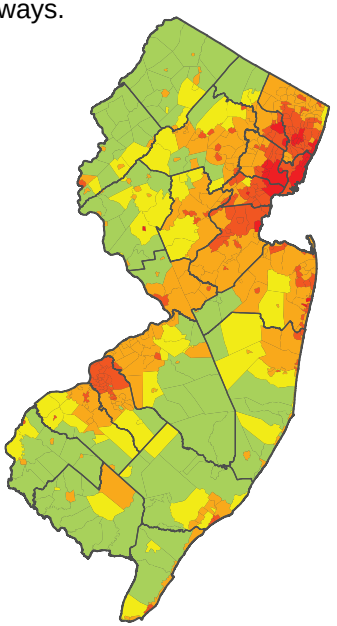
RUTGERS
New Jersey Agricultural Experiment Station

GREEN INFRASTRUCTURE GUIDANCE

FOR REDUCING THE IMPACTS OF IMPERVIOUS COVER ON WATER QUALITY

GREEN INFRASTRUCTURE FOR NEW JERSEY

As the amount of impervious surfaces like roadways, parking lots, and rooftops increase, stormwater runoff increases. Scientific research has linked these increases in impervious surfaces to degraded waterways. Because of this, many municipalities have limits on impervious cover for individual building lots. Green infrastructure can be designed to mitigate these increases in impervious cover by reducing their impact on local waterways.



New Jersey has

675,200

acres of impervious cover

Impervious Surface (%) by Municipality

- 1-5
- 5-10
- 10-30
- 30-50
- <50

This brochure is intended to serve as a quick reference guide for green infrastructure. Many of these practices can easily be installed on sites to offset increases in impervious surfaces.

Green infrastructure is an approach to stormwater management that is cost-effective, sustainable, and environmentally friendly. Green infrastructure practices capture, filter, absorb, and/or reuse stormwater to help restore the natural water cycle. When used as components of a stormwater management system, green infrastructure practices such as bioretention, green roofs, pervious pavement, rain gardens, and vegetated swales can produce a variety of environmental benefits. In addition to effectively retaining and infiltrating runoff, these practices can help filter air pollutants, reduce energy demands, mitigate urban heat islands, and sequester carbon while also providing communities with aesthetic and natural resource benefits.

When managing stormwater with green infrastructure practices, the overall goal is to disconnect impervious surfaces that are connected (i.e., drain directly to sewer systems or local waterways). Green infrastructure practices can be designed to capture and infiltrate stormwater. These practices tend to filter water using soil, as in the case of bioretention, or using stone, as in the case of porous asphalt. In areas where infiltration is not possible, these green infrastructure practices can be used as a detention system to store runoff and slowly release it after the storm event. Some green infrastructure practices are used to harvest stormwater runoff for non-potable water usage such as watering gardens. Other green infrastructure practices, like bioswales, are designed to move water from one location to another while filtering pollutants.

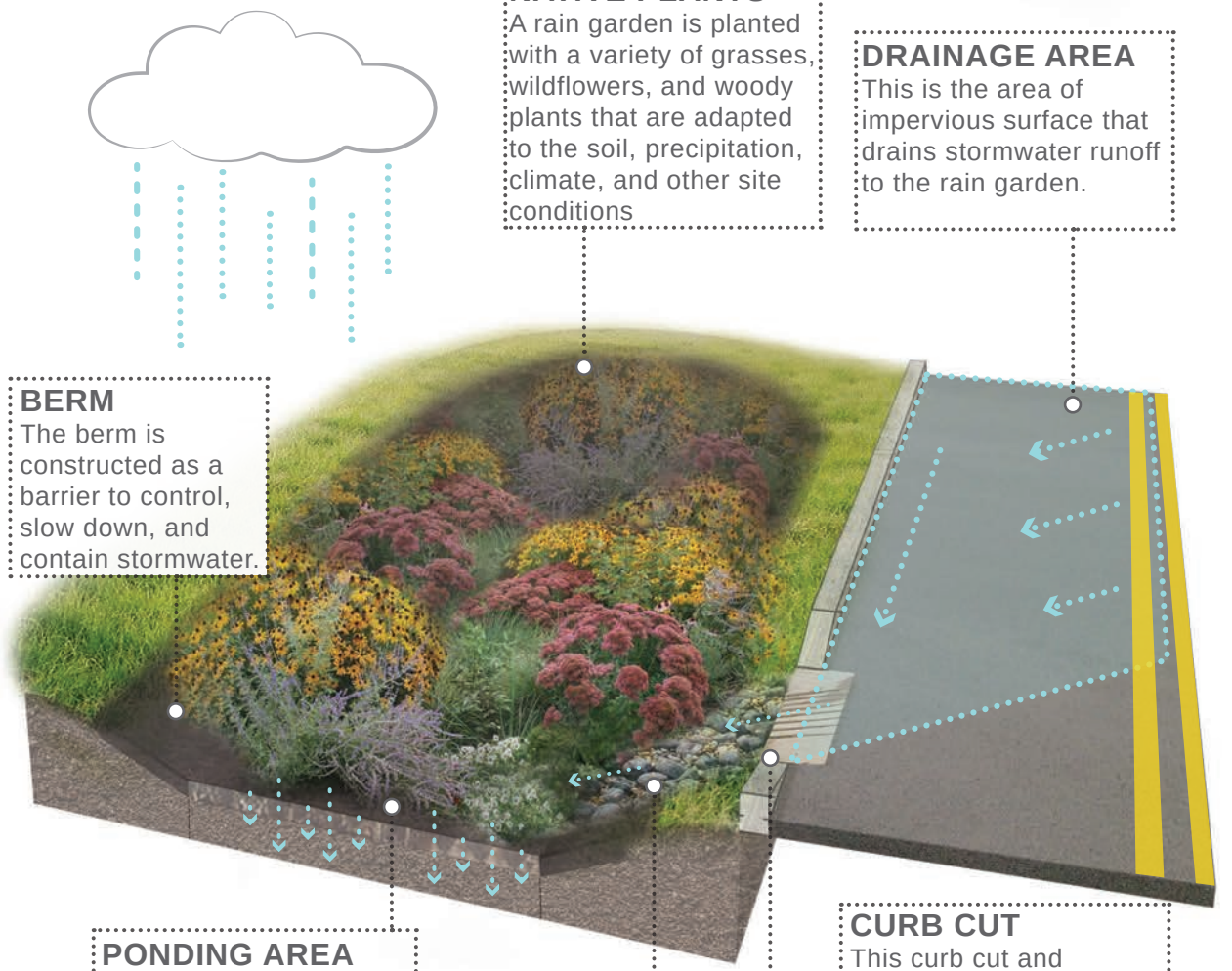
The following pages describe some green infrastructure practices that have been proven to be successful in New Jersey. These practices include: bioretention/rain gardens, bioswales, downspout planters, stormwater planters, cisterns and rain barrels, permeable pavements, tree filter boxes, and dry well systems.

