Introduction to Green Infrastructure

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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.

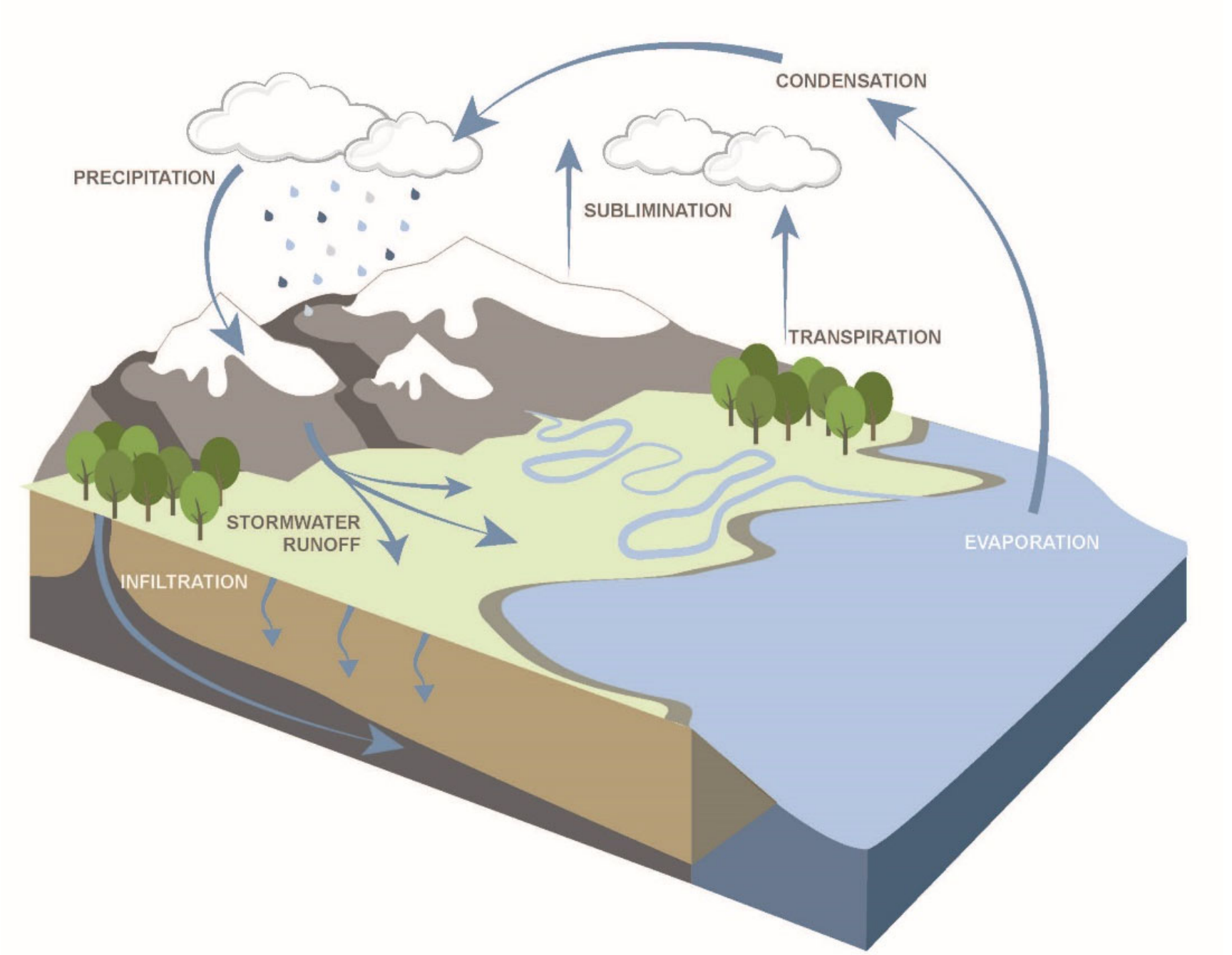
Water Quality

Water Quantity (flooding)

