RAIN GARDENS:
Introduction and Practice

New Jersey Green Infrastructure Forum

July 31ST, 2013

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Rutgers Cooperative Extension

Water Resources Program

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WHO ARE WE?

Rutgers Cooperative Extension Water Resources Program
The Water Resources Program is one of many specialty programs under Rutgers Cooperative Extension. The mission of the Program is to identify and address community water resources issues using sustainable and practical science-based solutions. This is accomplished through research, education, outreach, and implementation.

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WHAT ARE RAIN GARDENS?

RAIN GARDENS

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A rain garden is a landscaped, shallow depression that is designed to intercept, treat, and infiltrate stormwater at the source before it becomes runoff. The plants used in the rain garden are native to the region and help retain pollutants that could otherwise harm nearby waterways.

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HOW DO YOU BUILD A RAIN GARDEN?

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- The design of a rain garden involves understanding several interrelated principles including:
  - The hydrologic cycle or water cycle,
  - Nonpoint source pollution,
  - Natural resource conservation,
  - Wildlife habitat,
  - Nutrient cycles,
  - Soil chemistry,
  - Horticulture,
  - Landscape architecture,
  - Design,
  - Ecology, and more.

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PARTS OF A RAIN GARDEN

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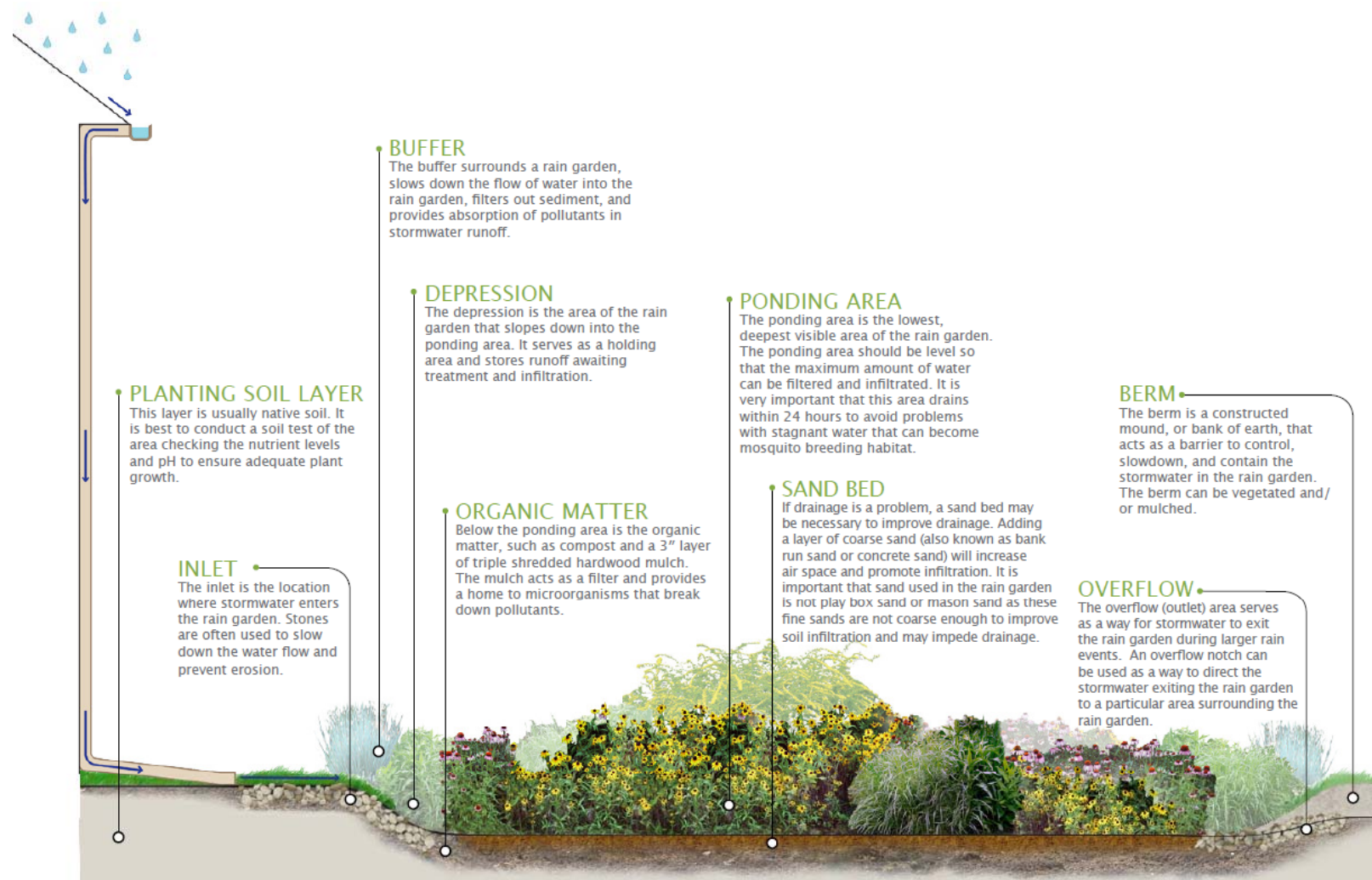
BUFFER
The buffer surrounds a rain garden, slows down the flow of water into the rain garden, filters out sediment, and provides absorption of pollutants in stormwater runoff.

