

RUTGERS

THE STATE UNIVERSITY
OF NEW JERSEY

Green Infrastructure Overview

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NJDEP Definition

"Green Infrastructure" means methods of stormwater management that reduce wet weather/stormwater volume, flow, or changes the characteristics of the flow into combined or separate sanitary or storm sewers, or surface waters, by allowing the stormwater to infiltrate, to be treated by vegetation or by soils; or to be stored for reuse. Green infrastructure includes, but is not limited to, pervious paving, bioretention basins, vegetated swales, and cisterns.



US EPA Definition

Green infrastructure is a cost-effective, resilient approach to managing wet weather impacts that provides many community benefits. While single-purpose gray stormwater infrastructure—conventional piped drainage and water treatment systems—is designed to move urban stormwater away from the built environment, green infrastructure reduces and treats stormwater at its source while delivering environmental, social, and economic benefits.



Green Infrastructure

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

Green Infrastructure projects:

- capture
- filter
- absorb
- reuse

stormwater to help restore the natural water cycle.



Green Infrastructure includes:

- Simple disconnection
- Pervious pavements
- Bioretention systems/rain gardens
- Downspout planter boxes
- Rainwater harvesting systems
- Bioswales
- Stormwater planters
- Tree filter boxes
- Green streets
- Green roofs



Parker Urban Greenscapes. 2009.



SIMPLE DISCONNECTION

- Simply divert stormwater runoff to pervious area so it infiltrates
- Usually rooftop runoff is diverted to a lawn area

