Introduction to Green Infrastructure

Presented to Woodbridge Township

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Christopher C. Obropta, Ph.D., P.E.
Phone: 908-229-0210
Email: obropta@envsci.rutgers.edu

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.

Stormwater Basics

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.

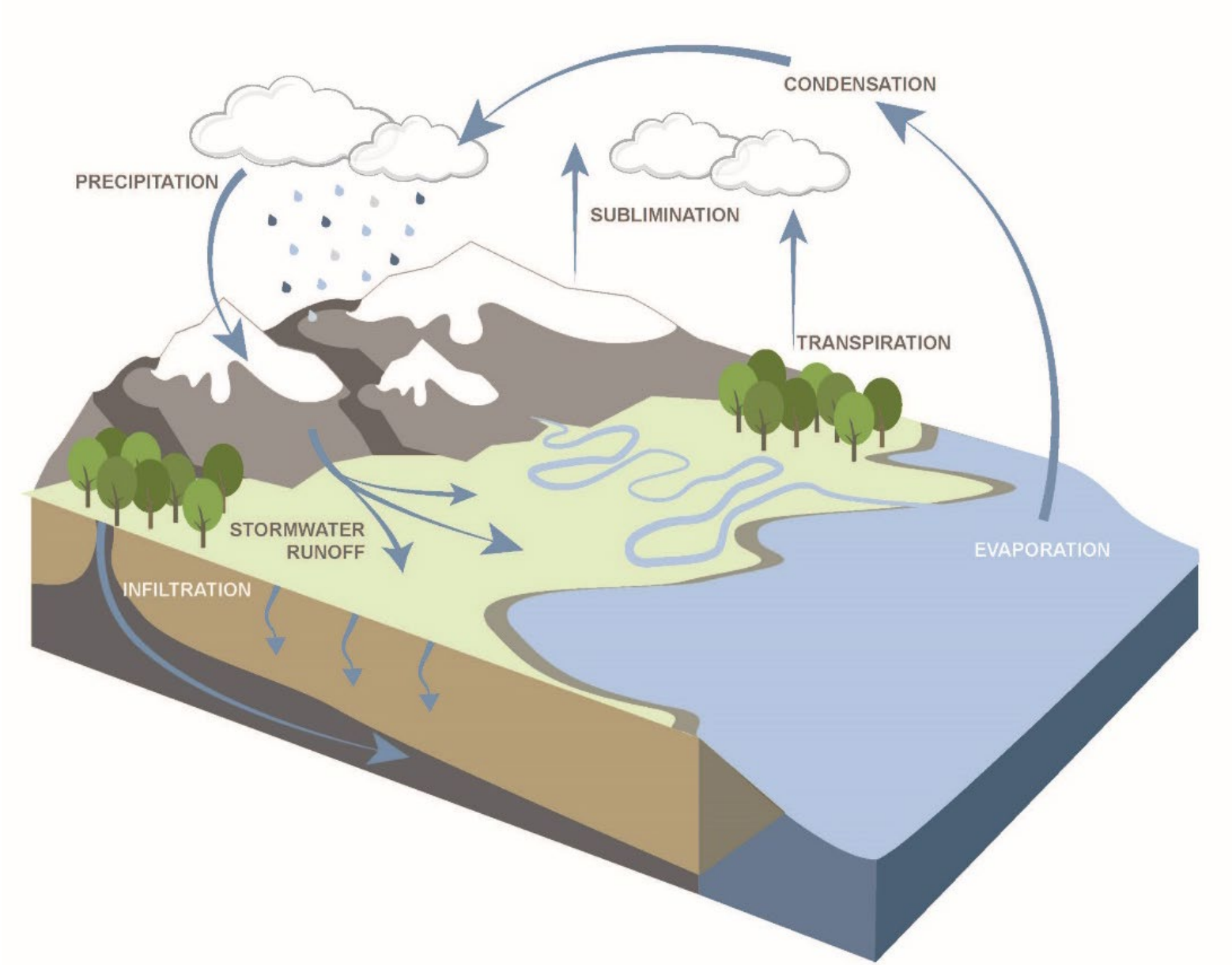
Water Quality

Water Quantity (flooding)

More Flooding

And even more flooding

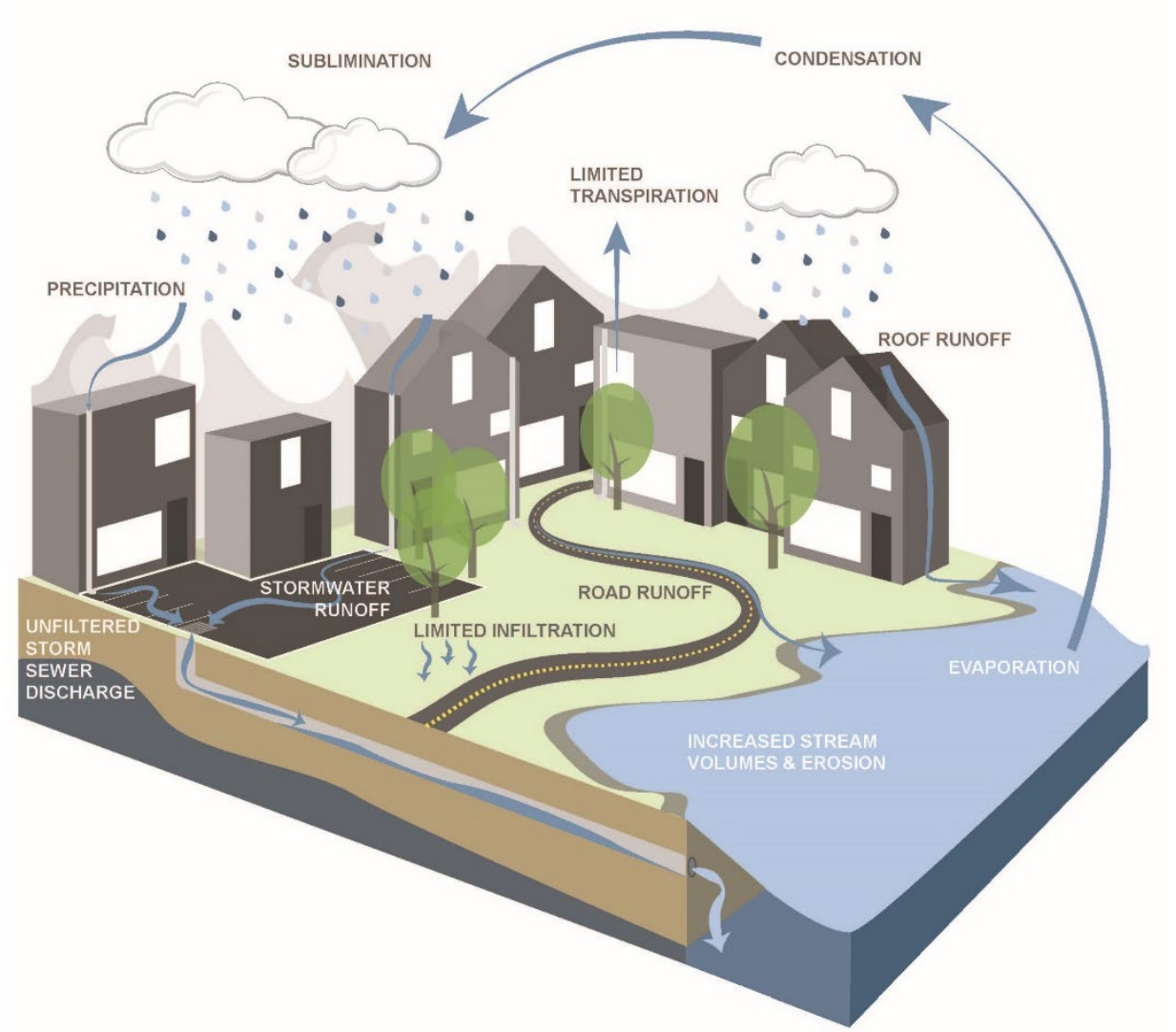
The Natural Hydrologic Cycle



The Impact of Development on Stormwater Runoff

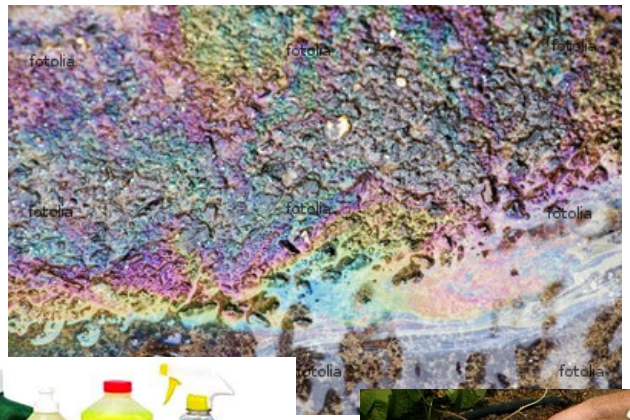
More development → *More impervious surfaces* → *More stormwater runoff*

