Green Stormwater Infrastructure for the 2nd Northwest New Jersey Rivers Conference

Christopher C. Obropta, Ph.D., P.E.
on November 12, 2020

RUTGERS
New Jersey Agricultural
Experiment Station

Rutgers Cooperative Extension

Rutgers Cooperative Extension (RCE) helps the diverse population of New Jersey adapt to a rapidly changing society and improves their lives through an educational process that uses science-based knowledge.

Water Resources Program

Our Mission is to identify and address water resources issues by engaging and empowering communities to employ practical science-based solutions to help create a more equitable and sustainable New Jersey

Water Resources Problems of NJ

- Localized flooding
- Major flooding (hurricanes, Northeasters, etc)
- Poor stream health (chemical, physical, biological)
- Harmful Algal Blooms (HABs)
- Erosion and sedimentation

Causes of Water Resources Problems

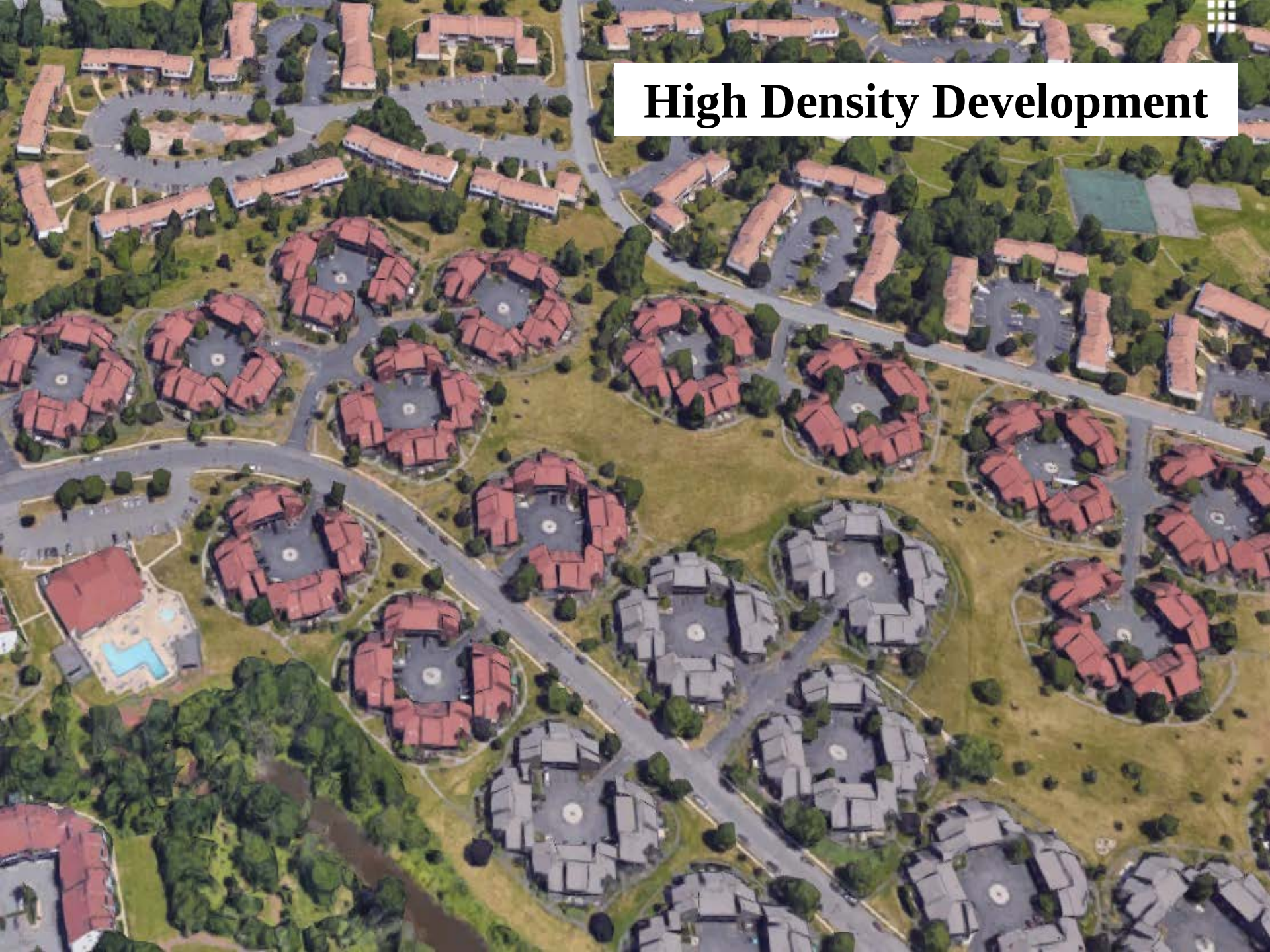
- Existing Development
- New Development (Major and Minor)
- Agriculture Land Uses
- Natural Lands

Natural Lands

Agriculture

Commercial Development

High Density Development



Single Family Homes

Development with and without stormwater management in NJ

- 1986 Urban: 1,252,139 acres
- 2015 Urban: 1,569,210 acres
- Difference: 317,071 acres (28% ⇧)

- **79.8% of all urban land existed in 1986**

Green Infrastructure (GI or GSI)

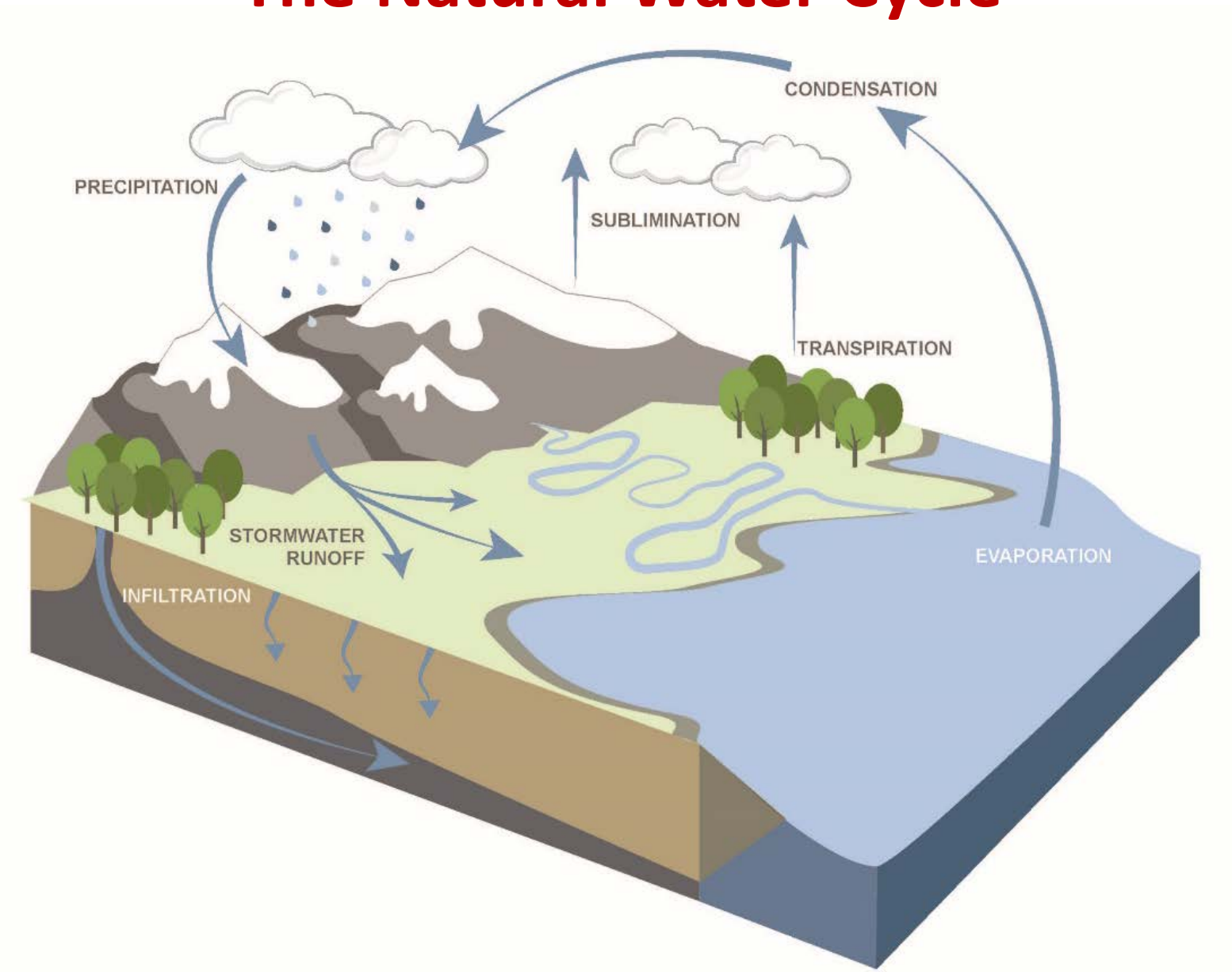
…an approach to stormwater management that is cost-effective, sustainable, and environmentally friendly.

Green Infrastructure projects:

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

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

The Natural Water Cycle



Impervious Surfaces

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

The Urban Water Cycle

Green Infrastructure

Stormwater management practices that protect, restore, and mimic the native hydrologic condition by providing the following functions:

- Infiltration
- Filtration
- Storage
- Evaporation
- Transpiration

Green Infrastructure Practices

<u>Bioretention Systems</u>

- Rain Gardens
- Bioswales
- Stormwater Planters
- Curb Extensions
- Tree Filter Boxes

<u>Permeable Pavements</u>

<u>Rainwater Harvesting</u>

- Rain barrels
- Cisterns

<u>Dry Wells</u>

<u>Rooftop Systems</u>

- Green Roofs
- Blue Roofs








Parker Urban Greenscapes. 2009.