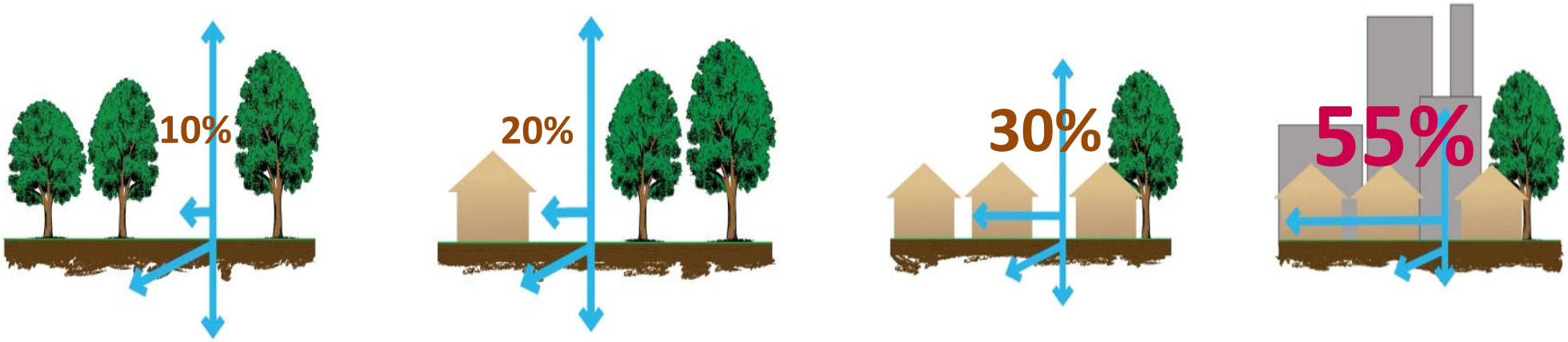
More Flooding

And even more flooding

The Natural Hydrologic Cycle

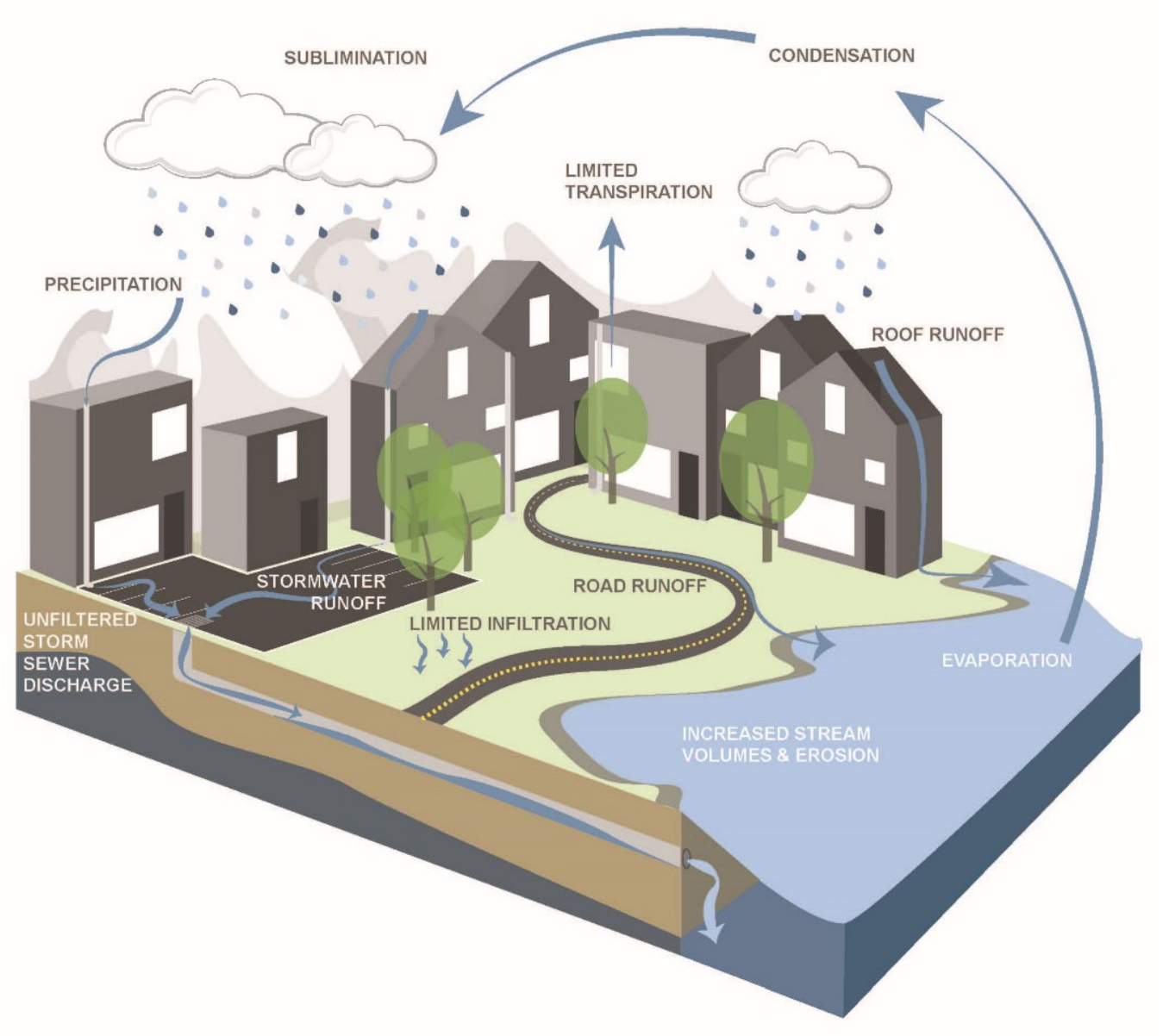


The Impact of Development on Stormwater Runoff



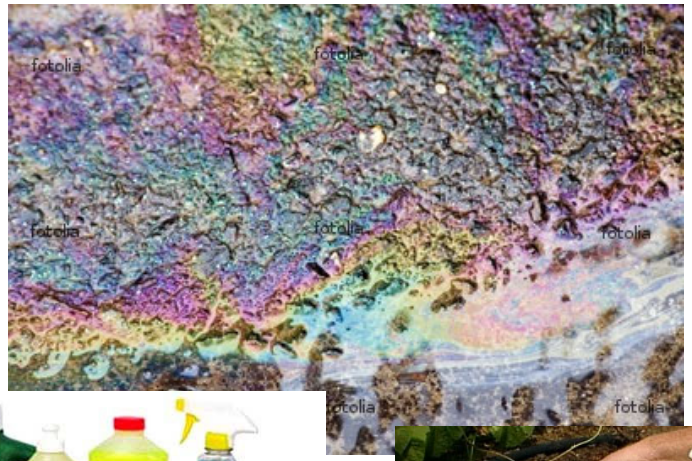
More development → *More impervious surfaces* → *More stormwater runoff*