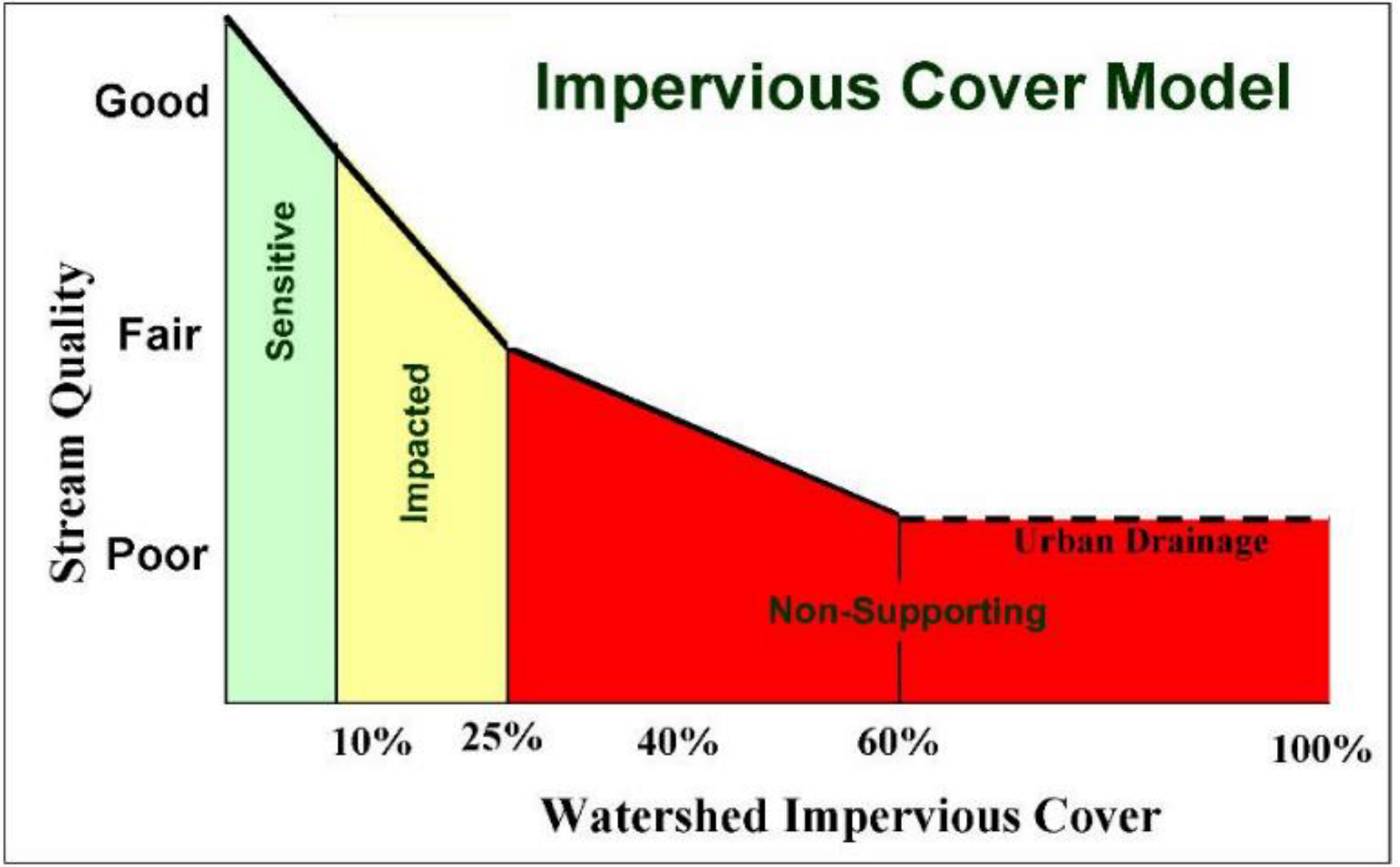
The Urban Hydrologic Cycle

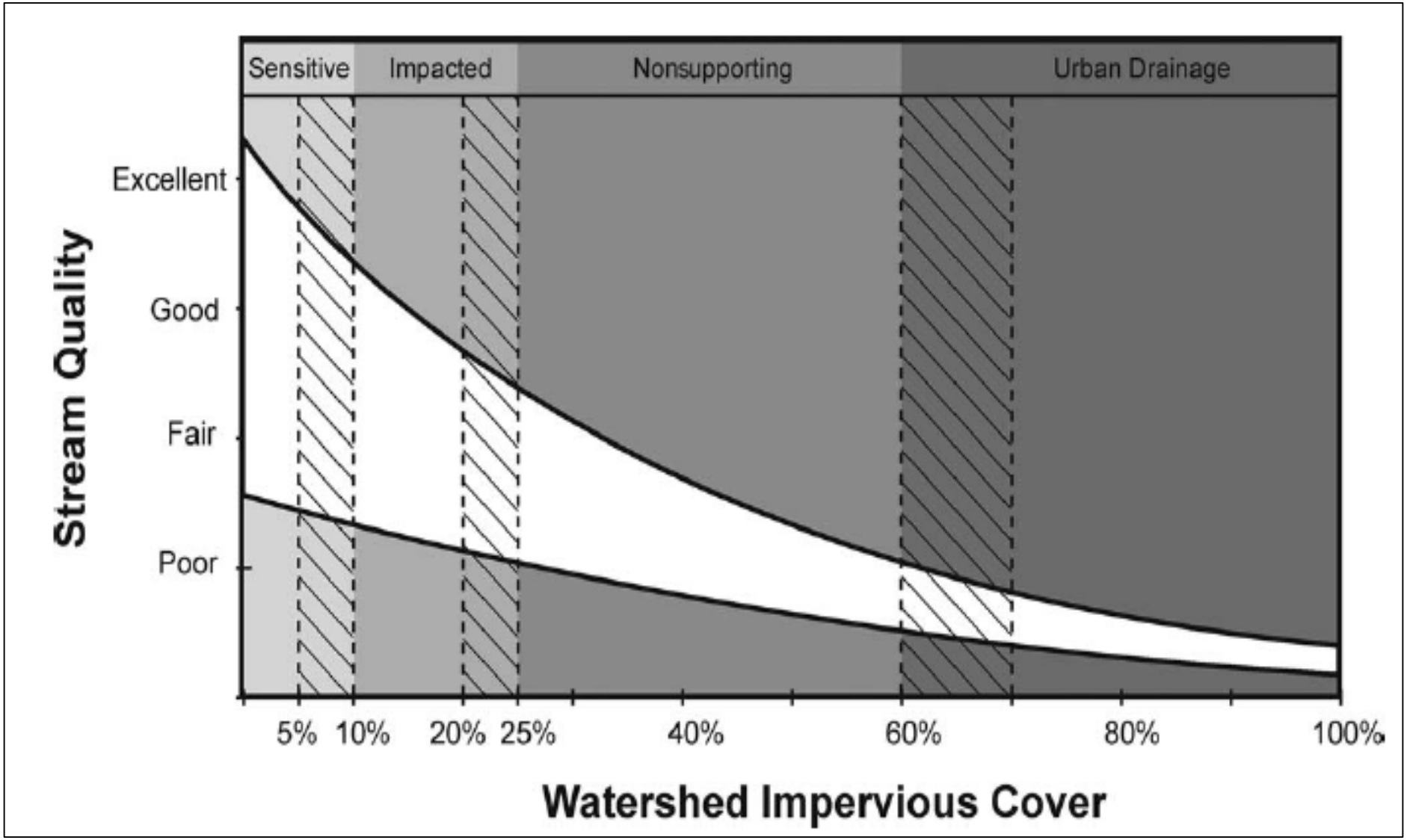


EXAMPLES OF NPS

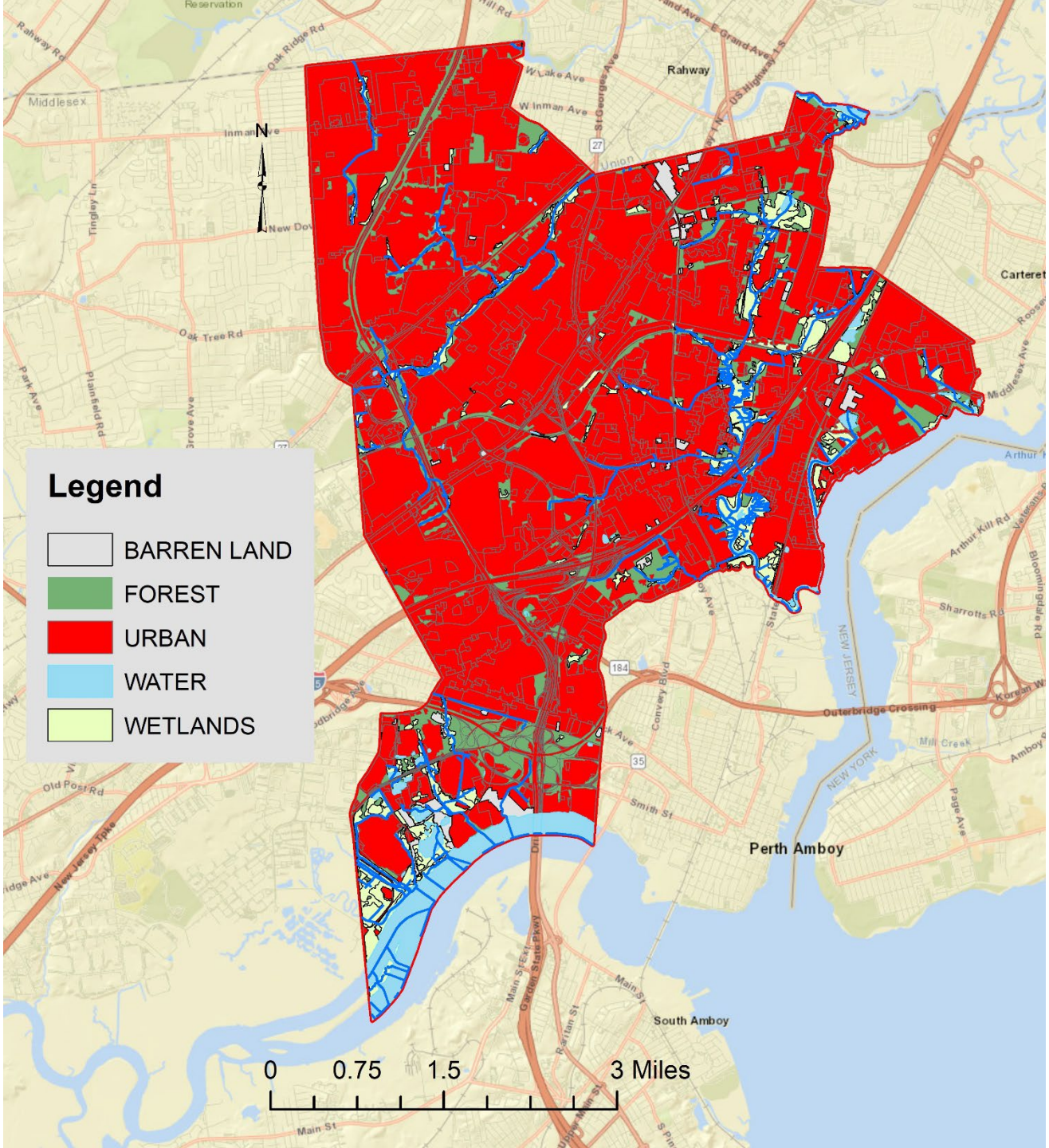
- Oil and grease from cars
- Fertilizers
- Animal waste
- Grass clippings
- Septic systems
- Sewage leaks
- Household cleaning products
- Litter
- Agriculture
- Sediment