DEPRESSION
The depression is the area of the rain garden that slopes down into the ponding area. It serves as a holding area and stores runoff awaiting treatment and infiltration.

PONDING AREA
The ponding area is the lowest, deepest visible area of the rain garden. The ponding area should be level so that the maximum amount of water can be filtered and infiltrated. It is very important that this area drains within 24 hours to avoid problems with stagnant water that can become mosquito breeding habitat.

PLANTING SOIL LAYER
This layer is usually native soil. It is best to conduct a soil test of the area checking the nutrient levels and pH to ensure adequate plant growth.

BERM
The berm is a constructed mound, or bank of earth, that acts as a barrier to control, slowdown, and contain the stormwater in the rain garden. The berm can be vegetated and/or mulched.

ORGANIC MATTER
Below the ponding area is the organic matter, such as compost and a 3″ layer of triple shredded hardwood mulch. The mulch acts as a filter and provides a home to microorganisms that break down pollutants.

SAND BED
If drainage is a problem, a sand bed may be necessary to improve drainage. Adding a layer of coarse sand (also known as bank run sand or concrete sand) will increase air space and promote infiltration. It is important that sand used in the rain garden is not play box sand or mason sand as these fine sands are not coarse enough to improve soil infiltration and may impede drainage.

INLET
The inlet is the location where stormwater enters the rain garden. Stones are often used to slow down the water flow and prevent erosion.

OVERFLOW
The overflow (outlet) area serves as a way for stormwater to exit the rain garden during larger rain events. An overflow notch can be used as a way to direct the stormwater exiting the rain garden to a particular area surrounding the rain garden.

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A RAIN GARDEN CAN BE. . .

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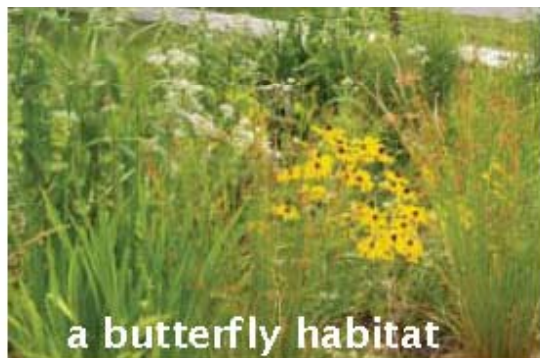
a butterfly habitat

along a sidewalk

trees and shrubs

a parking island

a wet meadow

a perennial garden

- **Rain gardens can be readily implemented throughout communities to begin the process of re-establishing the natural processes of the land.**

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RAIN GARDEN BENEFITS

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- Rain gardens provide a high level of treatment for some types of pollutants.
- The plant material (trees, shrubs, flowers, grasses) within the rain gardens provide native diversity in the landscape and wildlife habitat.
- Stormwater treatment requirements may be satisfied using rain gardens.
- They are aesthetically pleasing and easily incorporated into the existing landscape.