The Urban Hydrologic Cycle



Examples OF Nonpoint Source Pollution

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



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

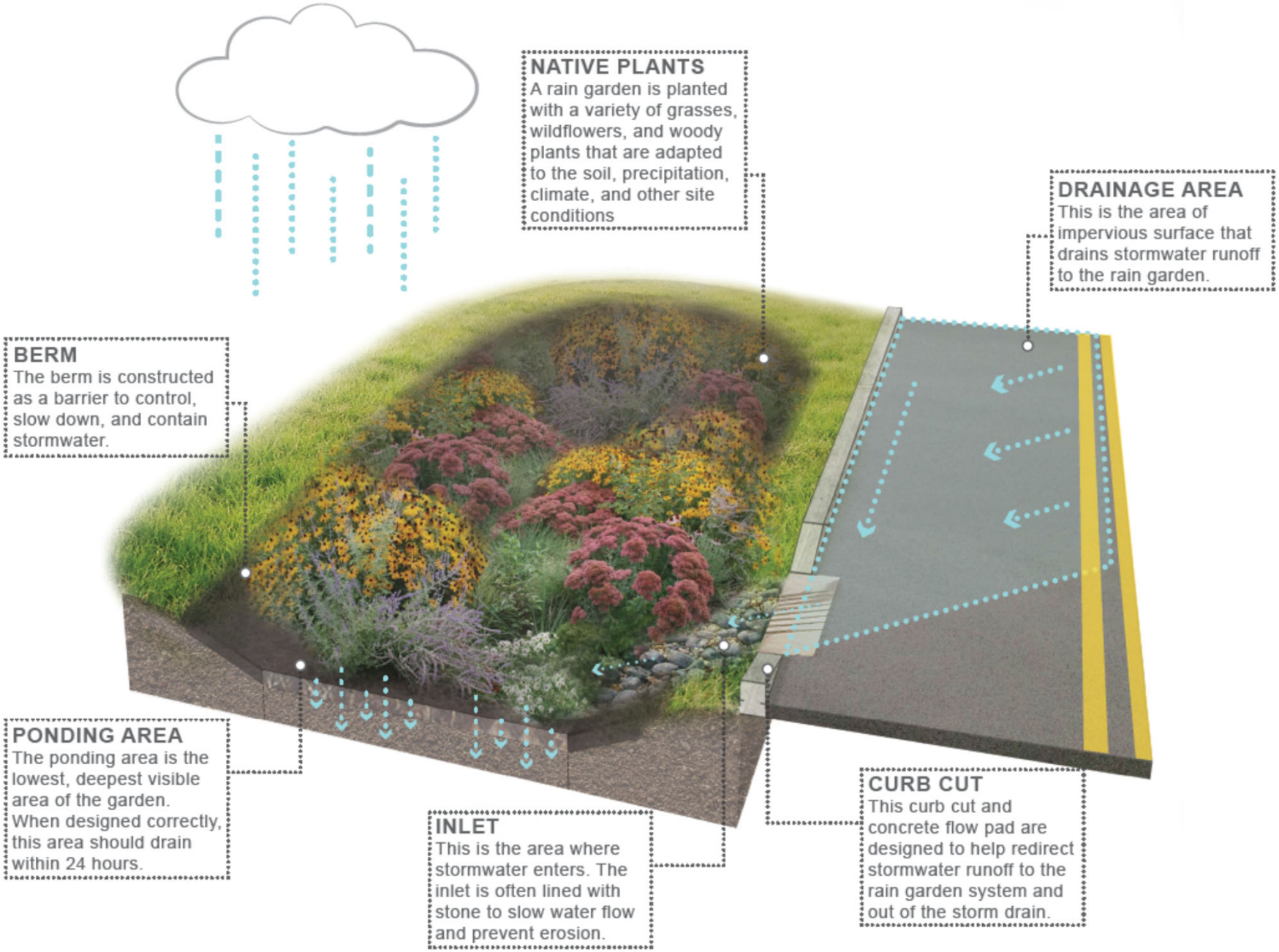
- Green Roofs