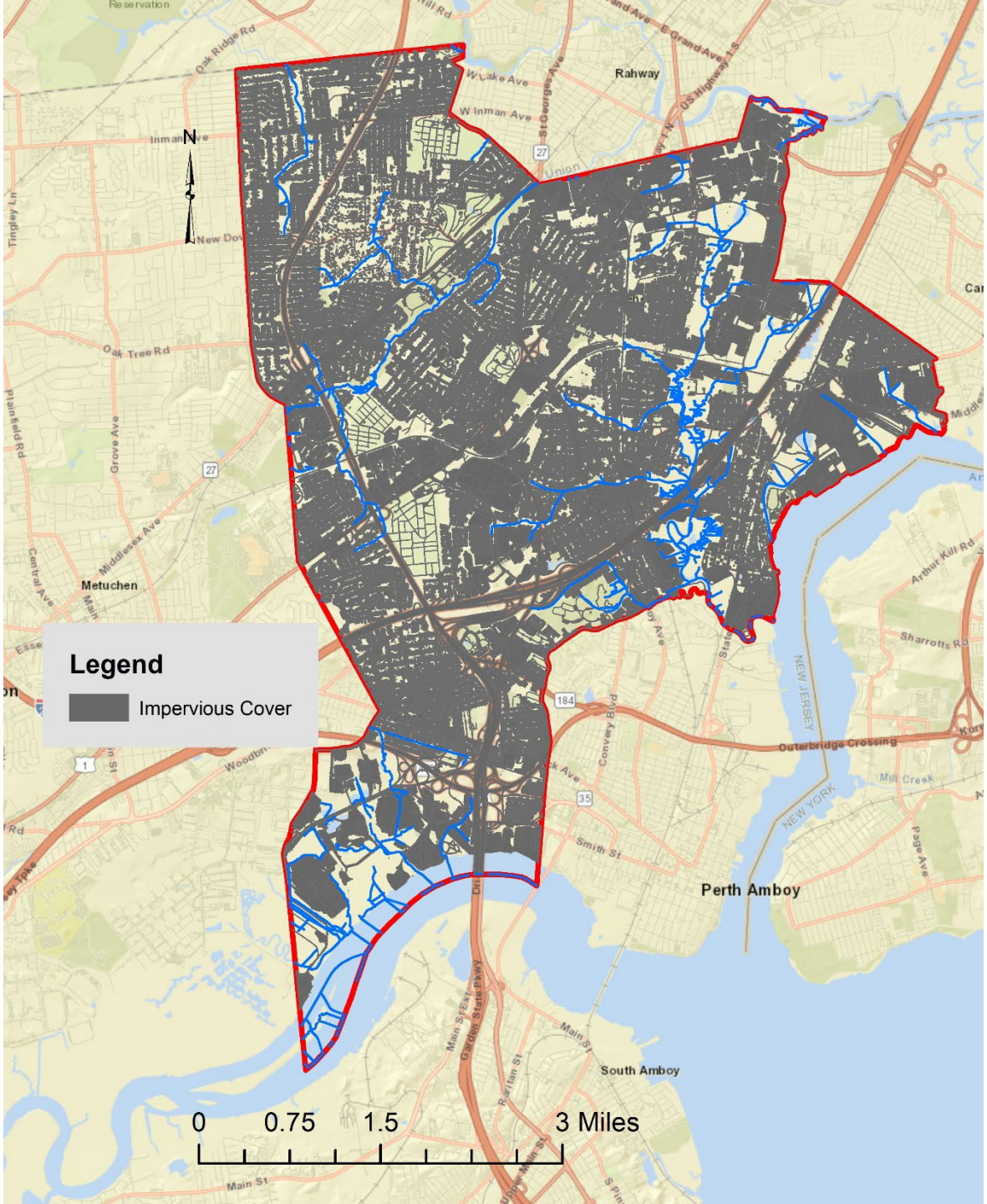



Impervious Cover Model
Good
Fair
Poor
Stream Quality
Sensitive
Impacted
Urban Drainage
Non-Supporting
10%
25%
40%
60%
100%
Watershed Impervious Cover


Sensitive
Impacted
Nonsupporting
Urban Drainage
Excellent
Good
Fair
Poor
Stream Quality
5%
10%
20%
25%
40%
60%
80%
100%
Watershed Impervious Cover


N
0
0.75
1.5
3 Miles
Rahway
Colonia
Iselin
Avenel
Woodbridge
Port Reading
Metuchen
Fords
Perth Amboy
South Amboy
Sayreville
Ash Brook Reservation
Oak Ridge Rd
Madison Hill Rd
Lake Ave
W Lake Ave
W Inman Ave
St Georges Ave
W Grand Ave
E Grand Ave
US Highway 1 S
Inman Ave
New Dover Rd
Garden State Pkwy
Union
Middlesex
US Highway 1 N
Oak Tree Rd
Lincoln Hwy
Green St
Grove Ave
Middlesex Ave
Main St
Amboy Ave
Woodbridge Ave
S Main St
Avenel St
Rahway Ave
New Jersey Turnpike
Port Reading Ave
W Middlesex Ave
West Ave
Woodbridge Ave
Main St
New Jersey Turnpike
Lower Main St
Amboy Ave
W Pond Rd
New Brunswick Ave
Convery Blvd
Outerbridge Crossing
NEW JERSEY
NEW YORK
Mill Creek
Arthur Kill Rd
Sharrotts Rd
Page Ave
Smith St
Driscoll Brg
Main St Ext
Garden State Pkwy
Raritan St
Main St
Upper Main St
S Pine Ave
Main St


Legend
BARREN LAND
FOREST
URBAN
WATER
WETLANDS
N
0
0.75
1.5
3 Miles
Perth Amboy
South Amboy
Rahway
Carteret
Middlesex
Reservation
Oak Ridge Rd
Inman Ave
W Lake Ave
W Inman Ave
St Georges Ave
Oak Tree Rd
Plainfield Rd
Park Ave
Grove Ave
Tingley Ln
Middlesex Ave
Arthur Kill Rd
Sharrotts Rd
Bloomingdale Rd
Outerbridge Crossing
NEW JERSEY
NEW YORK
Mill Creek
Page Ave
Amboy
Smith St
Main St
Raritan St
Old Post Rd
New Jersey Turnpike
Garden State Pkwy
Convery Blvd
184
35
27



Impervious Cover = 51%

History of Stormwater Management

1st Attempt at Stormwater Management

Capture all runoff, pipe it, and send it directly to the river . . .prior to mid 1970's

2nd Iteration of Stormwater Management

Capture runoff, detain it, release it slowly to the river…mid 1970's to 2004

- Detain peak flow during large storm events for 18 hours (residential) or 36 hours (commercial)
- Reduce downstream flooding during major storms
- Use concrete low flow channels to minimize erosion, reduce standing water, quickly discharge low flows
- Does not manage runoff from smaller storms allowing stormwater to pass through the system
- Directly discharges stormwater runoff to nearby stream, waterway, or municipal storm sewer system (at a controlled/managed rate)

3rd Generation of Stormwater Management

- Reduce stormwater runoff volume
- Reduce peak flows and flooding

…and….

- Maintain infiltration and groundwater recharge
- Reduce pollution discharged to local waterways

ABC Action News, August 27, 2012

4th Generation of Stormwater Management (Started March 2, 2021)

- All major development must use green infrastructure to comply with the New Jersey Stormwater Regulations

Green Infrastructure

…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.

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

Bioretention Systems

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

Permeable Pavements

Rainwater Harvesting

- Rain Barrels
- Cisterns

Dry Wells

Rooftop Systems

- Green Roofs
- Blue Roofs









Parker Urban Greenscapes. 2009.

