INTRODUCTION TO GREEN INFRASTRUCTURE

HOW WE CAN PROTECT OUR COMMUNITIES AND OUR WATERS

Maywood Public Library
Bergen County, New Jersey

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February 26, 2013

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What is stormwater?

Stormwater is the water from rain or melting snows that can become “runoff,” flowing over the ground surface and returning to lakes and streams.

OVERVIEW

1. What is a watershed?
2. Where does precipitation go?
3. Land Use/Land Cover Changes
4. Nonpoint Source Pollution
5. How can we better manage stormwater?

WHAT IS A WATERSHED?

- An area of land that water flows across, through, or under on its way to a stream, river, lake, ocean or other body of water.

- A watershed is like one big bathtub...

Do you know what a watershed is?

Courtesy of Texas Watershed Stewards, Texas A&M AgriLife Extension

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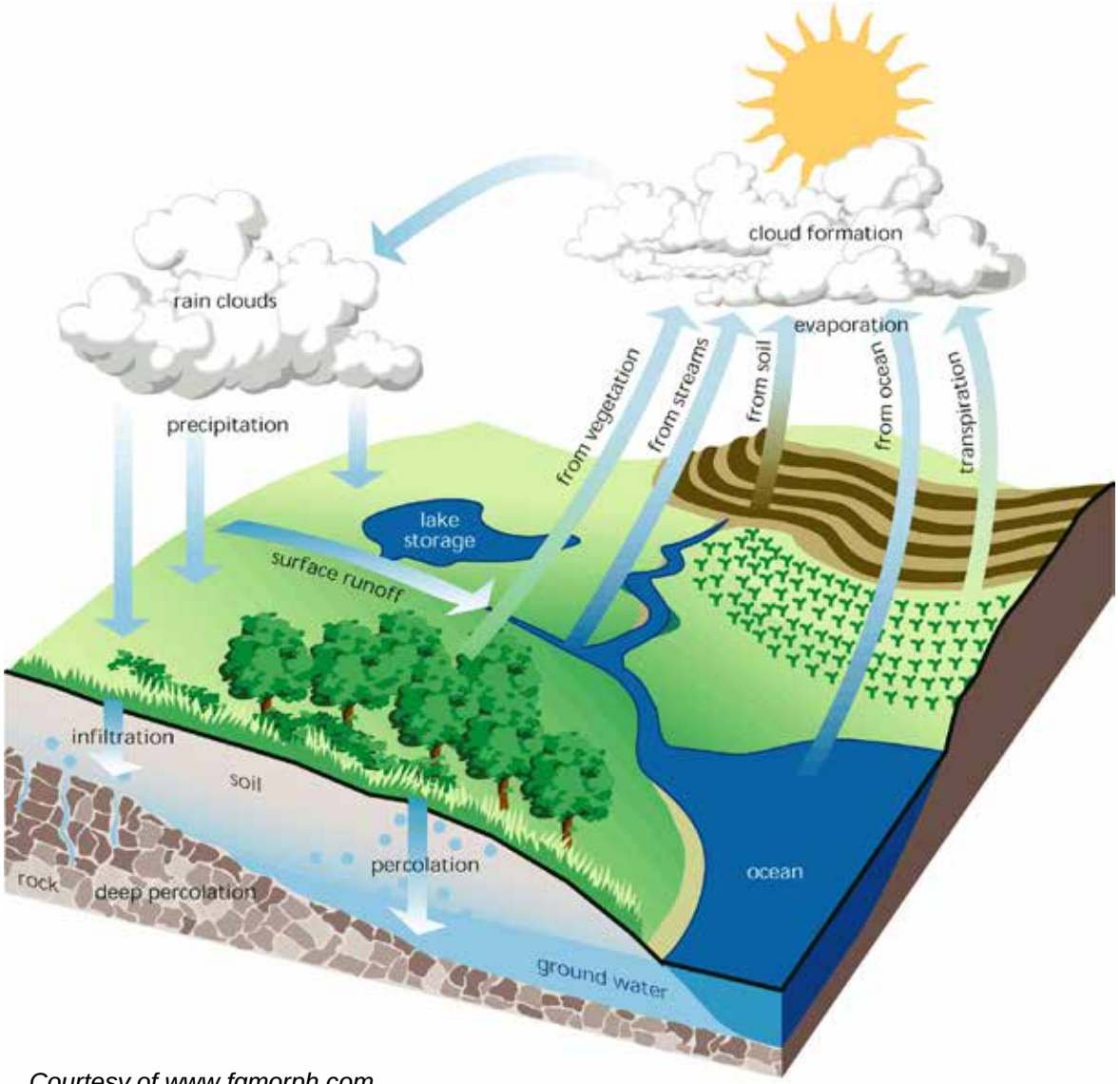
HYDROLOGIC CYCLE



Courtesy of www.fgmorph.com

WHERE DOES PRECIPITATION GO?

1. It can *run off*

Courtesy of Texas Watershed Stewards, Texas A&M AgriLife Extension

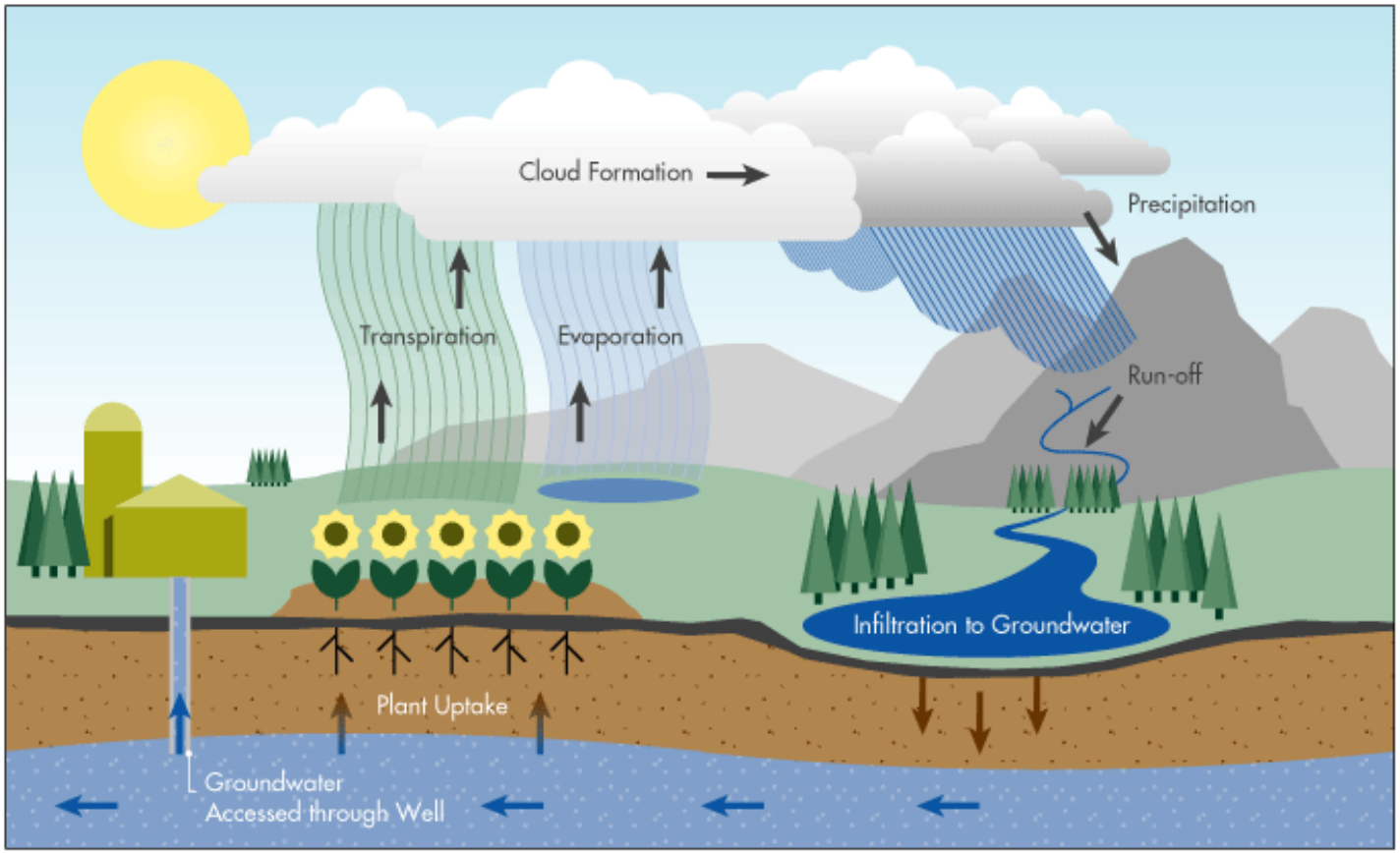
WHERE DOES PRECIPITATION GO?