- Blue Roofs



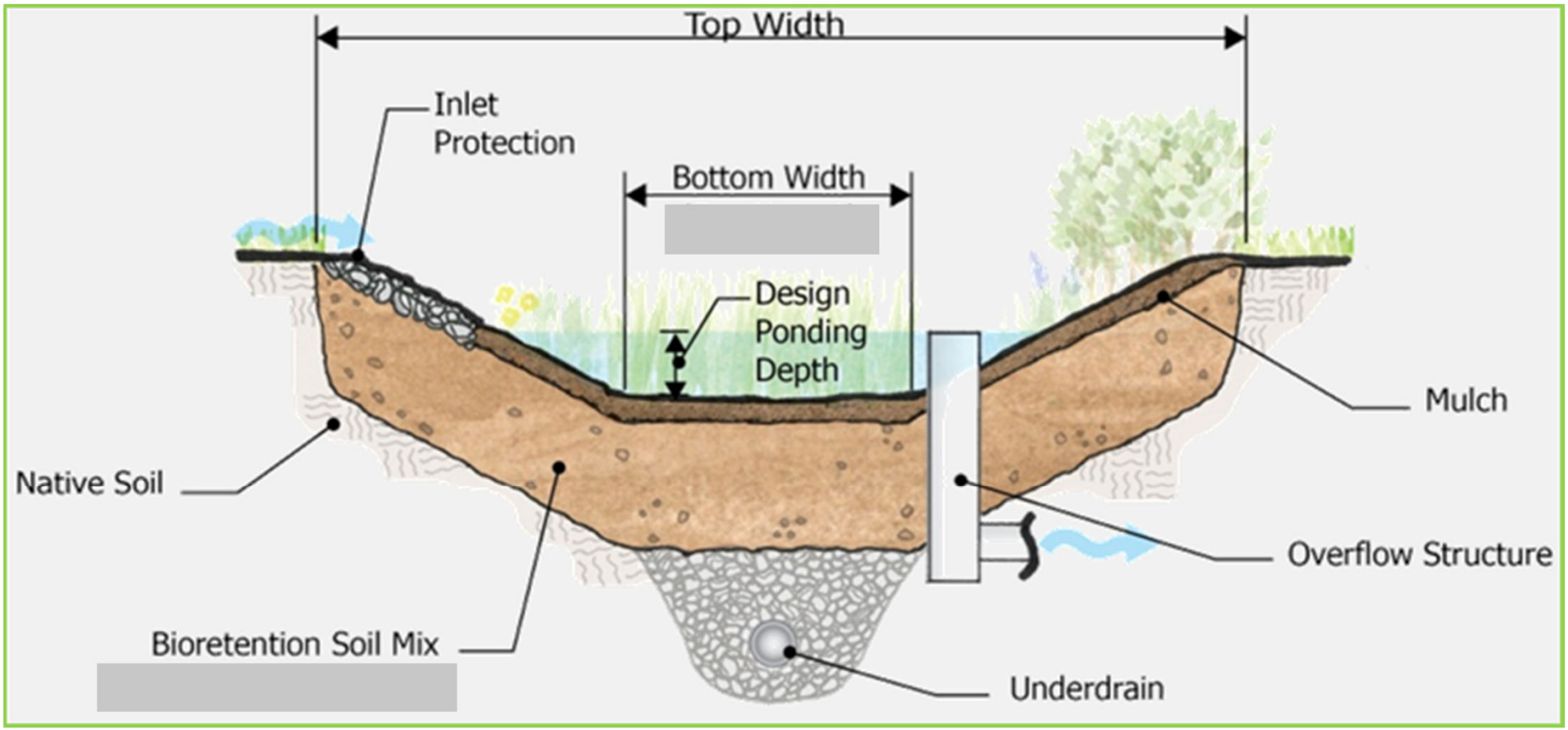





Rain Gardens

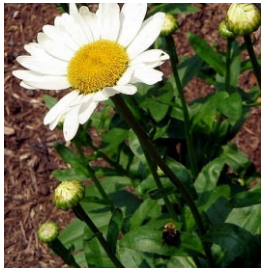


Rain Garden Cross-Section



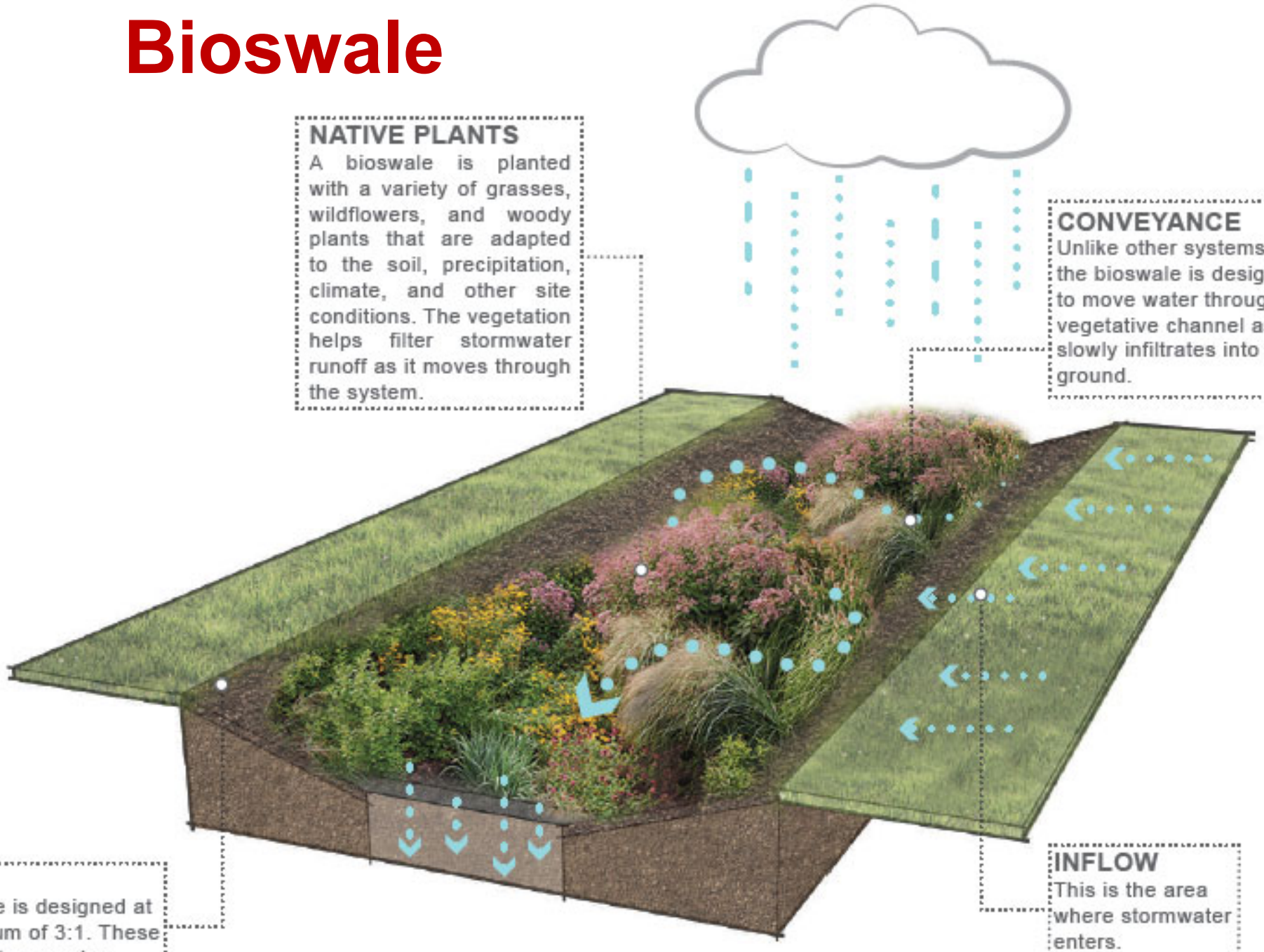

8. 2. 2004

Lots of Rain Gardens




116