RAIN GARDEN BENEFITS

- Infiltration of runoff/volume control
  - *Provides flood control, groundwater recharge, and nutrient removal*
- Sedimentation and filtration
  - *Removes total suspended solids, floating debris, trash, soil-bound phosphorus, some soil-bound pathogens*
- Absorption to soil particles
  - *Removes dissolved metals and soluble phosphorus*
- Plant uptake
  - *Removes small amounts of nutrients*
- Microbial processes
  - *Removes organics and pathogens*
- Exposure to sunlight and dryness
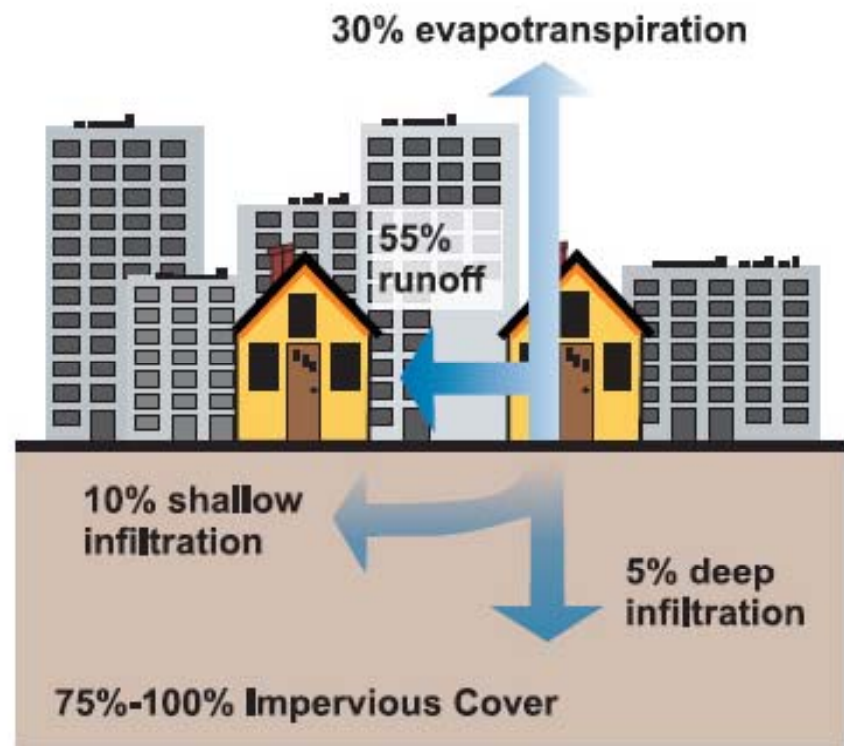 - *Removes pathogens*

