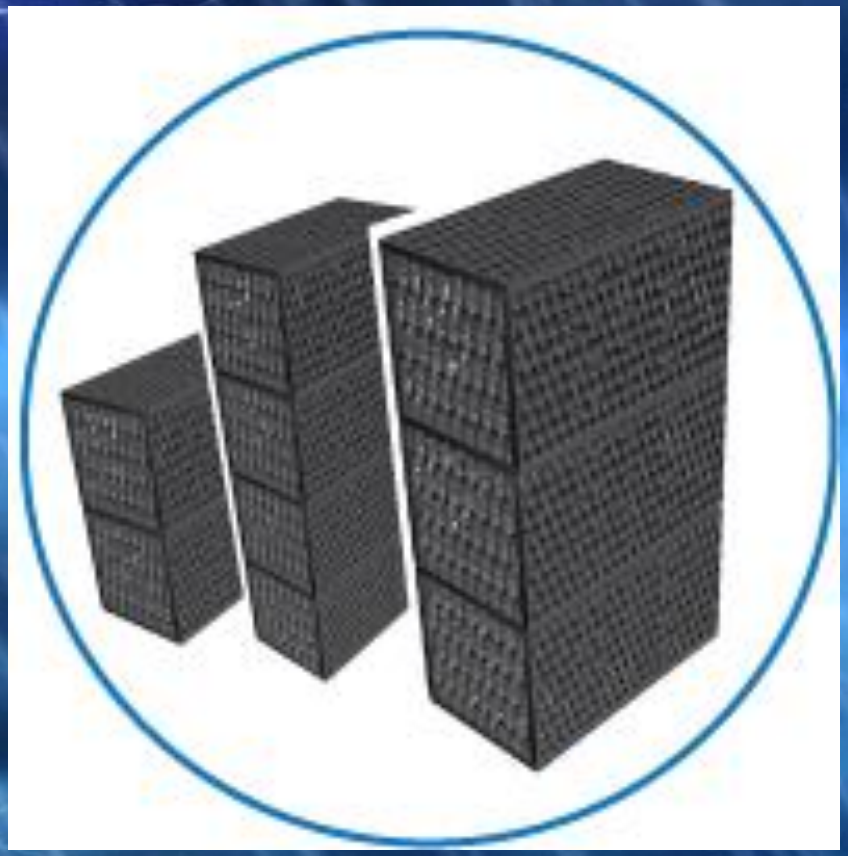
- Pipe Creates Additional Void Area
- Heavy use of stone (60-70%) to fill corners



Plastic Arch & Stone Filled Bed

- Squares off bottom corners to increase efficiency
- Stone still required (59%) to fill corners and provide structural support

Geo-Cellular Detention Systems
Evolution of Drain Fields



New Technology provides 95% VOID Space!

Geo-Cellular Detention Systems
Evolution of Drain Fields

Geo-Cellular Detention Systems
Evolution of Drain Fields

No uniform design standard in USA

CIRIA

C680/C737

- Inconsistent product design / specifications.
- No lifetime creep testing requirements for structural design.
- System loading dependent on civil design.
- Installation accuracy extremely important.
- Access and Maintenance Requirements