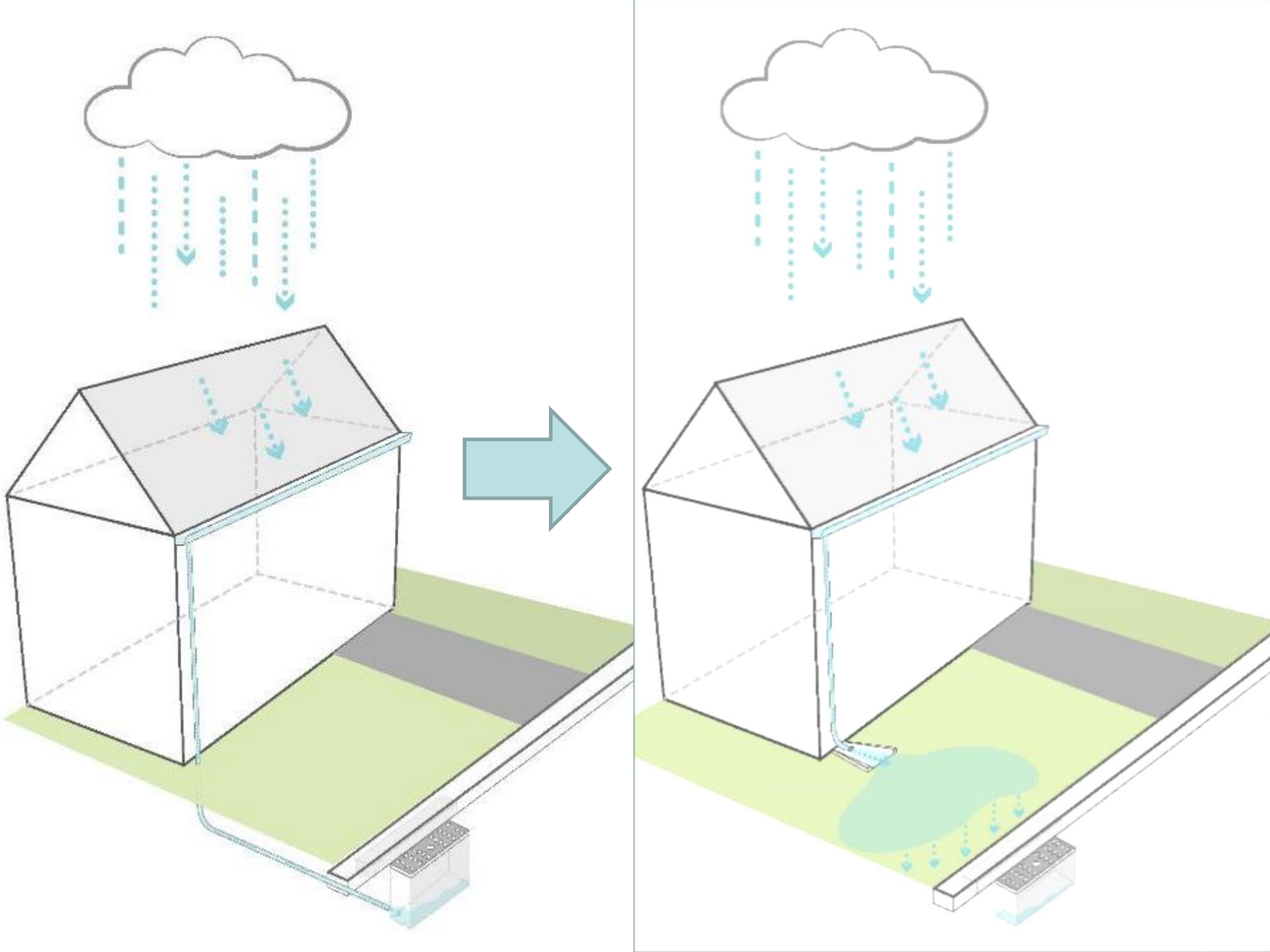
ADVANTAGES

- Easy and inexpensive

DISADVANTAGES

- Only manage small amounts of rainfall





PERVIOUS PAVEMENTS

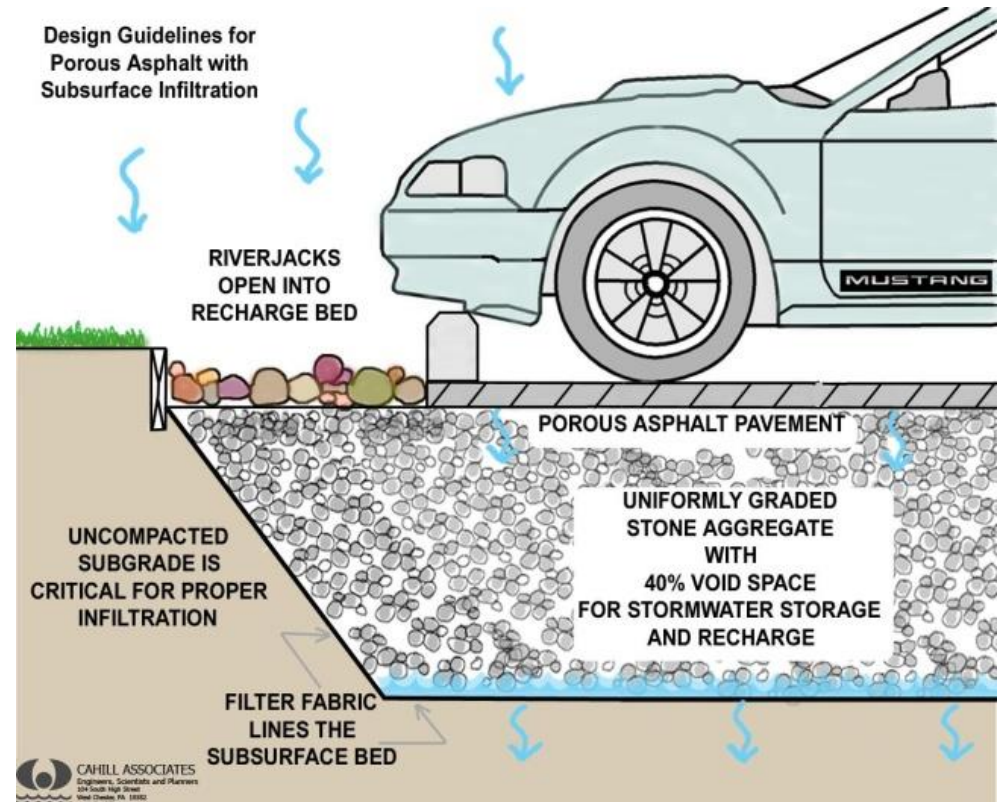
- Underlying stone reservoir
- Porous asphalt and pervious concrete are manufactured without "fine" materials to allow infiltration
- Grass pavers are concrete interlocking blocks with open areas to allow grass to grow
- Ideal application for porous pavement is to treat a low traffic or overflow parking area



ADVANTAGES

- Manage stormwater runoff
- Minimize site disturbance
- Promote 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



DISADVANTAGES

- More expensive than regular asphalt and concrete
- Permeable paving systems are expensive
- Pervious concrete has not stood up over time
- Cannot apply grit/sand in winter, only salt
- Special mixes are not always available
- Installers are hard to find
- Yet to be embraced by many traditional engineers