TYPES OF BIORETENTION

Bioretention Cells

- Single-family lots
- Commercial areas
- Parking lots

Rain Gardens

- Single-family lots
- Small commercial areas

Bioretention Swales/ Bioswales/Vegetated Swales

- Typically in right-of-way

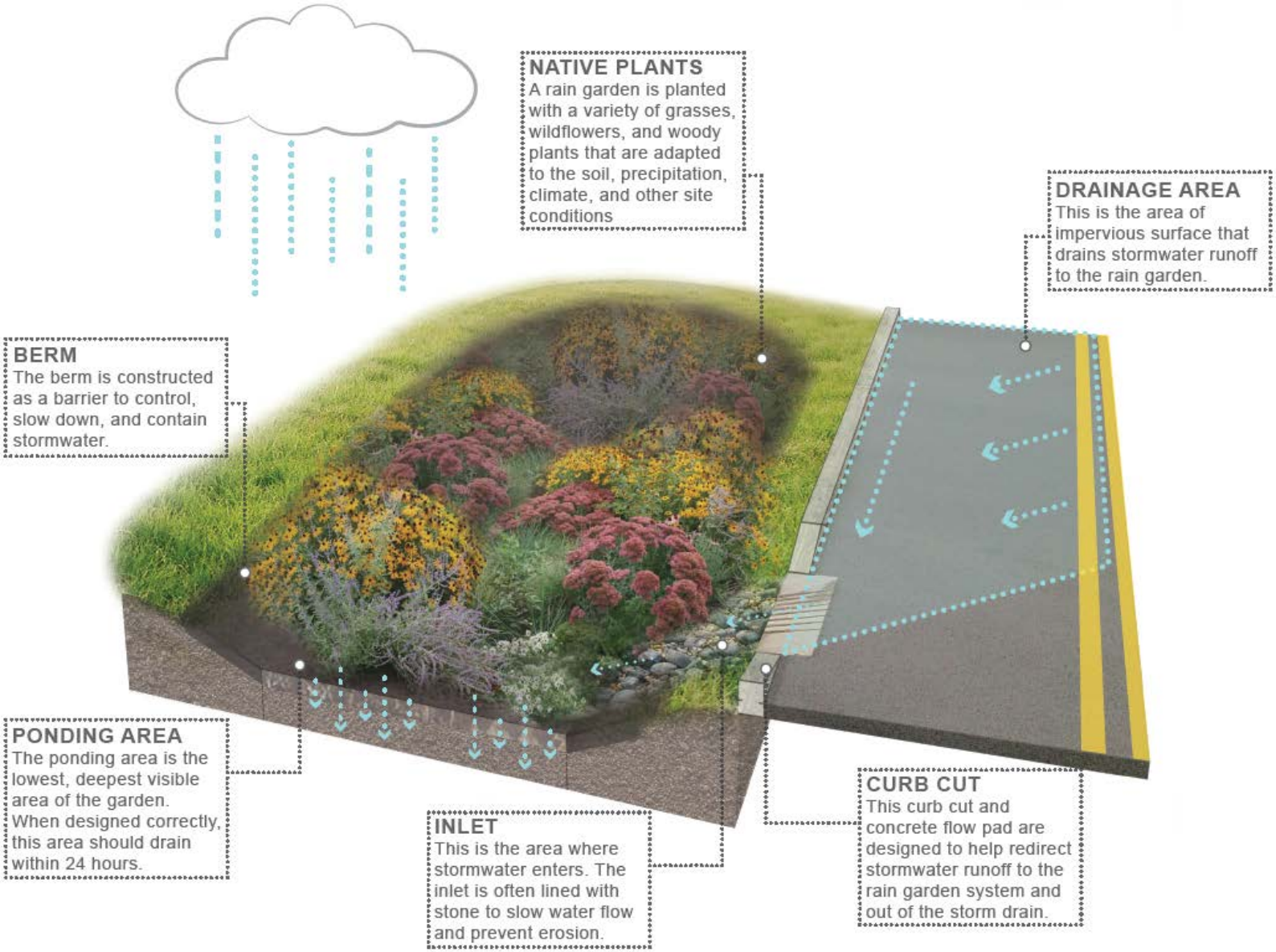
Planters & Planter Boxes

- Highly urban areas
- Right-of-way and adjacent to buildings

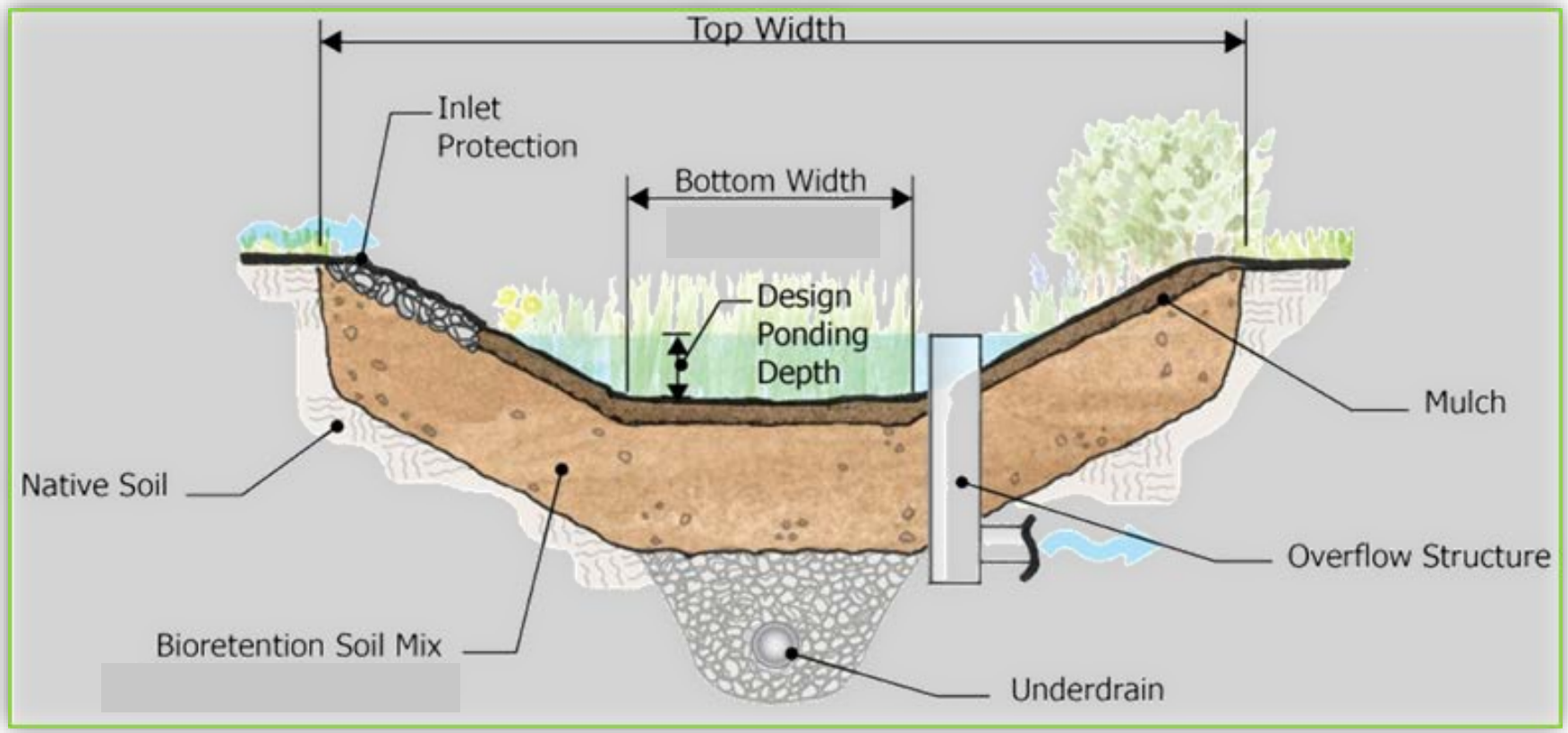
Vegetated Curb Extensions

- Bioretention incorporated into right-of-way in urban and suburban areas

Rain Gardens

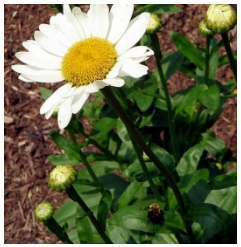


Rain Garden Cross-Section



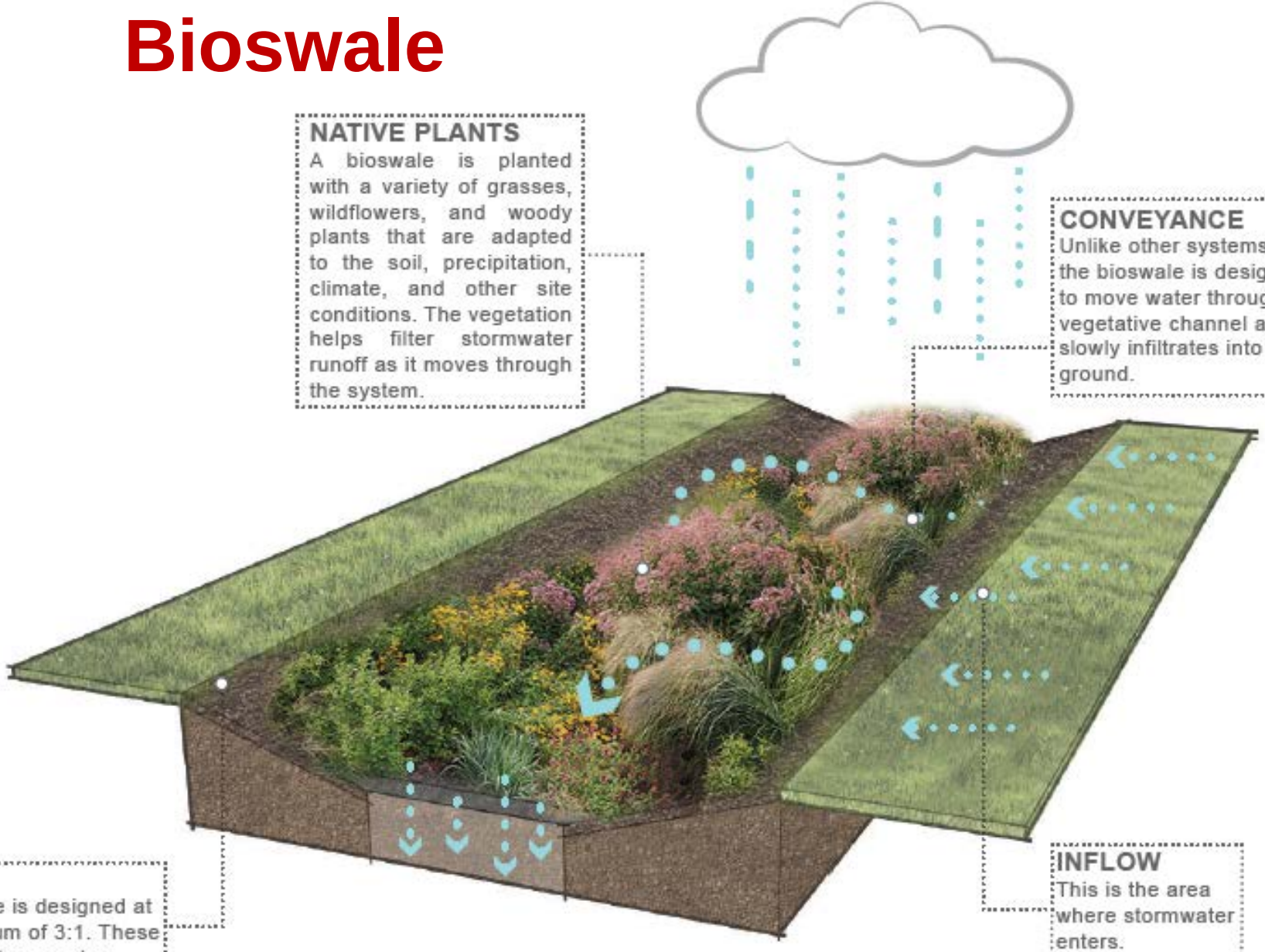

8 2 2004

Lots of Rain Gardens

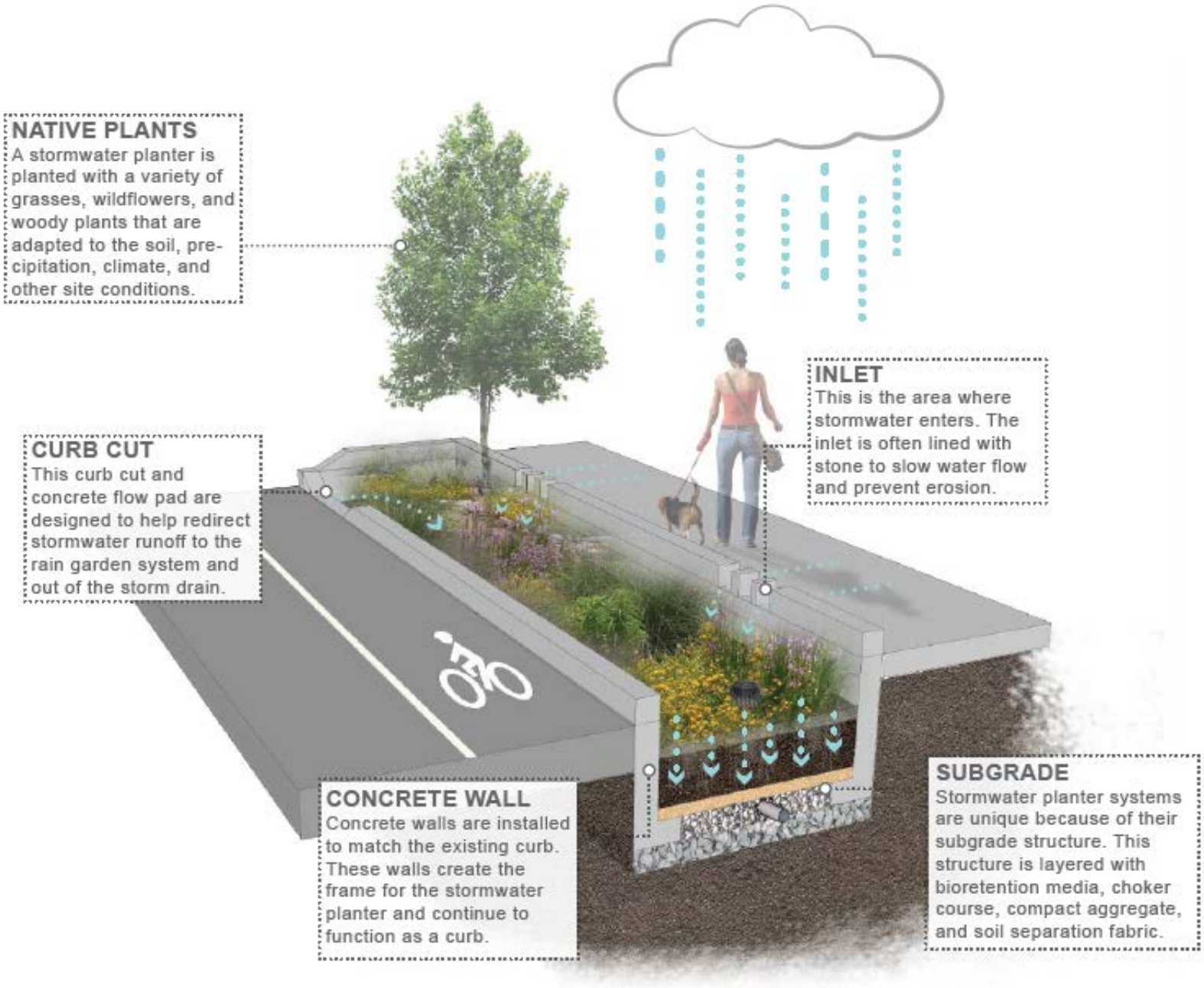



116

Bioswale


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.
INFLOW
This is the area where stormwater enters.

Stormwater Planters



OTES:

S AND OTHER
CTIONS (E.G. SCUPPER,
RUNNEL) FROM BUILDING
GN PONDING ELEVATION.
E SAN FRANCISCO DBI
NCE CONNECTION

F EXISTING SUBGRADE
INFILTRATION FACILITIES.