BIORETENTION/RAIN GARDEN SYSTEMS
INFILTRATION AND STORAGE

A rain garden, or bioretention system, is a landscaped, shallow depression that captures, filters, and infiltrates stormwater runoff. The rain garden removes nonpoint source pollutants from stormwater runoff while recharging groundwater. A rain garden serves as a functional system to capture, filter, and infiltrate stormwater runoff at the source while being aesthetically pleasing. Rain gardens are an important tool for communities and neighborhoods to create diverse, attractive landscapes while protecting the health of the natural environment. Rain gardens can also be installed in areas that do not infiltrate by incorporating an underdrain system.

Rain gardens can be implemented throughout communities to begin the process of re-establishing the natural function of the land. Rain gardens offer one of the quickest and easiest methods to reduce runoff and help protect our water resources. Beyond the aesthetic and ecological benefits, rain gardens encourage environmental stewardship and community pride.

LOCATION: Hamilton, NJ
This residential rain garden is 150 square feet and six (6) inches deep. It was designed to capture the rainwater from the roof of this home.



NATIVE PLANTS

A rain garden is planted with a variety of grasses, wildflowers, and woody plants that are adapted to the soil, precipitation, climate, and other site conditions

DRAINAGE AREA

This is the area of impervious surface that drains stormwater runoff to the rain garden.

BERM

The berm is constructed as a barrier to control, slow down, and contain stormwater.

PONDING AREA

The ponding area is the lowest, deepest visible area of the garden. When designed correctly, this area should drain within 24 hours.

INLET

This is the area where stormwater enters. The inlet is often lined with stone to slow water flow and prevent erosion.

CURB CUT

This curb cut and concrete flow pad are designed to help redirect stormwater runoff to the rain garden system and out of the storm drain.

BIOSWALES

CONVEYANCE AND INFILTRATION

Bioswales are landscape features that convey stormwater from one location to another while removing pollutants and allowing water to infiltrate. Bioswales are often designed for larger scale sites where water needs time to move and slowly infiltrate into the groundwater.

Much like rain garden systems, bioswales can also be designed with an underdrain pipe that allows excess water to discharge to the nearest catch basin or existing stormwater system.

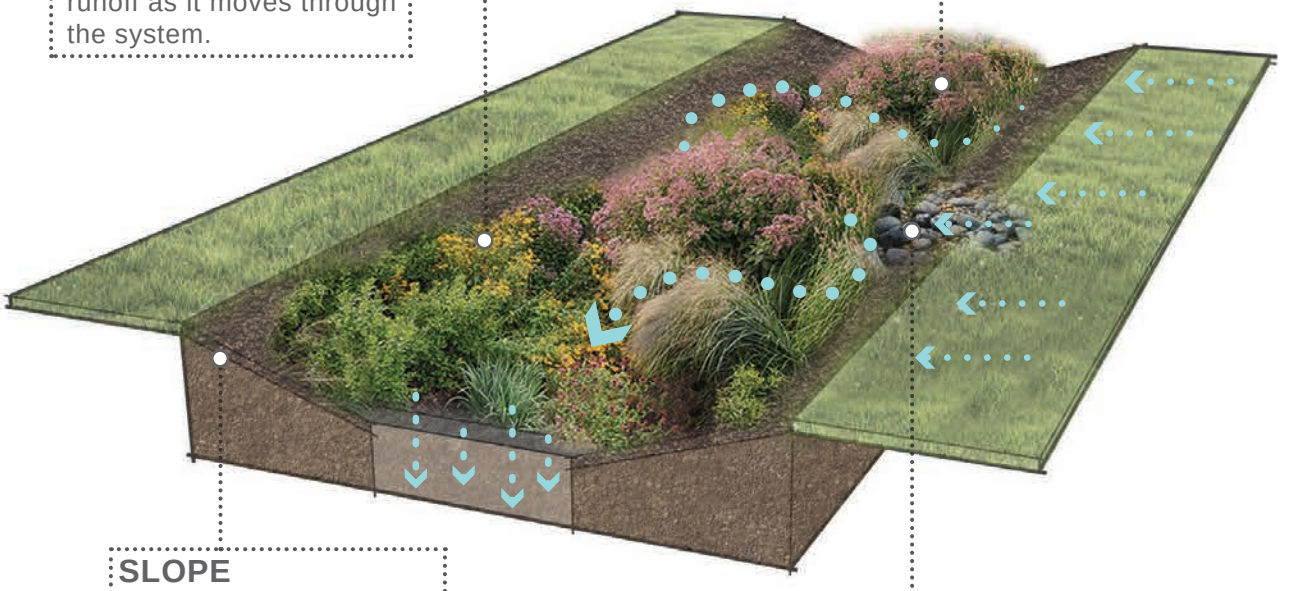
LOCATION: Parsippany, NJ
This bioswale was installed at St. Gregory's Church. The bioswale was designed to capture water from the parking lot and move it toward the forest area on the south end of the site.