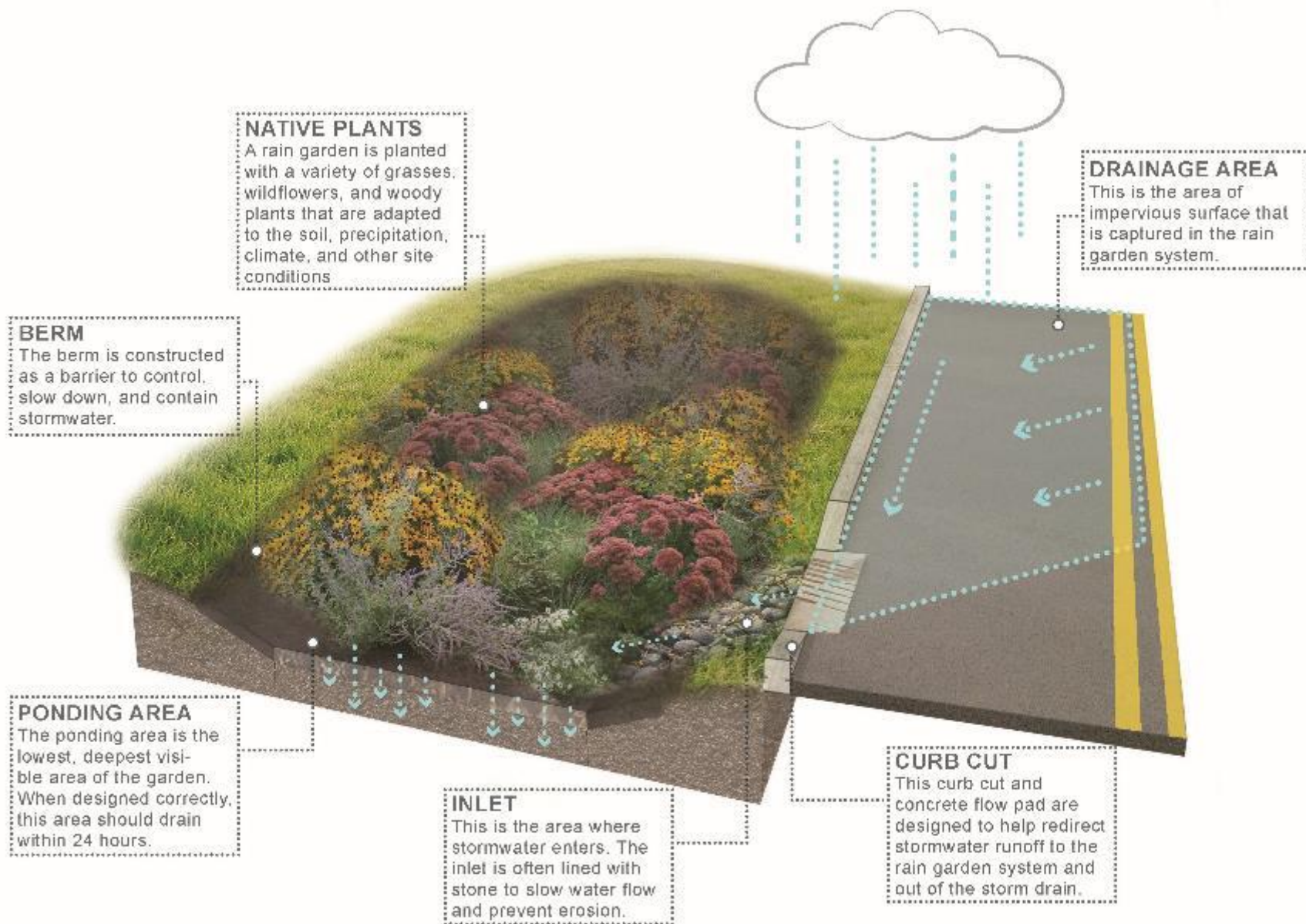
Porous Asphalt



Grass Pavers



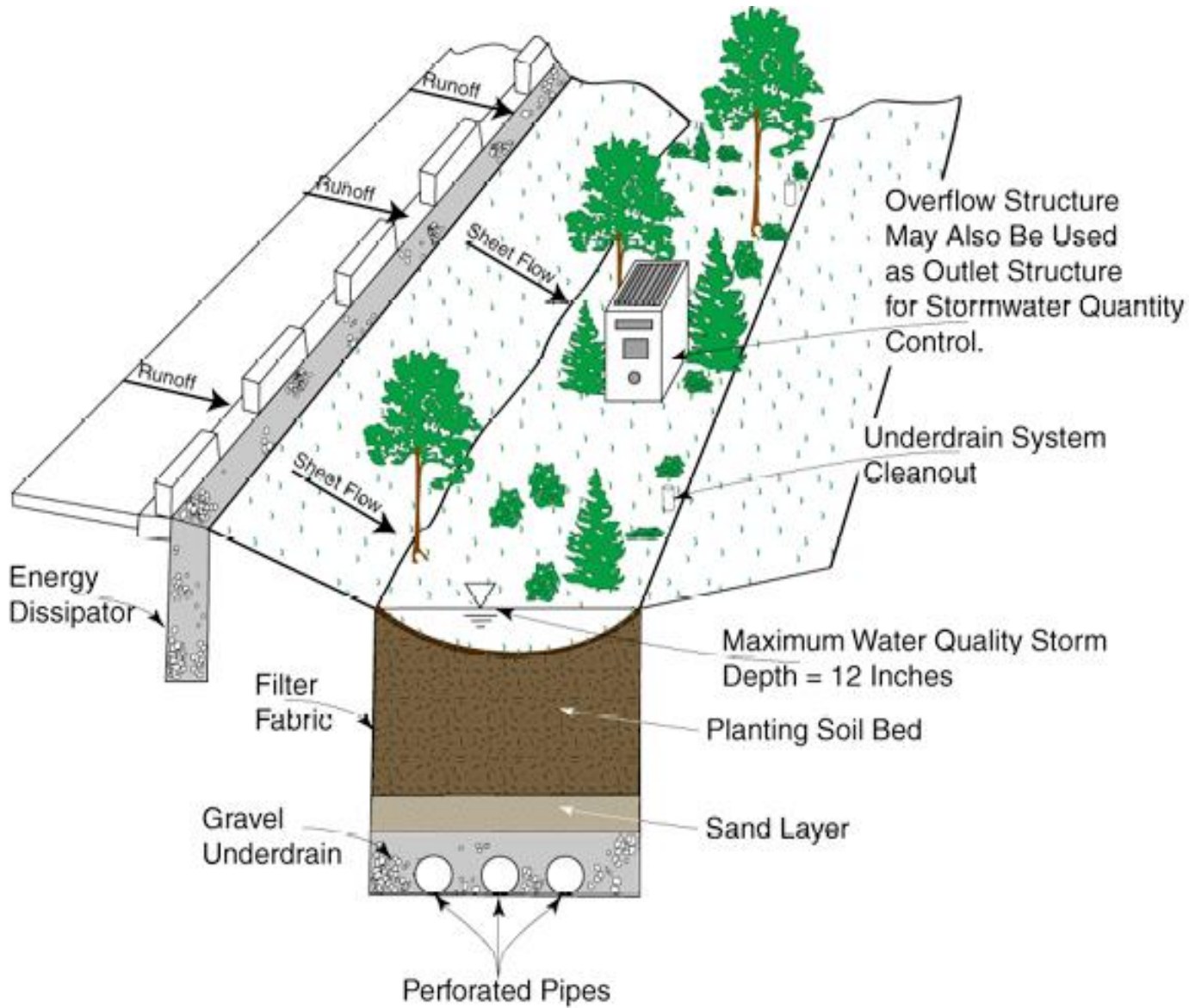
BIORETENTION SYSTEMS/RAIN GARDENS



ADVANTAGES

- 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
- Provided wildlife habitat
- Sequesters carbon
- Produces oxygen