TYPES OF BIORETENTION

Bioretention Cells

- Single-family lots
- Commercial areas
- Parking lots

Planters & Planter Boxes

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

Rain Gardens

- Single-family lots
- Small commercial areas

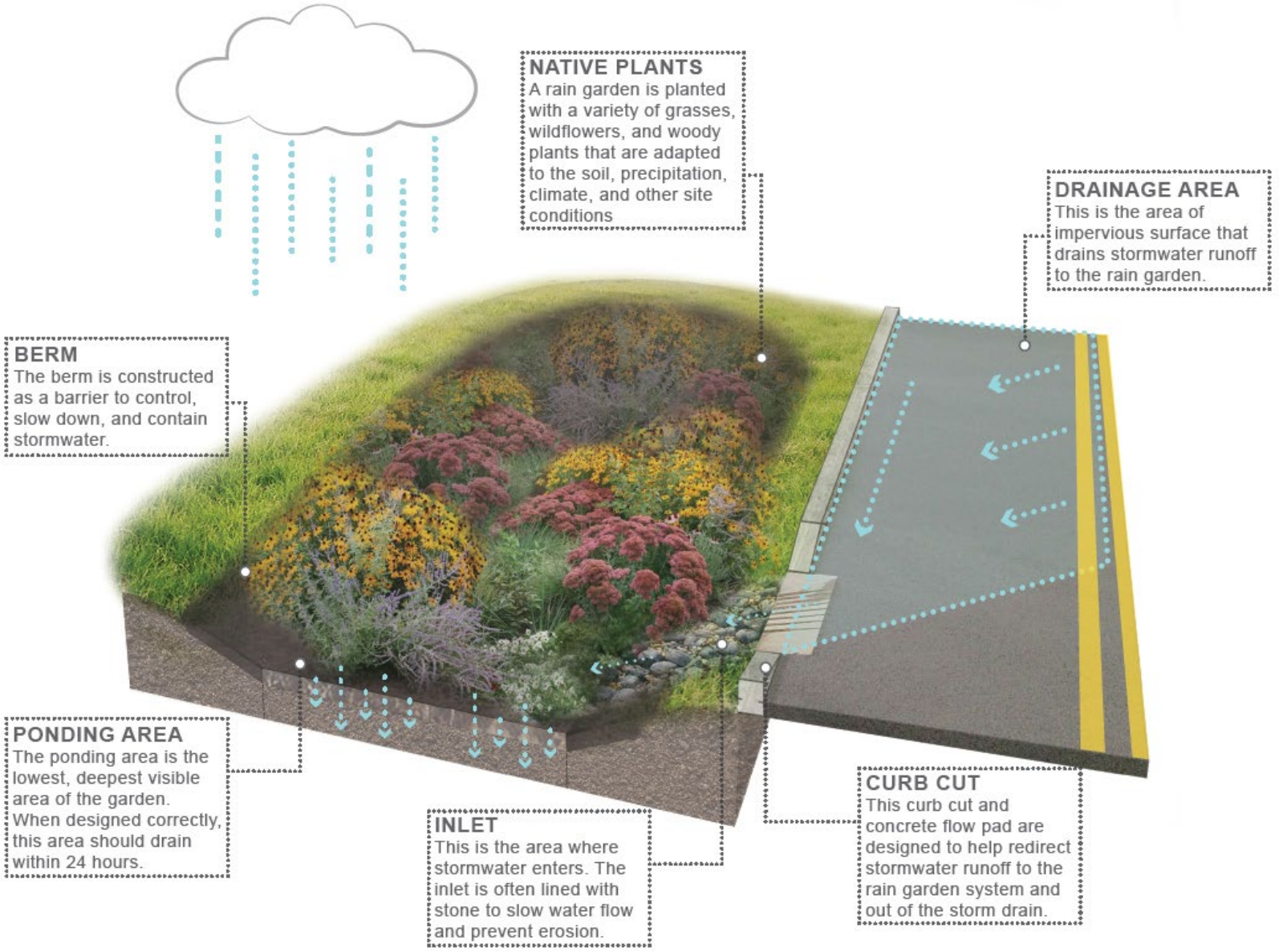
Bioretention Swales/ Bioswales/Vegetated Swales