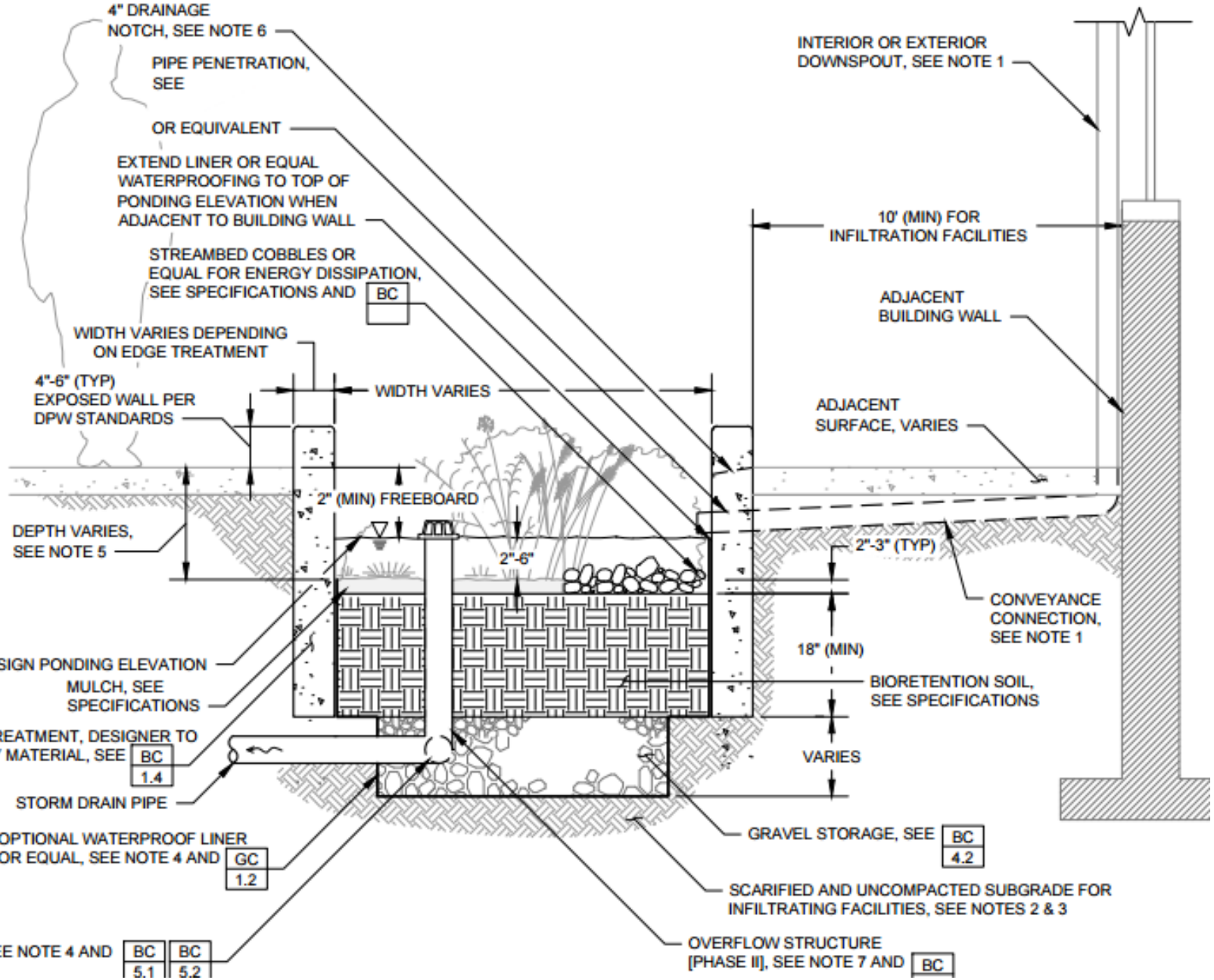
O A DEPTH OF 6 INCHES
IOR TO PLACEMENT OF
D BIORETENTION SOIL.

ER REQUIRED WITHIN 10
VELOPE UNLESS
INER NOTE 8 (SEE BP 5.1).

TOP OF WALKING
MULCH SHALL INCLUDE
E SOIL SETTLEMENT.
ISCO DBI CODES FOR
REQUIREMENTS.

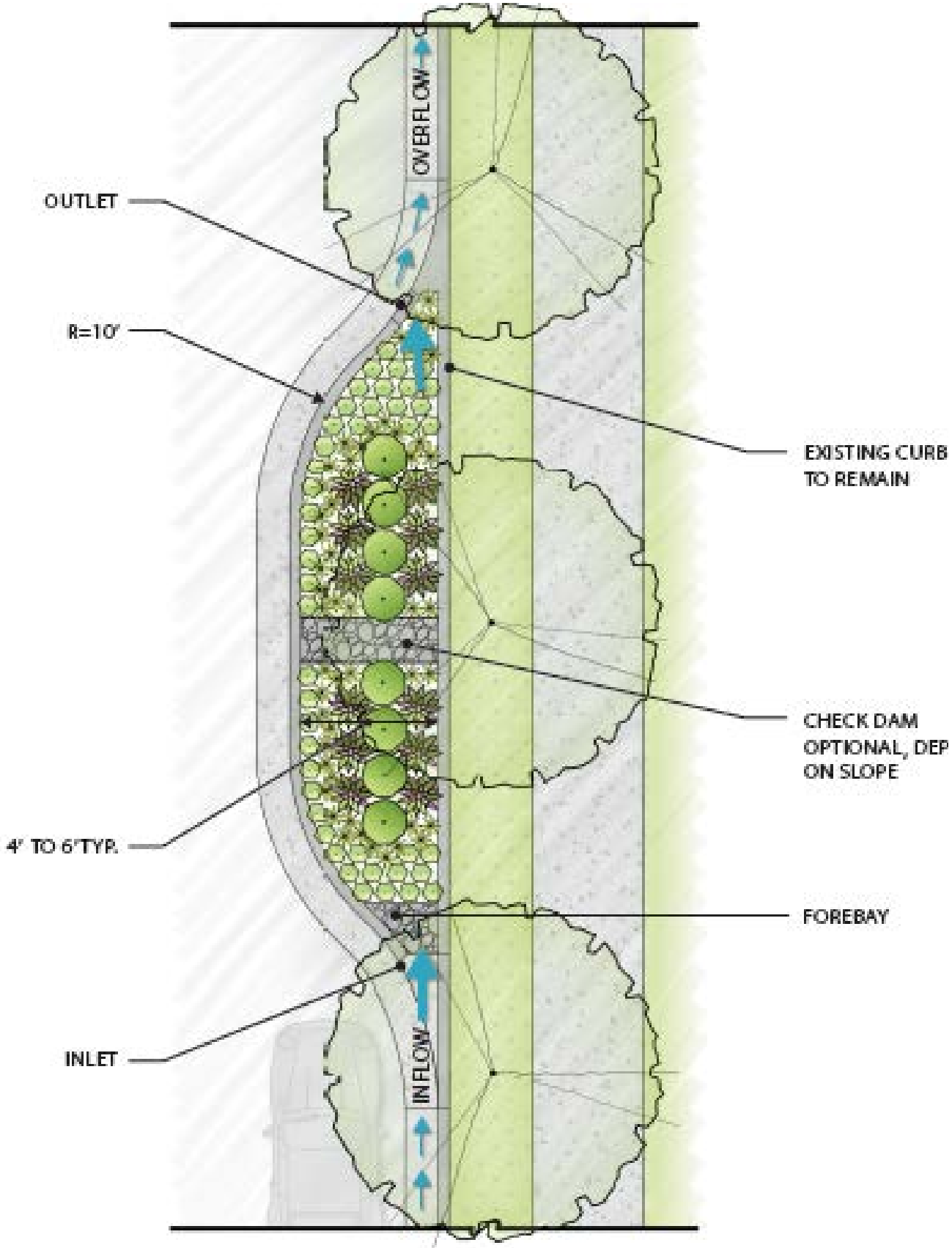
OTCHES TO PREVENT
NTER WALL. SLOPE
D PLANTER.

ORKMANSHIP FOR
RES SHALL CONFORM TO
NCISCO DBI CODES.