NATIVE PLANTS

A bioswale is planted with a variety of grasses, wildflowers, and woody plants that are adapted to the soil, precipitation, climate, and other site conditions. The vegetation helps filter stormwater runoff as it moves through the system.

CONVEYANCE

Unlike other systems, the bioswale is designed to move water through a vegetative channel as it slowly infiltrates into the ground.



SLOPE

The slope is designed at a maximum of 3:1. These slopes often require erosion control materials for stabilization.

INLET

This is the area where stormwater enters. The inlet is often lined with stone to slow water flow and prevent erosion.

DOWNSPOUT PLANTERS
STORAGE

Downspout planter boxes are wooden or concrete boxes with plants installed at the base of the downspout that provide an opportunity to beneficially reuse rooftop runoff. Although small, these systems have some capacity to store rooftop runoff during rainfall events and release it slowly back into the storm sewer system through an overflow.

Most often, downspout planter boxes are a reliable green infrastructure practice used to provide some rainfall storage and aesthetic value for property.

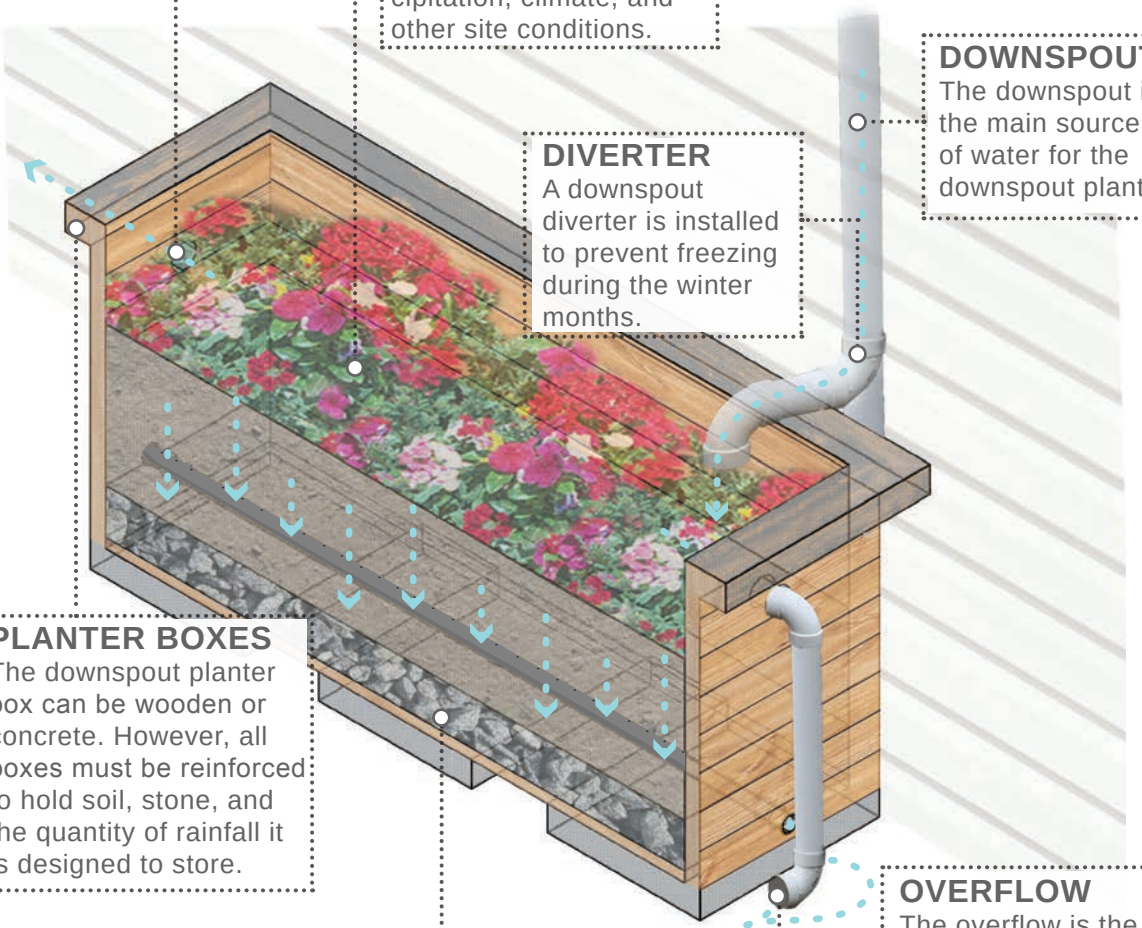
LOCATION: Camden, NJ
Downspout planters are installed at the end of a downspout to capture, store, and slowly discharge stormwater back to the nearest storm sewer system.