- Typically in right-of-way

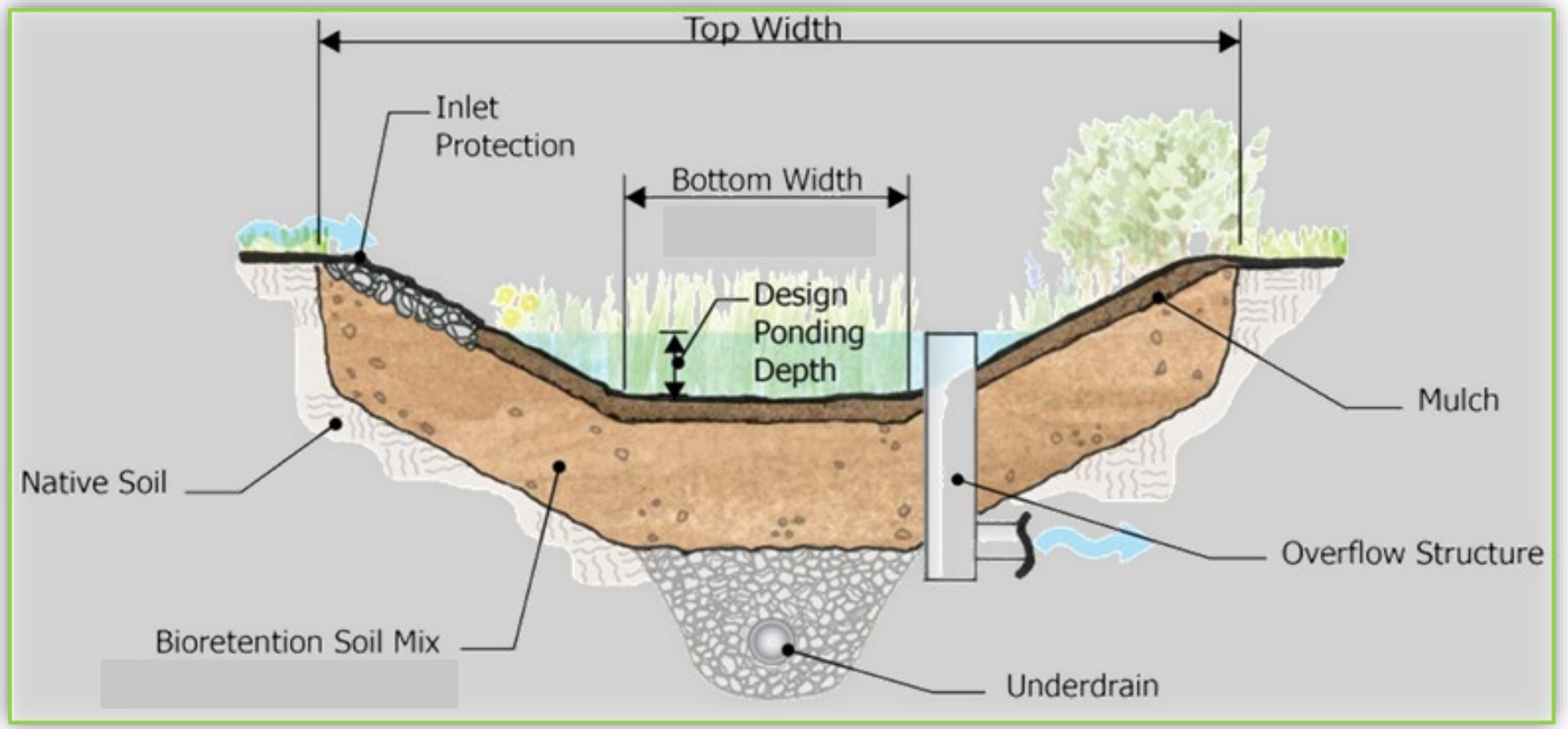
Vegetated Curb Extensions

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

Rain Gardens



Rain Garden Cross-Section

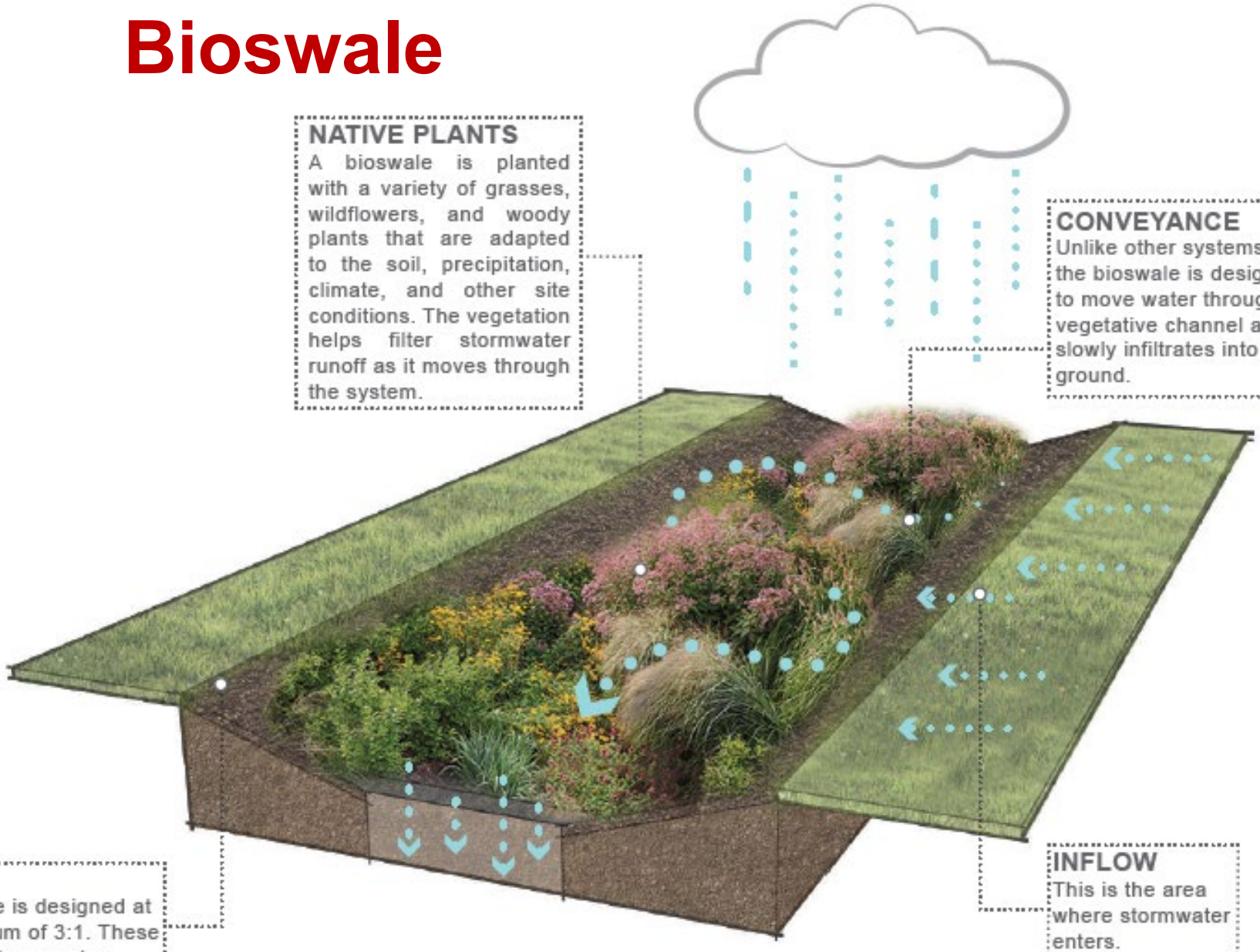



8.2.2004

Lots of Rain Gardens


116

Bioswale



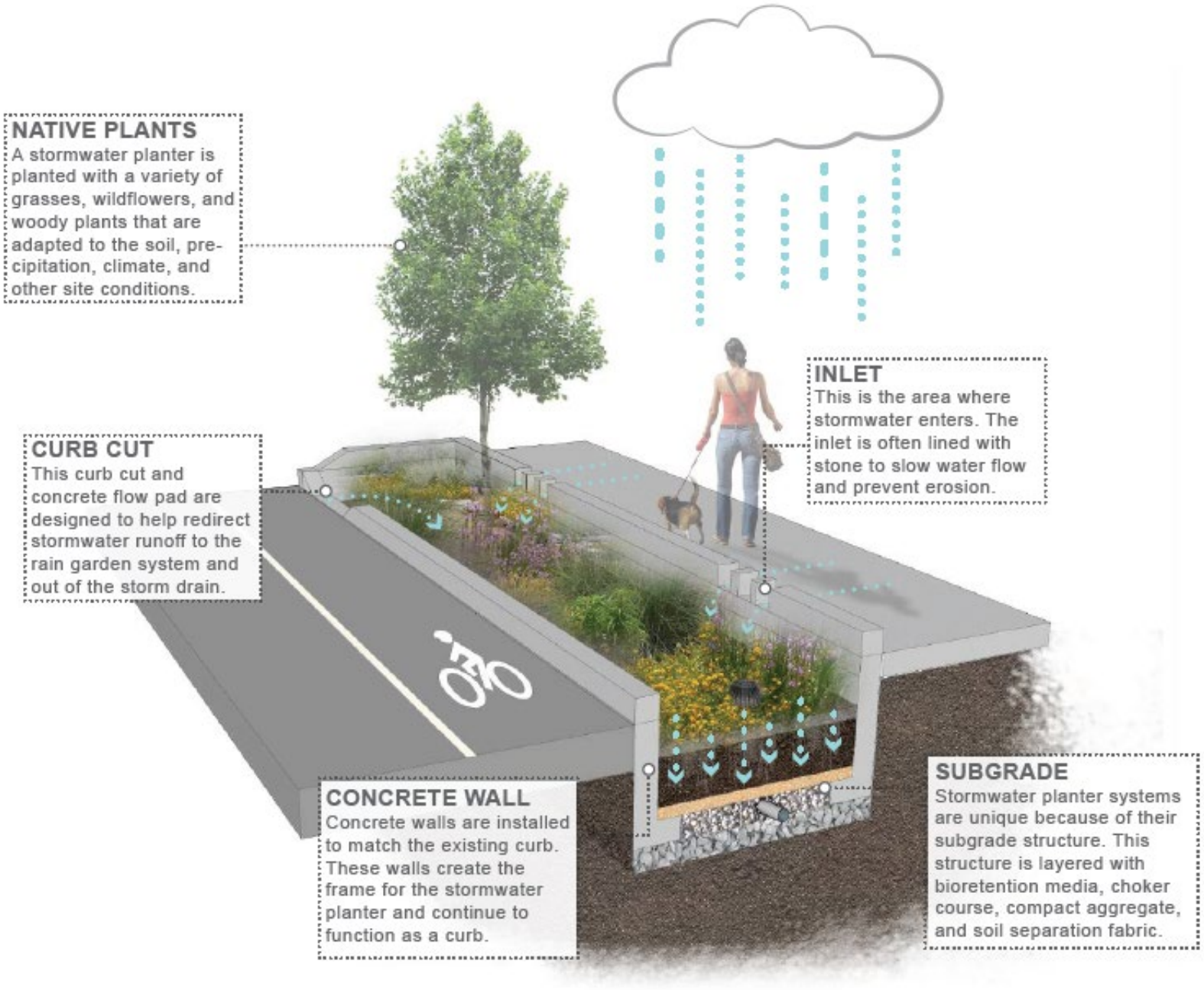
NATIVE PLANTS
A bioswale is planted with a variety of grasses, wildflowers, and woody plants that are adapted to the soil, precipitation, climate, and other site conditions. The vegetation helps filter stormwater runoff as it moves through the system.

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:

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

F EXISTING SUBGRADE
INFILTRATION FACILITIES.

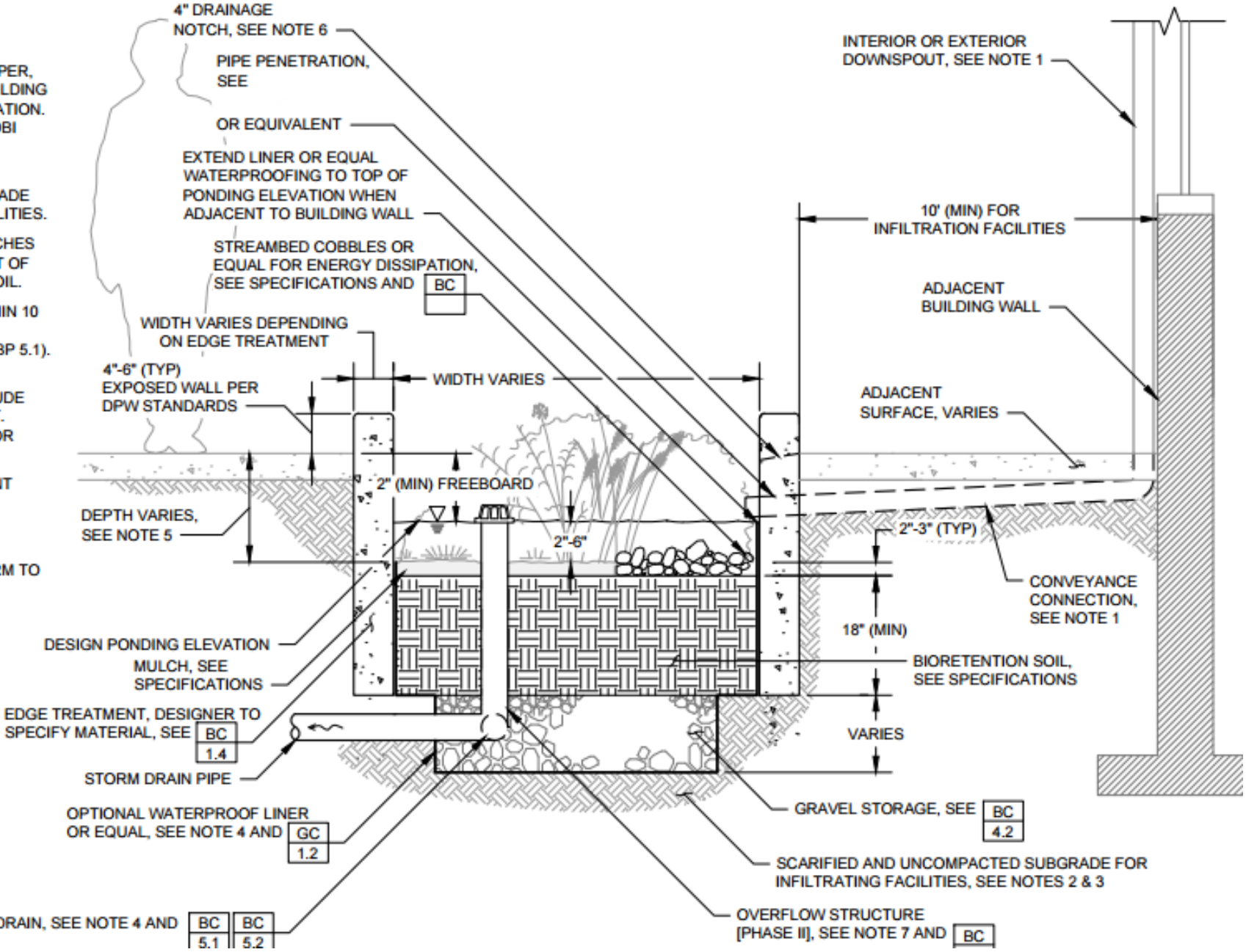
O A DEPTH OF 6 INCHES
IOR TO PLACEMENT OF
O BIORETENTION SOIL.