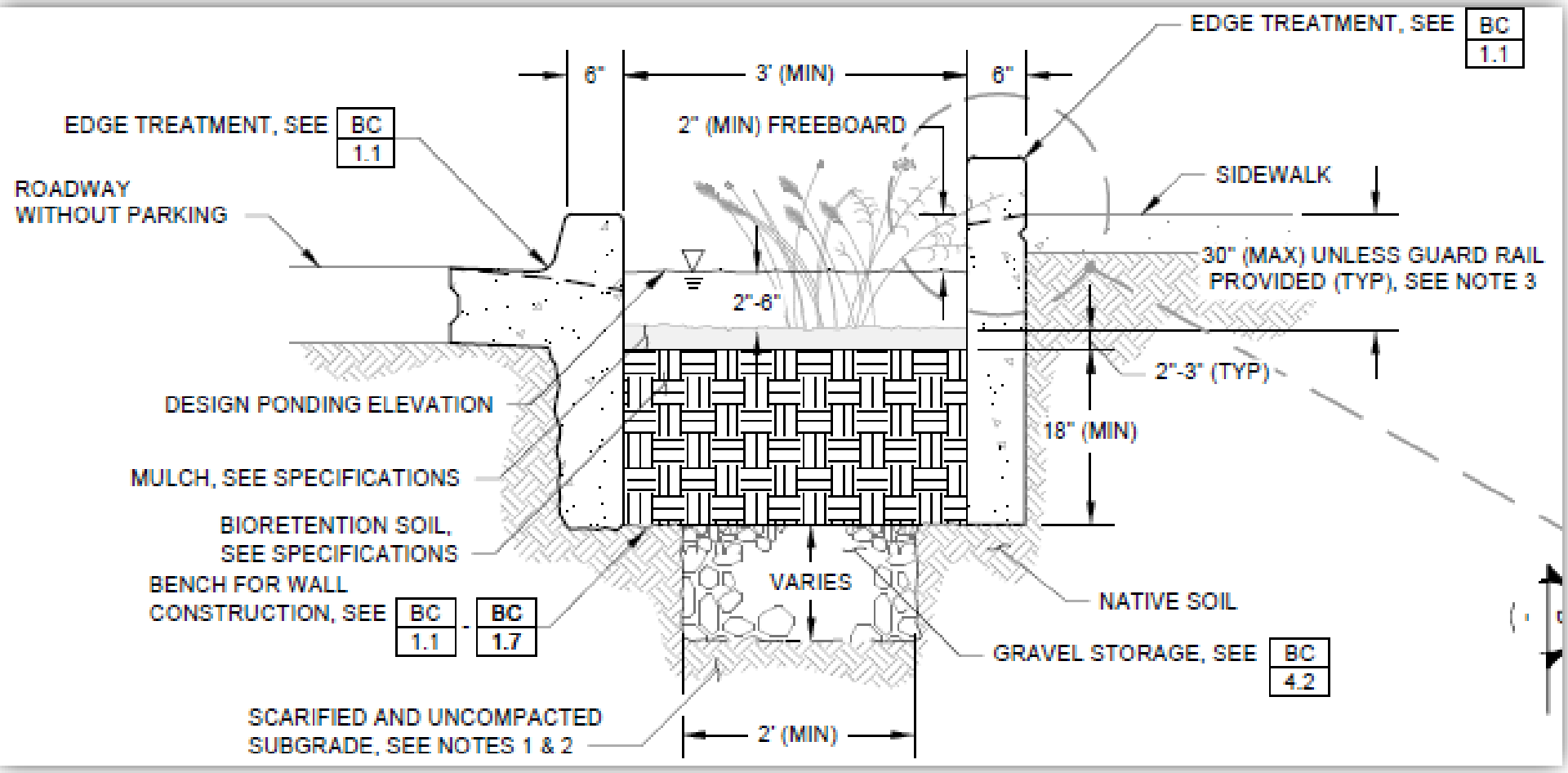


Stormwater Planter Cross-section

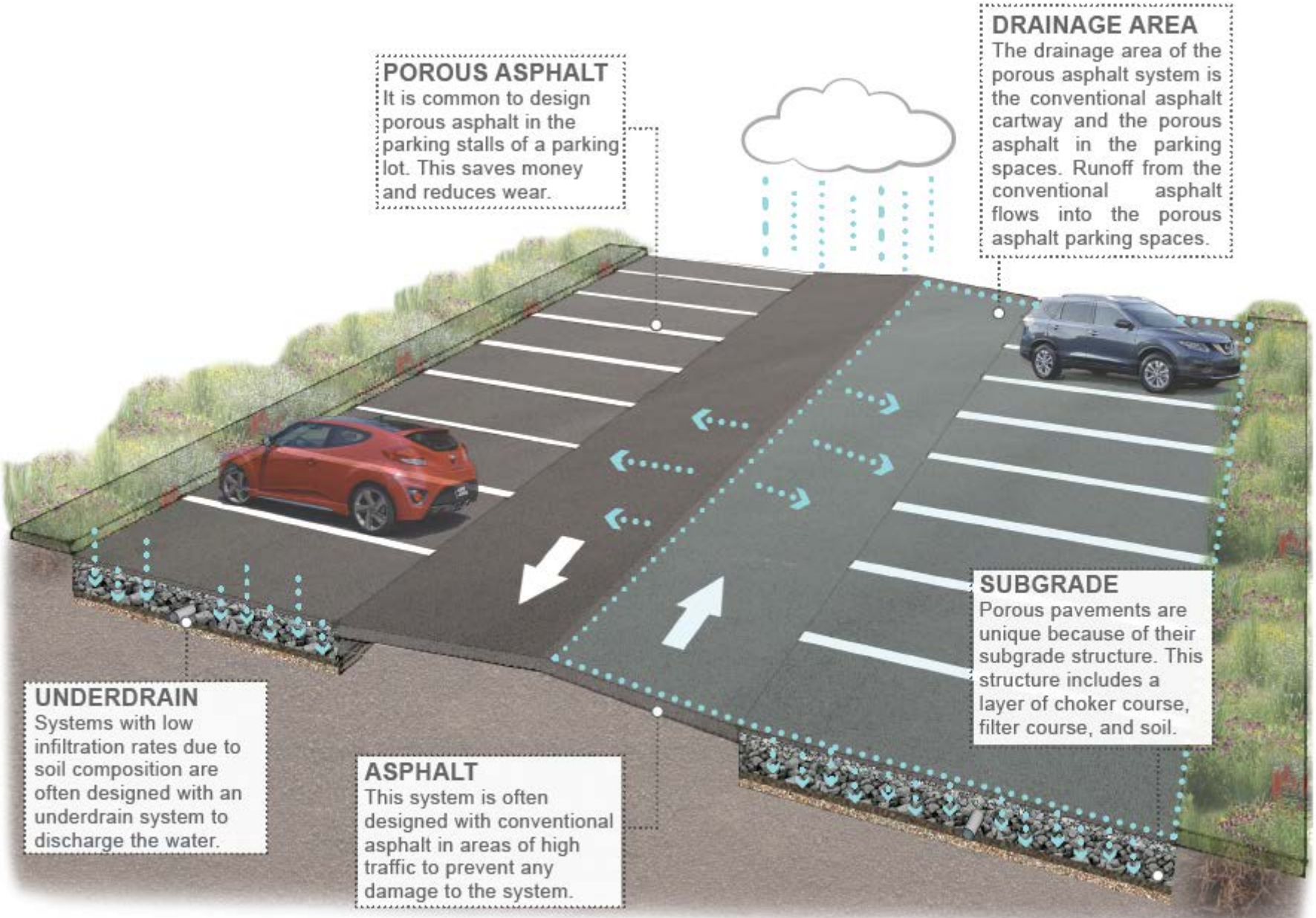
Curb Extensions



NOTE:
Graphic adapted fr
Portland, OR Storm
Manual Details

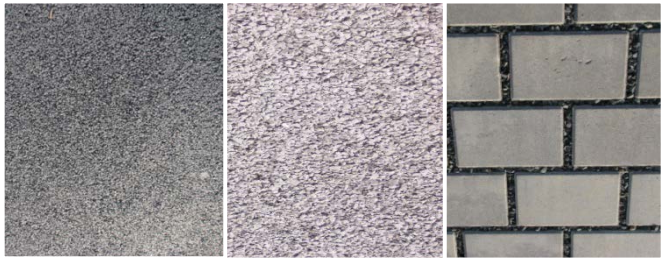

EDGE TREATMENT, SEE BC 1.1
6"
3' (MIN)
6"
EDGE TREATMENT, SEE BC 1.1
2" (MIN) FREEBOARD
SIDEWALK
ROADWAY
WITHOUT PARKING
30" (MAX) UNLESS GUARD RAIL
PROVIDED (TYP), SEE NOTE 3
2"-6"
2"-3" (TYP)
DESIGN PONDING ELEVATION
18" (MIN)
MULCH, SEE SPECIFICATIONS
BIORETENTION SOIL,
SEE SPECIFICATIONS
BENCH FOR WALL
CONSTRUCTION, SEE BC 1.1 - BC 1.7
VARIES
NATIVE SOIL
GRAVEL STORAGE, SEE BC 4.2
SCARIFIED AND UNCOMPACTED
SUBGRADE, SEE NOTES 1 & 2
2' (MIN)

Permeable Pavement



Permeable Pavements

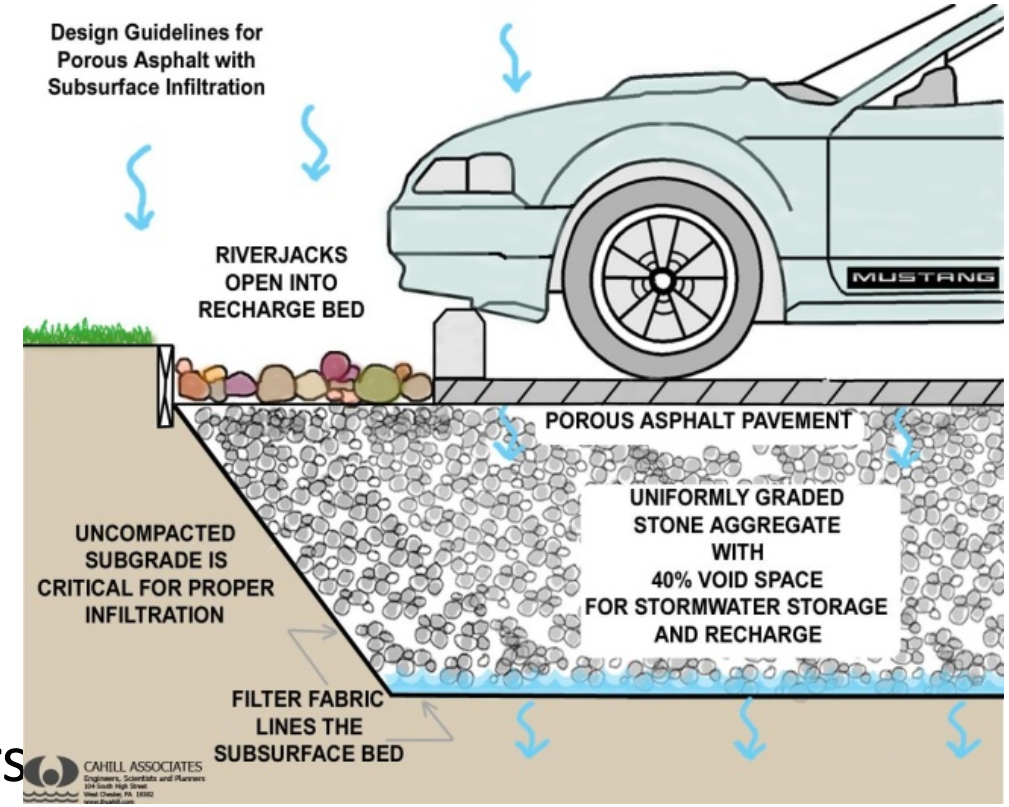
- Underlying stone reservoir
- Porous asphalt and pervious concrete are manufactured without "fine" materials to allow infiltration
- Grass pavers are concrete interlocking blocks with open areas to allow grass to grow
- Permeable pavers systems are concrete pavers with infiltration between the spaces of the pavers
- 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