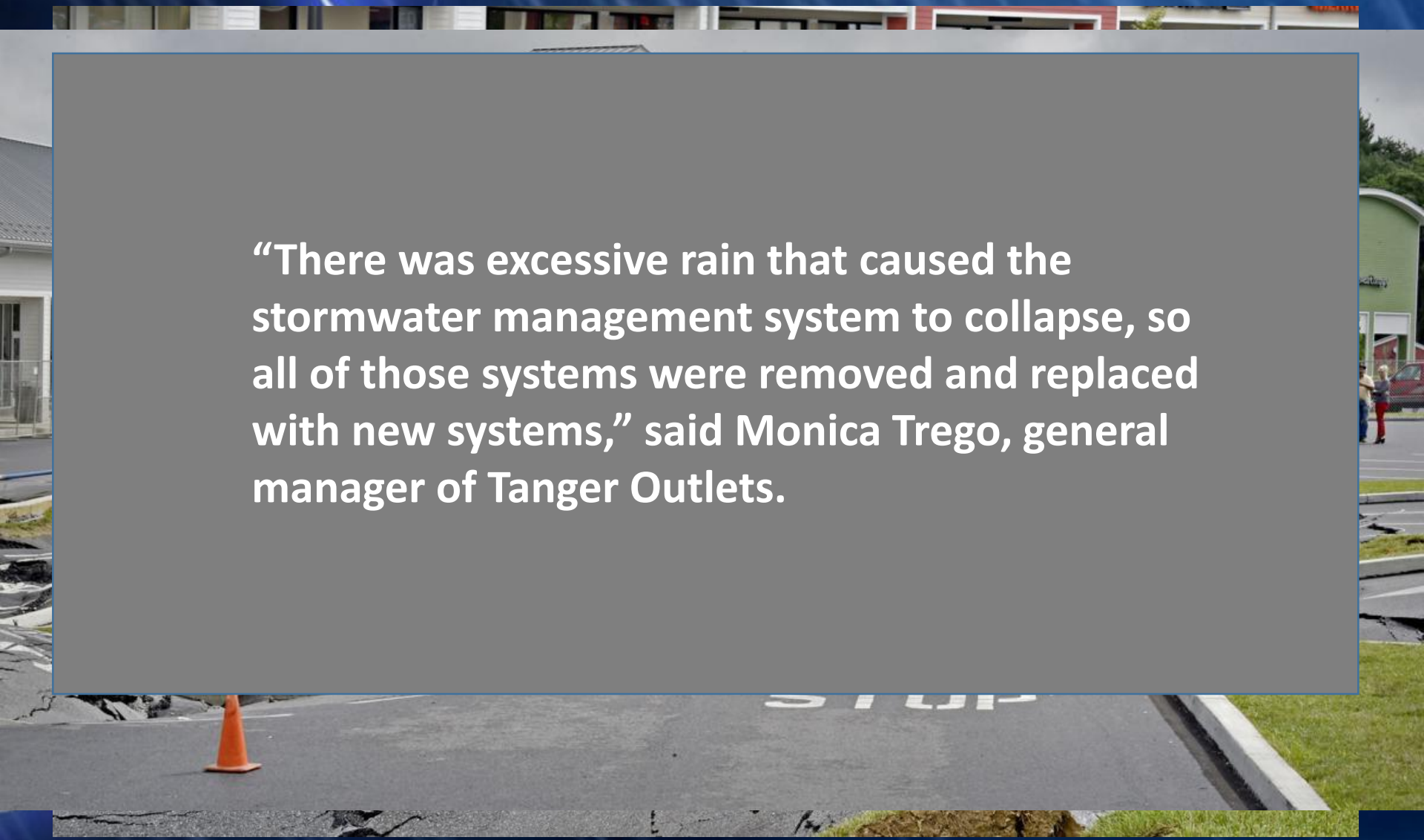
Geo-Cellular Detention Systems
Evolution of Drain Fields

- Ultimate (ULS) and Serviceability(SLS) Limit States
- Partial factors of safety for loads and materials
- Ultimate Limit State Loads
  a) Vertical 1.4 and 1.6
  b) Buoyancy 1.0, 0.95 and 1.5
  c) Lateral 1.35 and 1.5
- Serviceability Limit Sate Loads
  a) Vertical 1.0
- Ultimate Limit State Materials
  a) General 2.75
  b) Accidental 2.0 – 2.75
- Serviceability Limit State Materials
  a) Short term elastic deflections 1.5
  b) Long term creep deflections 1.0 - 1.5
- Testing
  a) Static vertical and lateral load tests
  b) Dynamic/cyclic tests
  c) Creep and durability tests