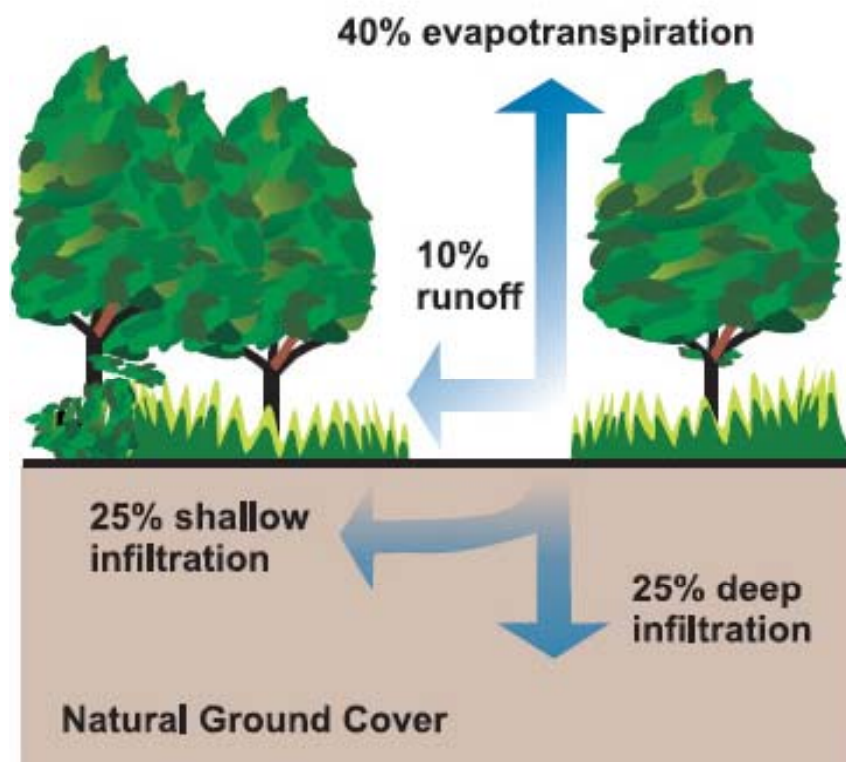# Linking stormwater to flooding, recharge, and pollution…What is impervious cover?

It is the roads, rooftops, parking lots, and other hard surfaces that do not allow stormwater to soak into the ground.

➢ **provides a surface for accumulation of pollutants**

➢ **leads to increased polluted runoff and flooding**

➢ **inhibits recharge of groundwater**

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Impact of impervious cover on stormwater

40% evapotranspiration

10% runoff

25% shallow infiltration

25% deep infiltration

Natural Ground Cover

30% evapotranspiration

55% runoff

10% shallow infiltration

5% deep infiltration

75%-100% Impervious Cover

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We must deal with impacts from impervious cover.

Are there impervious surfaces that you can eliminate?

If we can't eliminate it, can we reduce it?

If we can't eliminate or reduce it, can we disconnect it?

Are there impervious surfaces that you can harvest rainwater for reuse?

Are there conveyance systems that can be converted to bioswales?

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RAIN GARDENS IN PRACTICE

RAIN GARDENS IN NEW JERSEY

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LEGEND

▲ Rain Garden

County Boundary

Physiographic Province

Coastal Plain

Highlands

Piedmont

Valley and Ridge

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TREATMENT OF CAR WASH RUNOFF