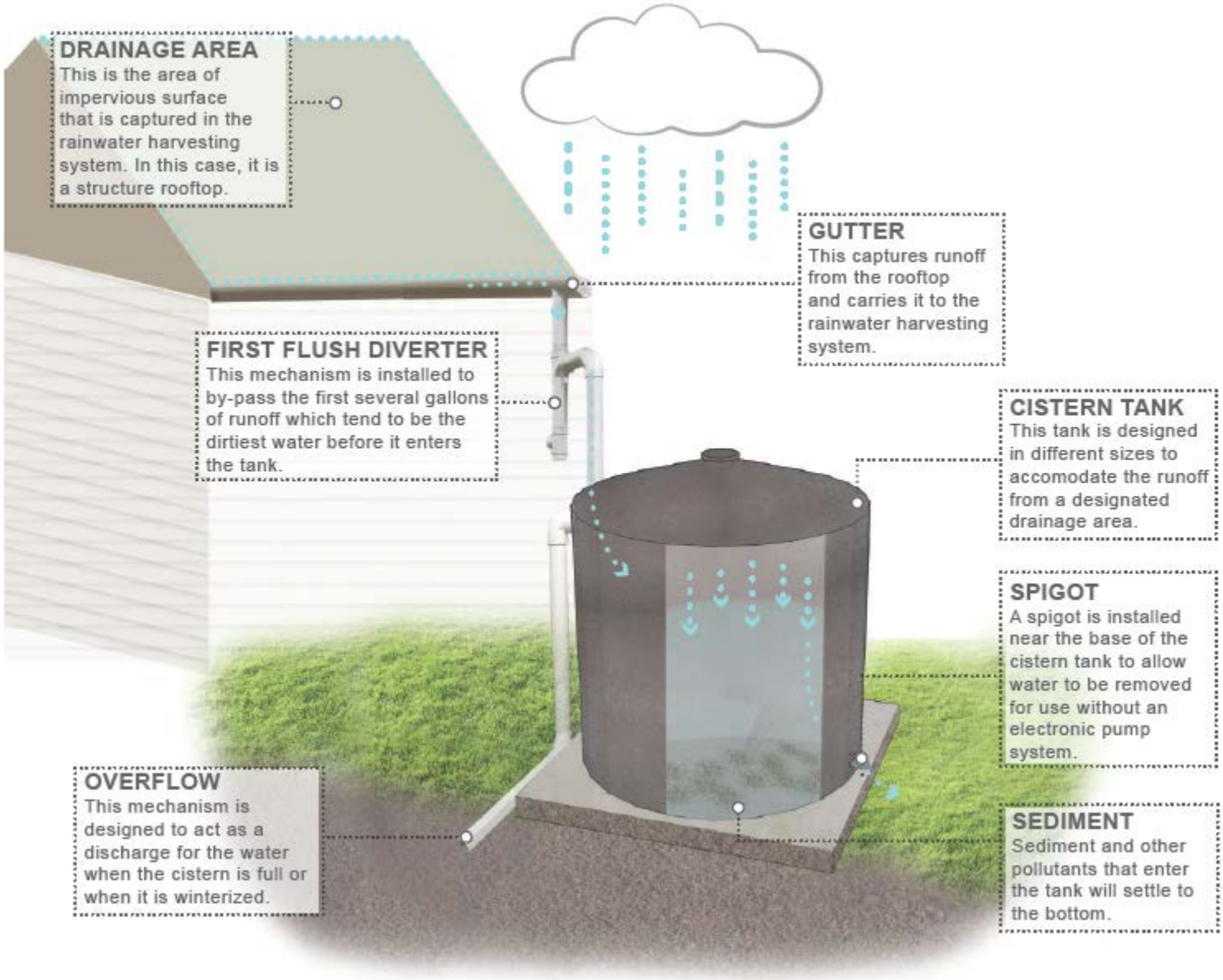
Porous Asphalt


Pervious Concrete


Permeable Pavers

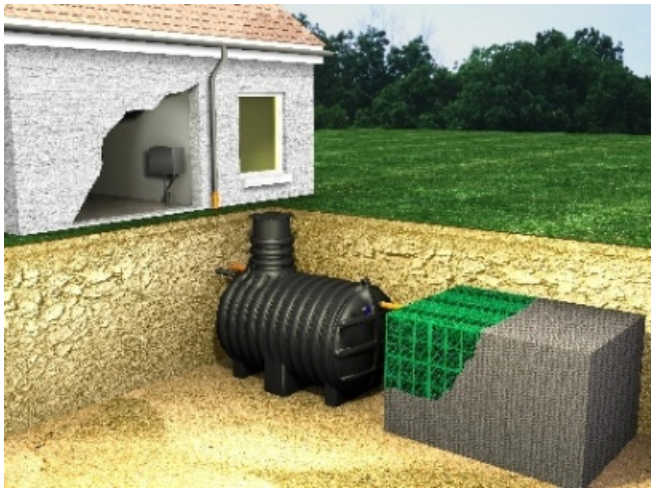

Grass Pavers

Rainwater Harvesting Systems

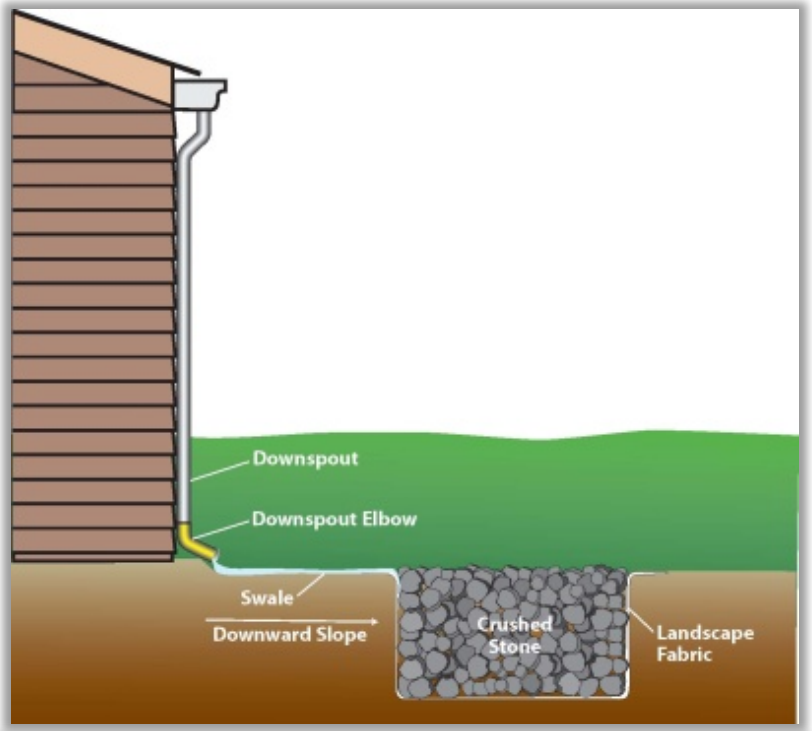


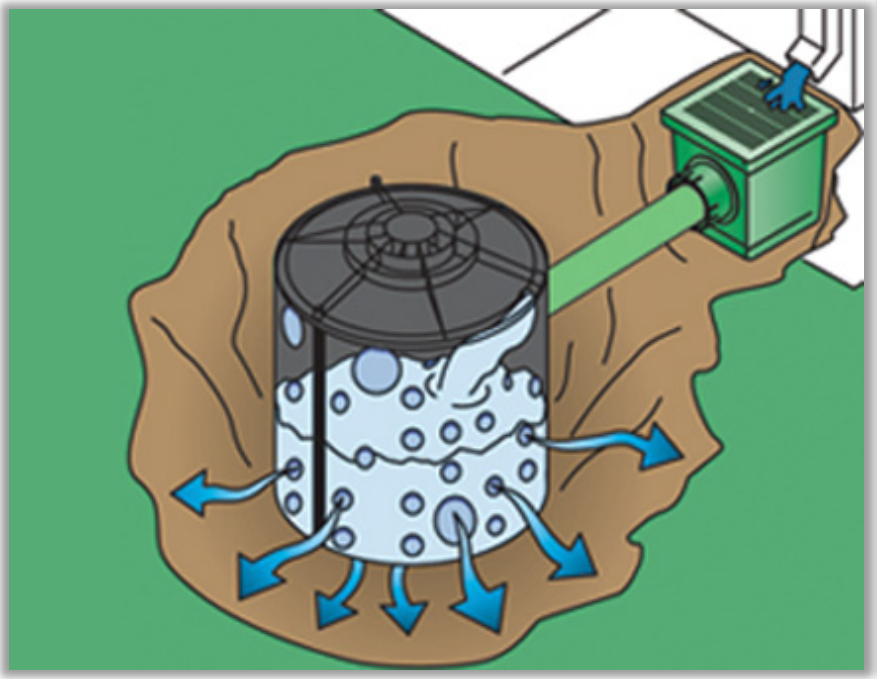
Rain Barrels

Cisterns

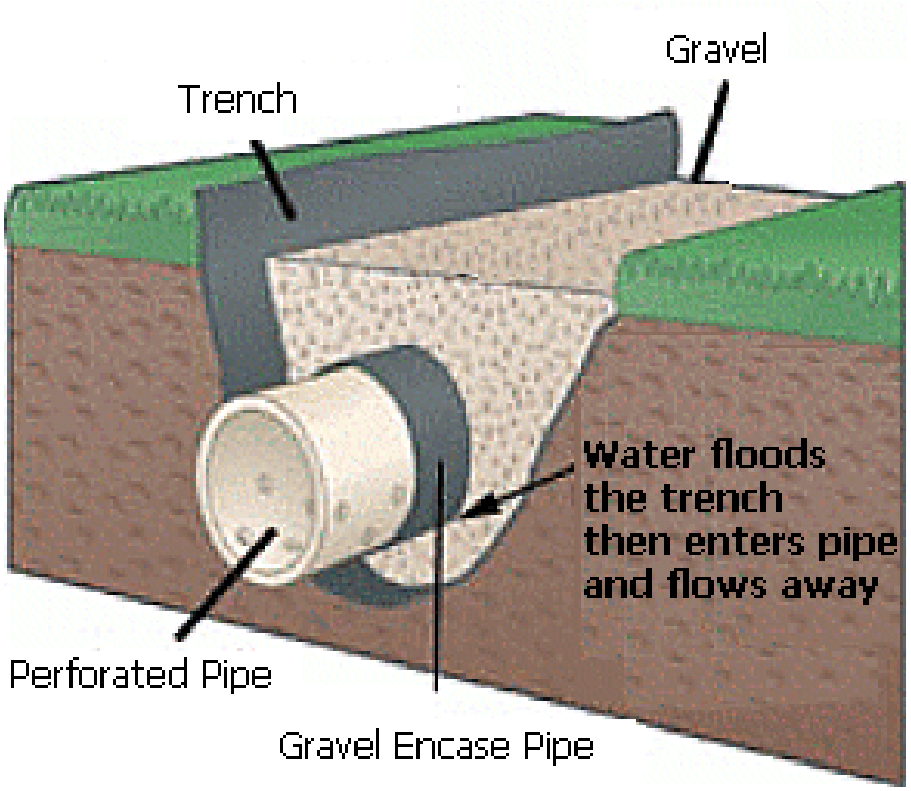


Dry Wells


Downspout
Downspout Elbow
Swale
Downward Slope
Crushed Stone
Landscape Fabric



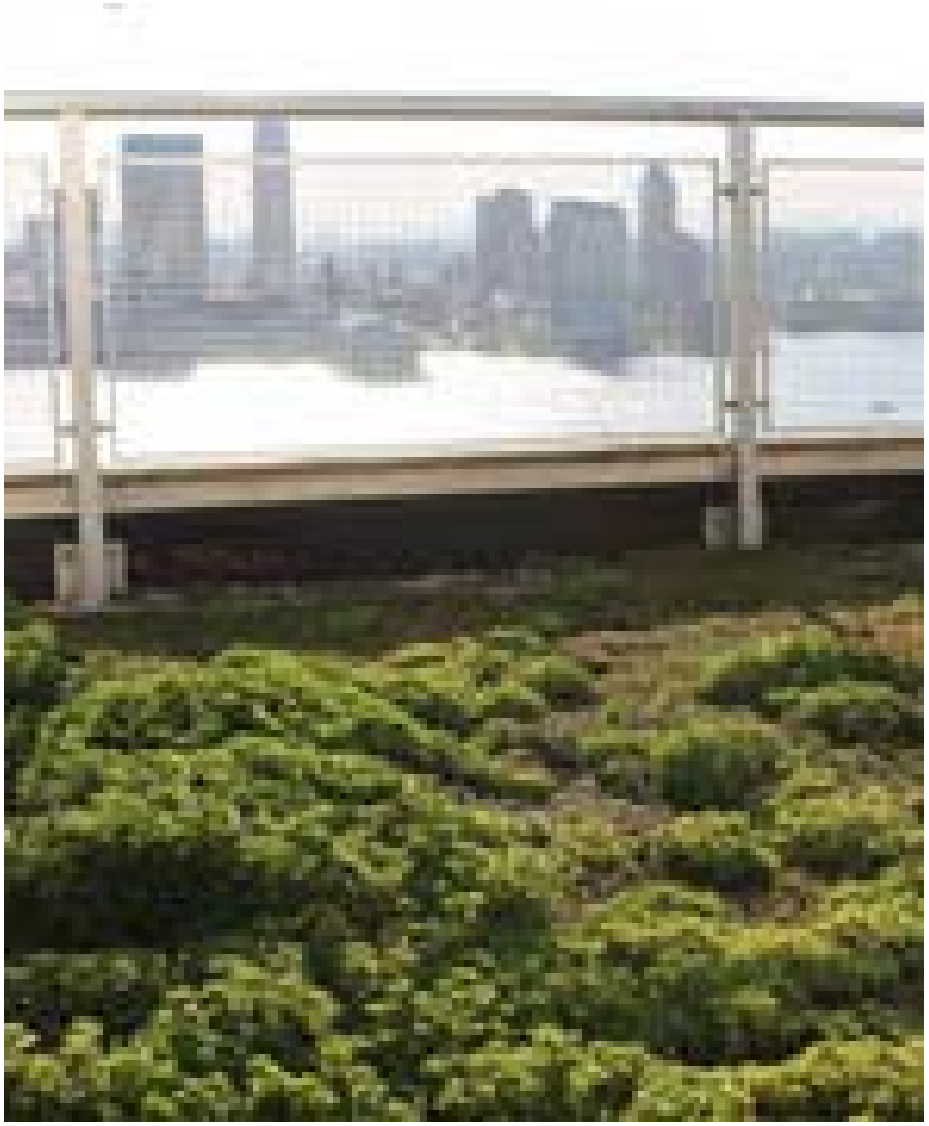
Infiltration Trench



Rooftop Practices – Green Roof

Types of Green Roofs

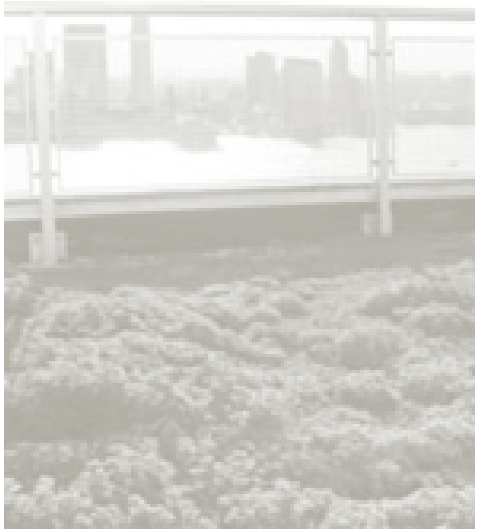
Extensive



Intensive

Types of Green Roofs

Extensive



Soil depth up to 6 inches

Lightweight

Limited plant species options

Lower maintenance, nutrient, and irrigation requirements

Intensive

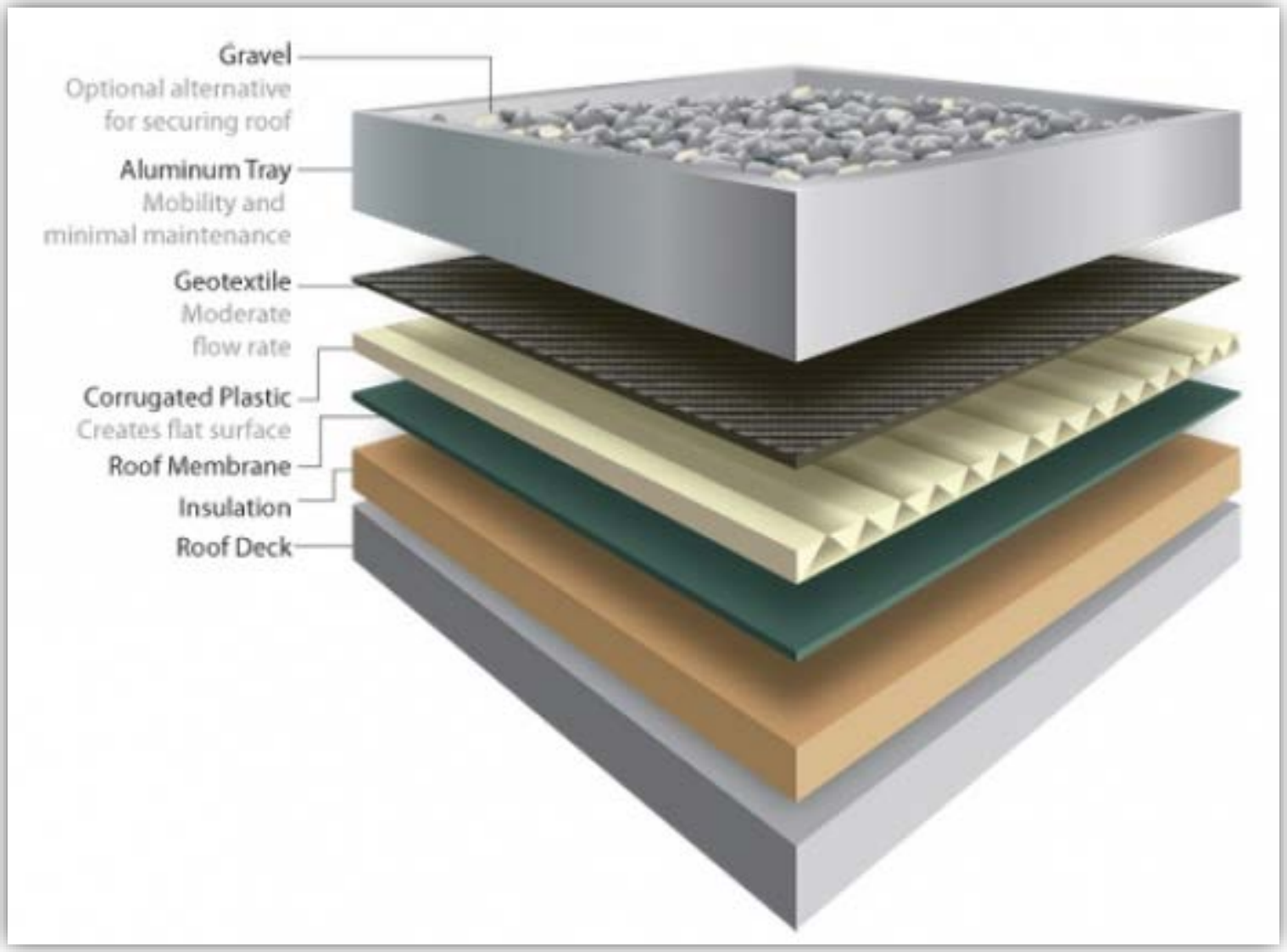
Soil depth typically 6 inches or greater