CIRIA

C680/C737

Geo-Cellular Detention Systems
Evolution of Drain Fields

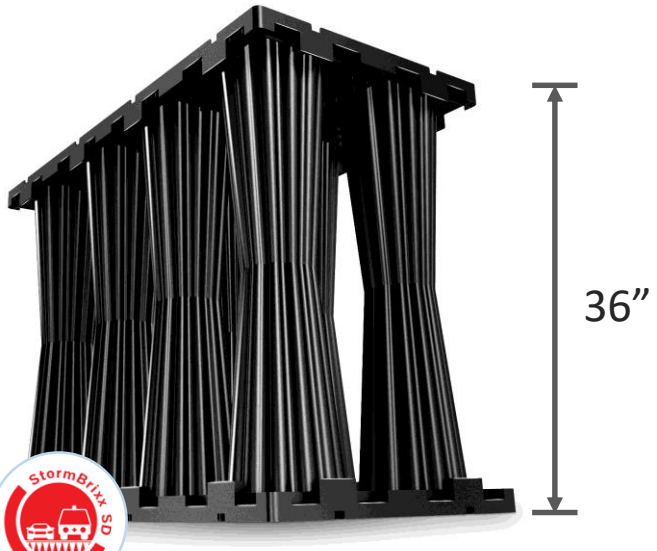


“There was excessive rain that caused the stormwater management system to collapse, so all of those systems were removed and replaced with new systems,” said Monica Trego, general manager of Tanger Outlets.

Pittsburgh Botanical Gardens

- STORMBRIX X SD & HD

MAIN BODY PIECES

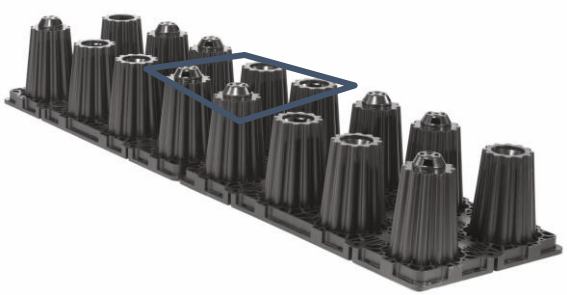


(2 half bodies - 1 layer)

(2 half bodies - 1 layer)