Bioswale



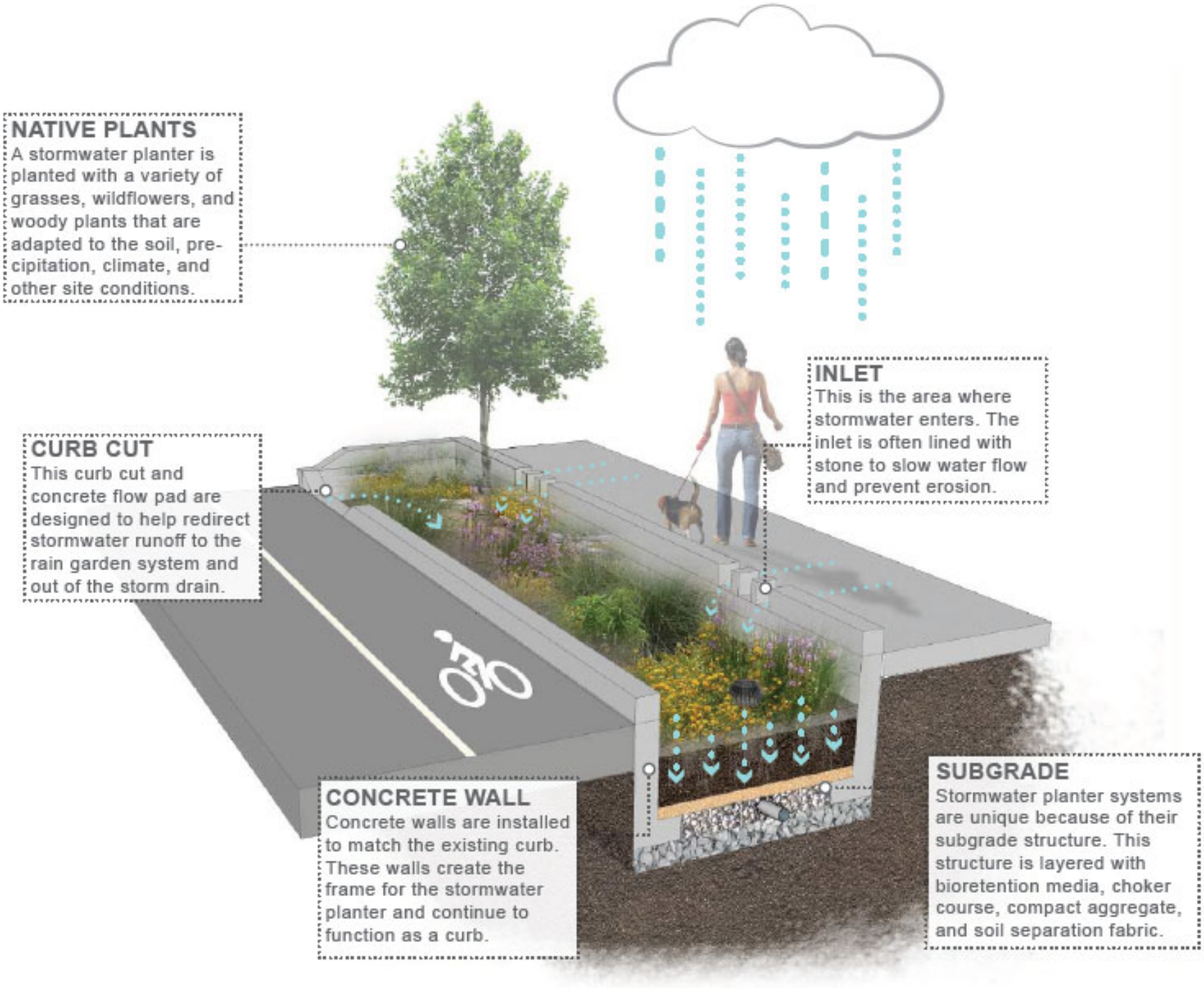
NATIVE PLANTS
A bioswale is planted with a variety of grasses, wildflowers, and woody plants that are adapted to the soil, precipitation, climate, and other site conditions. The