2. It can be *absorbed* by plants and used for photosynthesis and other biological processes

Courtesy of Texas Watershed Stewards, Texas A&M AgriLife Extension

WHERE DOES PRECIPITATION GO?

3. It can *infiltrate* through the soil surface and percolate downward to groundwater *aquifers*



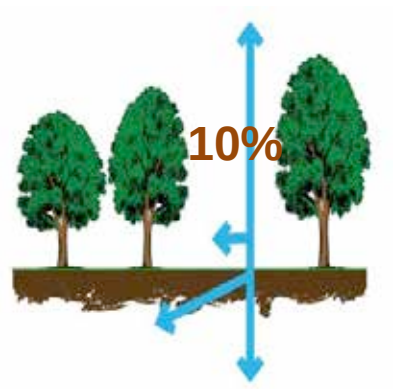
Courtesy of Texas Watershed Stewards, Texas A&M AgriLife Extension

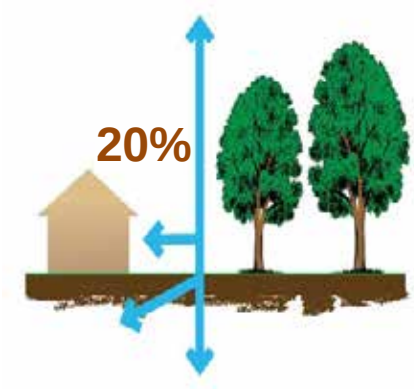
WHERE DOES PRECIPITATION GO?

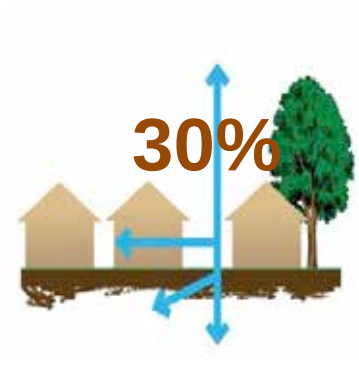
4. It can *evaporate*

Courtesy of Texas Watershed Stewards, Texas A&M AgriLife Extension

The Impact of Development on Stormwater Runoff







More development → *More impervious surfaces* → *More stormwater runoff*

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LAND USE/LAND COVER CHANGES

LAND USE

HOW LAND IS USED BY HUMANS:

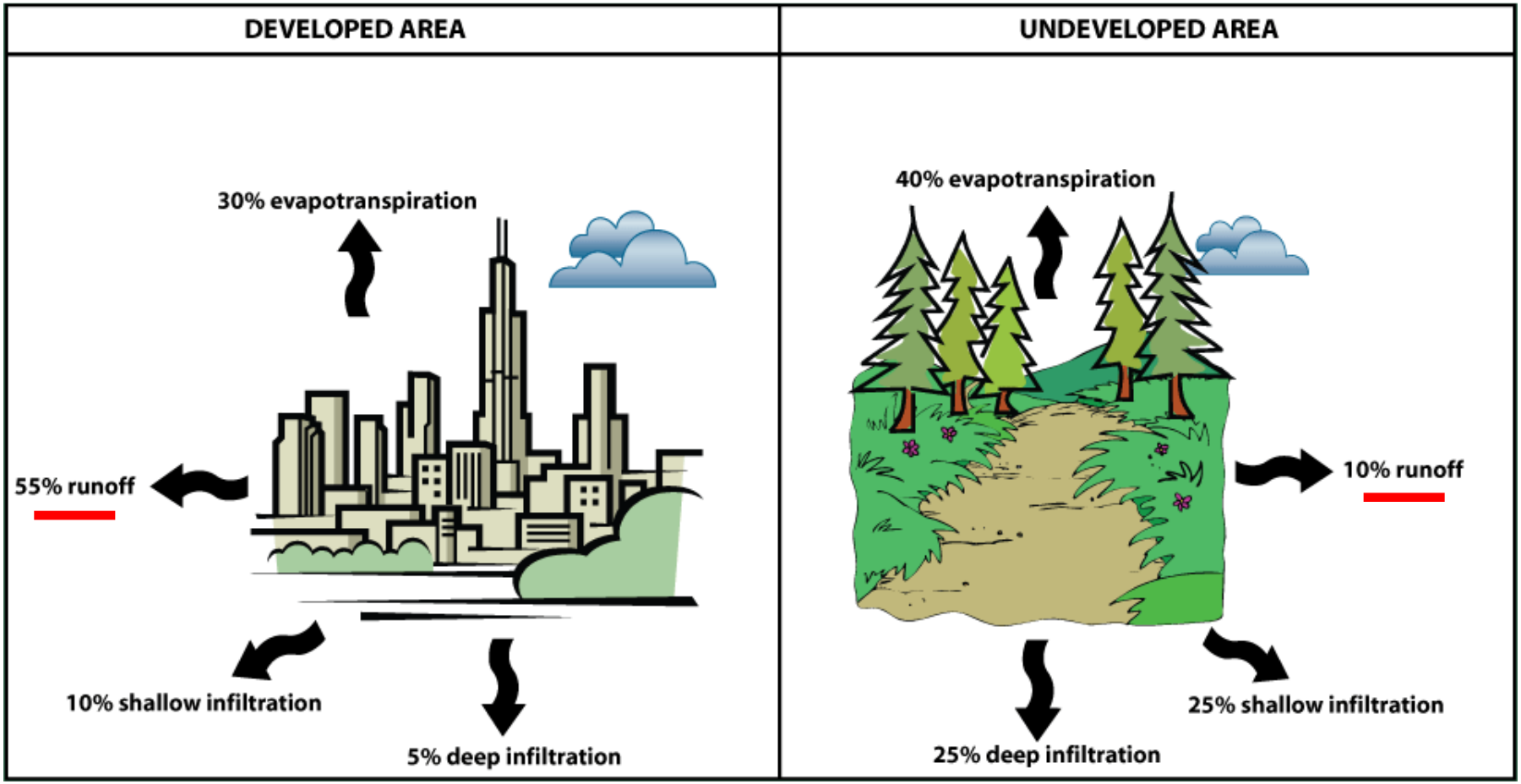
- AGRICULTURE
- INDUSTRY
- URBAN
- RESIDENTIAL
- RECREATION

LAND COVER

BIOLOGICAL AND PHYSICAL FEATURES OF THE LAND:

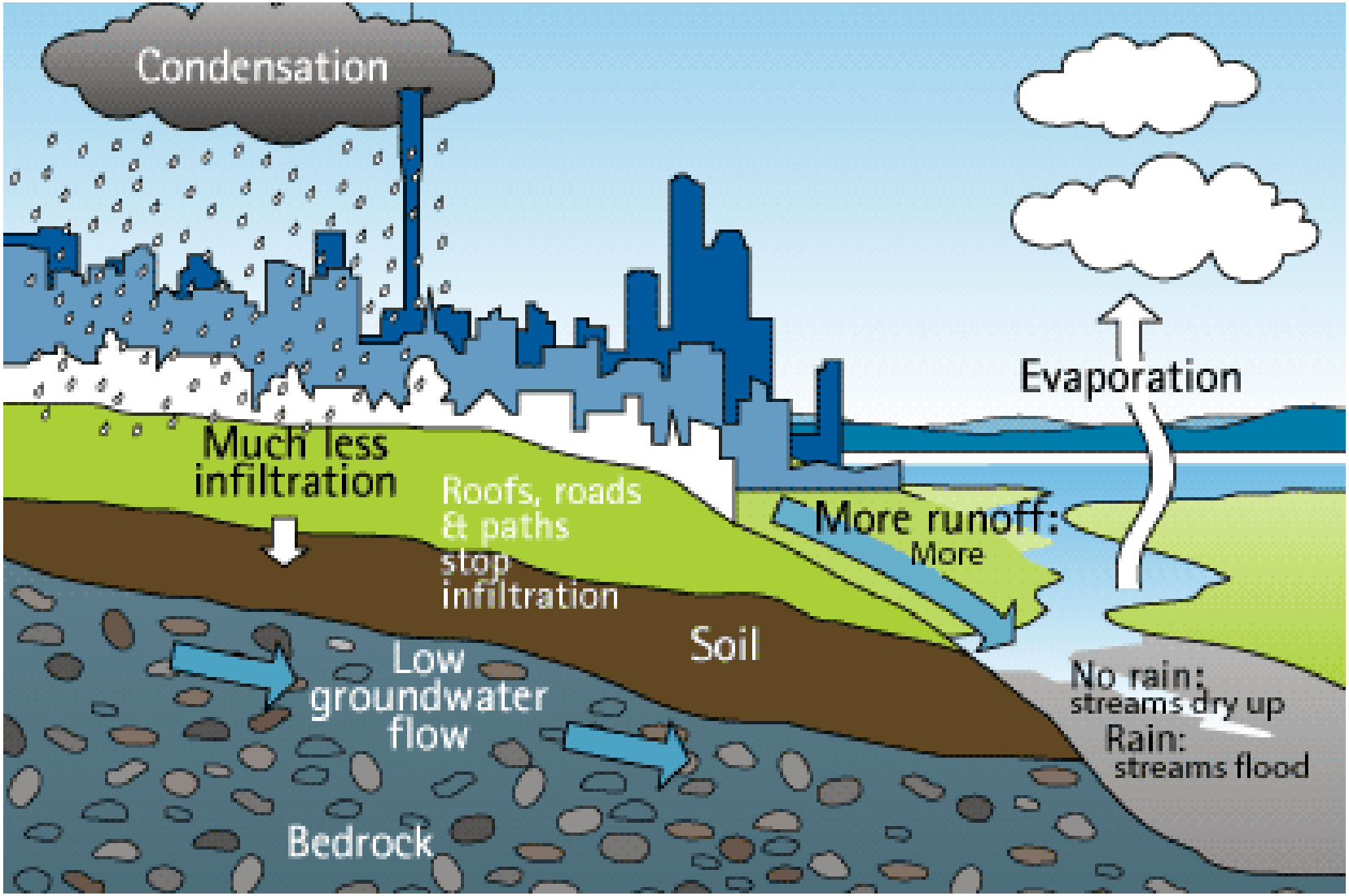
- FORESTS
- GRASSLANDS
- AGRICULTURAL FIELDS
- RIVERS, LAKES
- BUILDINGS, PARKING LOTS

LAND USE/LAND COVER CHANGES



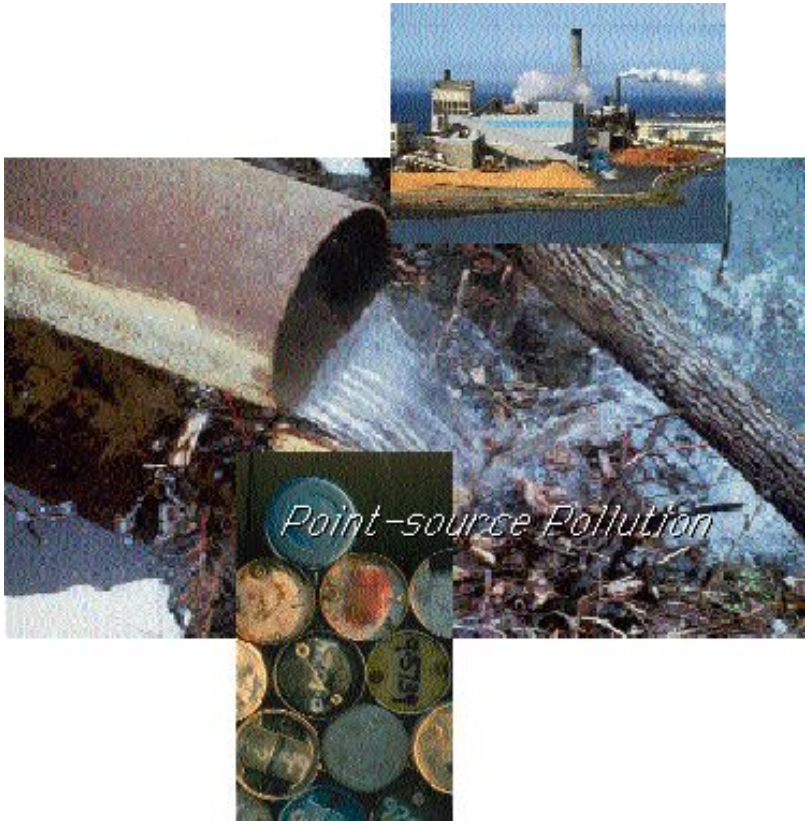
Courtesy of Texas Watershed Stewards, Texas A&M AgriLife Extension

The *Urban* Hydrologic Cycle



WATER POLLUTION SOURCES

POINT SOURCE POLLUTION



NONPOINT SOURCE POLLUTION

Environmental Health Perspective, National Institute of Health

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POINT SOURCE POLLUTION

- Comes from a specific source, like a pipe
- Factories, industry, municipal treatment plants
- Can be monitored and controlled by a permit system (NPDES)

NONPOINT SOURCE POLLUTION

- Nonpoint Source (NPS) Pollution is pollution associated with stormwater or runoff
- NPS occurs when runoff collects pollutants on its way to a collection system or water body
- NPS pollution cannot be traced to a direct discharge point such as a wastewater treatment facility

NPS = “People Pollution”

These pollutants build up on the land then wash off

IMPACT OF NPS

- Fish and wildlife
- Recreational water activities
- Commercial fishing
- Tourism
- Drinking water quality

What are ways we can better manage stormwater in our community?

WHAT ARE OUR TOOLS?

Green Infrastructure

and

Low Impact Development (LID)

Green Infrastructure is …

…an approach to stormwater management that is cost-effective, sustainable, and environmentally friendly.

Green Infrastructure projects:

- capture,
- filter,
- absorb, and
- reuse

stormwater to maintain or mimic natural systems and treat runoff as a resource.

Low Impact Development (LID) is

"a stormwater design approach that replicates or maintains the hydrologic function of the natural system"

Integration of local climate, site conditions, culture, and community, in order to improve our resources and quality of life.

"Interactions with the environment at the watershed scale"

Green Infrastructure and LID includes:

Green Roofs

Rainwater Harvesting

Tree Filter/Planter Boxes

Rain Gardens/Bioretention Systems

Permeable Pavements

Vegetated Swales or Bioswales

Natural Retention Basins

Trees & Urban Forestry

Green Streets









Parker Urban

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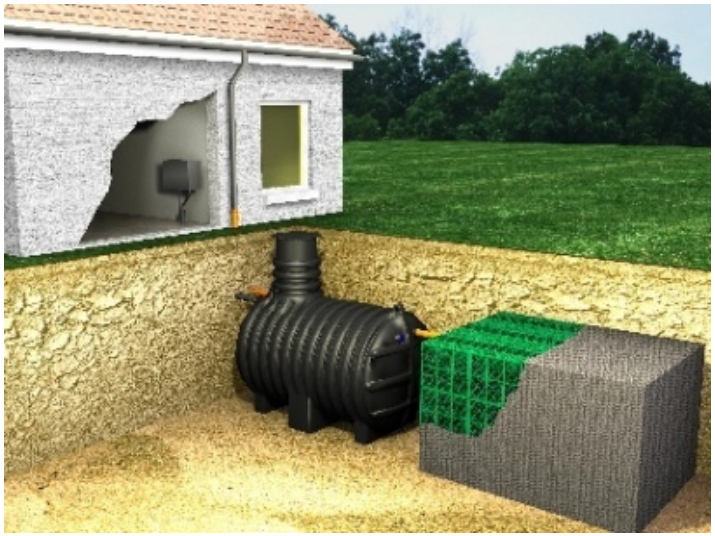
Rainwater Harvesting

FUNCTIONS

- Collecting, filtering and storing water from roof tops, paved and unpaved areas for multiple uses.
- Harvested water can be used for nonpotable or potable purposes after testing and treatment.
- Surplus water after usage can be used for recharging ground water.
- Systems can range in size from a simple PVC tank or cistern to a contractor designed and built tank/sump with water treatment facilities.