- COMPONENTS

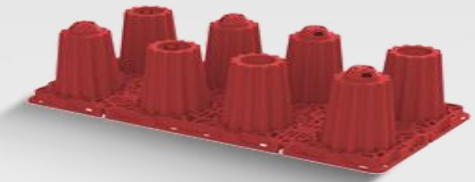
- ADVANTAGES OF BRICK BONDING

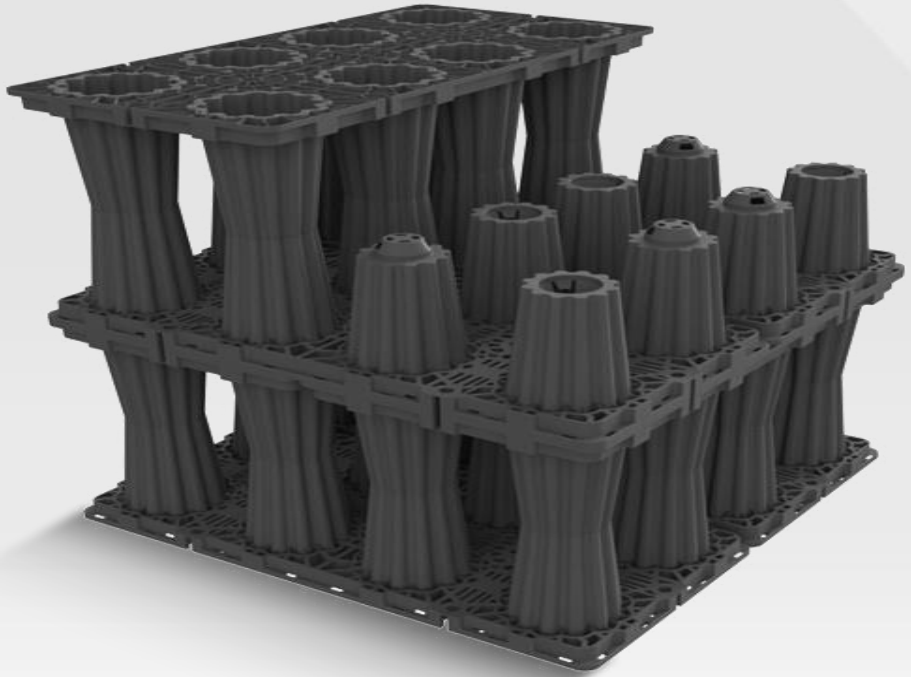


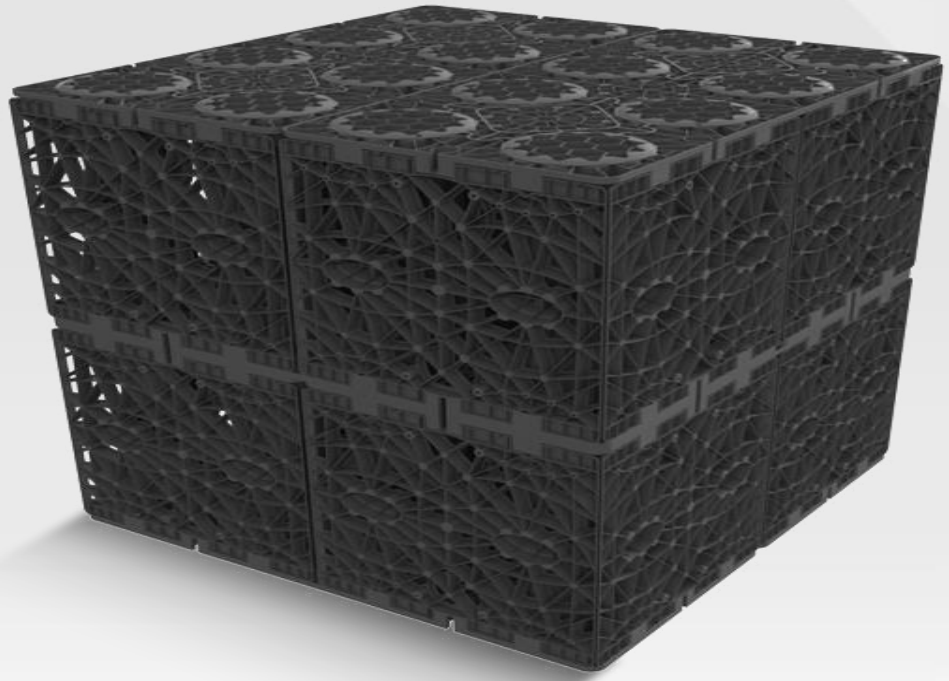
ADVANTAGES

- High structural strength due to female-male connections
- No connectors needed within 1 layer
- No shifting between the base elements → even load distribution on pillars
- Faster and easier installation → time and cost saving
- Protection against differential settlement