vegetation helps filter stormwater runoff as it moves through the system.

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.

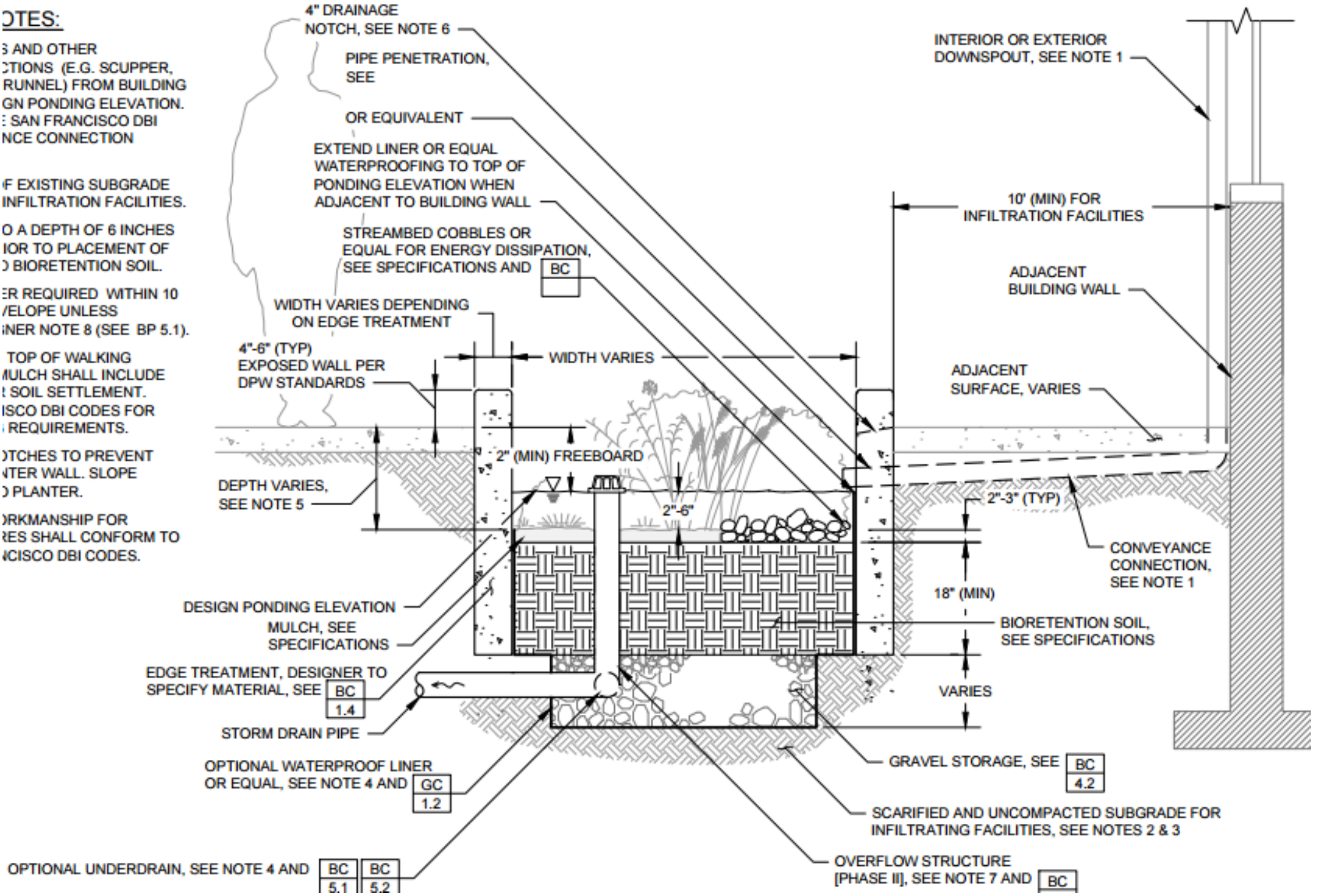
O A DEPTH OF 6 INCHES
IOR TO PLACEMENT OF
O BIORETENTION SOIL.