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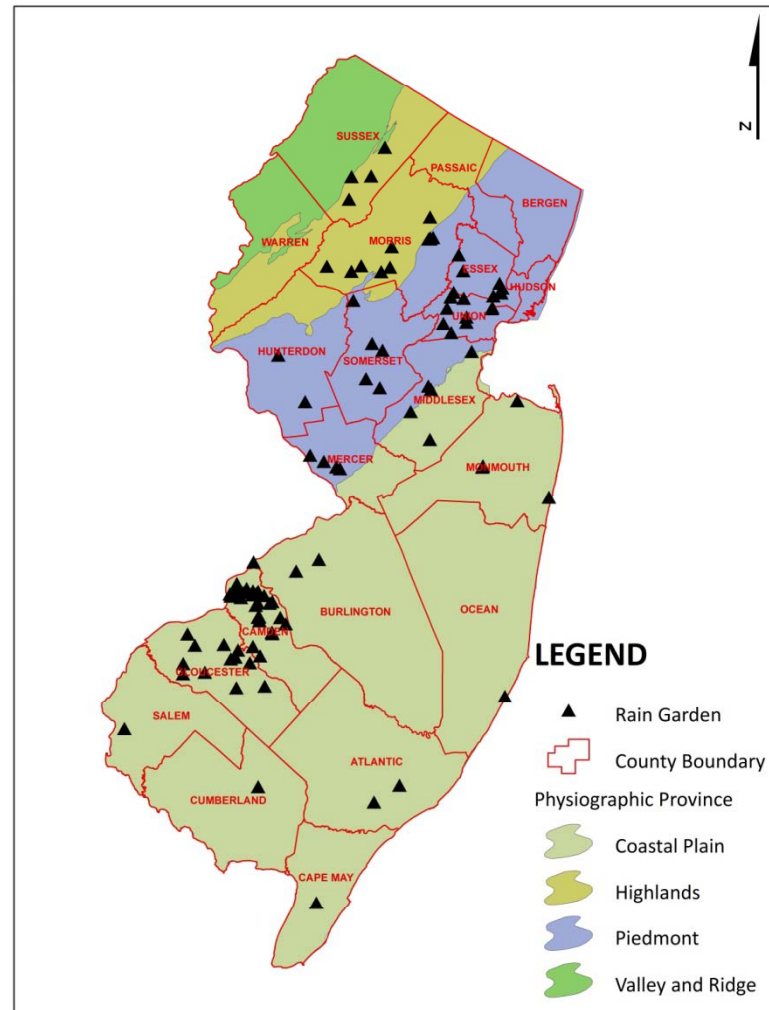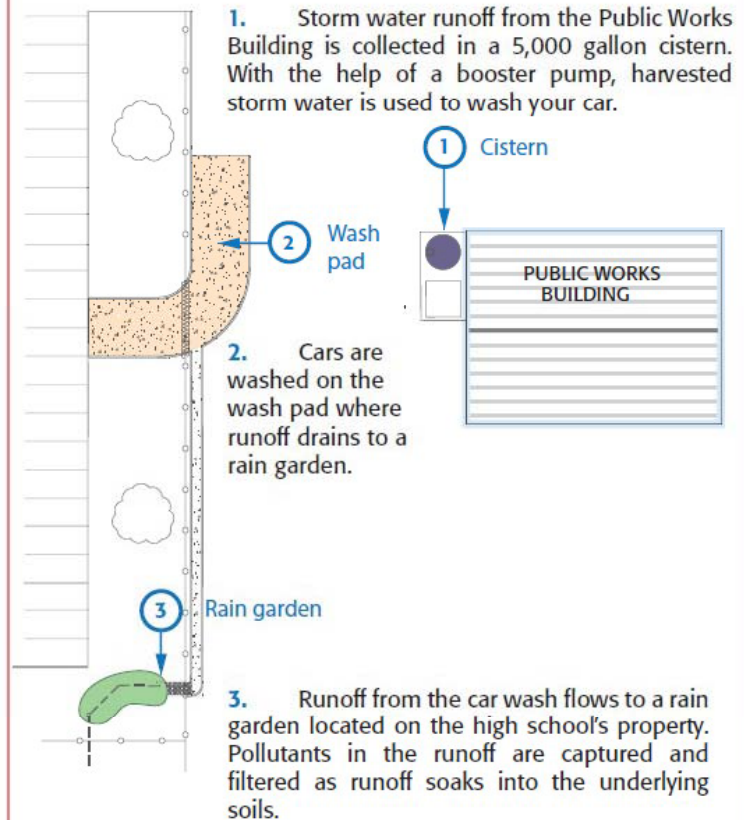
Clark Township Green Car Wash

- We partnered with Clark Township's Department of Public Works (DPW) to build a sustainable car wash in 2012 using low-impact stormwater management techniques (rain water harvesting and a rain garden).

- DPW is adjacent to Clark High School.

Welcome to the **Clark Green Car Wash**, a sustainable car wash that uses harvested rain water to wash your car and a rain garden to filter out and absorb dirty runoff.

Read about the car wash below and thanks for your support!

1. Storm water runoff from the Public Works Building is collected in a 5,000 gallon cistern. With the help of a booster pump, harvested storm water is used to wash your car.