CONNECTION
The system is designed to overflow into adjacent boxes using a connecting pipe that is sealed with silicon.

NATIVE PLANTS
A downspout planter is planted with a variety of grasses, wildflowers, and woody plants that are adapted to the soil, precipitation, climate, and other site conditions.

DOWNSPOUT
The downspout is the main source of water for the downspout planter.

DIVERTER
A downspout diverter is installed to prevent freezing during the winter months.



PLANTER BOXES
The downspout planter box can be wooden or concrete. However, all boxes must be reinforced to hold soil, stone, and the quantity of rainfall it is designed to store.

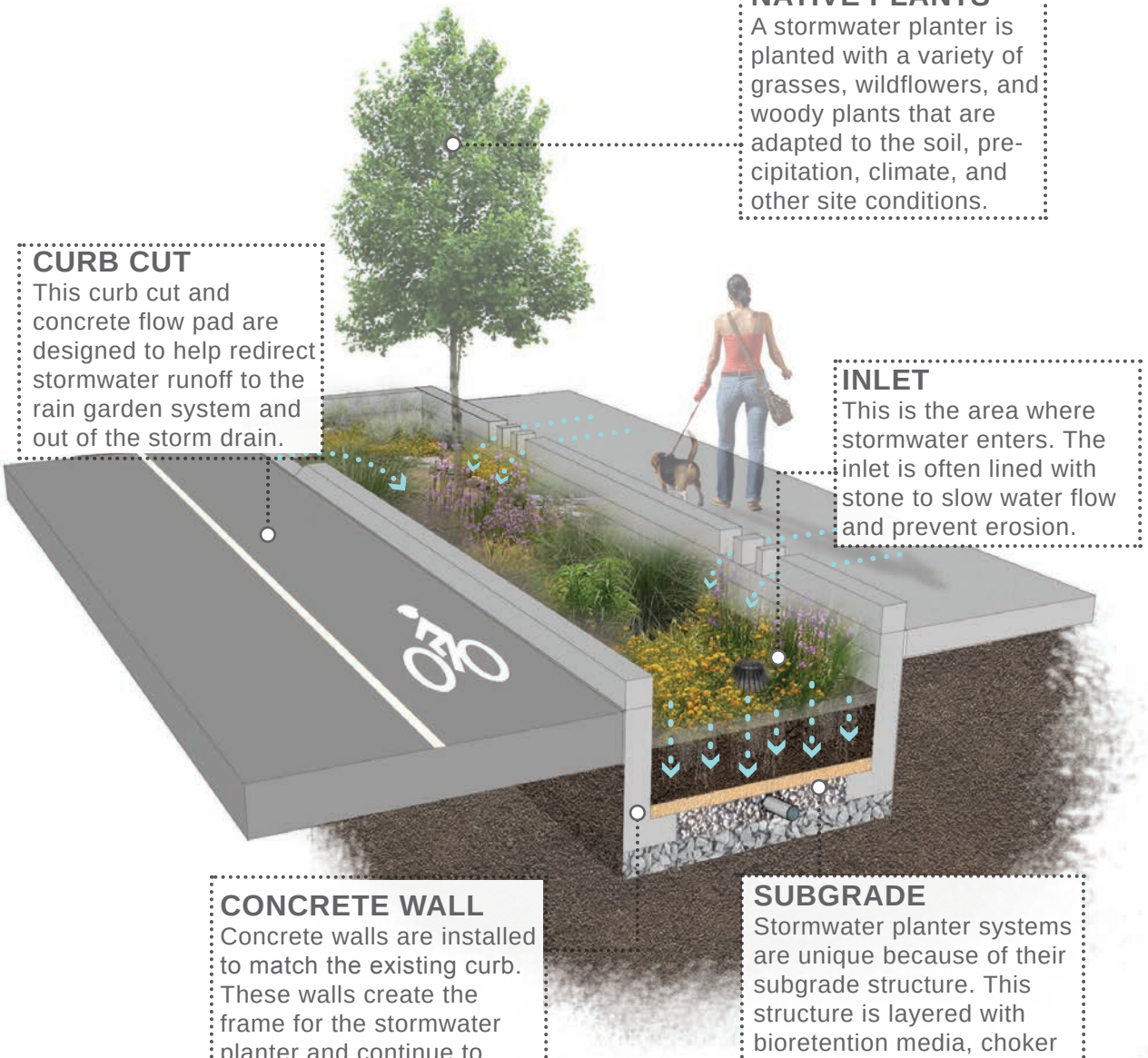
SUBGRADE
The system is designed to overflow using a perforated pipe located at the bottom of the downspout planter box.

OVERFLOW
The overflow is the point where water discharges from the downspout planter.