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

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

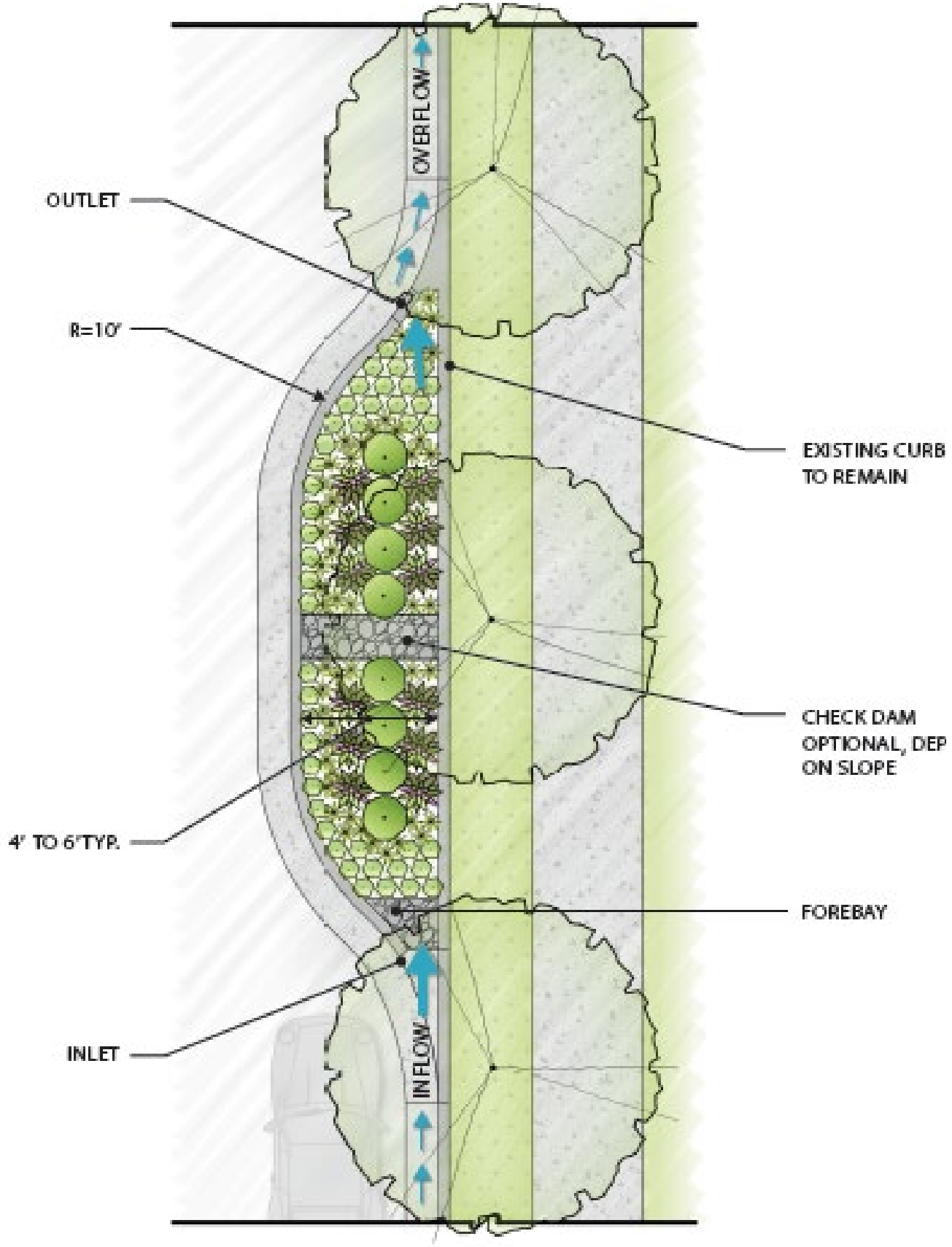
OTCHES TO PREVENT
NTER WALL. SLOPE
O PLANTER.

ORKMANSHIP FOR
RES SHALL CONFORM TO
NCISCO DBI CODES.