① Cistern

② Wash pad

PUBLIC WORKS BUILDING

2. Cars are washed on the wash pad where runoff drains to a rain garden.

③ Rain garden

3. Runoff from the car wash flows to a rain garden located on the high school's property. Pollutants in the runoff are captured and filtered as runoff soaks into the underlying soils.

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CLARK TOWNSHIP GREEN CAR WASH

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- Car washing fundraisers can be done with harvested rain water at Clark High School and the car wash runoff is treated by the rain garden.

- Each paying customer will also get an educational pamphlet describing the car wash and how low-impact techniques can be applied at home.
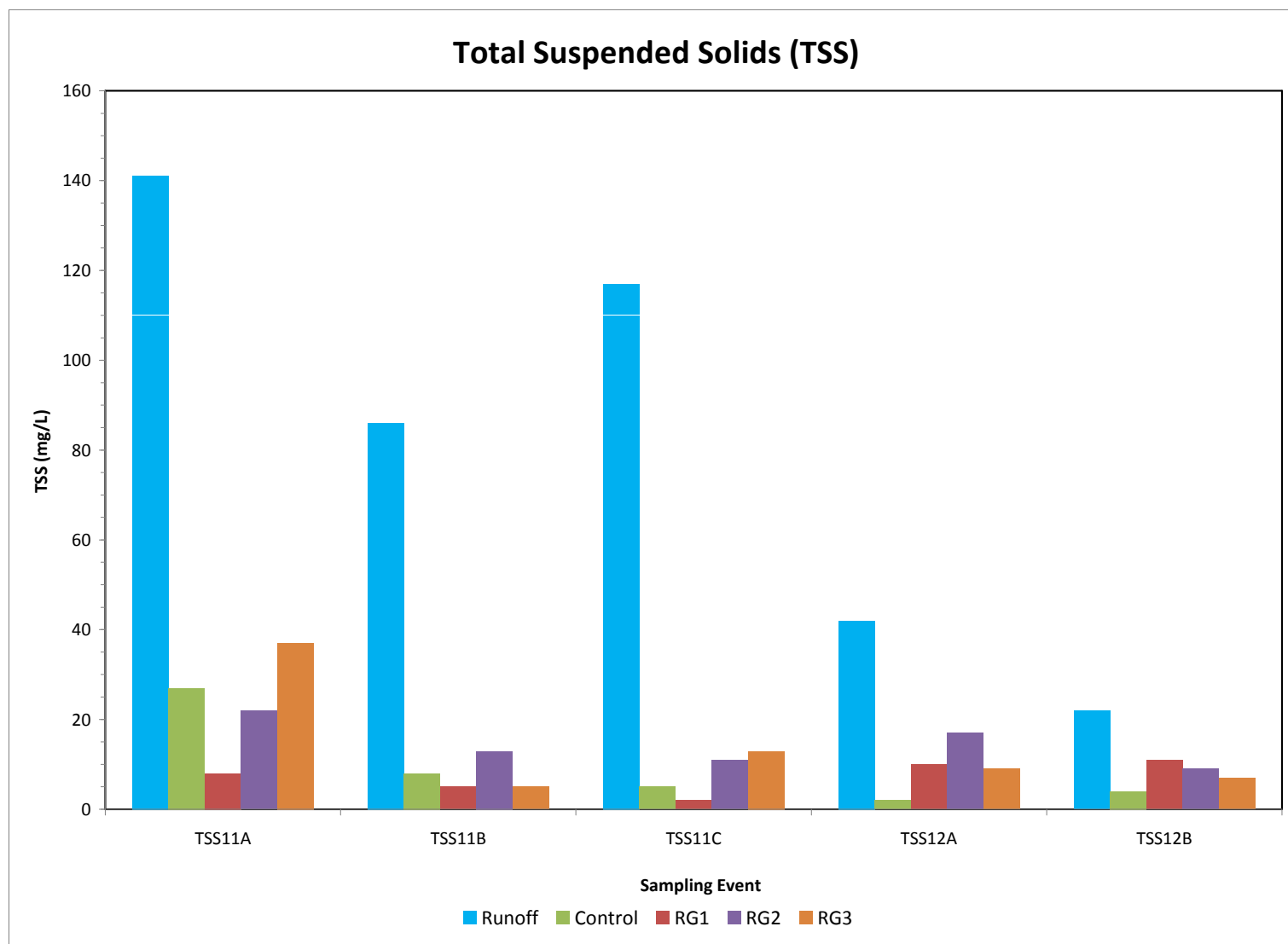
TREATMENT OF CAR WASH RUNOFF