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.

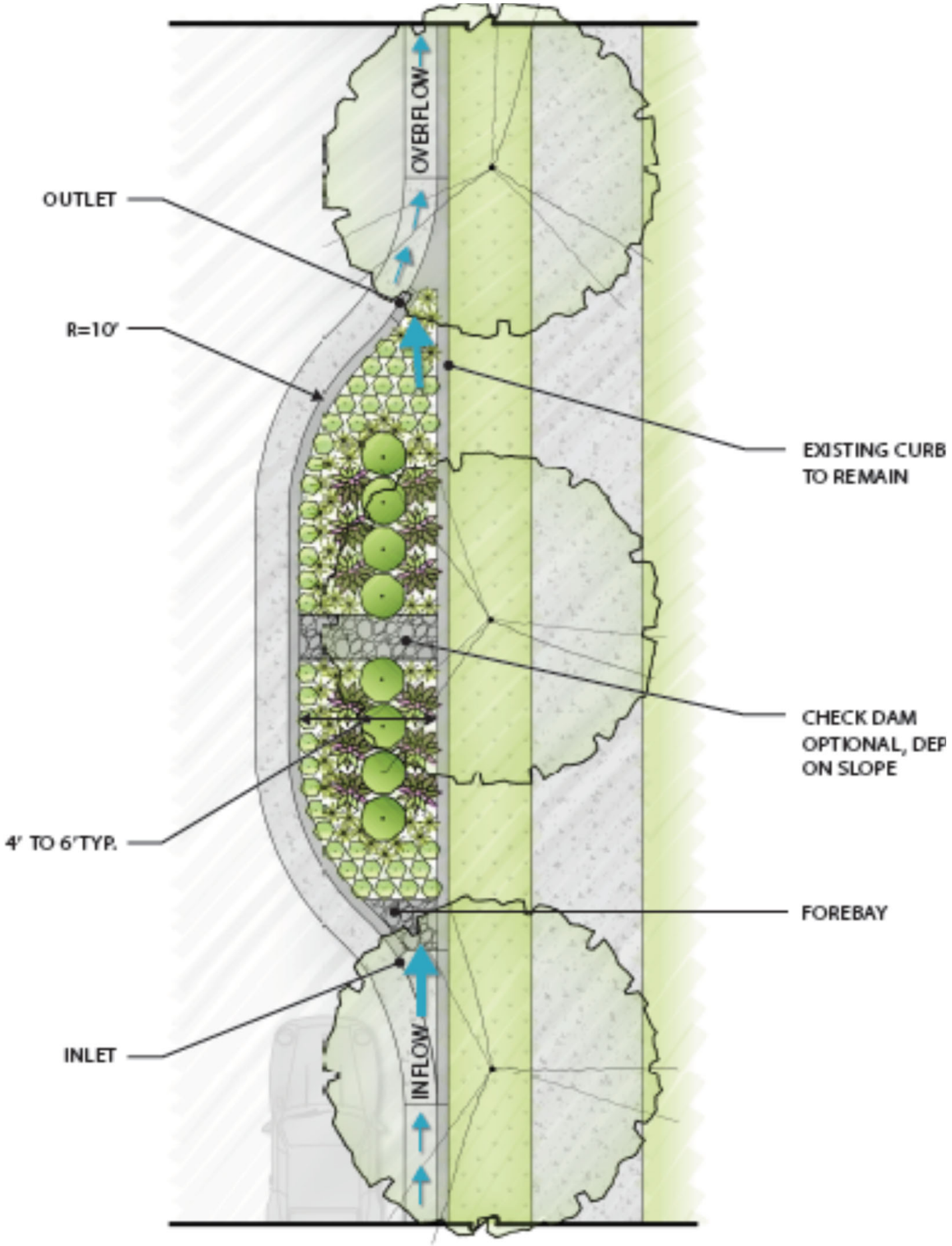
OTCHES TO PREVENT
NTER WALL. SLOPE
O PLANTER.