Heavier weight load on roof

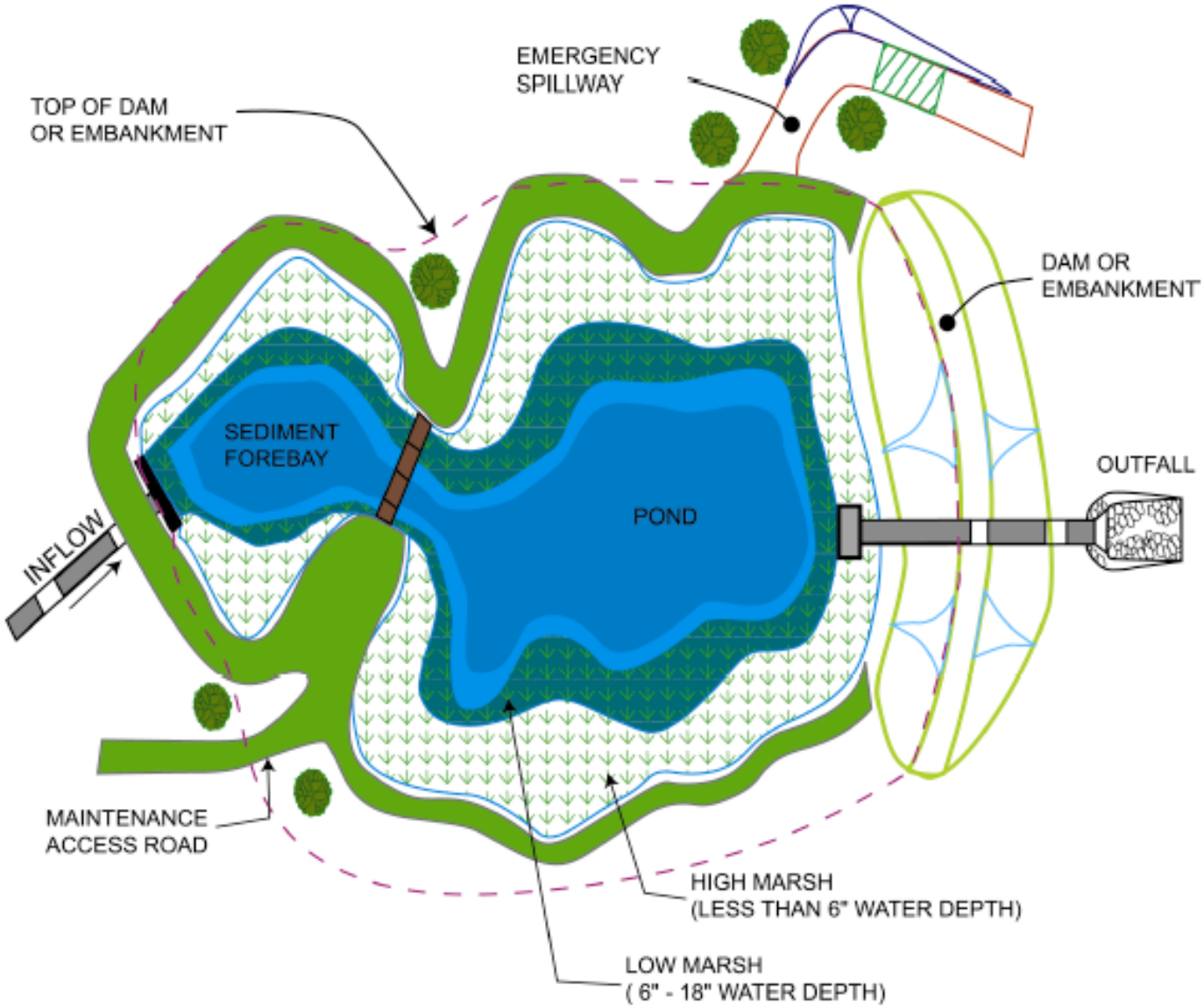
Many more plant options, including trees and shrubs

Requires irrigation, fertilization, and maintenance

Rooftop Practices – Blue Roof

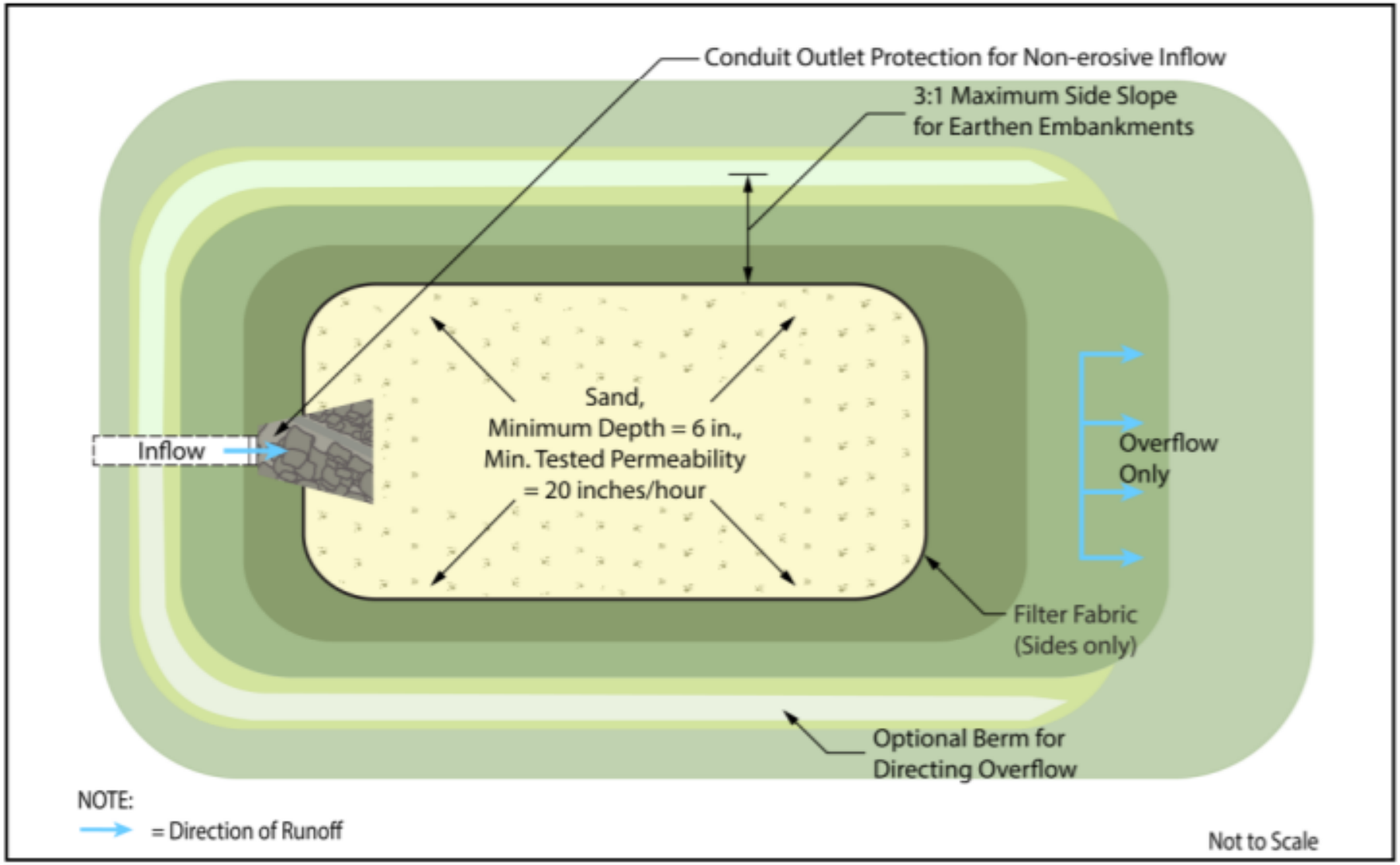


Stormwater Wetlands

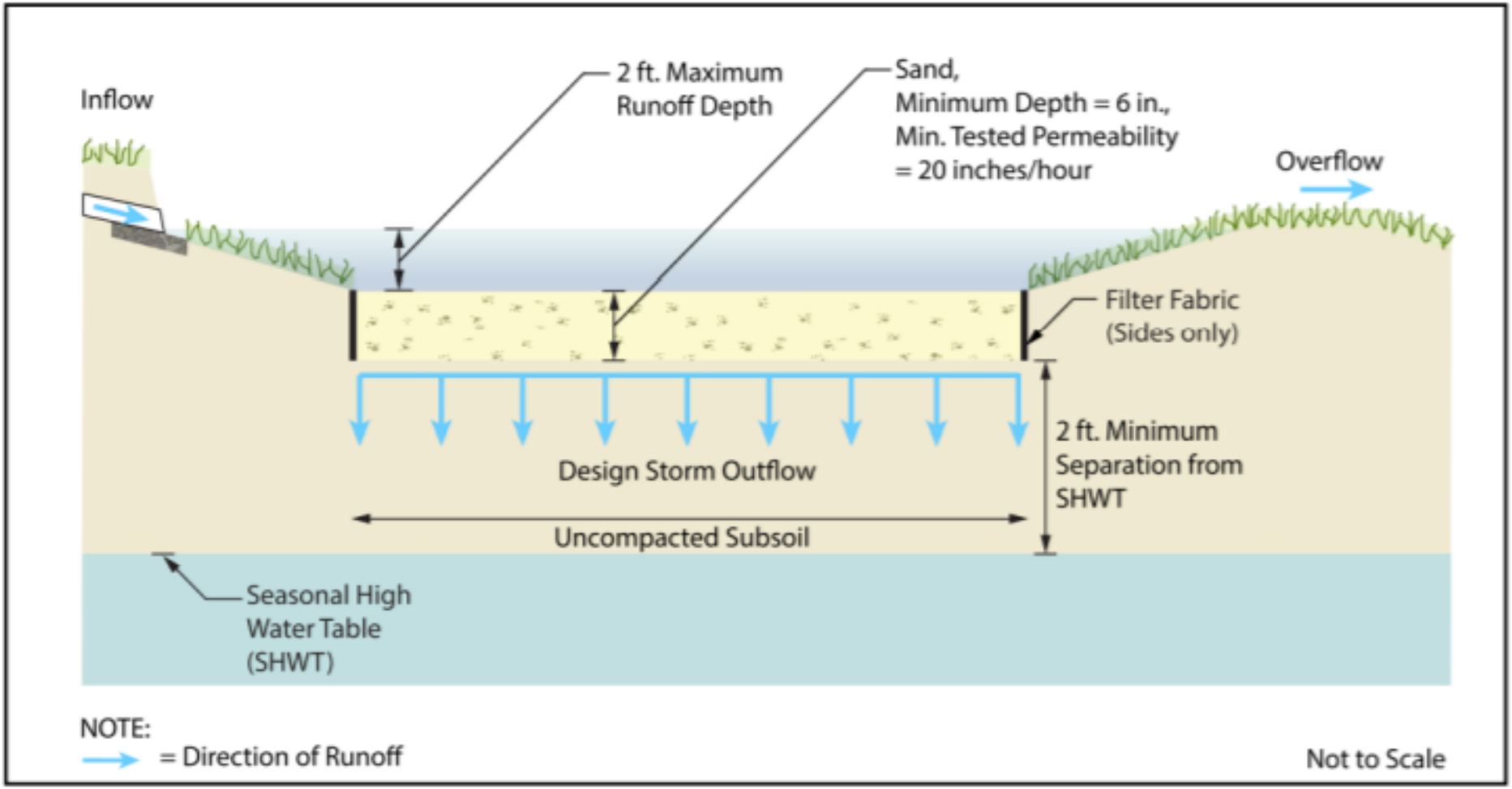

EMERGENCY
SPILLWAY
TOP OF DAM
OR EMBANKMENT
DAM OR
EMBANKMENT
SEDIMENT
FOREBAY
OUTFALL
POND
INFLOW
MAINTENANCE
ACCESS ROAD
HIGH MARSH
(LESS THAN 6" WATER DEPTH)
LOW MARSH
(6" - 18" WATER DEPTH)