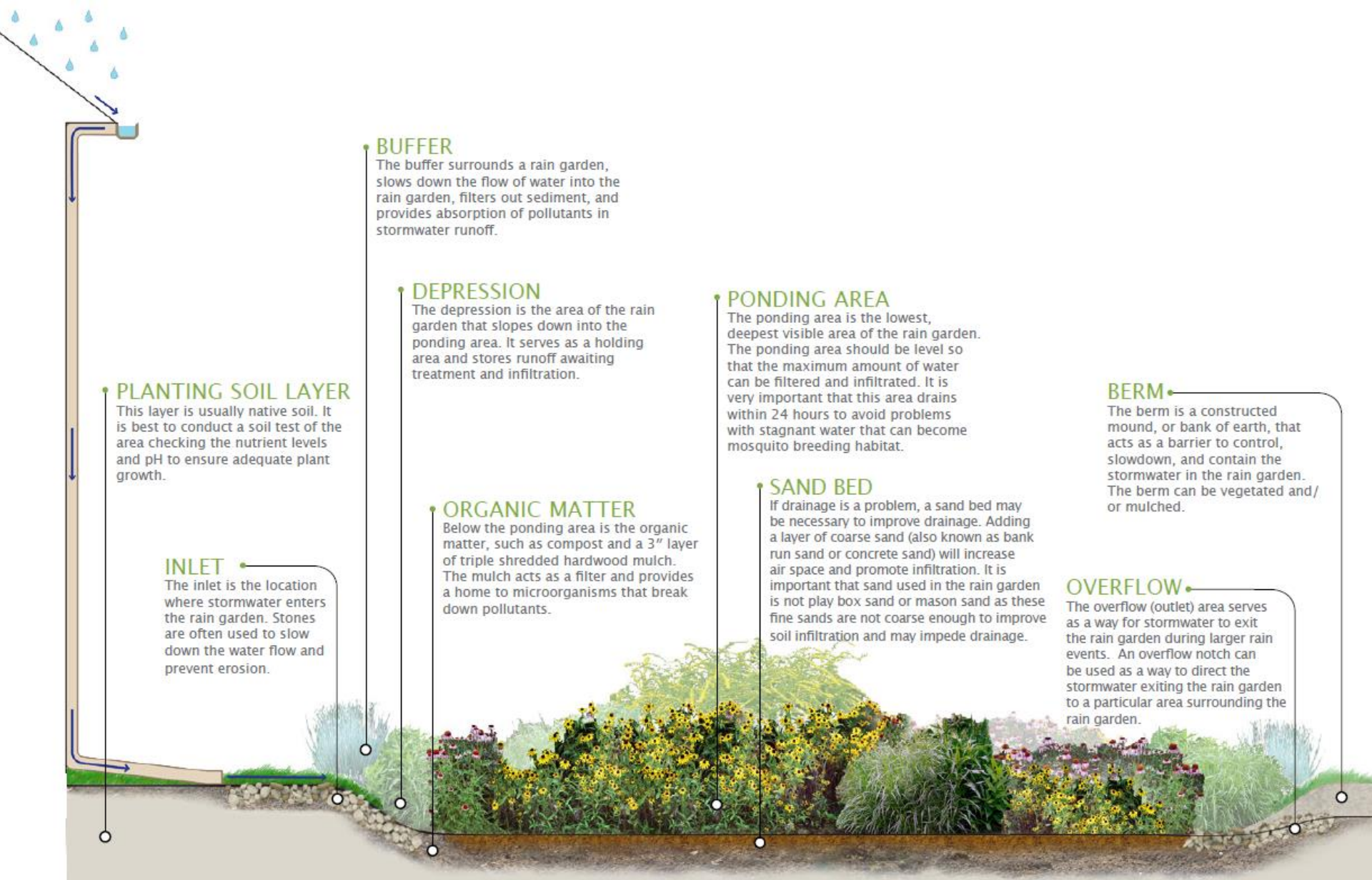




DISADVANTAGES

- Requires maintenance (weeding, pruning, mulching)
- Collects trash
- Can release nutrients from bioretention soil mix
- May not be aesthetically appealing to everyone





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.

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.

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.

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.

DOWNSPOUT PLANTER BOXES

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.

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.

CONNECTION

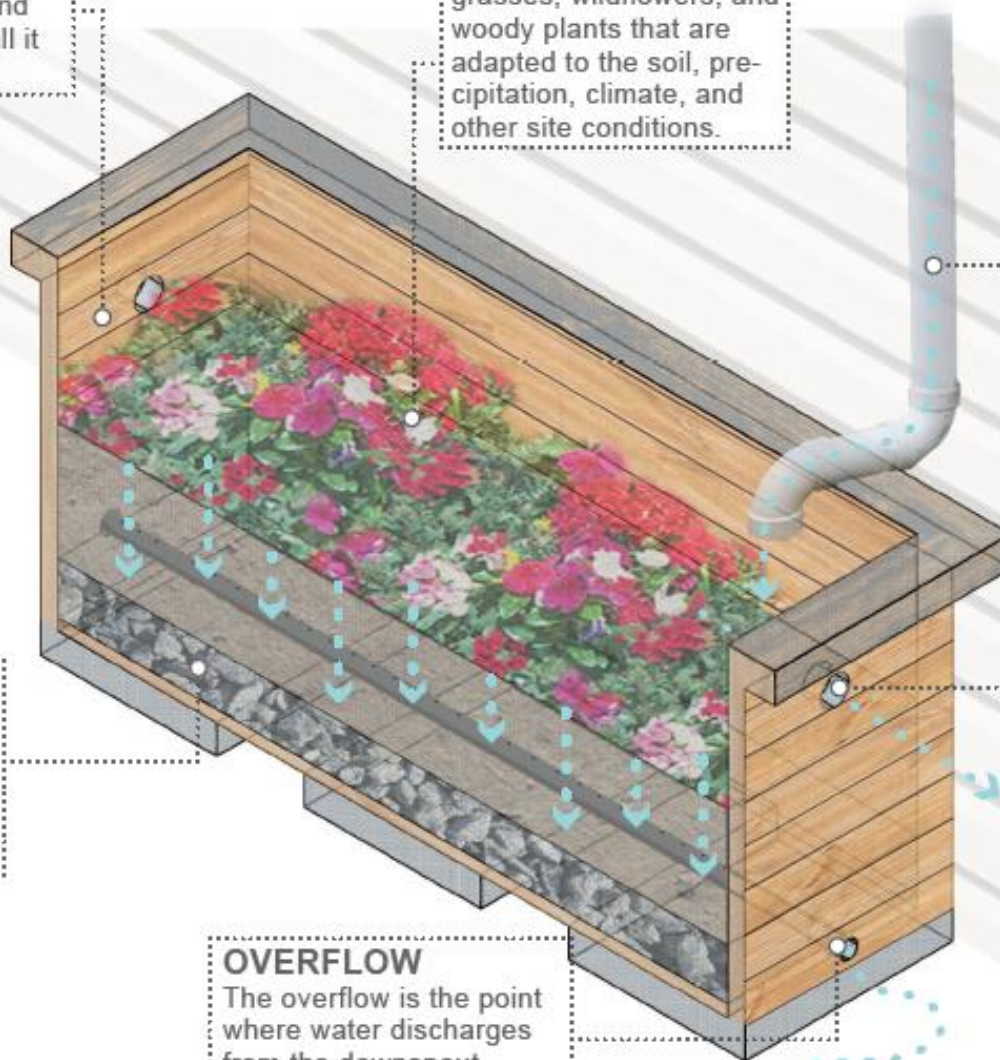
The system is designed to overflow into adjacent boxes using a connecting pipe that is sealed with silicon.

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.



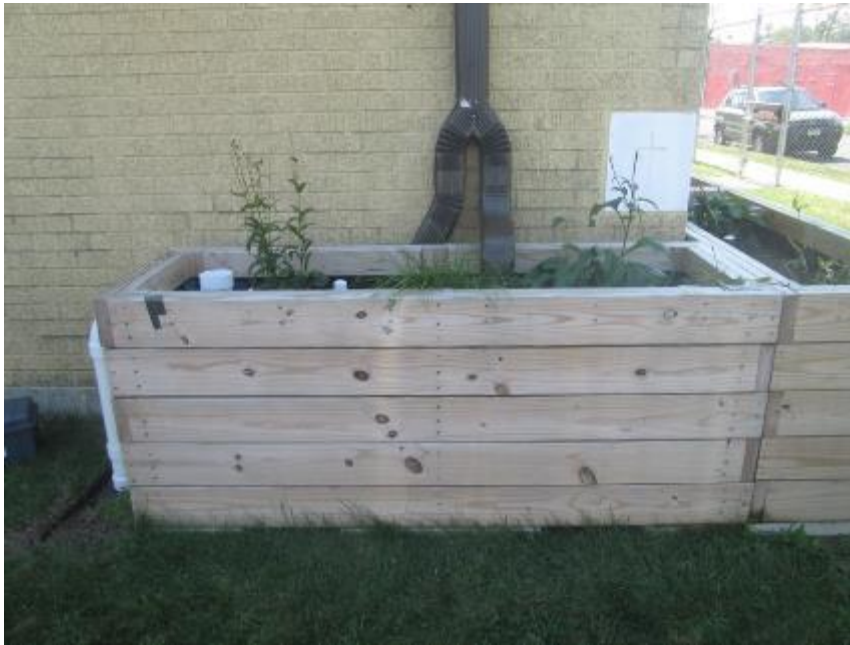
ADVANTAGES

- Requires very little space
- Can enhance aesthetics of building
- Relatively inexpensive
- Can be designed to match architectural structure
- Can be constructed out of recycled materials