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Rainwater Harvesting

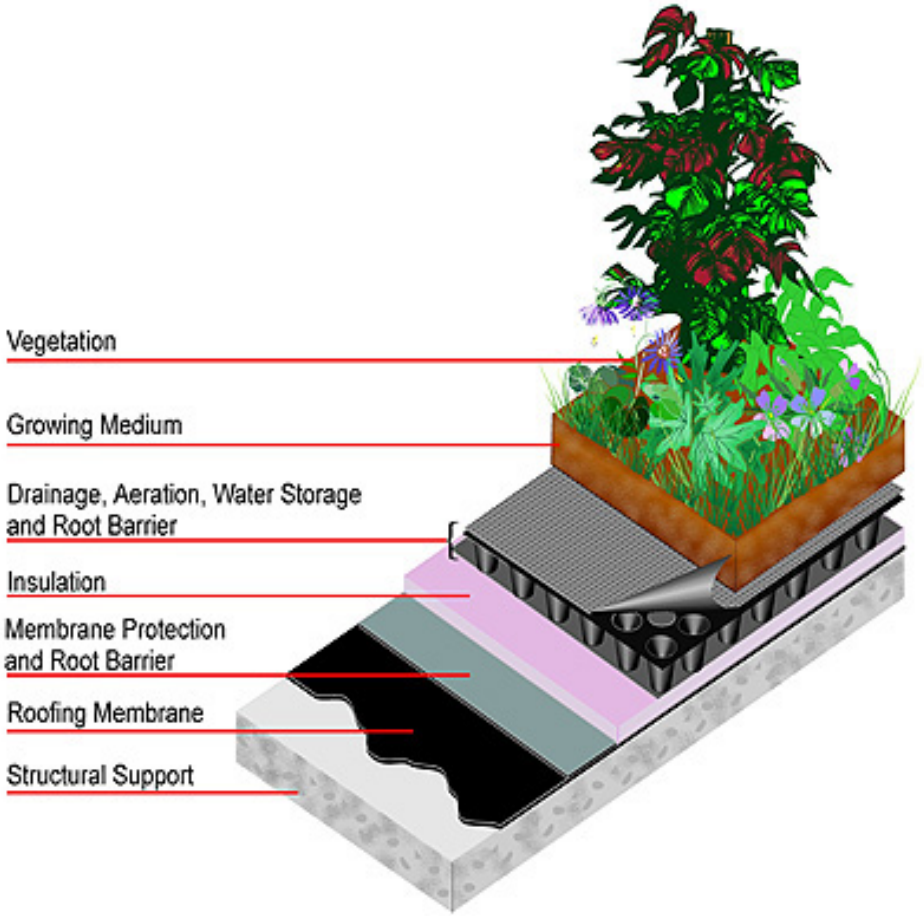
Samuel Mickle School Rainwater Harvesting System

Green Roofs

FUNCTIONS

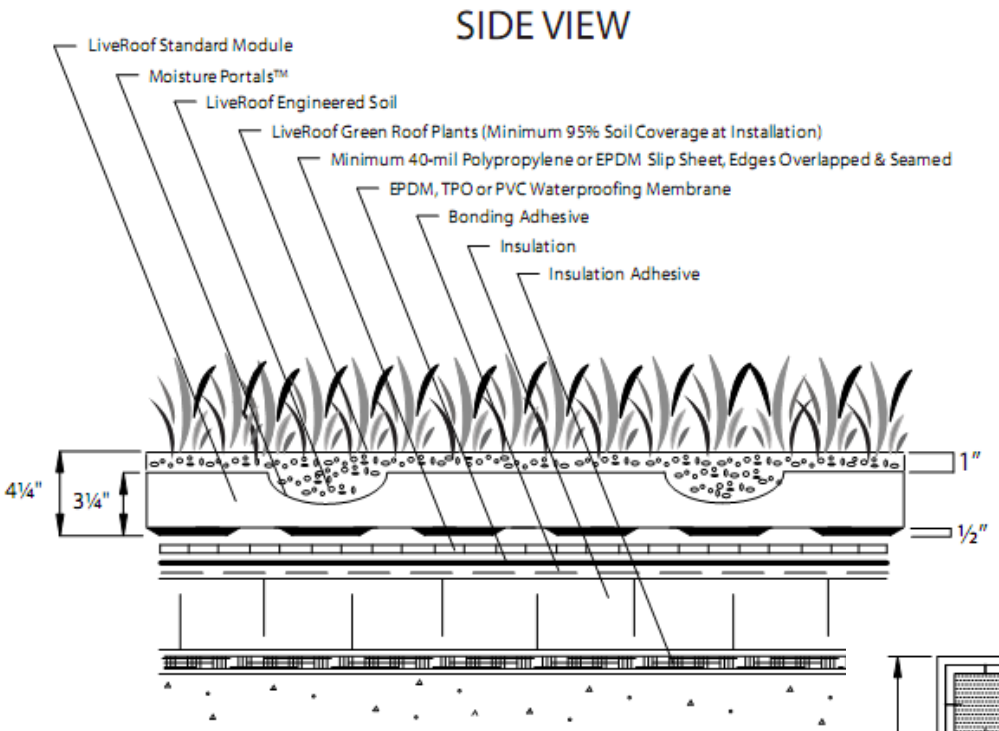
- Improves stormwater management
- Improves air quality
- Temperature regulation (moderation of Urban Heat Island Effect)
- Carbon dioxide/oxygen exchange
- Increased urban wildlife habitat

COMPONENTS

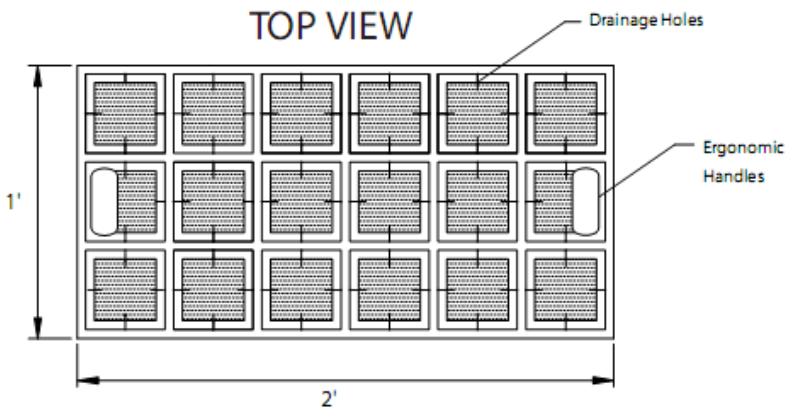


Green Roof Design

Modular System Specifications:




Parker Urban Greenscapes.