STORMWATER PLANTERS
STORAGE AND INFILTRATION

Stormwater planters are vegetated structures that are built into the sidewalk to intercept stormwater runoff from the roadway or sidewalk. Stormwater planters, like rain gardens, are a type of bioretention system. This means many of these planters are designed to allow the water to infiltrate into the ground. However, some are designed simply to filter the water and convey it back into the storm sewer system via an underdrain system.

LOCATION: Camden, NJ
This stormwater planter was designed to capture stormwater runoff from the street in front of the Brimm School in Camden, New Jersey.



NATIVE PLANTS
A stormwater planter is planted with a variety of grasses, wildflowers, and woody plants that are adapted to the soil, precipitation, climate, and other site conditions.

CURB CUT
This curb cut and concrete flow pad are designed to help redirect stormwater runoff to the rain garden system and out of the storm drain.

INLET
This is the area where stormwater enters. The inlet is often lined with stone to slow water flow and prevent erosion.

CONCRETE WALL
Concrete walls are installed to match the existing curb. These walls create the frame for the stormwater planter and continue to function as a curb.

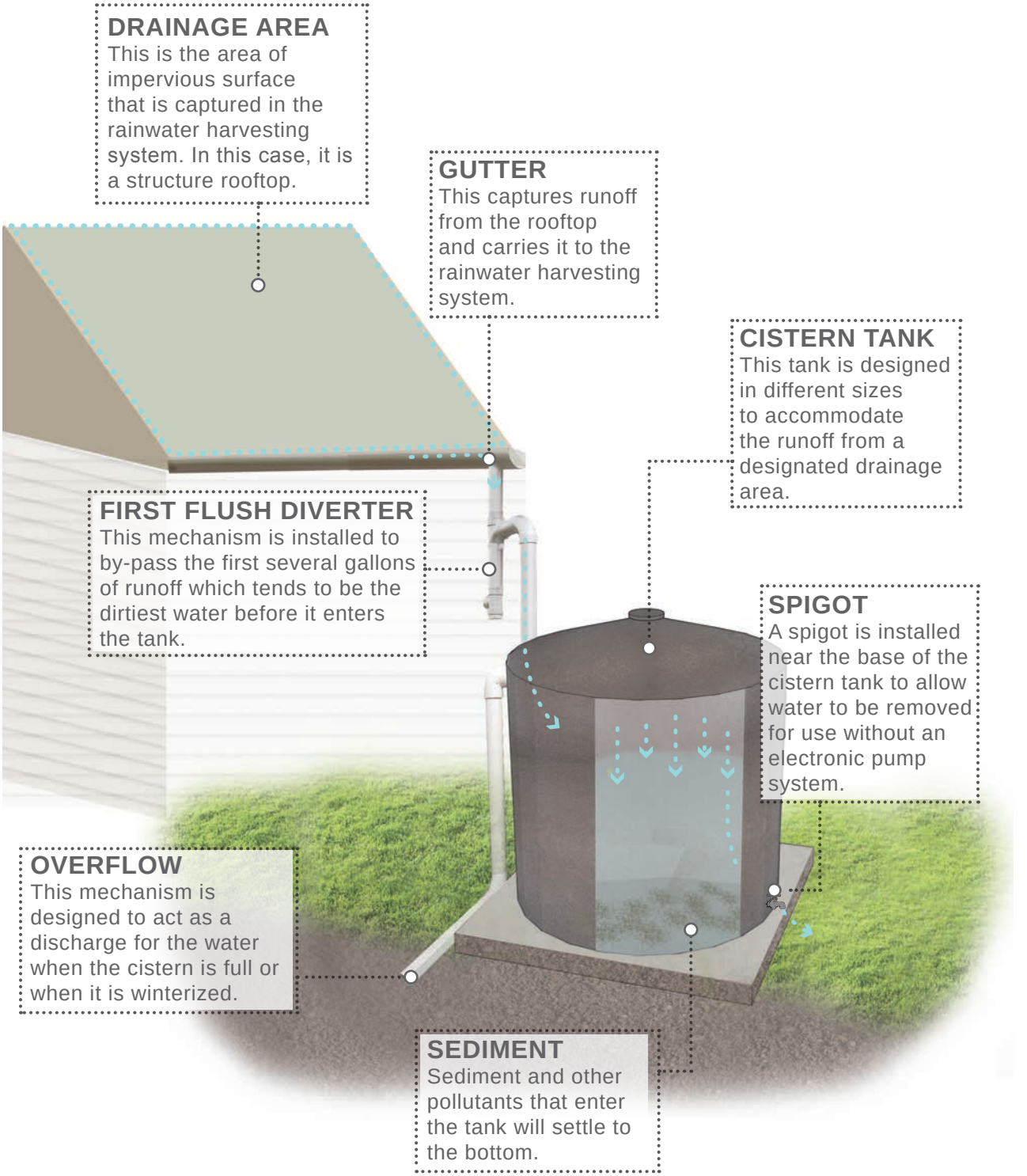
SUBGRADE
Stormwater planter systems are unique because of their subgrade structure. This structure is layered with bioretention media, choker course, compact aggregate, and soil separation fabric.

CISTERNS & RAIN BARRELS
RAINWATER HARVESTING

These systems capture rainwater, mainly from rooftops, in cisterns or rain barrels. The water can then be used for watering gardens, washing vehicles, or for other non-potable uses.