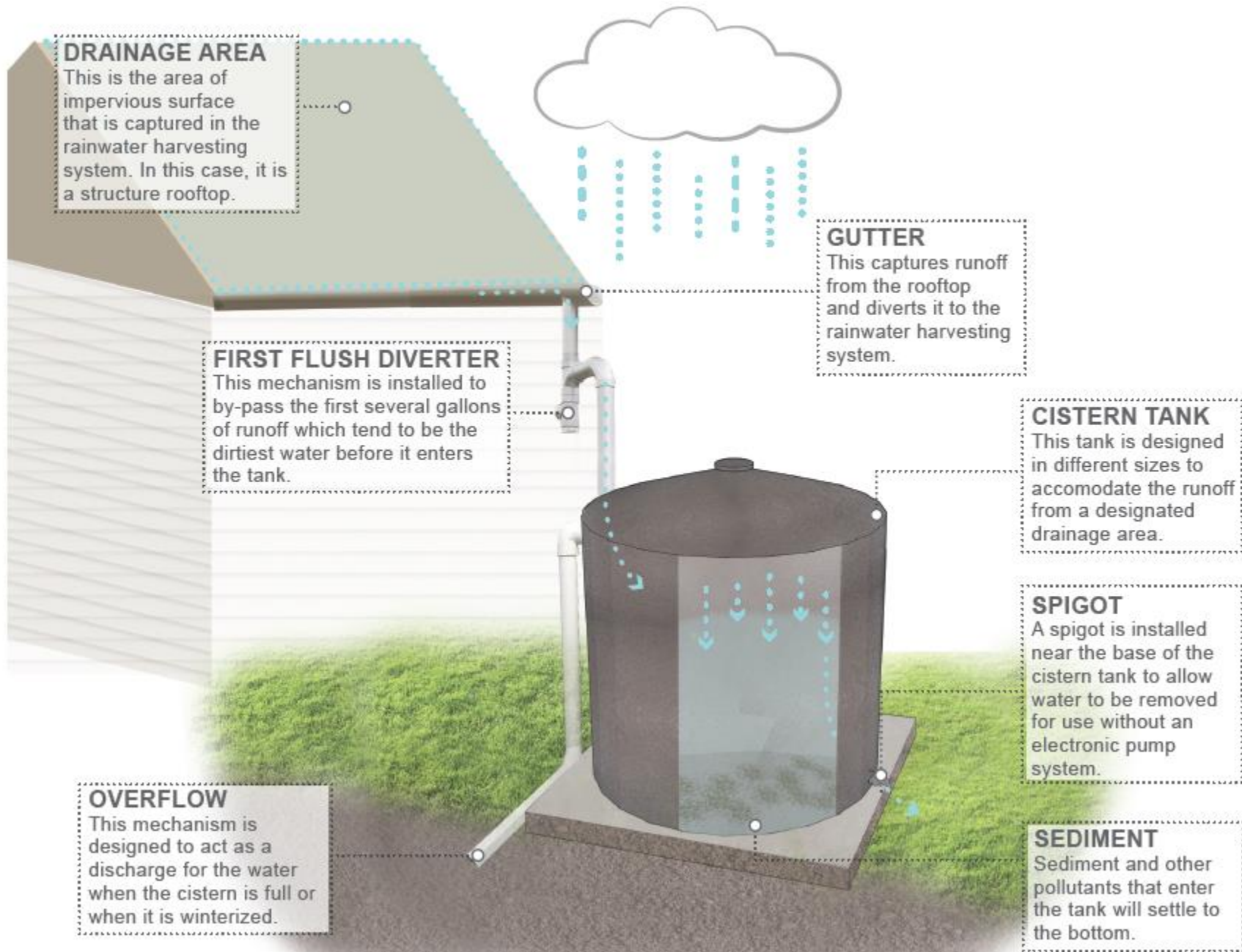


DISADVANTAGES

- Provide very little storage
- Easily vandalized
- Maintenance of the box and plants is required
- Heavy rainfall could damage plants



RAINWATER HARVESTING SYSTEMS



ADVANTAGES

- Free water
- Fairly easy to install
- Fairly inexpensive
- Easily winterized
- Tanks come in all shapes and sizes