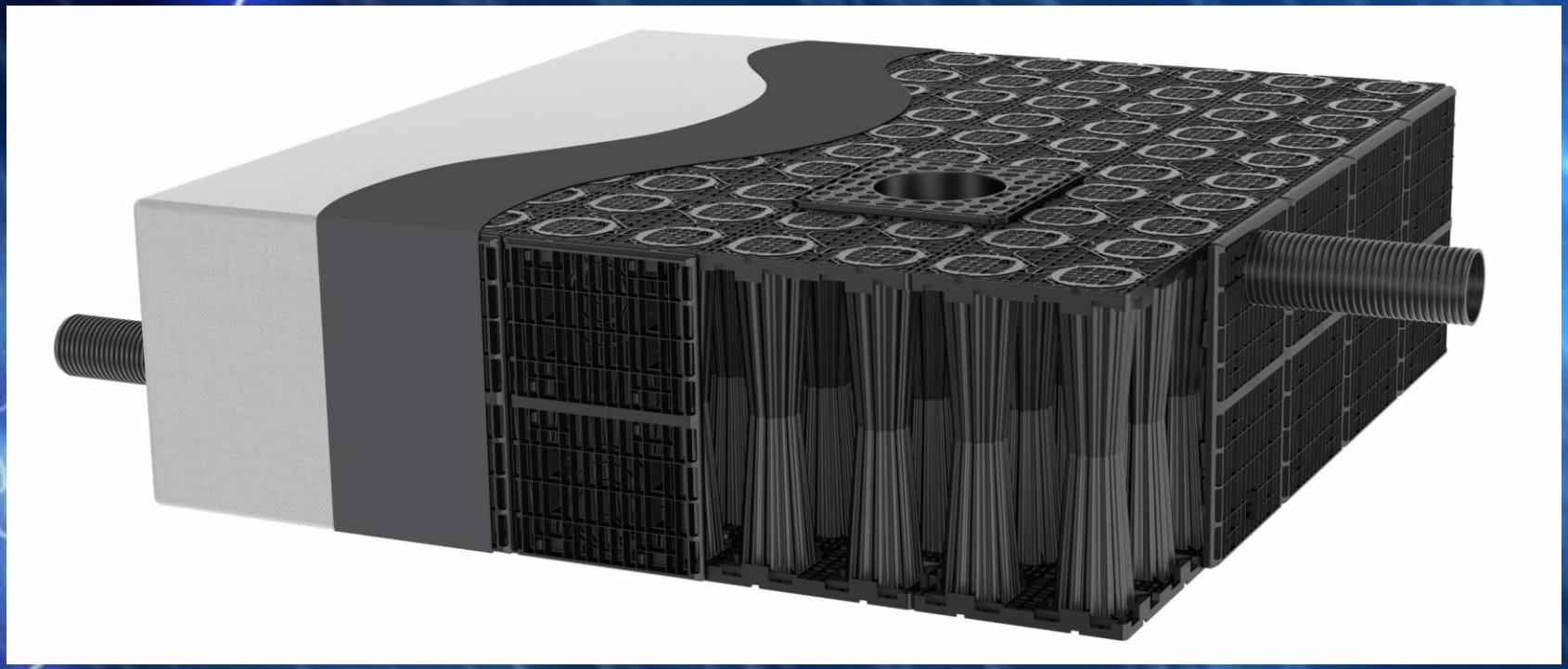
- PRODUCT CONFIGURATIONS







Geo-Cellular Detention Systems
Evolution of Drain Fields



Geo-Cellular Detention Systems
Evolution of Drain Fields

Geo-Cellular Detention Systems
Evolution of Drain Fields

From This

To This in a little over an hour

Area: 21.5’x 20’
Volume: 1,240CF

Lyndonville NY
Dollar General

Tank Dimensions

45’ x 13’ x 6’

4 Laborers 2.5 hours

Blodgett School
Syracuse, NY

Tank Dimension

31.5’ x 21.5’ x 3’