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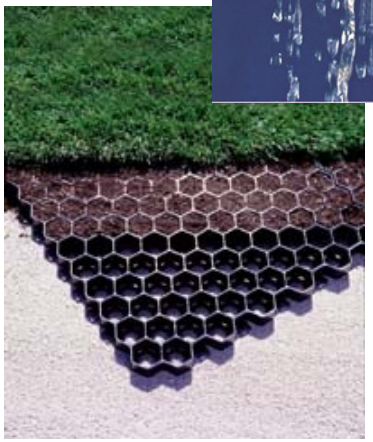
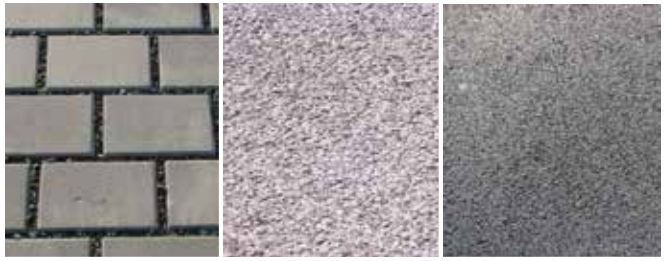
Pervious Pavements

- Underlying stone reservoir that temporarily stores surface runoff before infiltrating into the subsoil
- Porous asphalt and pervious concrete are manufactured without "fine" materials, and incorporate void spaces to allow infiltration
- Grass pavers are concrete interlocking blocks or synthetic fibrous grid systems with open areas designed to allow grass to grow within the void areas
- Ideal application for porous pavement is to treat a low traffic or overflow parking area



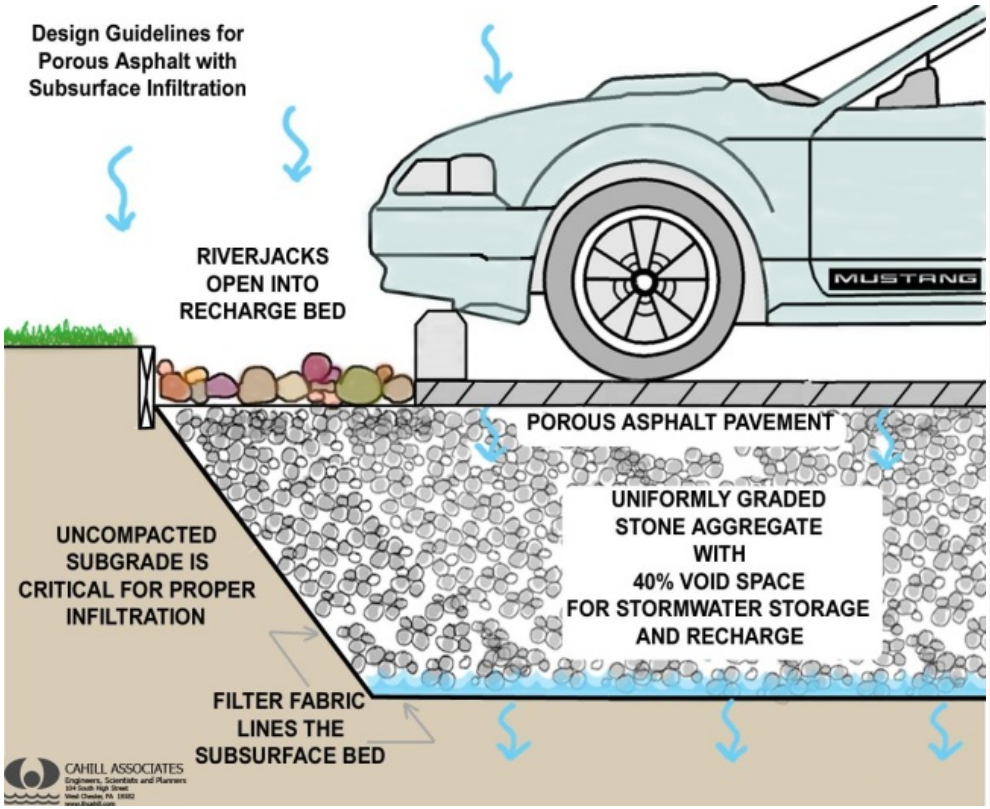


Pervious Pavements

FUNCTIONS

- Manage stormwater runoff
- Minimize site disturbance
- Possibility of groundwater recharge
- Low life cycle costs, alternative to costly traditional stormwater management methods
- Mitigation of urban heat island effect
- Contaminant removal as water moves through layers of system

COMPONENTS



Pervious Pavement

Pervious Pavements

Bioretention Systems & Rain Gardens

Traditional Approach

Design Dry Detention Basin:

- Treat Water Quality Storm (1.25” rain over 24 hours)
- Detain for 18 hours (residential) or 36 hours (commercial)
- Minimum outflow orifice = three inches
- Use Concrete Low Flow Channels to Minimize Erosion

New Approach

- Combines settling of detention basin with physical filtering and absorption processes
- Provides very high pollutant removal efficiencies
- More aesthetically pleasing than conventional detention basins
- Can be incorporated into the landscapes of individual homes

Bioretention Systems & Rain Gardens

NJDEP. 2004. NJ Stormwater BMP Manual.

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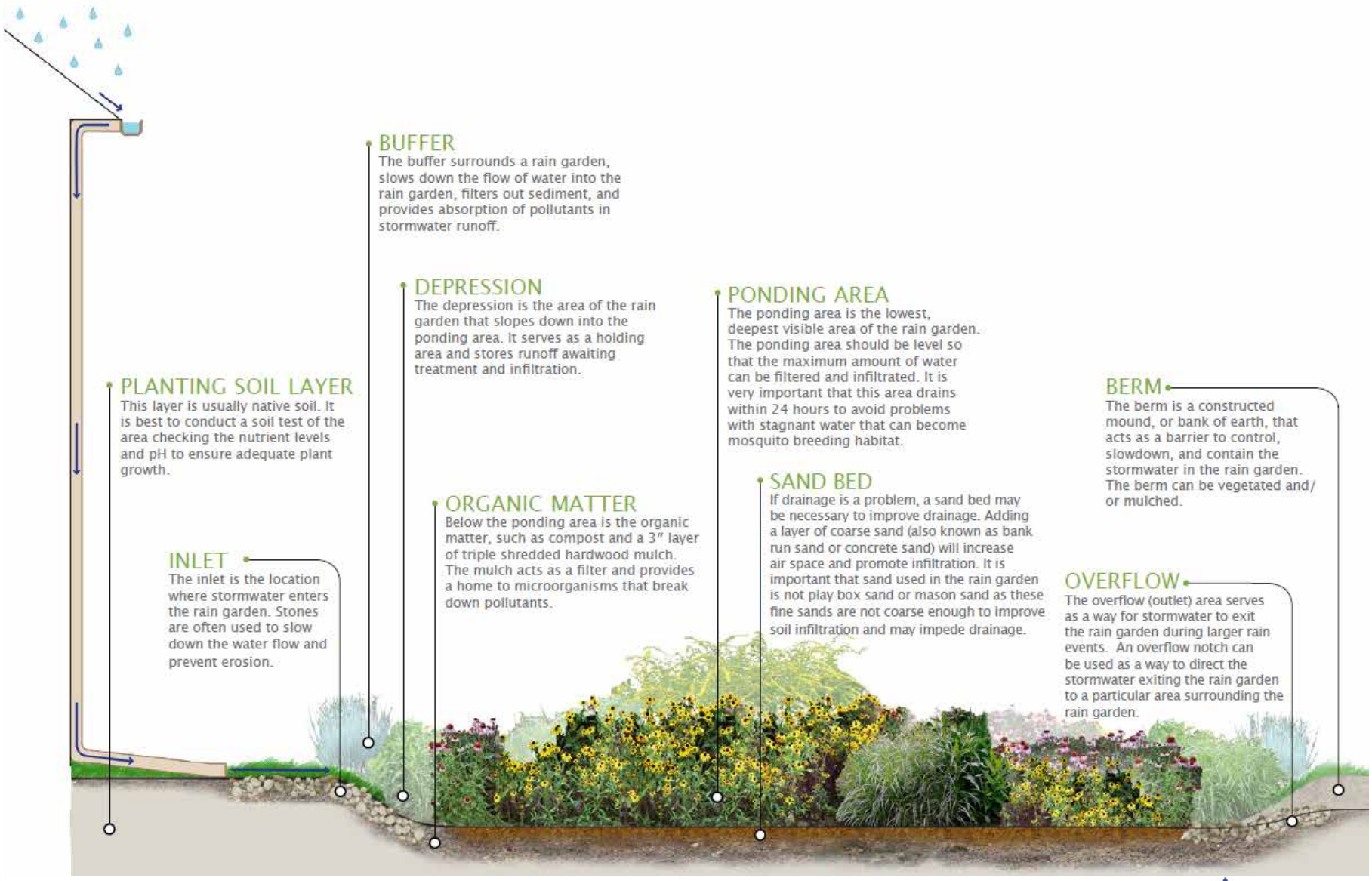
Bioretention Systems & Rain Gardens



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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Curb Extensions/Green Streets

Curb extension with a planted swale that captures stormwater from the gutter: Portland, OR (Credit: Abby Hall)