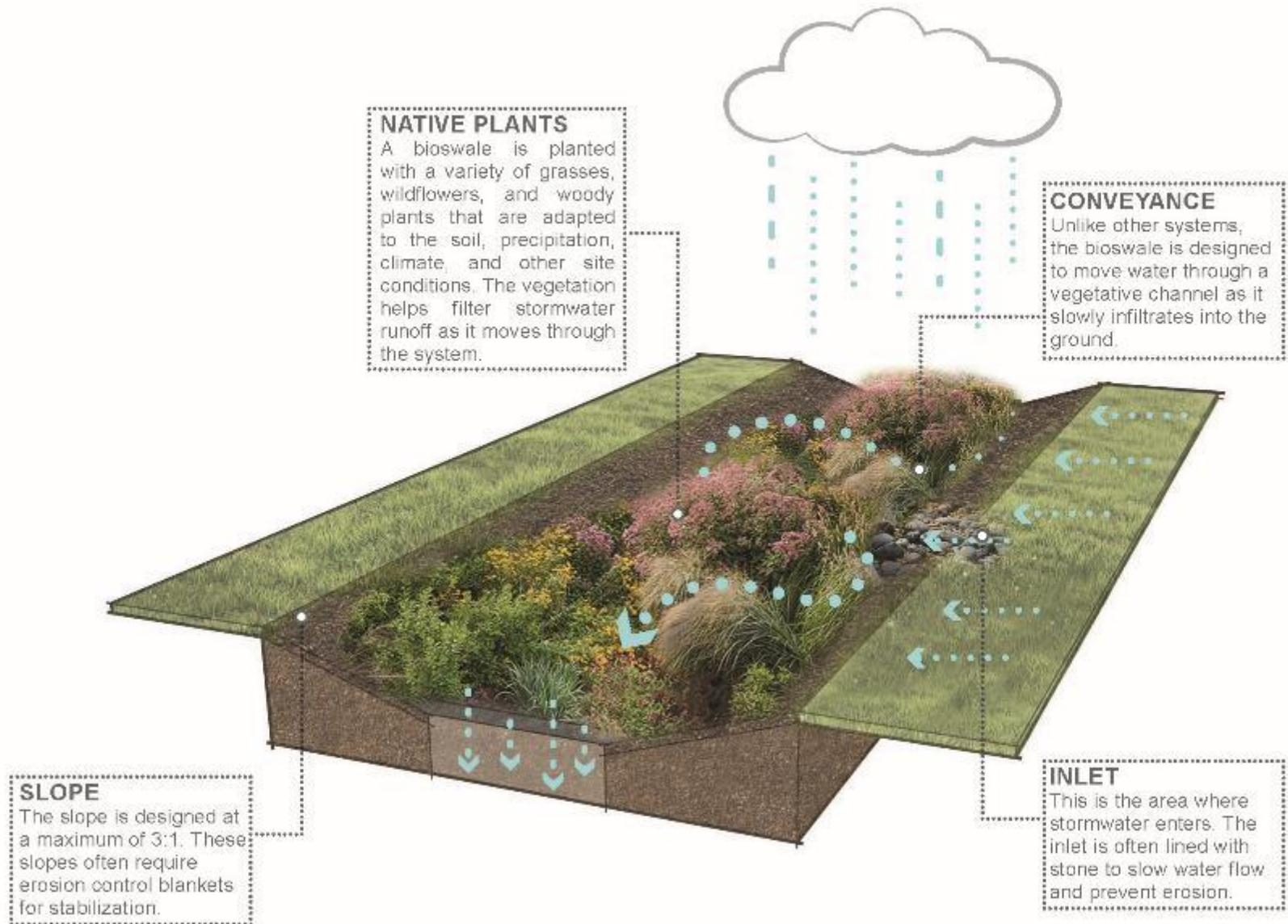


DISADVANTAGES

- Rain barrel is only 50 gallons, not much for stormwater management
- Only functions in warm months, must be winterized
- Must have use for water
- Must drain between storm events



BIOSWALE



ADVANTAGES

- Transports stormwater
- Filters stormwater
- Infiltrates stormwater
- Aesthetically pleasing
- Creates wildlife habitat



DISADVANTAGES

- Maintenance including sediment and trash removal
- High flow can cause erosion
- Hazard for vehicles



STORMWATER PLANTERS

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.

CONCRETE WALL

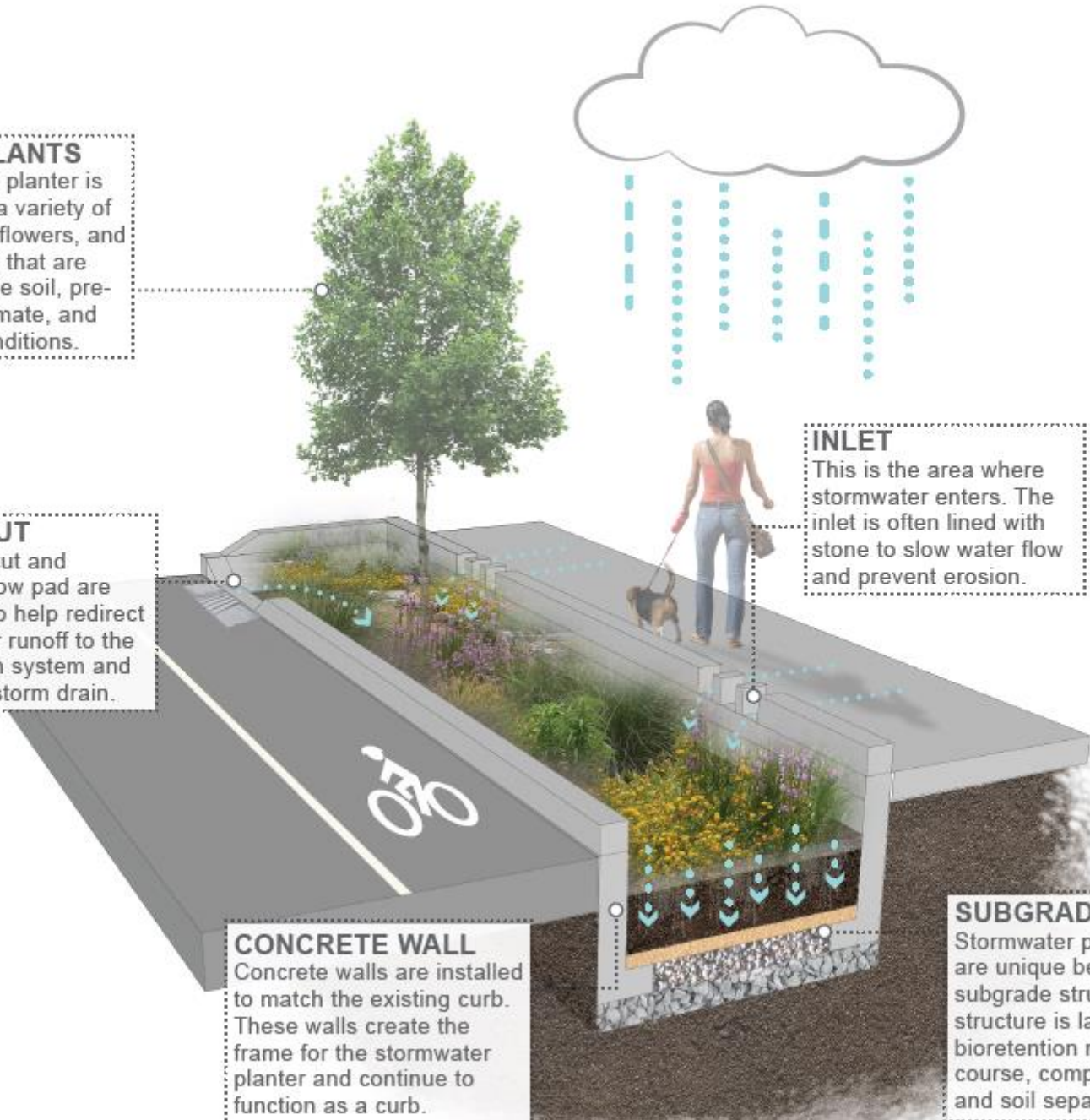
Concrete walls are installed to match the existing curb. These walls create the frame for the stormwater planter and continue to function as a curb.