Rainwater harvesting systems come in all shapes and sizes. These systems are good for harvesting rainwater in the spring, summer, and fall but must be winterized during the colder months. Cisterns are winterized, and then their water source is redirected from the cistern back to the original discharge area.

LOCATION: Clark, NJ
This cistern was installed at a public works department. The rainwater is harvested from the rooftop of the building and used as part of a "green car wash" system that uses rainwater.

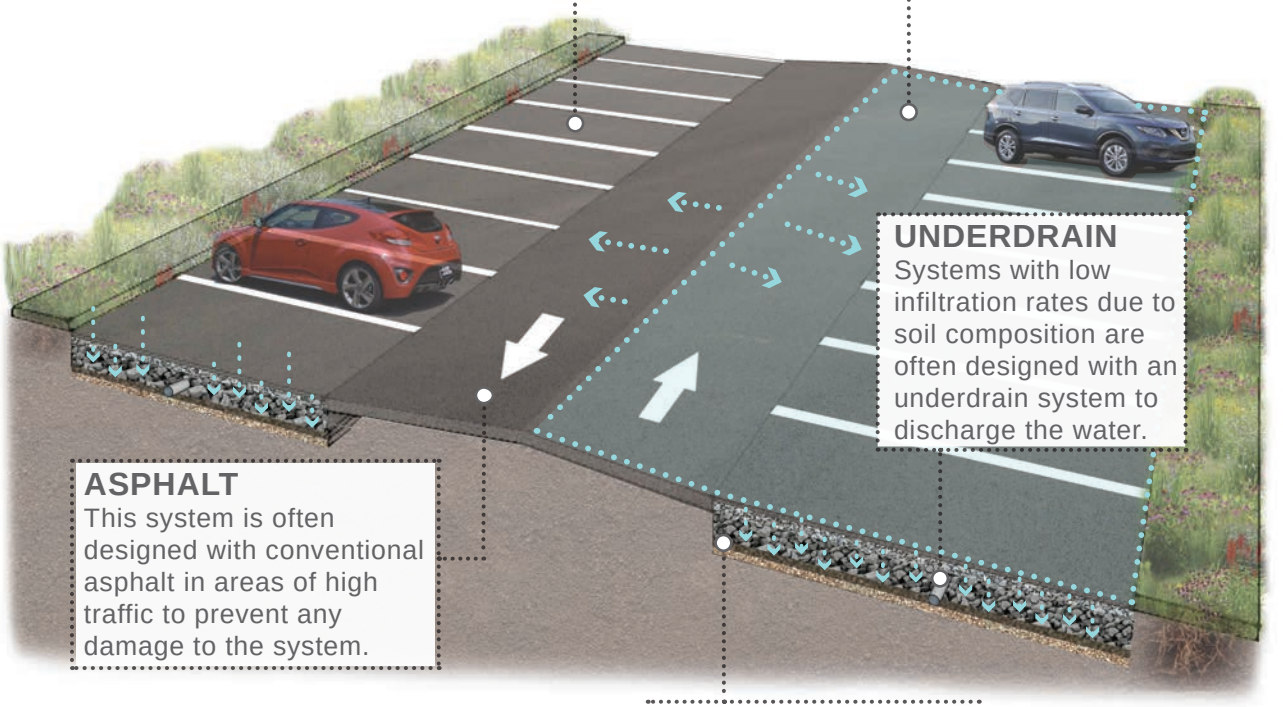

DRAINAGE AREA
This is the area of impervious surface that is captured in the rainwater harvesting system. In this case, it is a structure rooftop.
GUTTER
This captures runoff from the rooftop and carries it to the rainwater harvesting system.
CISTERN TANK
This tank is designed in different sizes to accommodate the runoff from a designated drainage area.
FIRST FLUSH DIVERTER
This mechanism is installed to by-pass the first several gallons of runoff which tends to be the dirtiest water before it enters the tank.
SPIGOT
A spigot is installed near the base of the cistern tank to allow water to be removed for use without an electronic pump system.
OVERFLOW
This mechanism is designed to act as a discharge for the water when the cistern is full or when it is winterized.
SEDIMENT
Sediment and other pollutants that enter the tank will settle to the bottom.

PERMEABLE PAVEMENTS
STORAGE AND INFILTRATION

These surfaces include pervious concrete, porous asphalt, interlocking concrete pavers, and grid pavers. Pervious concrete and porous asphalt are the most common of the permeable surfaces. They are similar to regular concrete and asphalt but without the fine materials. This allows water to quickly pass through the material into an underlying layered system of stone that holds the water, allowing it to infiltrate into the underlying uncompacted soil. They have an underlying stone layer to store stormwater runoff and allow it to slowly seep into the ground.

By installing an underdrain system, these systems can be used in areas where infiltration is limited. The permeable pavement system will still filter pollutants and provide storage but will not infiltrate the runoff.

TYPICAL POROUS ASPHALT SUBGRADE: *CROSS-SECTION*



DRAINAGE AREA

The drainage area of the porous asphalt system is the conventional asphalt cartway and the porous asphalt in the parking spaces. Runoff from the conventional asphalt flows into the porous asphalt parking spaces.

POROUS ASPHALT

It is common to design porous asphalt in the parking stalls of a parking lot. This saves money and reduces wear.

UNDERDRAIN

Systems with low infiltration rates due to soil composition are often designed with an underdrain system to discharge the water.