Small-Scale Infiltration Systems

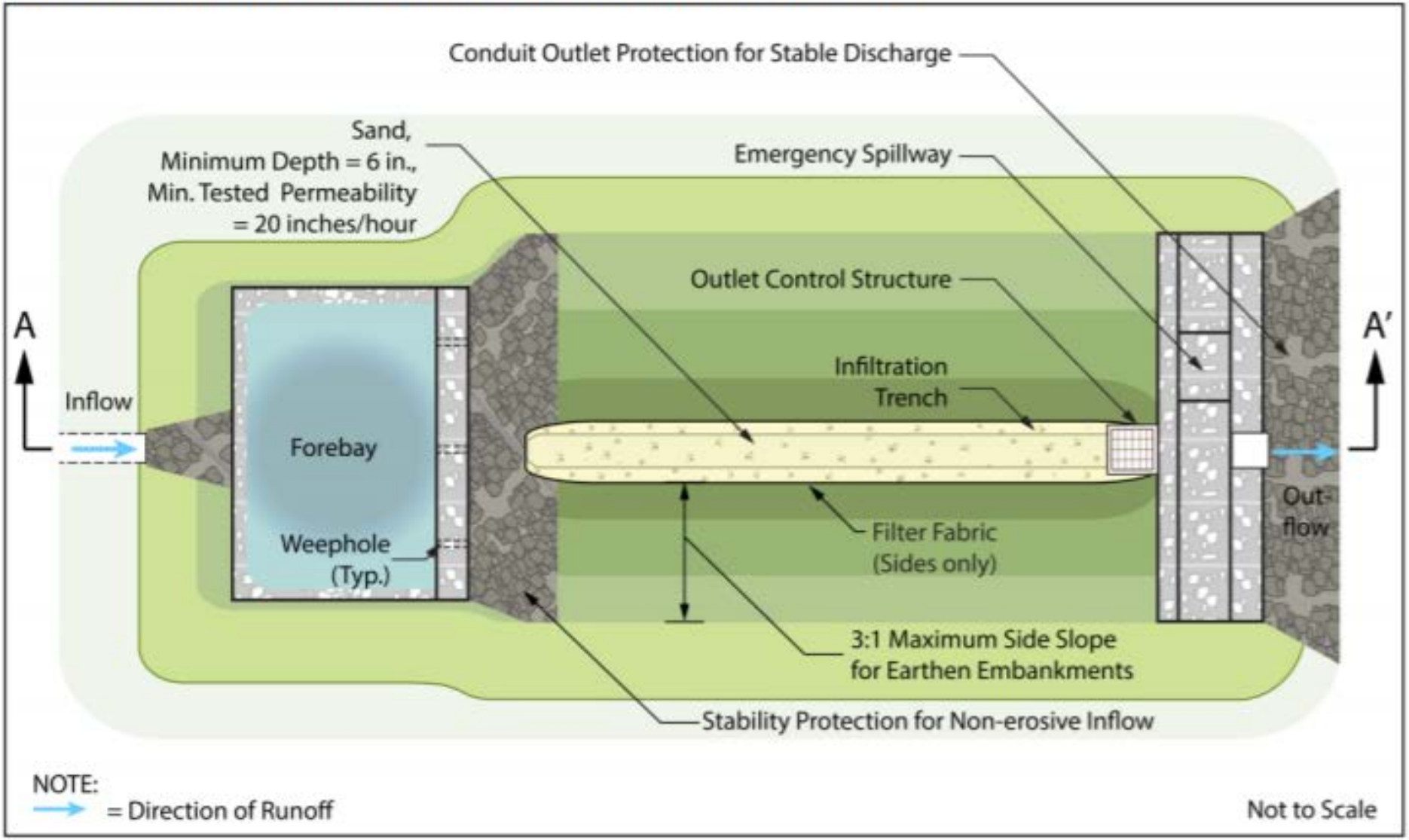
Surface Infiltration Basin – Plan View



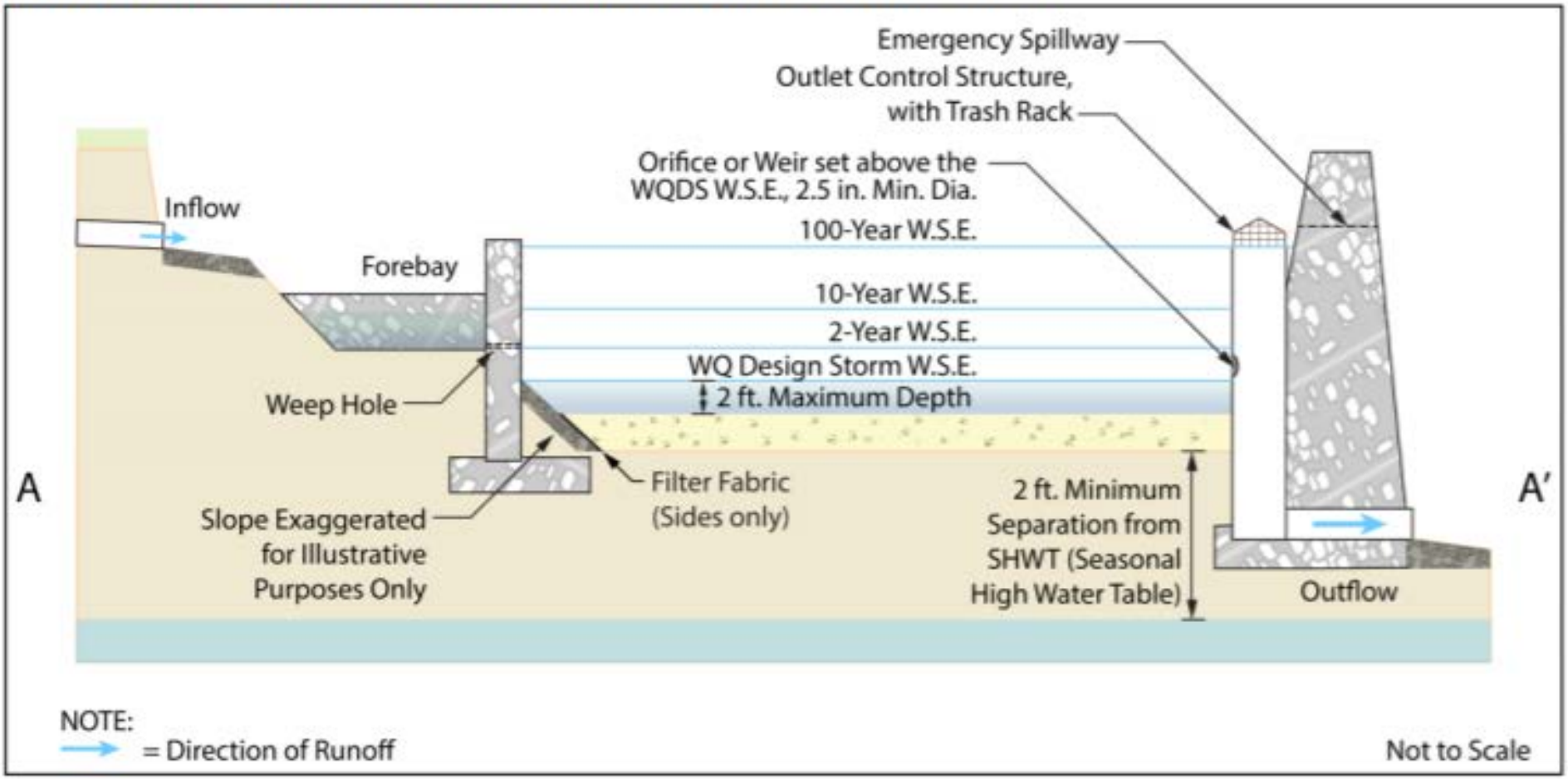
Surface Infiltration Basin – Profile View