INLET

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

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.



ADVANTAGES

- Combines settling with physical filtering and absorption processes
- Provides very high pollutant removal efficiencies
- More aesthetically pleasing and can be incorporated into the landscapes of most streetscapes
- Provided wildlife habitat
- Sequesters carbon
- Produces oxygen

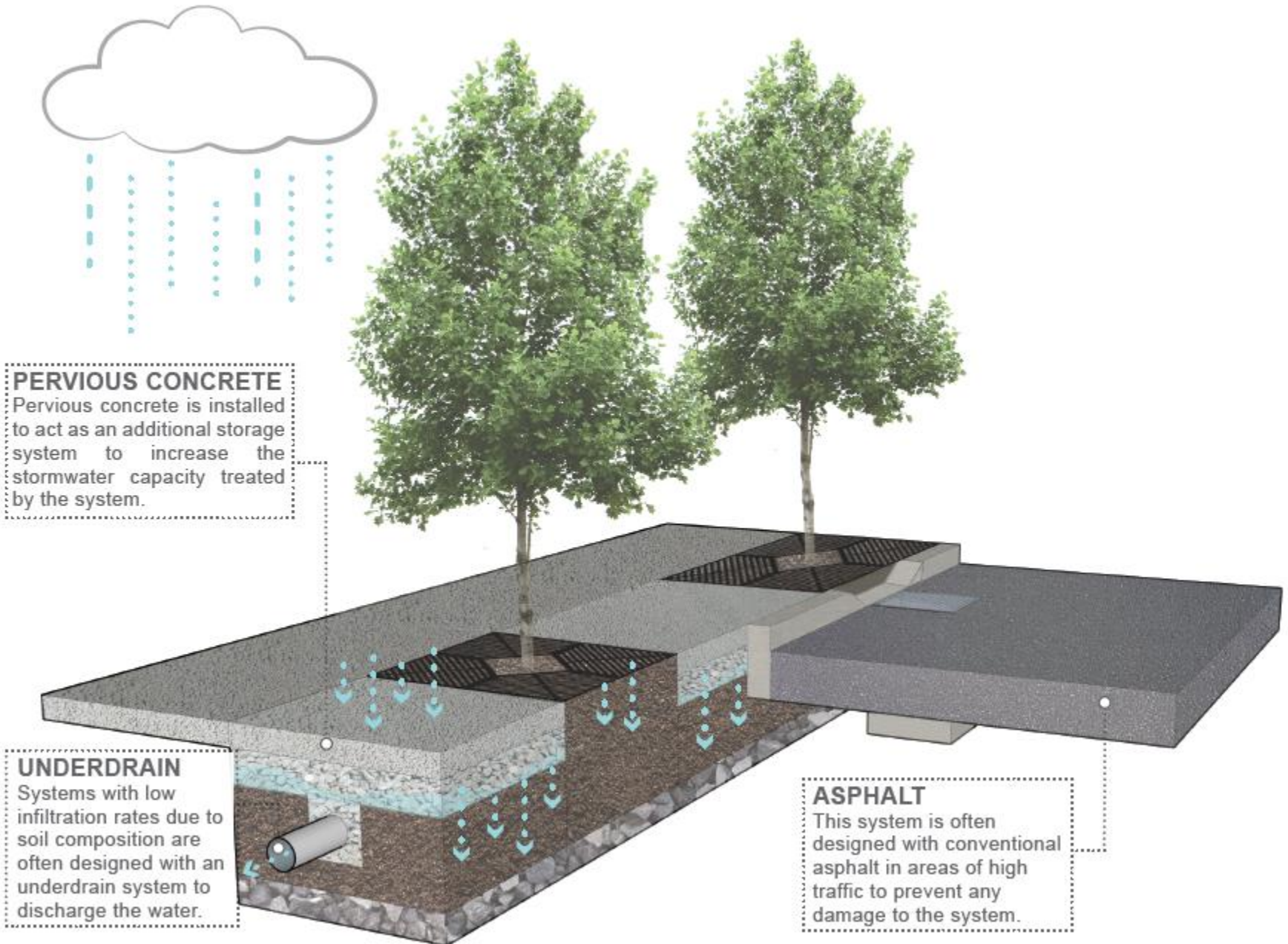


DISADVANTAGES

- Requires maintenance (weeding, pruning, mulching)
- Collects trash
- Can release nutrients from bioretention soil mix
- May not be aesthetically appealing to everyone
- Can be expensive due to curbing and sidewalk removal
- Utilities can be a problem to work around
- Possible tripping hazard



TREE FILTER BOXES IN A STREETScape



ADVANTAGES

- Easy to incorporate into streetscapes
- Provides shading and helps with heat island effect
- Enhance aesthetics
- Provided wildlife habitat
- Sequesters carbon
- Produces oxygen



DISADVANTAGES

- Can be expensive
- Tree filter box has little storage capacity unless incorporated into an enhanced tree pit system
- Maintenance – trees need pruning
- Wildlife habitat – too many birds; can stimulate local car wash business