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Newark, NJ / 2010-2011

NEWARK ENVIRONMENTAL JUSTICE

298 Sussex Avenue Newark, NJ

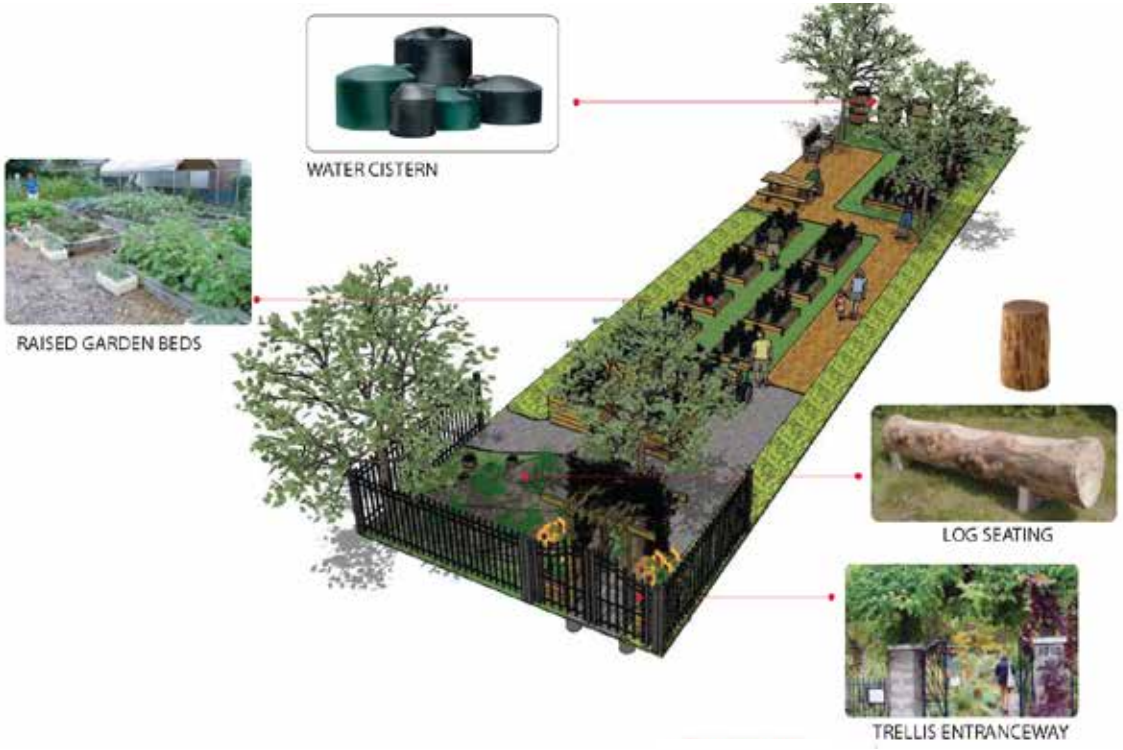
Project: ***Community Gardens + Rain Gardens***

Partner: ***Greater Newark Conservancy, City of Newark***

Funding: ***NJDEP 319h Environmental Justice Funds ($200,000)***

Raised Planter Bed

Proposed Community Garden + Stormwater Management Demonstration Site



298 Sussex Avenue Newark, NJ

Installation Photos with GNC Clean & Green Team

298 Sussex Avenue Newark, NJ

Installation Photos with GNC Clean & Green Team

298 Sussex Avenue Newark, NJ

Completed Rain Garden Excavation - Ready for Planting

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298 Sussex Avenue Newark, NJ

Sussex Avenue School of Arts & Sciences – Ms. Waters' 6th Grade Class Planting

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Sussex Avenue School of Arts & Sciences – Ms. Waters' 6th Grade Class Planting

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298 Sussex Avenue Newark, NJ

Sussex Avenue School of Arts & Sciences – After School Program Tree Planting with New Jersey Tree Foundation

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298 Sussex Avenue Newark, NJ

Above Ground Cistern Installation Workshop with Rainwater Harvest Company

298 Sussex Avenue Newark, NJ

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Above Ground Cistern Installation Workshop with Rainwater Harvest Company

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Above Ground Cistern Installation Completed

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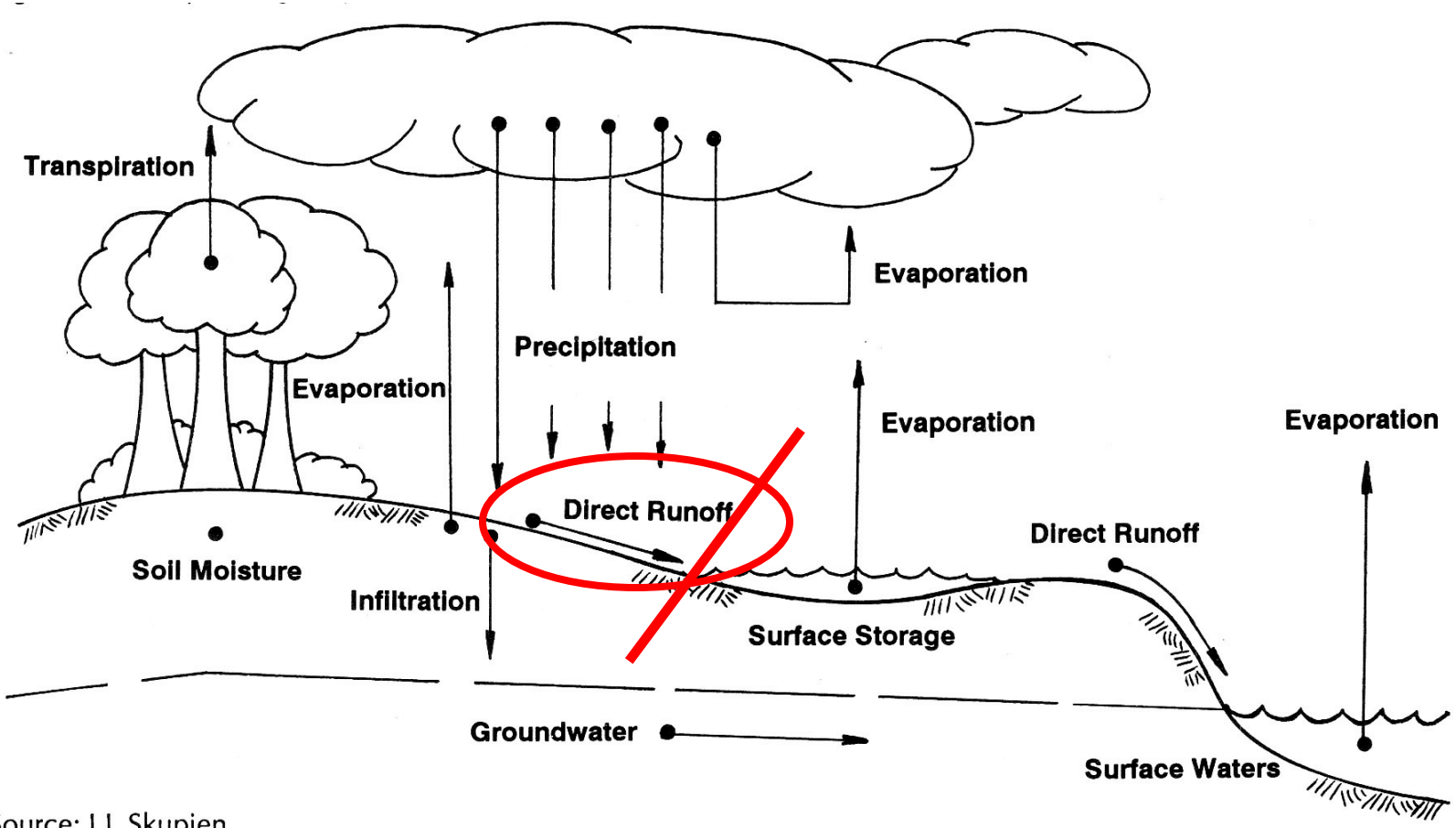
298 Sussex Avenue Newark, NJ

Above Ground Cistern Installation Completed

IN 10 YEARS . . .