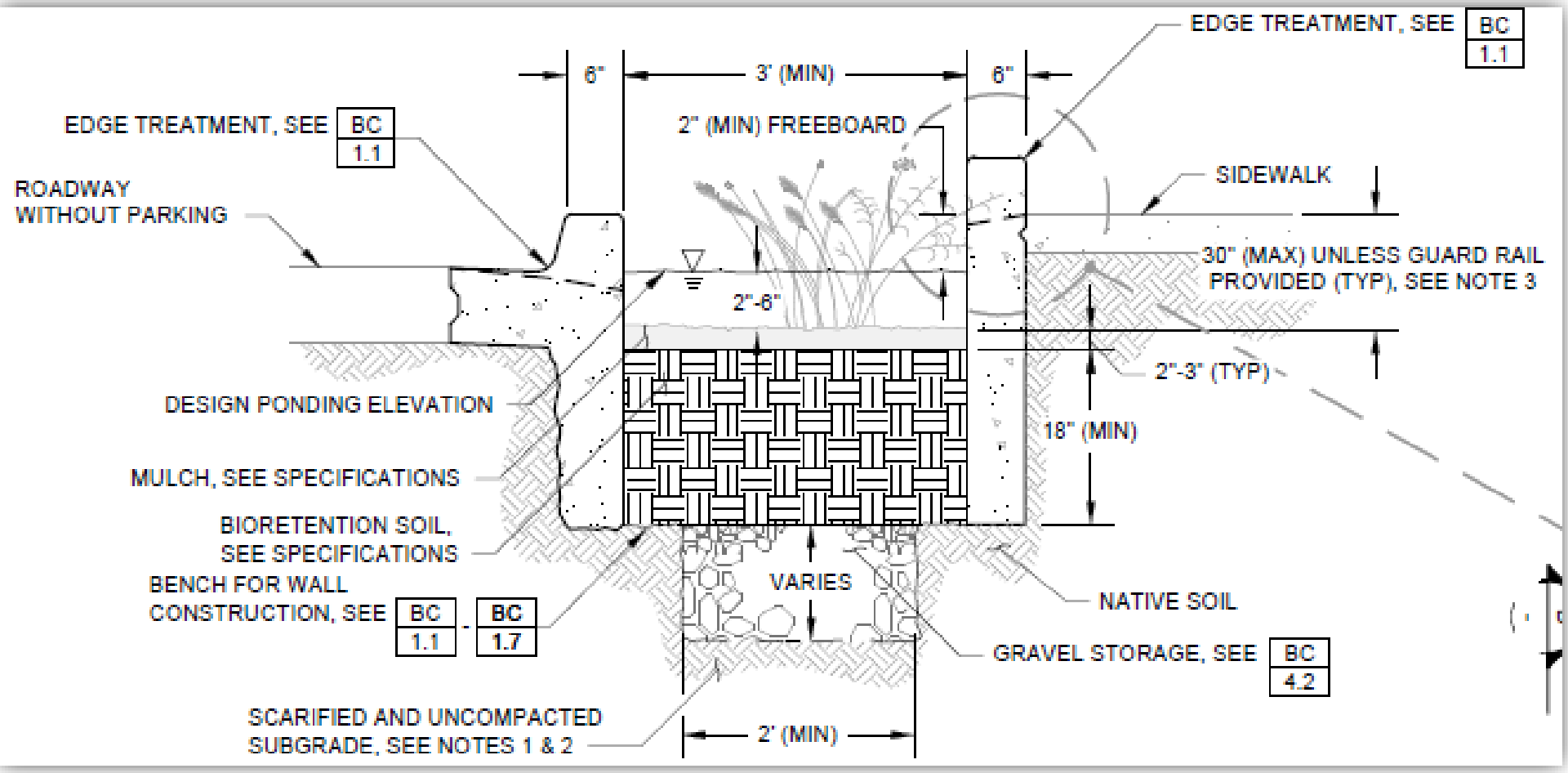


Stormwater Planter Cross-section

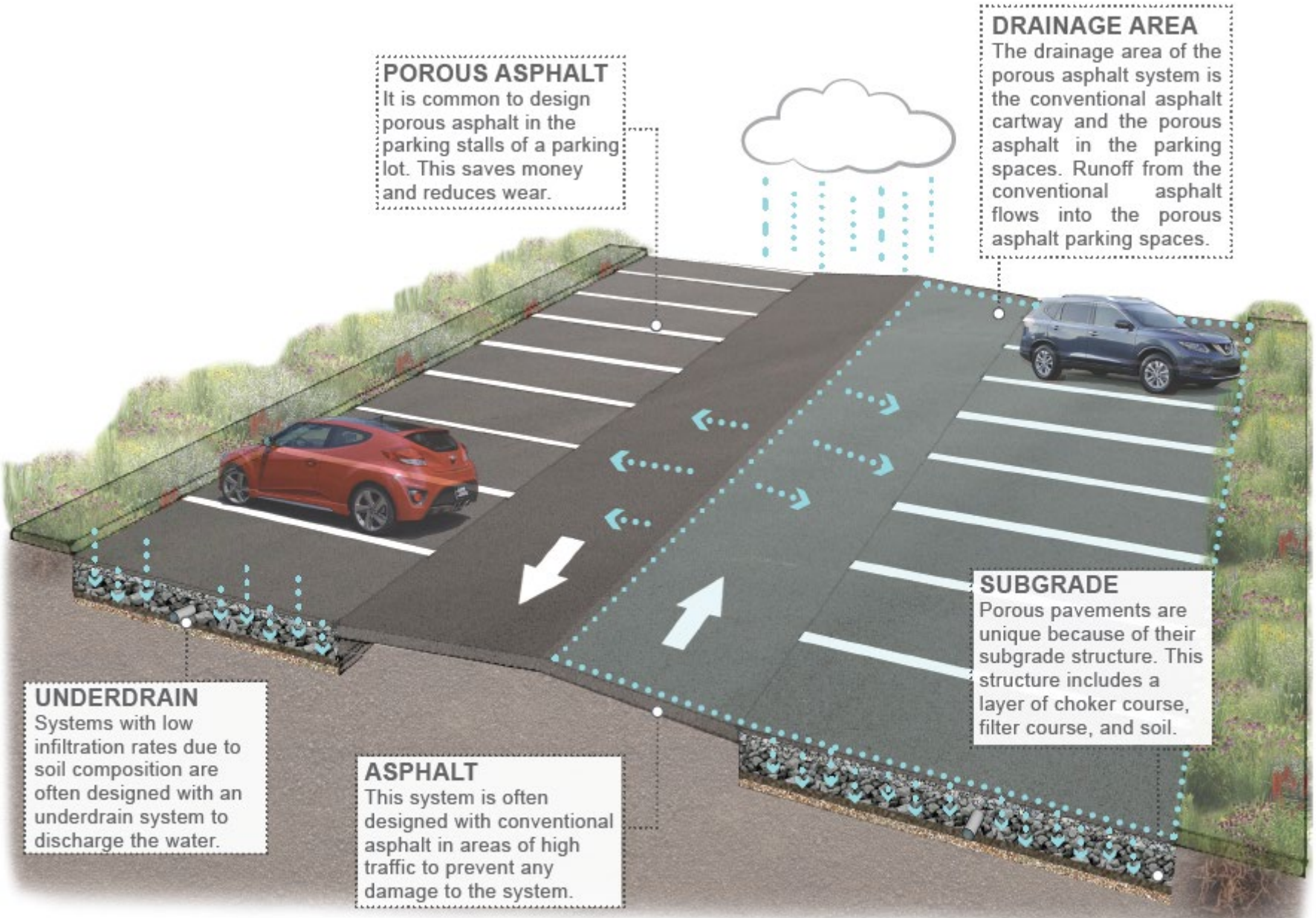
Curb Extensions



NOTE:
Graphic adapted fr
Portland, OR Storm
Manual Details

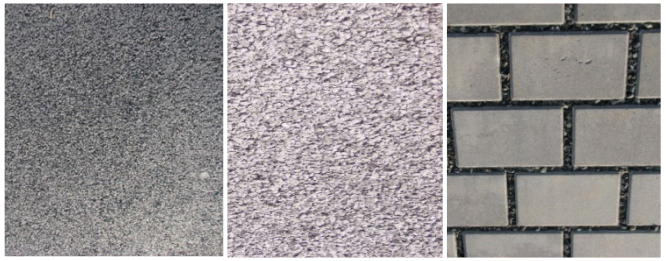

6"
3' (MIN)
6"
EDGE TREATMENT, SEE BC 1.1
EDGE TREATMENT, SEE BC 1.1
2" (MIN) FREEBOARD
ROADWAY WITHOUT PARKING
SIDEWALK
30" (MAX) UNLESS GUARD RAIL PROVIDED (TYP), SEE NOTE 3
2"-6"
2"-3" (TYP)
DESIGN PONDING ELEVATION
18" (MIN)
MULCH, SEE SPECIFICATIONS
BIORETENTION SOIL, SEE SPECIFICATIONS
BENCH FOR 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

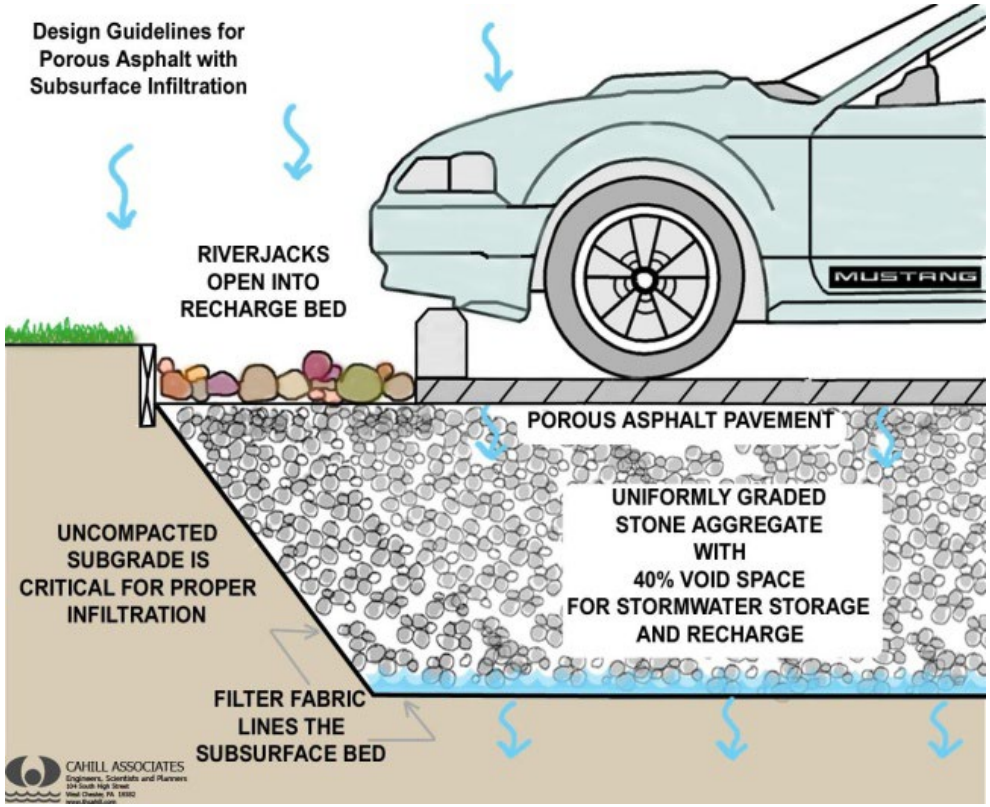
- Underlying stone reservoir
- Porous asphalt and pervious concrete are manufactured without "fine" materials to allow infiltration
- Grass pavers are concrete interlocking blocks with open areas to allow grass to grow
- Permeable paver systems are concrete pavers with infiltration between the spaces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