2 Laborers 1.5 hours

Horseheads CSD
Horseheads, NY

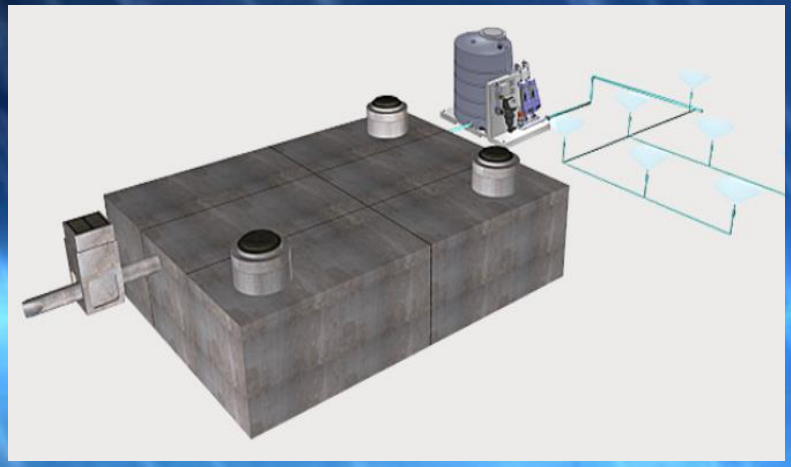
Tank Dimensions

98.5’ x 65’ x 18”

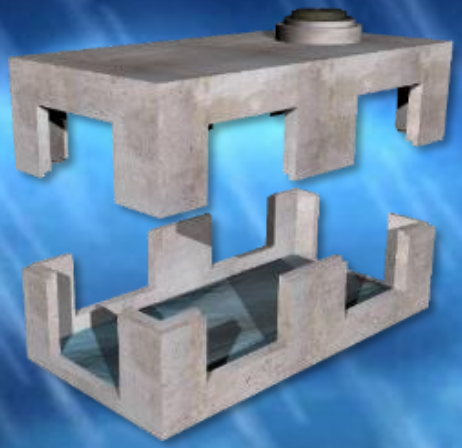
5 Laborers 5 hours

Don’t wait until it’s to late to call for help.