HERE IS WHAT WE LEARNED

The Hydrologic Cycle



Source: J.J. Skupien.

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?

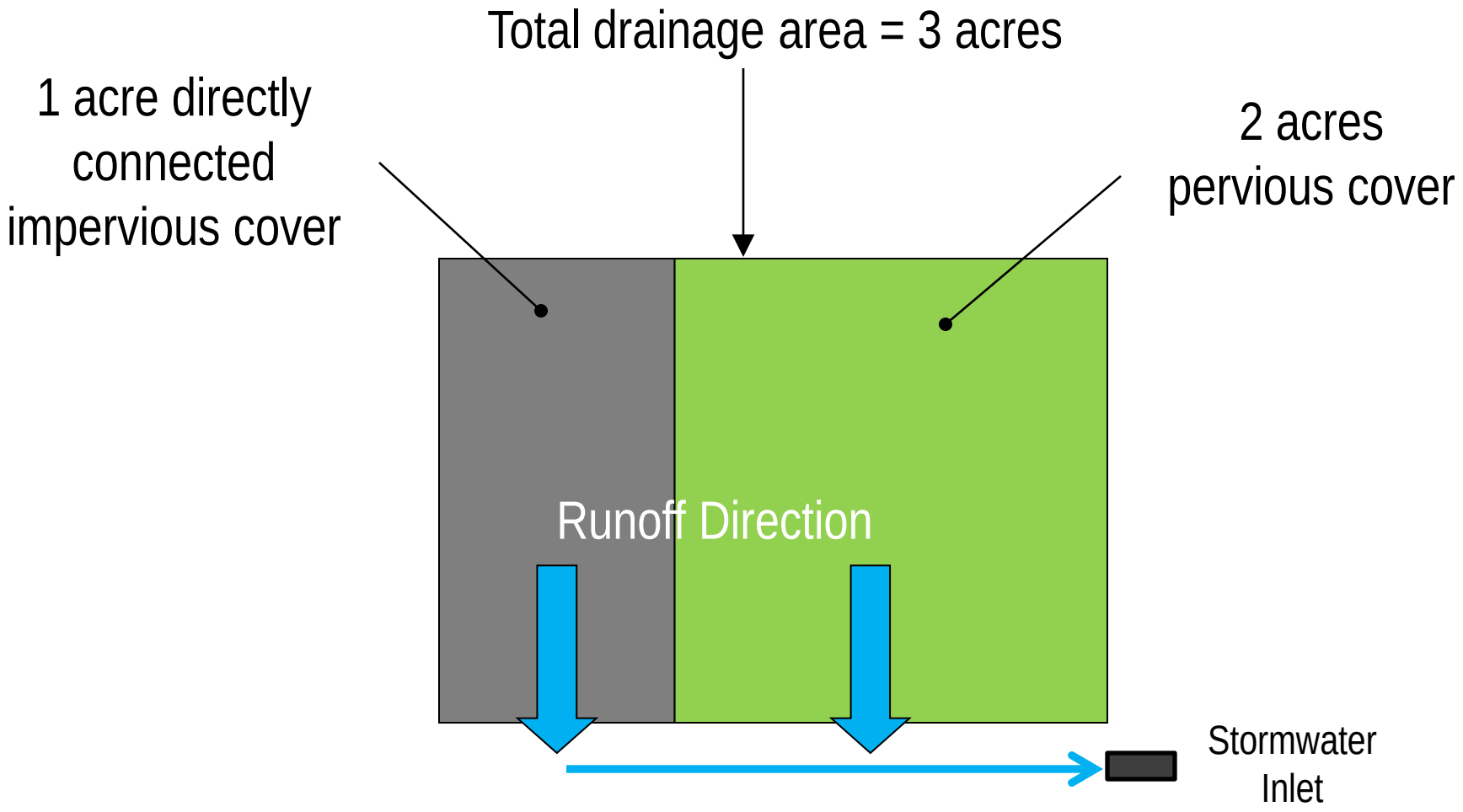
If we can't eliminate or reduce it, can we disconnect it?

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

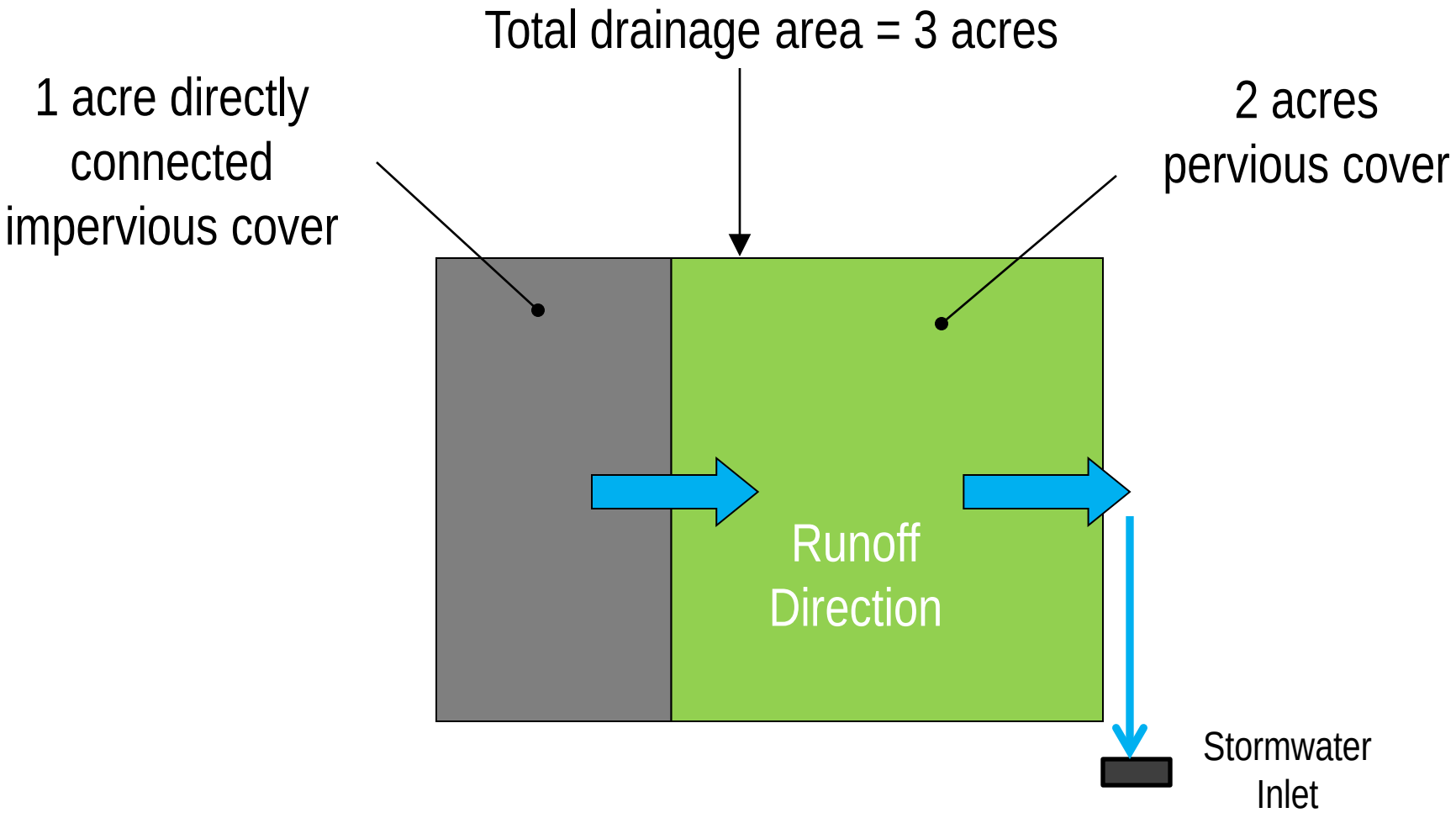
Are there conveyance systems that can be converted to bioswales?

Connected or Disconnected?