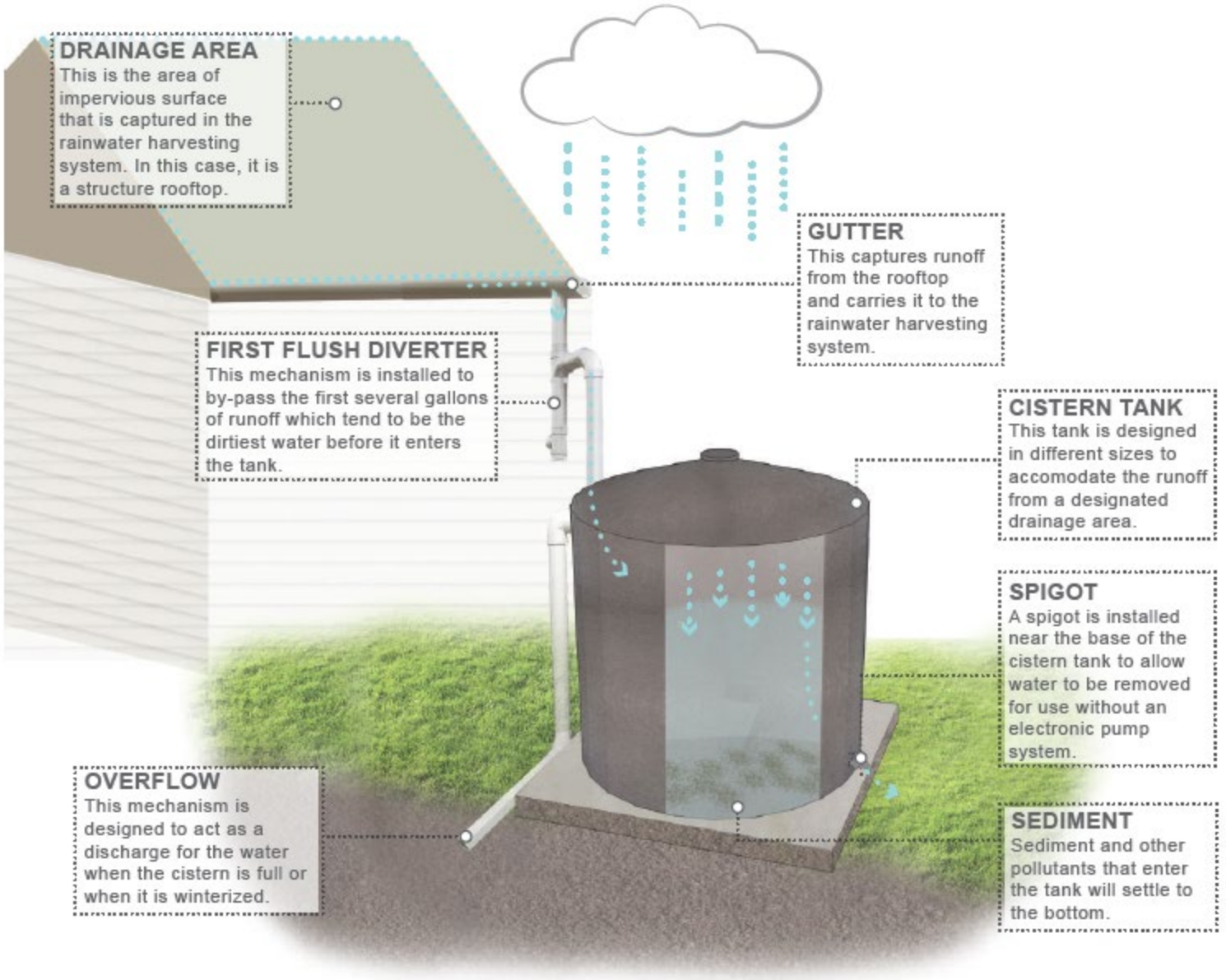
Porous Asphalt


Pervious Concrete


Permeable Pavers

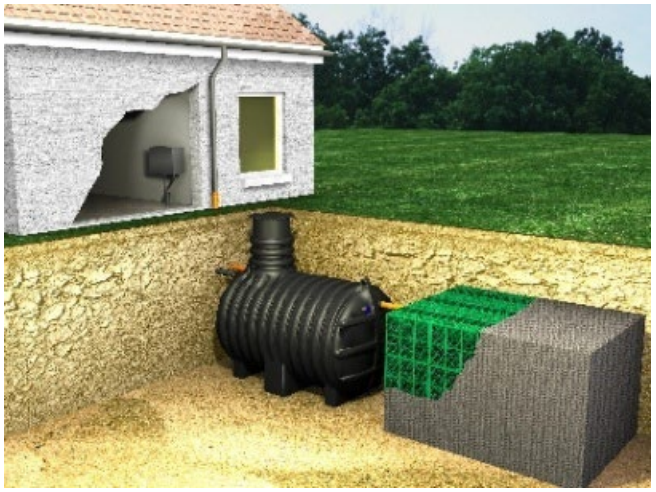

Grass Pavers

Rainwater Harvesting Systems

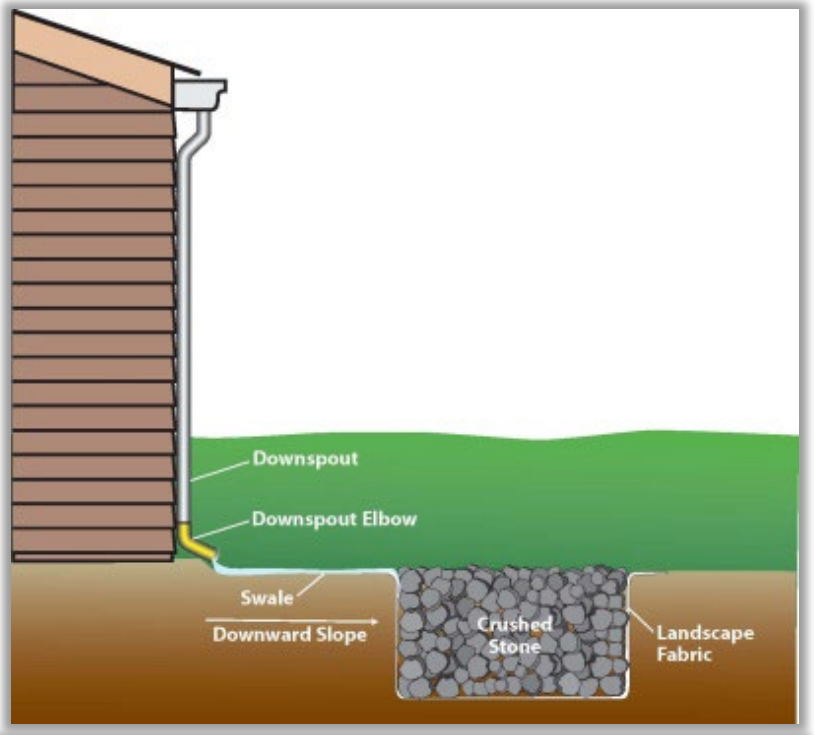


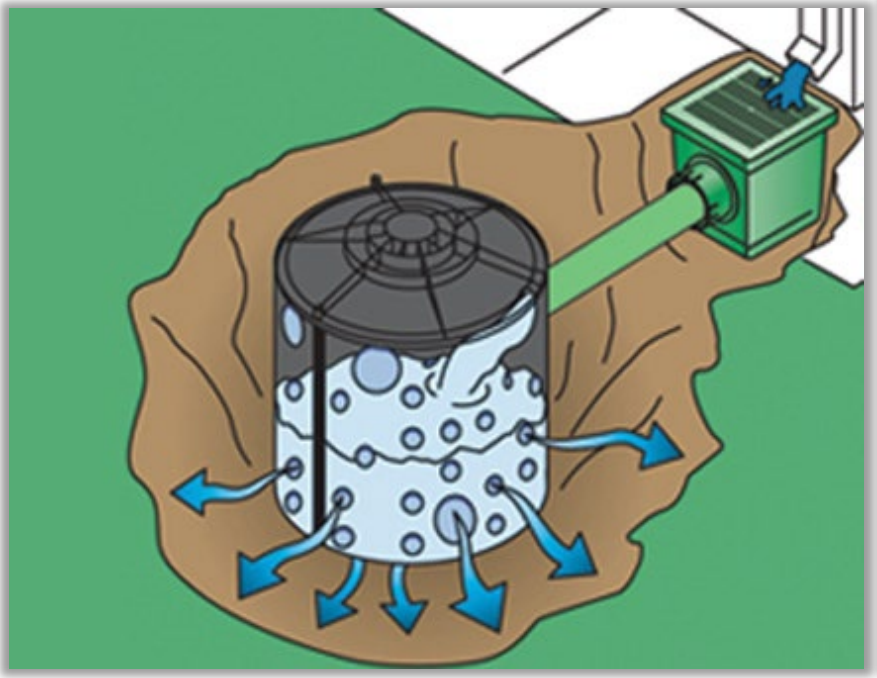
Rain Barrels

Cisterns

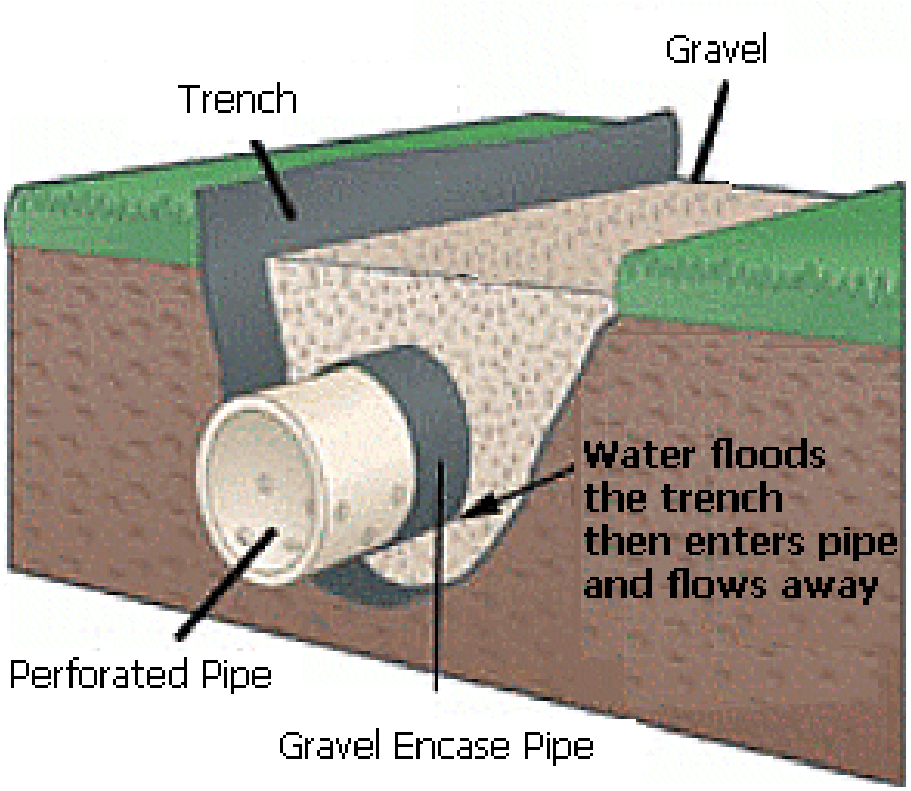


Dry Wells


Downspout
Downspout Elbow
Swale
Downward Slope
Crushed Stone
Landscape Fabric

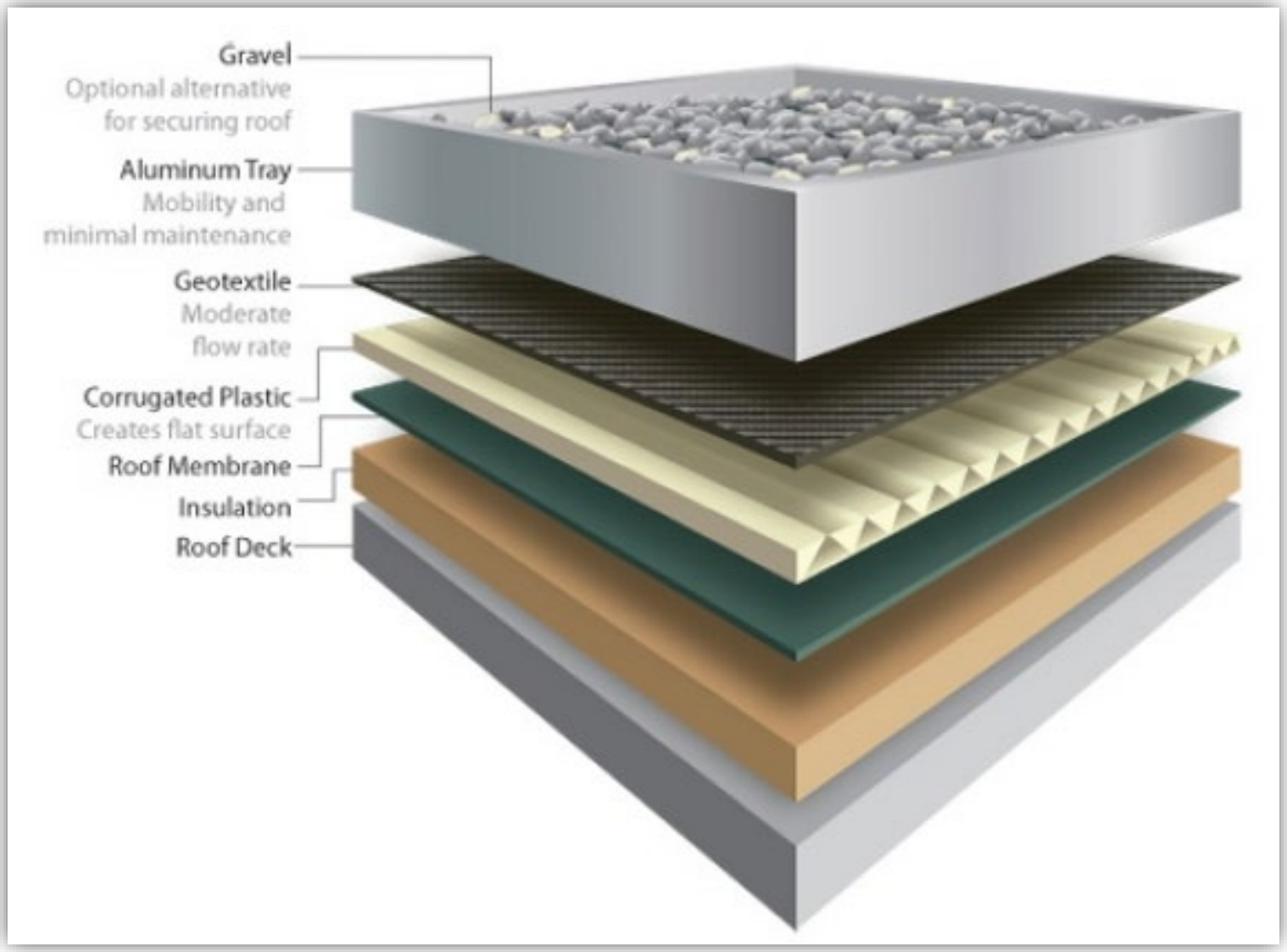


Infiltration Trench



Rooftop Practices – Green Roof

Rooftop Practices – Blue Roof




Stormwater Wetlands