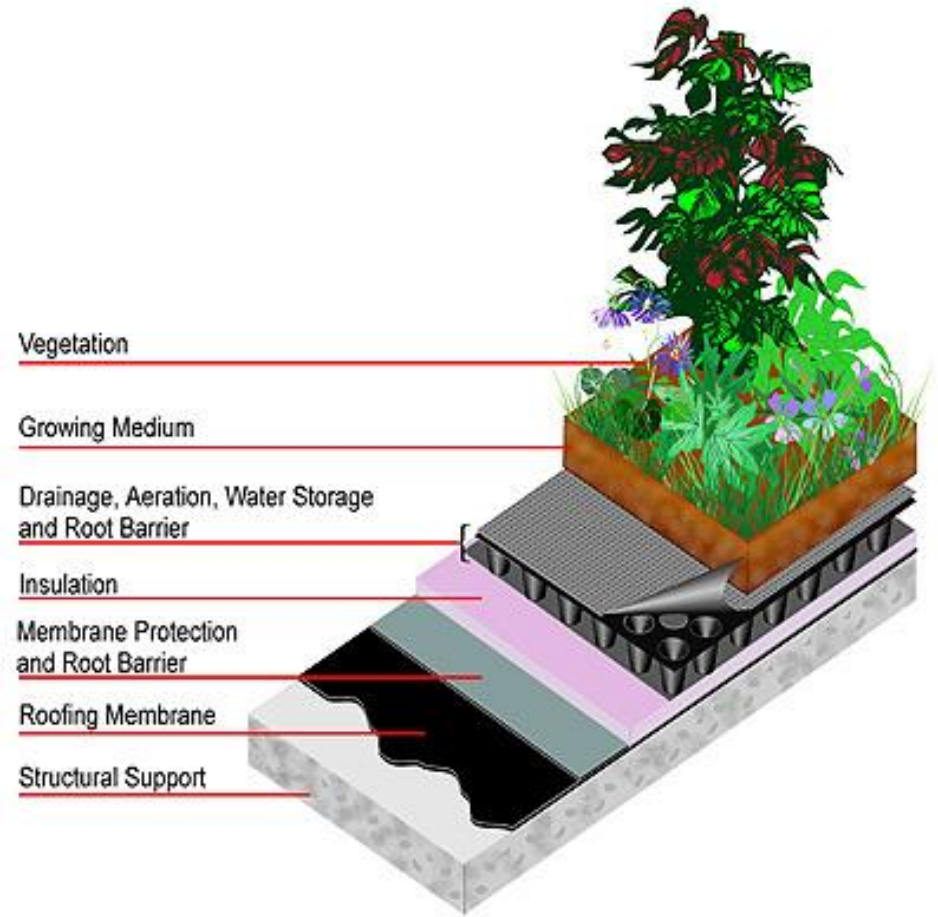


GREEN ROOFS

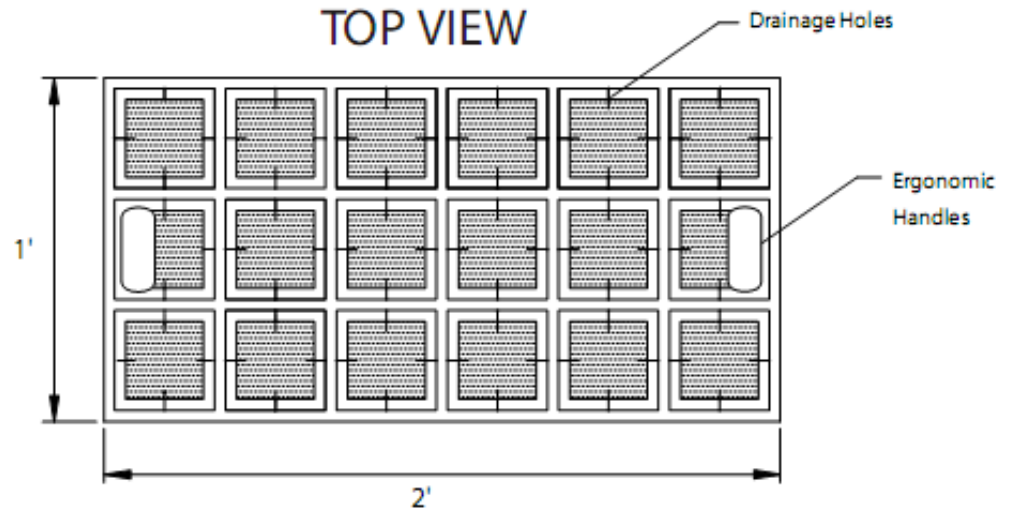
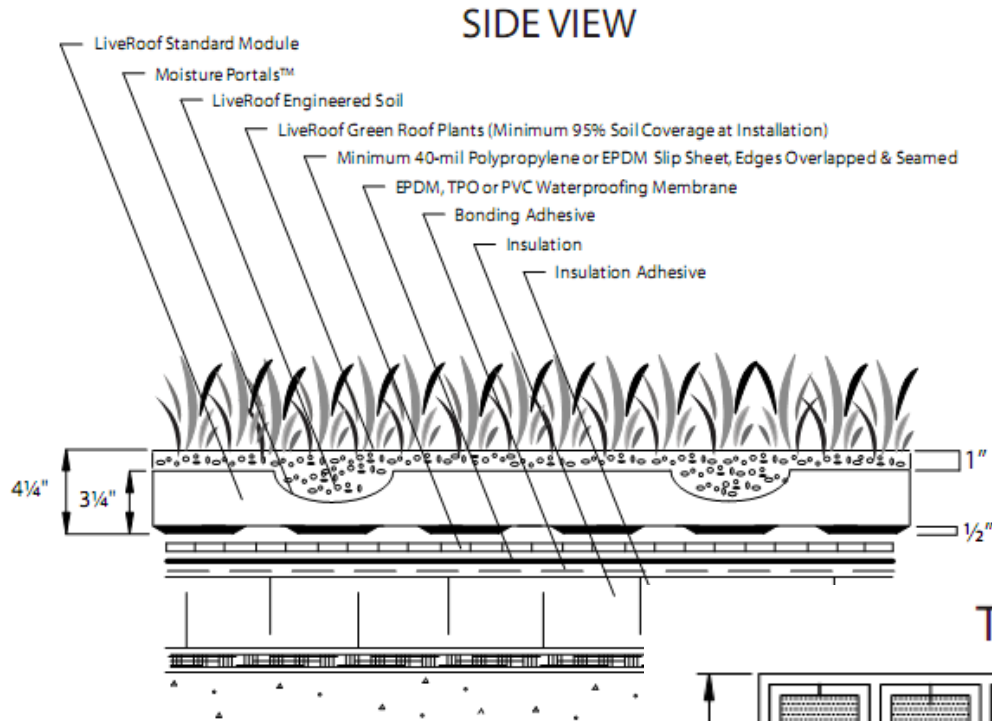
FUNCTIONS

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

COMPONENTS



Modular System Specifications



DISADVANTAGES

- Very expensive
- Minimal stormwater management (up to ½ inch of rain)
- Very heavy and hard to retrofit on existing roof
- Facility managers tend to not be very supportive – “roof will leak”
- Did I mention – very expensive



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QUESTIONS?

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