For 1.25 inch storm, 3,811 cubic feet of runoff = **28,500 gallons**



For 1.25 inch storm, 581 cubic feet of runoff = **4,360 gallons**



	Volume of Runoff		
Design Storm	**Connected (gallons)**	**Disconnected (gallons)**	**Percent Difference**
1.25 inches (water quality storm)	28,500	4,360	85%

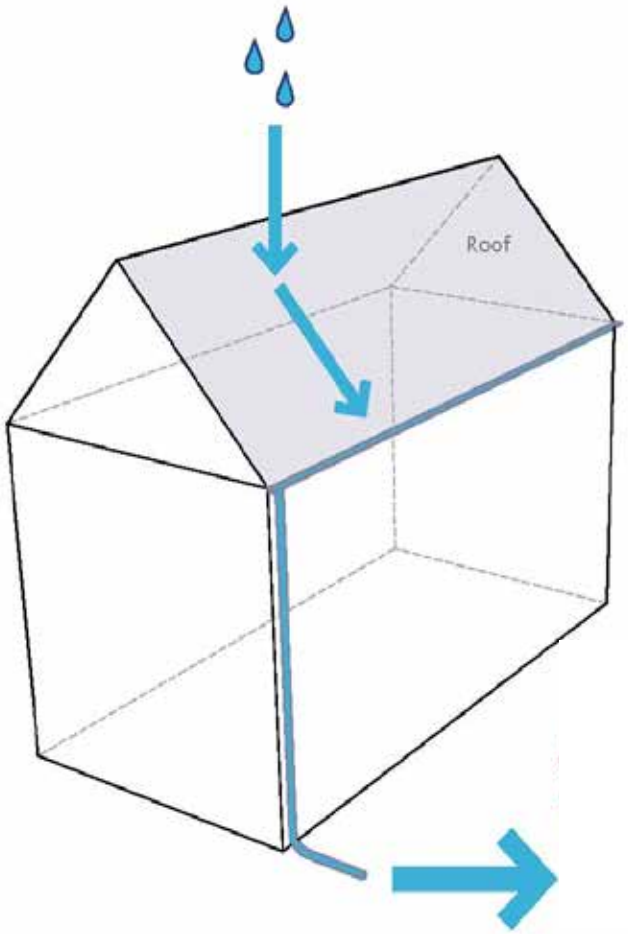
Impervious area is now ***"disconnected"*** from flowing directly into the storm sewer system

Table 3-3: New Jersey 24-Hour Rainfall Frequency Data
Rainfall amounts in Inches

County	Rainfall Frequency Data						
	1-Year	2-Year	5-Year	10-Year	25-Year	50-Year	100-Year
Atlantic	2.8	3.3	4.3	5.2	6.5	7.6	8.9
Bergen	2.8	3.3	4.3	5.1	6.3	7.3	8.4
Burlington	2.8	3.4	4.3	5.2	6.4	7.6	8.8
Camden	2.8	3.3	4.3	5.1	6.3	7.3	8.5
Cumberland	2.8	3.3	4.2	5.1	6.4	7.5	8.8
Gloucester	2.8	3.3	4.2	5.0	6.2	7.3	8.5
Hudson	2.7	3.3	4.2	5.0	6.2	7.2	8.3
Hunterdon	2.9	3.4	4.3	5.0	6.1	7.0	8.0
Mercer	2.8	3.3	4.2	5.0	6.2	7.2	8.3

	Volume of Runoff		
Design Storm	**Connected (gallons)**	**Disconnected (gallons)**	**Percent Difference**
1.25 inches (water quality storm)	28,500	4,360	85%
5.0 inches (10-year storm)	219,915	185,365	16%

Disconnection with Rain Water Harvesting



Disconnect your downspout by installing a rain barrel

REDUCE THE AMOUNT OF RUNOFF ENTERING STORM SEWERS

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So Many Barrels to Choose From...

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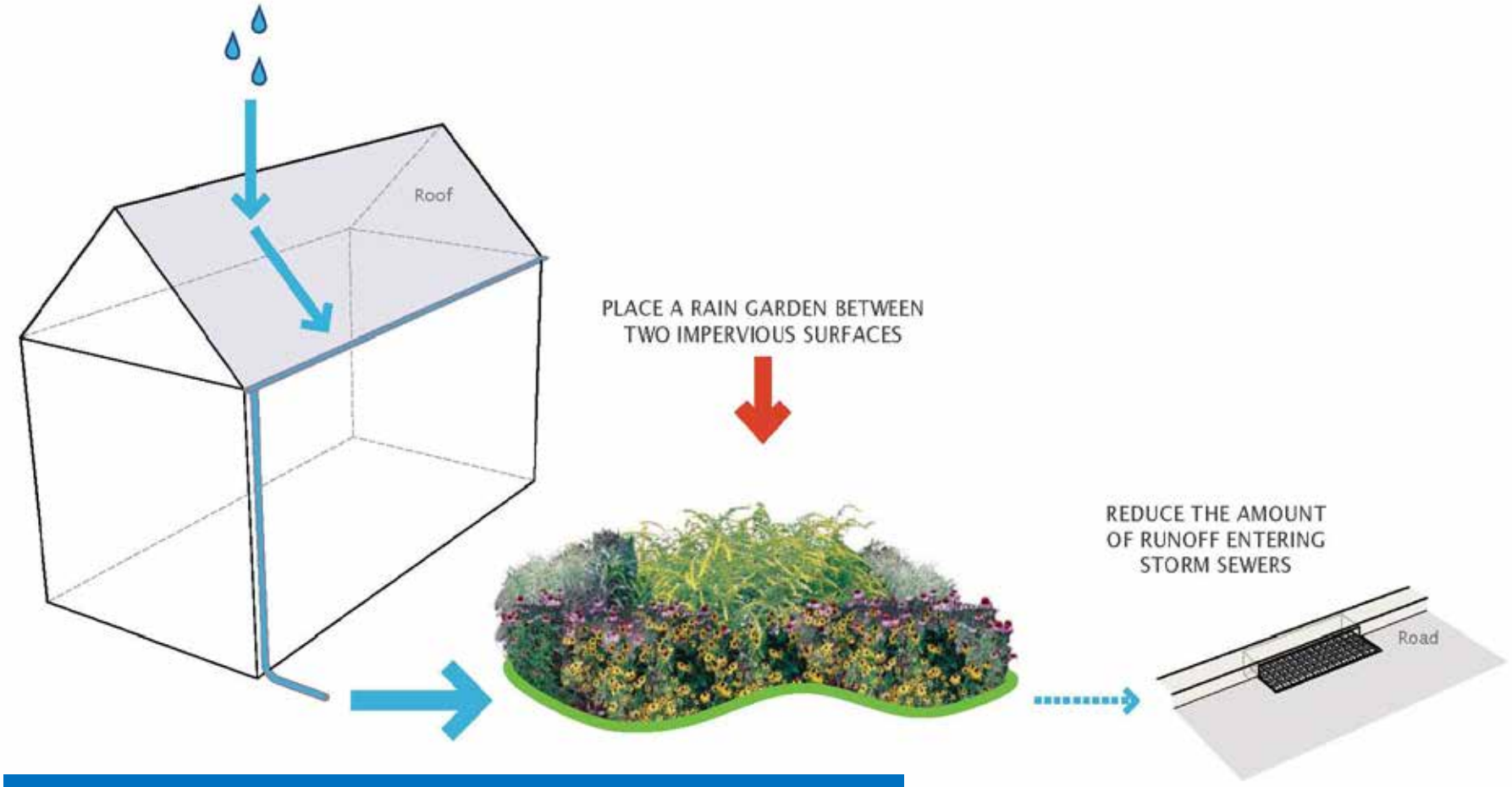
RCE Programs that can help

- Build-A-Rain Barrel Workshops
  www.water.rutgers.edu
- Rain Barrel Co-op
  www.water.rutgers.edu
- Train-the-Trainer Program
  www.tinyurl.com/rainbarreltrainer

Disconnection with Rain Gardens



Rooftop runoff is now ***"disconnected"*** from flowing directly into the storm sewer system

Lots of Rain Gardens

RCE Programs that can help

www.water.rutgers.edu

- Stormwater Management in Your Backyard
- Stormwater Management in Your School Yard
- Rain Garden Certification Program
- Rain Garden Training for Professional Landscapers
- Rain Garden Rebate Program

Questions?

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