Infiltration - Extended Detention Basin: Plan View

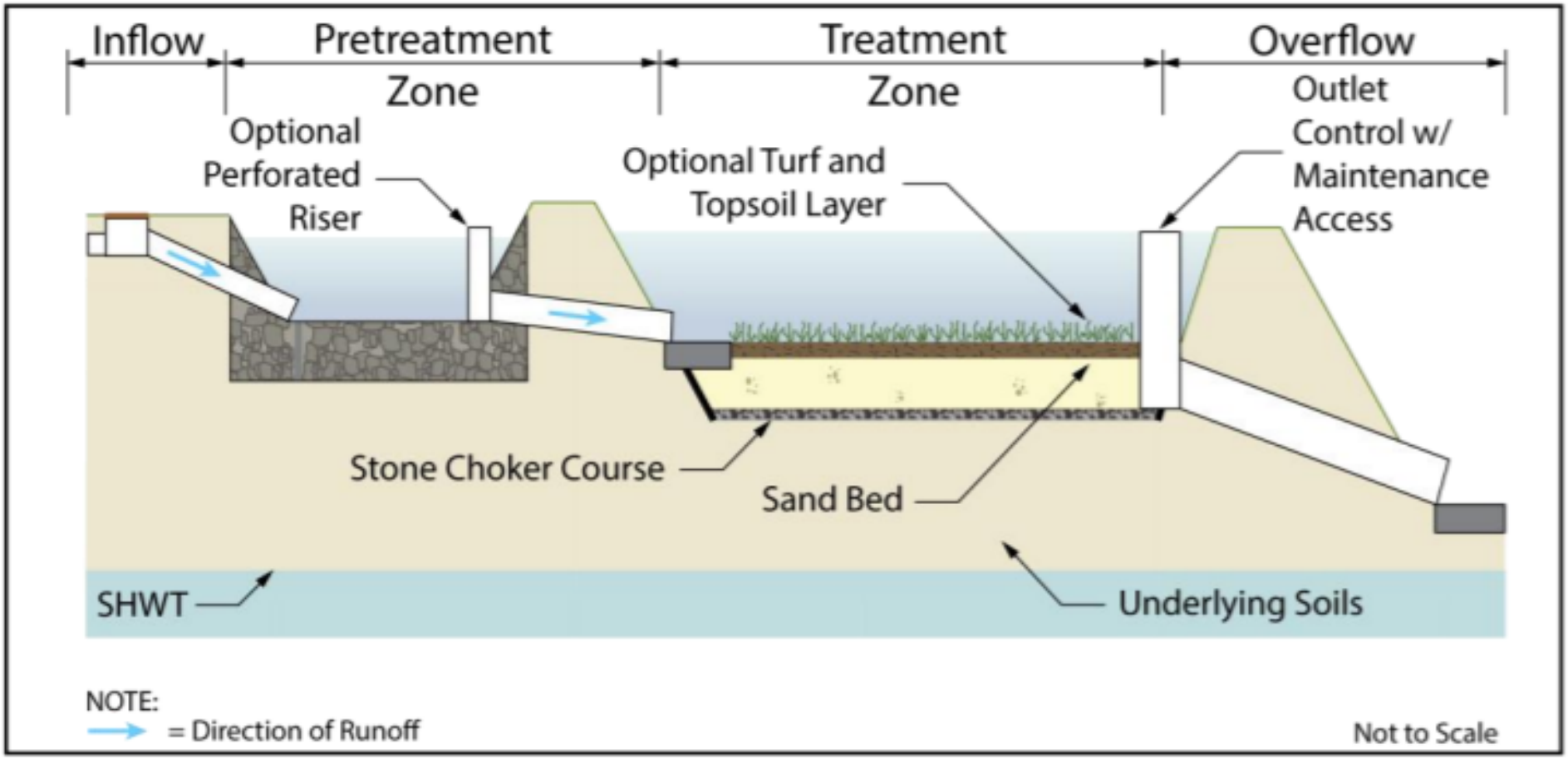


Infiltration – Extended Detention Basin: Profile View

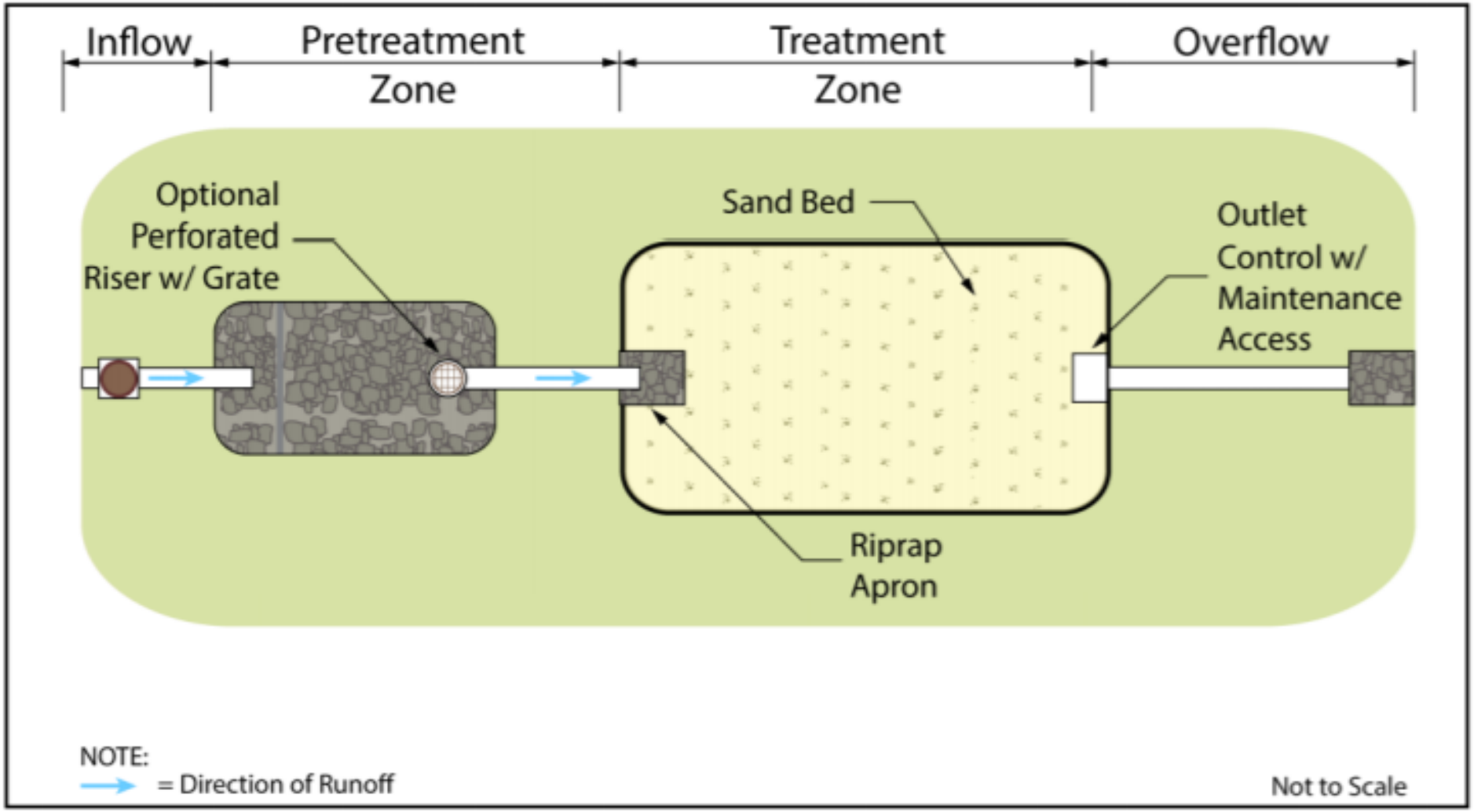


Small-Scale Sand Filter

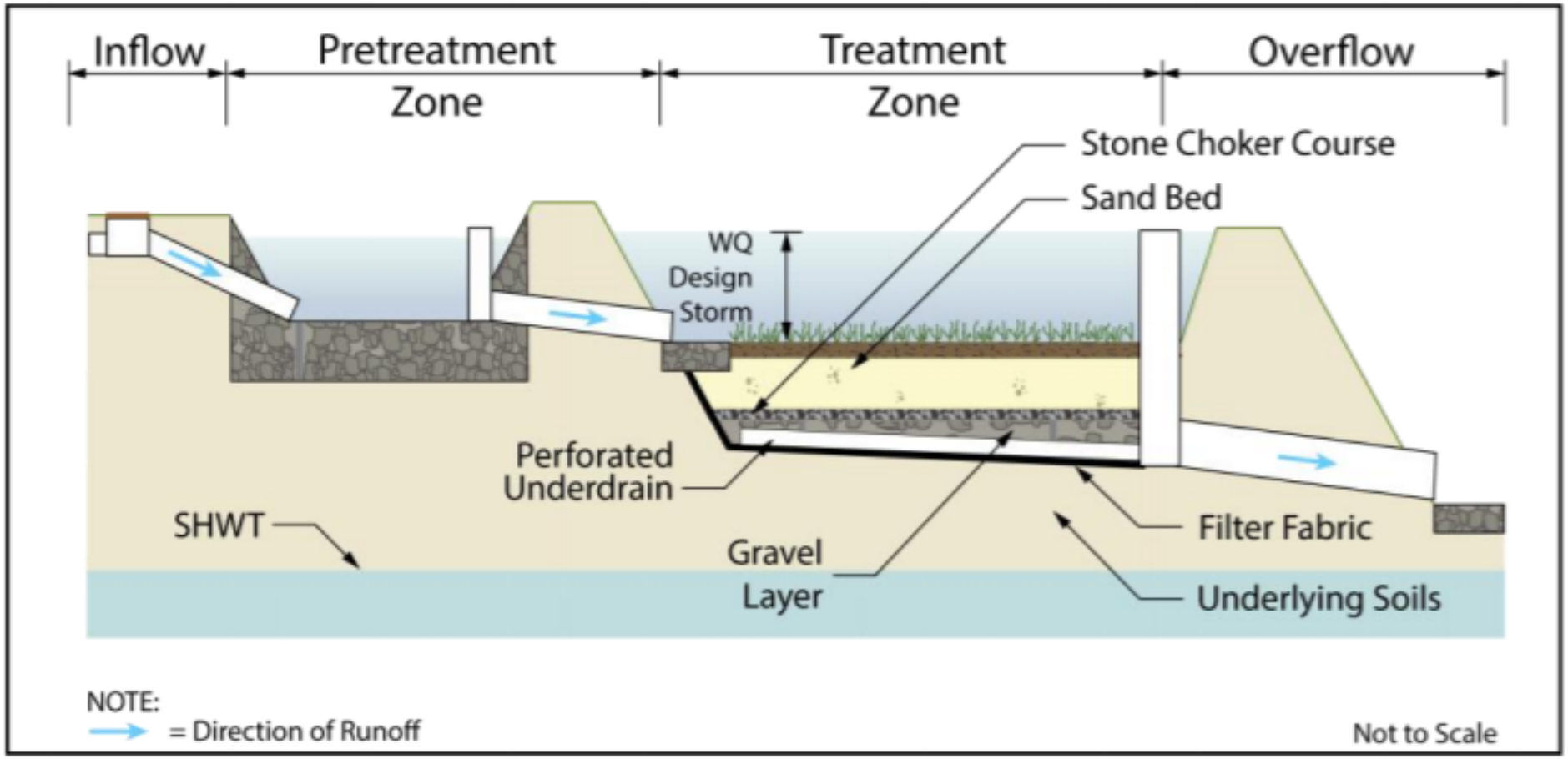
Profile View – Sand Filter Basics



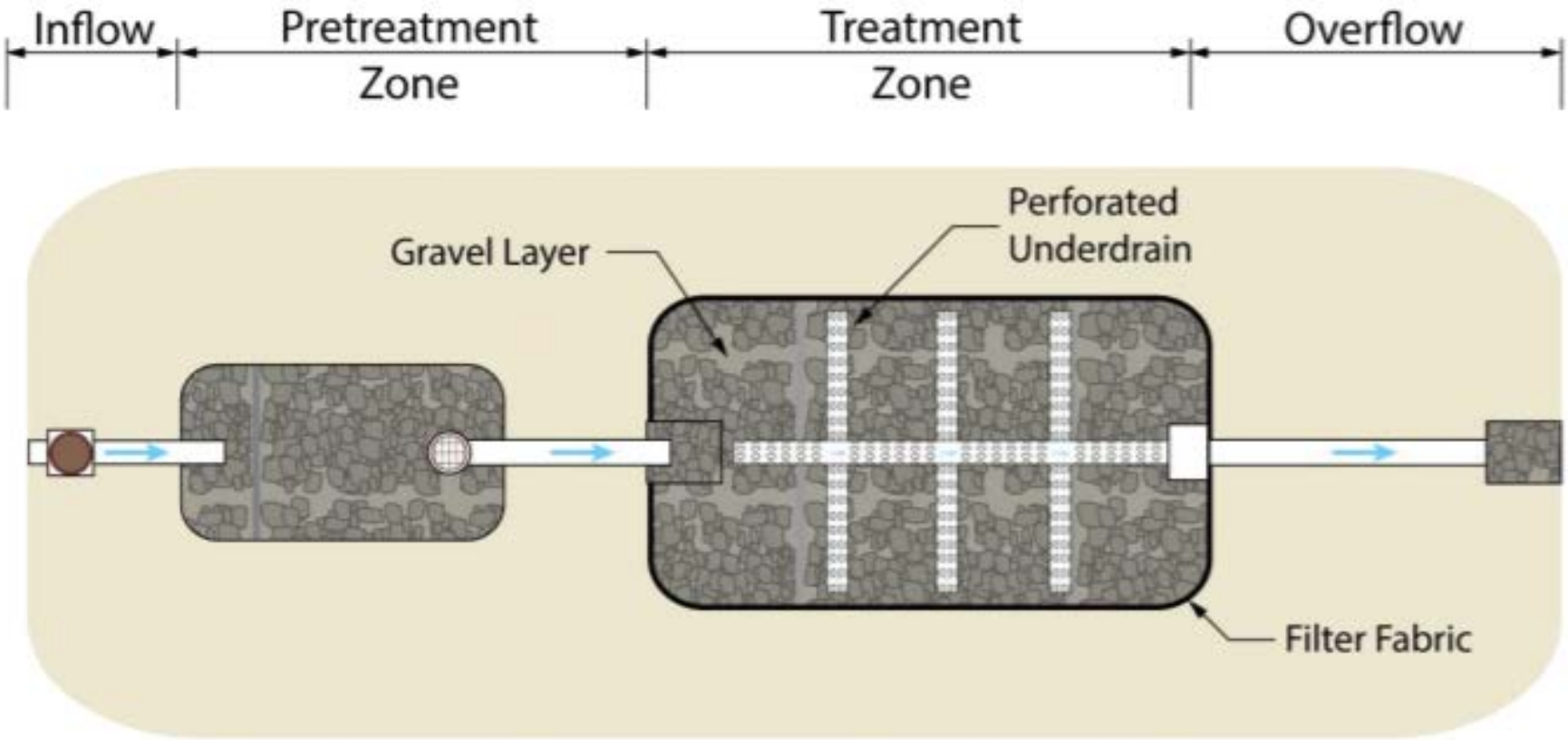
Plan View – Sand Filter Basics



Profile View – Sand Filter with Underdrain



Plan View – Sand Filter with Underdrain



NOTE:
→ = Direction of Runoff
Surface Vegetation, Topsoil, Sand Layer & Stone Choker Course Not Shown

Not to Scale

March 2021 – Major Development will mostly use these GI Practices

- Pervious Paving Systems
- Small-Scale Bioretention Systems
- Small-Scale Infiltration Basins
- Small-Scale Sand Filters

To satisfy groundwater recharge, stormwater quantity, and stormwater quality requirements.

RUTGERS
New Jersey Agricultural
Experiment Station

50 Rain Gardens for 50th Anniversary of Earth Day

Where did the funding come from?

- New Jersey Agricultural Experiment Station (Rutgers Cooperative Extension Water Resources Program)
- National Fish and Wildlife Foundation (NFWF)
- William Penn Foundation
- NJ Department of Environmental Protection (NJDEP)
- Sustainable Jersey
- Individual Municipalities
- NJ Sea Grant Consortium
- Geraldine R. Dodge Foundation
- Deal Lake Watershed Alliance

Municipal/County Support

- Bernardsville
- Bridgewater
- Caldwell
- East Brunswick
- Edison
- Evesham
- Hamilton (Mercer Co)
- Hammonton
- Jamesburg
- Manville
- Metuchen
- Millville
- Monmouth Beach
- Monroe
- Perth Amboy
- Phillipsburg
- Pittsgrove
- Ocean Township
- Union County Parks Dept.
- Vineland
- Warren
- Watchung
- Westfield
- West Grove, PA
- Woodbridge
- Woodstown

Saint Peters Episcopal Church Rectory

183 Rector Street, Perth Amboy, NJ

The Rutgers Cooperative Extension (RCE) Water Resources Program was awarded a 319h grant from the New Jersey Department of Environmental Protection to implement green infrastructure projects in the city of Perth Amboy. With funding from the 319h grant two rain gardens were installed at Saint Peters Episcopal Church on April 6, 2020. Enviroscapes Inc. excavated the rain gardens, added bioretention media, added mulch and constructed curb cut inlets to allow stormwater runoff to enter the rain gardens. The RCE Water Resources Program staff designed the rain gardens and installed the plants. The managed drainage area for the two rain gardens is 4,802 square feet. The rain gardens are 142 square feet and 280 square feet in size, filled with native plants that will attract pollinators. The rain gardens will capture, treat, and infiltrate approximately 94,640 gallons of stormwater runoff per year.

Planting underway by Hollie Dimuro!

American Legion

530 Smith Street, Perth Amboy, NJ

The Rutgers Cooperative Extension (RCE) Water Resources Program was awarded a 319h grant from the New Jersey Department of Environmental Protection to implement green infrastructure projects in the city of Perth Amboy. With funding from the 319h grant two rain gardens were installed at American Legion on April 8, 2020. Enviroscapes Inc. excavated the rain garden, added bioretention media, and added mulch to the rain garden. The RCE Water Resources Program staff designed the rain garden and installed the plants. The managed drainage area for the rain garden is 7,820 square feet. The rain garden is 390 square feet in size, filled with native plants that will attract pollinators. The rain garden will capture, treat, and infiltrate approximately 160,180 gallons of stormwater runoff per year.

Avon Grove Library

117 Rosehill Ave, West Grove Borough, PA

The Rutgers Cooperative Extension (RCE) Water Resources Program partnered with West Grove Borough and to complete a green infrastructure master plan. The first demonstration project was a rain garden completed in May 2020 at the Avon Grove Library. The Borough Department of Public Works excavated the rain garden, and the RCE Water Resources Program staff worked with the White Clay Watershed Association to install the plants. The managed drainage area for the rain garden is 3,350 square feet. The rain garden is 625 square feet in size, filled with native plants that will attract pollinators. The rain garden will capture, treat, and infiltrate approximately 58,850 gallons of stormwater runoff per year.

Plants are looking good, October 2020.

Bernardsville Public Library

1 Anderson Hill Road, Bernardsville Borough, NJ

During construction, June 2020.

On June 15, 2020 The Rutgers Cooperative Extension (RCE) Water Resources Program competed the installation of a rain garden at the Bernardsville Public Library by partnering with Borough Department of Public Works who assisted with the heavy lifting during the excavation. This rain garden opportunity was identified through funding provided by the New Jersey Highlands Council to complete an Impervious Cover Reduction Action Plan for Bernardsville Borough. The managed drainage area for the rain garden is 840 square feet. The rain garden is 215 square feet in size, and will serve as a demonstration project for residents that want to install rain gardens at their homes. The rain garden will capture, treat, and infiltrate approximately 13,380 gallons of stormwater runoff per year.

Green Infrastructure Champion Program

Green Infrastructure Champions are key players in implementing green infrastructure as a stormwater management approach in their community.

New on-line classes starting in January 2021.
To learn more about the program, go to:
http://water.rutgers.edu/Projects/GreenInfrastructureChampions/GIC.html

www.water.rutgers.edu

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Our green infrastructure initiative in urban centers focuses on capturing stormwater with cost-effective practices before it enters the combined sewer systems.

About Us

Rutgers Cooperative Extension
Water Resources Program

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New Brunswick, NJ 08901

News

- **CALENDAR OF UPCOMING EVENTS**
- In the News - November 3, 2020
- SEBS/NJAES Newsroom
- Earth Day Every Day Webinar Series Returns!
  - Interactive one hour sessions on Monday evenings at 6:30 pm starting 9/21/2020

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