ASPHALT

This system is often designed with conventional asphalt in areas of high traffic to prevent any damage to the system.

SUBGRADE

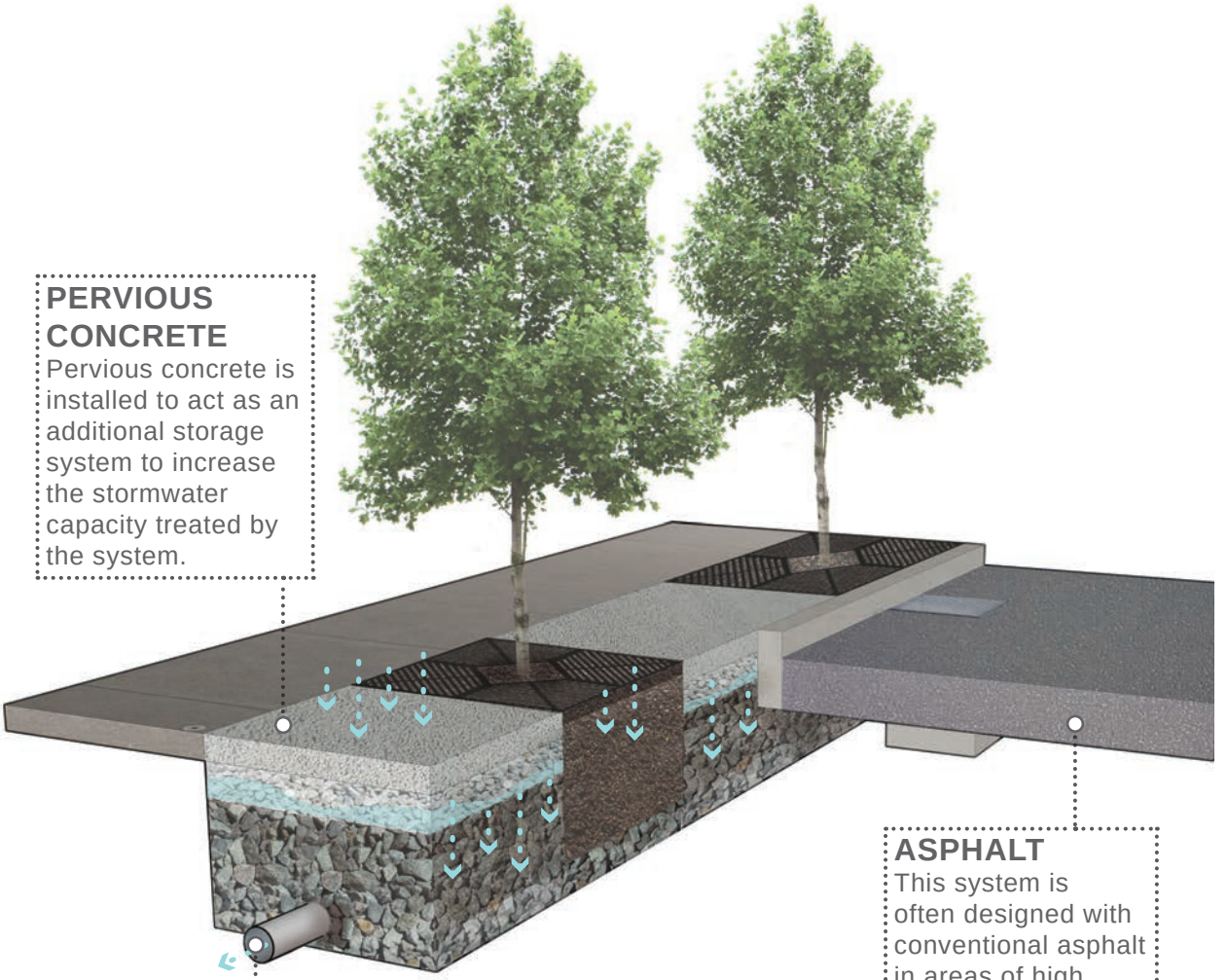
Porous pavements are unique because of their subgrade structure. This structure includes a layer of choker course, filter course, and soil.

TREE FILTER BOXES
STORAGE AND INFILTRATION

Tree filter boxes can be pre-manufactured concrete boxes or enhanced tree pits that contain a special soil mix and are planted with a tree or shrub. They filter stormwater runoff but provide little storage capacity. They are typically designed to quickly filter stormwater and then discharge it to the local storm sewer system.

LOCATION: Parsippany, NJ
This enhanced tree pit is located at the Parsippany-Troy Hills Municipal Court parking lot. The tree pit collects and filters water from the existing parking lot.

Often tree filter boxes are incorporated into streetscape systems that include an underlying stormwater system which connects several boxes (as shown on the next page). This is also coupled with pervious concrete to increase the storage capacity for rainwater in the system.



PERVIOUS CONCRETE
Pervious concrete is installed to act as an additional storage system to increase the stormwater capacity treated by the system.

UNDERDRAIN
Systems with low infiltration rates due to soil composition are often designed with an underdrain system to discharge the water.

ASPHALT
This system is often designed with conventional asphalt in areas of high traffic to prevent any damage to the system.