Concrete Retention/Detention



Concrete Retention/Detention



Concrete Retention/Detention

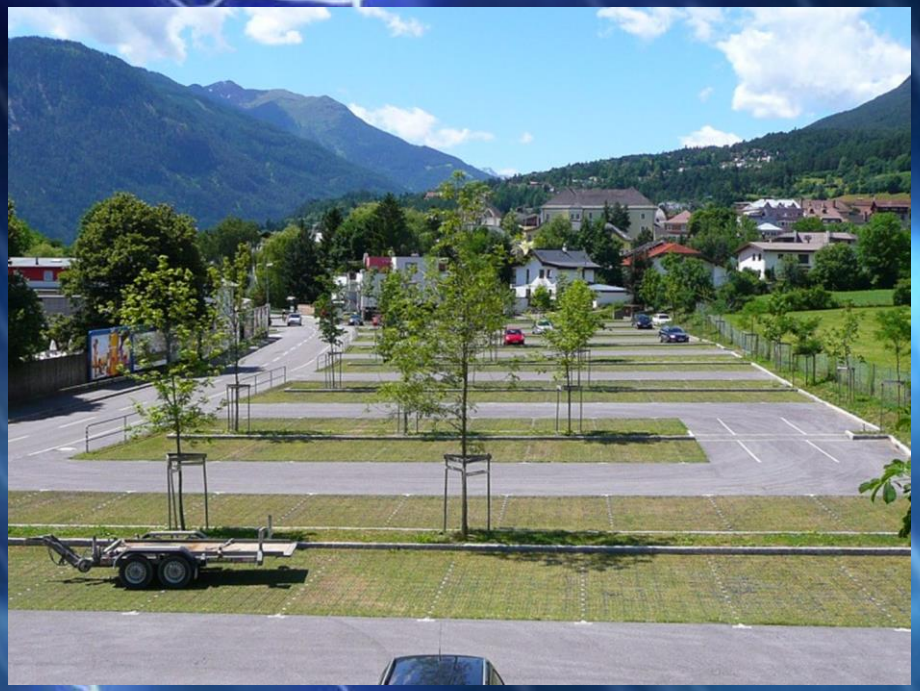
Concrete Retention/Detention

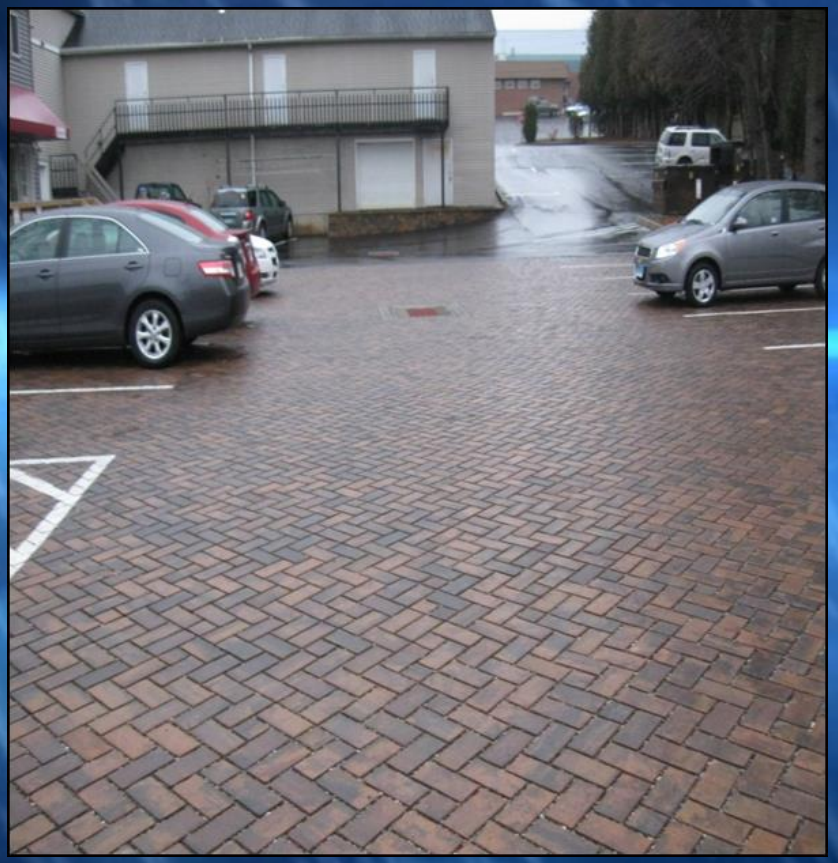
Concrete Retention/Detention

Don’t Forget

Maintenance

Permeable Pavements





PERMEABLE PAVEMENT BENEFITS

- Reduce storm water runoff. (Even when pervious pavement structure is saturated, its rough surface texture continues to slow surface flow of stormwater)
- Replenish groundwater
- Reduce flooding which may over-load combined sewer sewage treatment plants
- Reduce peak rates of discharge by preventing large fast pulses of precipitation from entering the stormwater system
- Require less land set aside and cost for development of retention basins
- Reduce pollutants in run-off & Improves water quality
- Reduce pavement ice buildup
- Reduced stream erosion
- Reduction in the urban heat island effect
- ADA Compliant

Assessment of Learning

1. 1” of rain on 1 acre of ground produces how much water?
2. T/F: One benefit of Modular Underground Stormwater systems is that you can capture stormwater in a smaller footprint compared to other applications
3. To eliminate contaminates from entering into waterbodies you could
   - A. Direct all stormwater directly into a receiving waterbody
   - B. Retain/Detain stormwater onsite
   - C. Construct asphalt lined stormwater ponds to warm the water effectively “boiling off” any pollutants
4. T/F: Stormwater Management practices are self – maintaining and therefore require no maintenance
5. What is considered the worlds most extracted raw material
6. Impacts of urbanization include
   - A. Streambank Erosion
   - B. Increased local flood risk
   - C. Contamination of receiving waterbodies
   - D. All of the above

Thank You

Doug McCluskey
Team EJP
518.764.8555
doug.mccluskey@ejprescott.com

TEAM EJP

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