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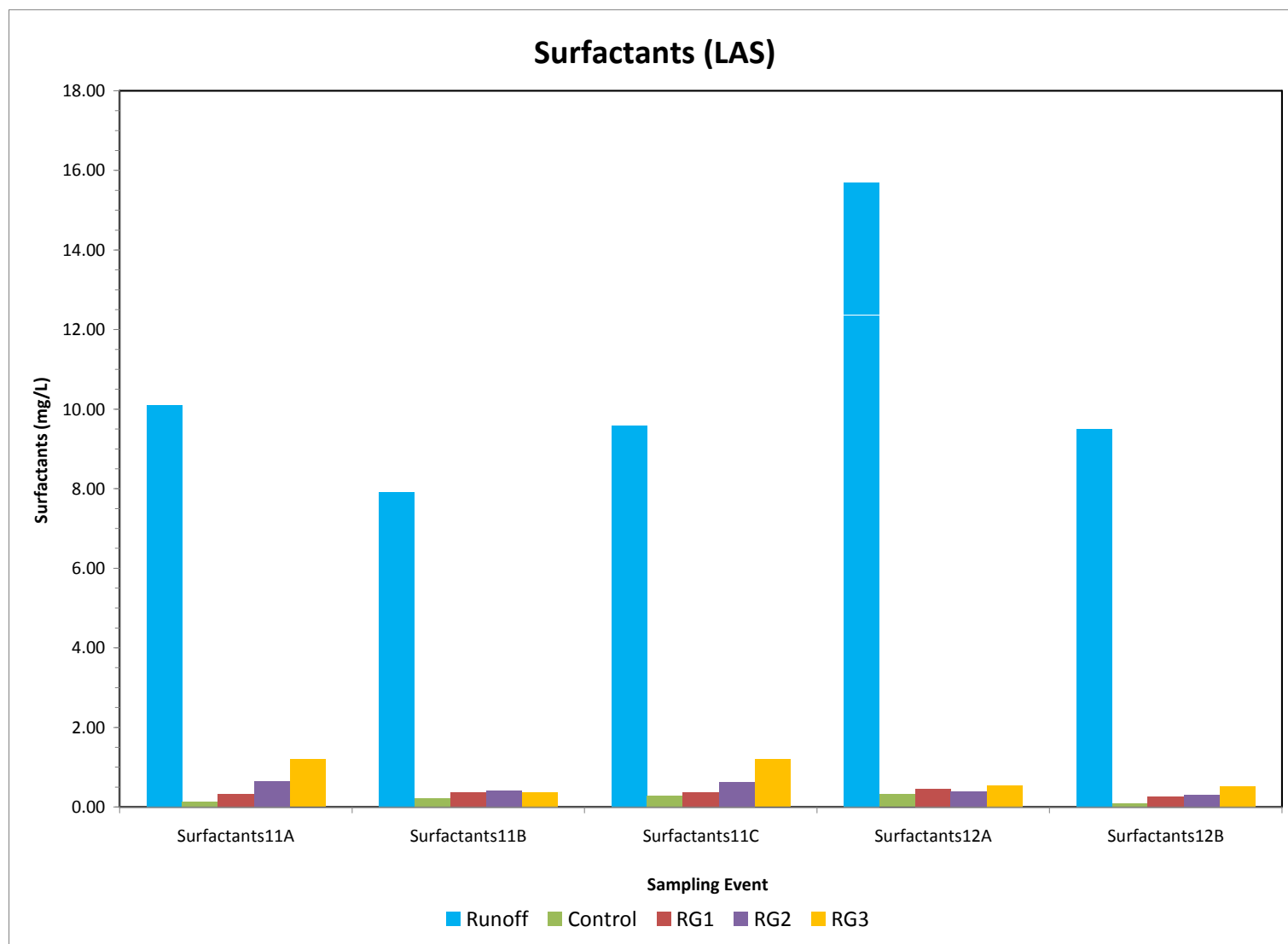New Jersey Agricultural
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- Eight sampling events conducted between October 2011 and July 2013.
- A vehicle was washed and the wash water was collected and discharged into 3 of the 4 mesocosms with clean tap water discharged into the 4th as a control.