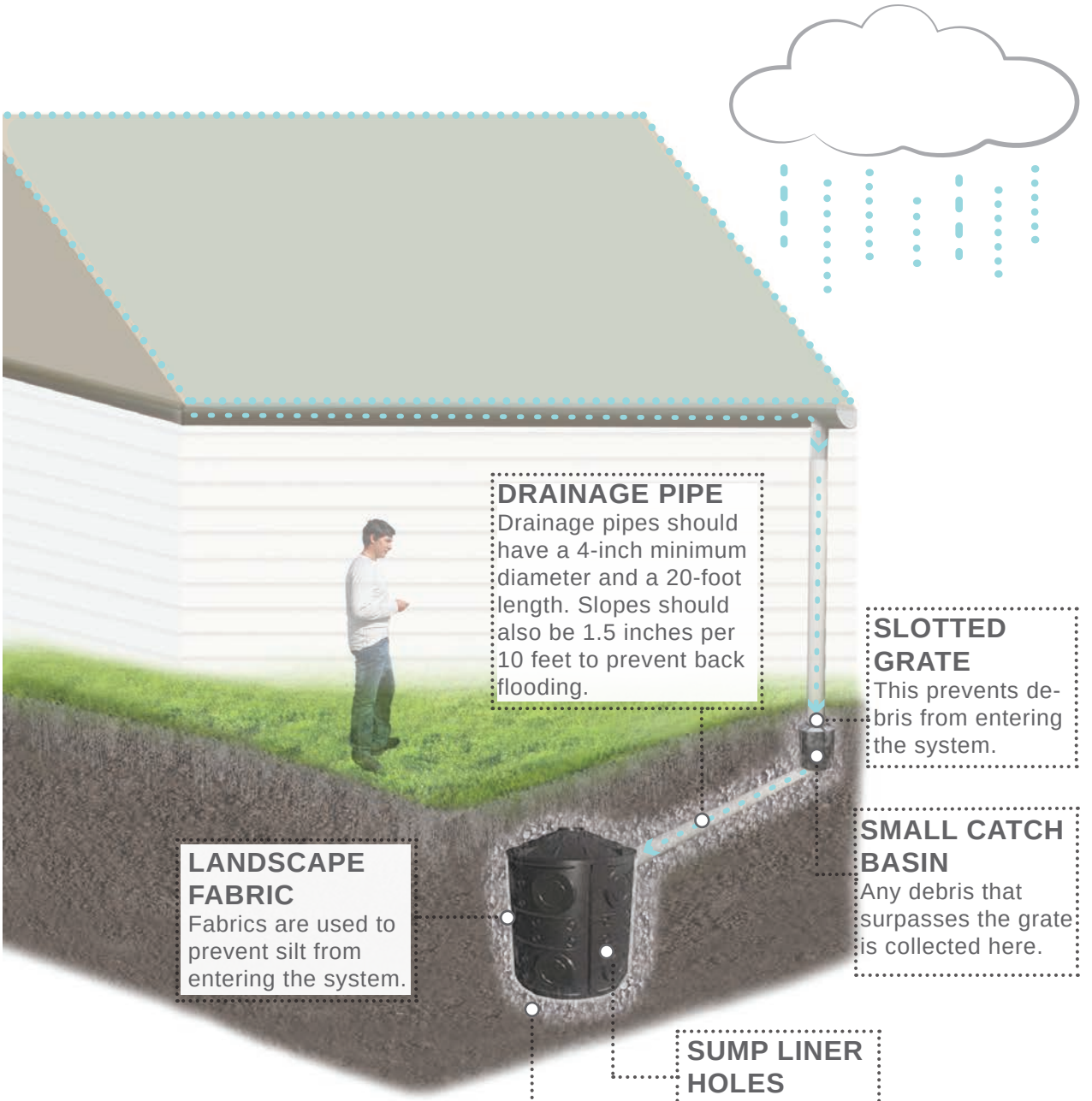
DRY WELL SYSTEMS
STORAGE AND INFILTRATION

A dry well is an underground structure built to manage surface runoff that cannot directly infiltrate into the ground. The system accepts stormwater runoff through a pipe and captures it in a large container. The system receives water from an entry pipe or channel and discharges the water through small openings distributed along the sides and bottom of the container. The system is designed to accept a large quantity of stormwater during a rainfall event. Subsequent to the storm, the dry well allows the stormwater to slowly infiltrate back into the ground.

Dry wells can be designed in a number of ways. Simple dry wells are a pit filled with gravel, riprap, and rubble. Other dry wells are designed as a large perforated concrete container. These dry wells are usually buried completely and provide storage for a larger stormwater capacity.

LOCATION: Holmdel, NJ.
This residential dry well was installed in Monmouth County. It is a underground system that uses an empty container to store large quantities of stormwater during rainfall events.

photo credit:
http://www.jemoweryandson-inc.com/drywells.html



DRAINAGE PIPE
Drainage pipes should have a 4-inch minimum diameter and a 20-foot length. Slopes should also be 1.5 inches per 10 feet to prevent back flooding.

SLOTTED GRATE
This prevents debris from entering the system.

SMALL CATCH BASIN
Any debris that surpasses the grate is collected here.

LANDSCAPE FABRIC
Fabrics are used to prevent silt from entering the system.

SUMP LINER HOLES
Liner holes help runoff infiltrate at a steady rate to prevent flooding.

AGGREGATE
A layer of 3-4 inch clean crushed rock is used for filtration and for extra protection.

RUTGERS COOPERATIVE EXTENSION WATER RESOURCES PROGRAM

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