RESULTS

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Total Suspended Solids (TSS)

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RESULTS

Surfactants (LAS)

ENHANCED NITROGEN REMOVAL

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- Partnership with Georgian Court University (GCU)

- Our project involves alteration of the 'traditional' rain garden design in order to maximize removal of nitrogen from stormwater runoff.

- Maintaining water storage/saturation in the rain garden media.

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ENHANCED NITROGEN REMOVAL

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SOURCE	PARAMETER		
	Suspended Solids	Total Phosphorus	Total Nitrogen
NJDEP Stormwater BMP Manual	90%	60%	30%
Davis et al. 2009	54% to 99%	-240% to 99%	32% to 99%
Lucas & Greenway 2008	N/A	6% to 36%	34% to 58%
Dietz & Clausen 2006	N/A	-117% to -98%	31% to 51%
Hunt et al. 2006	N/A	-240% to 65%	40%

ENHANCED NITROGEN REMOVAL

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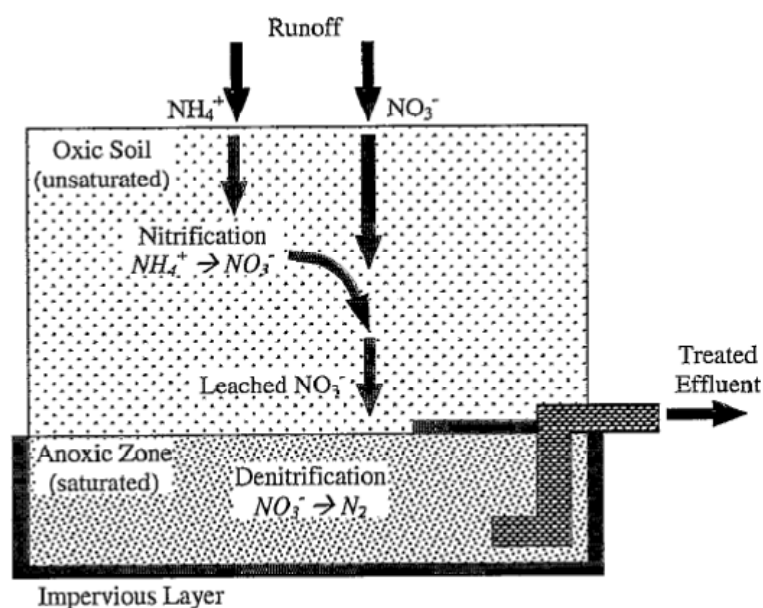
From: Kim, H, E.A. Seagren, and A.P. Davis. (2003).
"Engineered Bioretention for Removal of Nitrate from
Stormwater Runoff." *Water Environment Research*, 75(4),
355-367.

METHODS

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- Installed rain garden next to GCU dining hall to capture roof runoff in November 2011.

- Began monitoring nutrients (nitrogen and phosphorus) in the inflow and outflow to determine removal rates, in July 2012.

- **Project still in progress.**

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CONCLUSION

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- Rain gardens provide various opportunities for stormwater and green infrastructure education.
- Municipalities can benefit from working to improve water quality and lessen runoff volumes through the use of rain gardens.

Thank you!

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