ORKMANSHIP FOR
RES SHALL CONFORM TO
NCISCO DBI CODES.

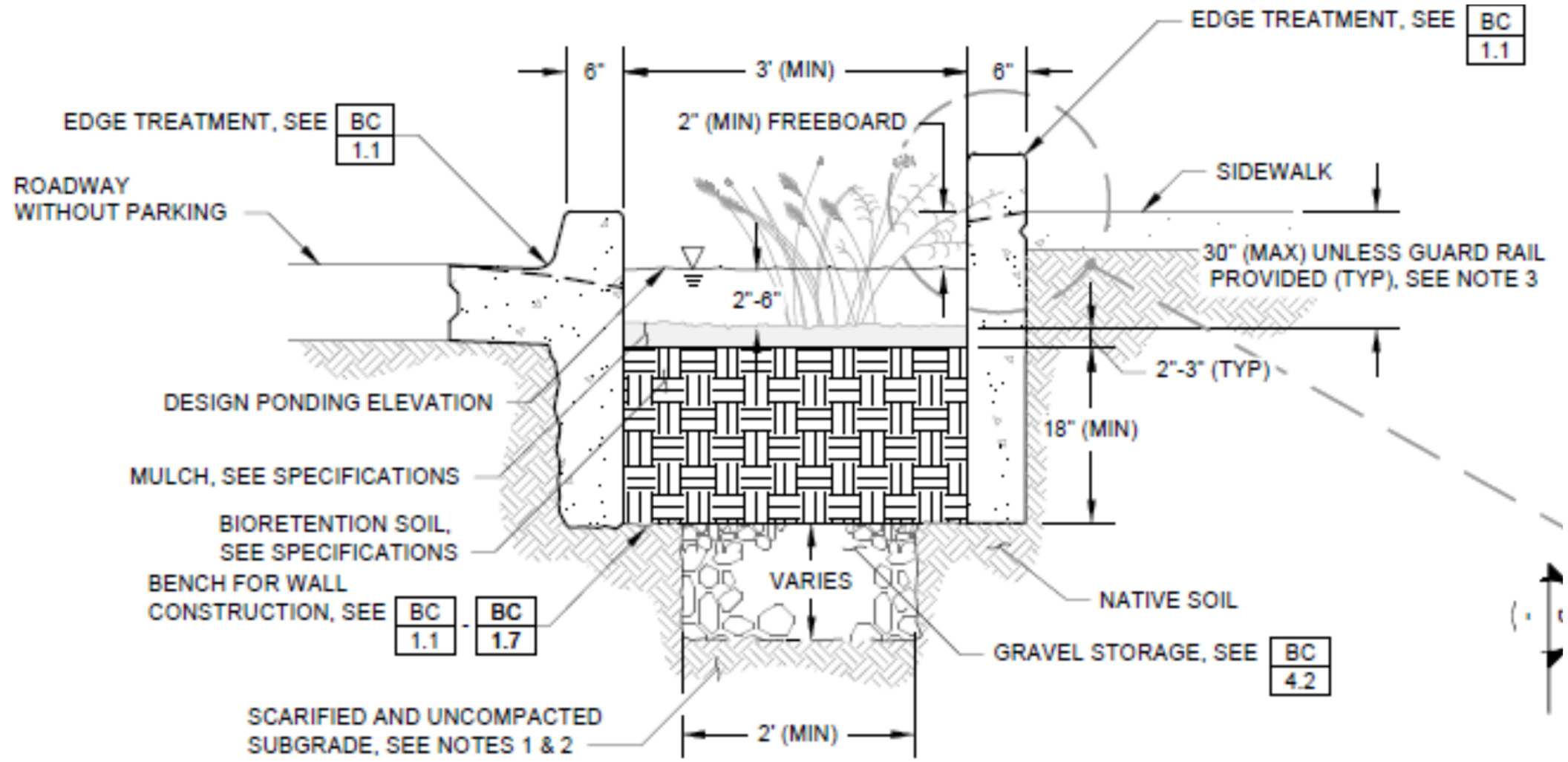


Stormwater Planter Cross-section

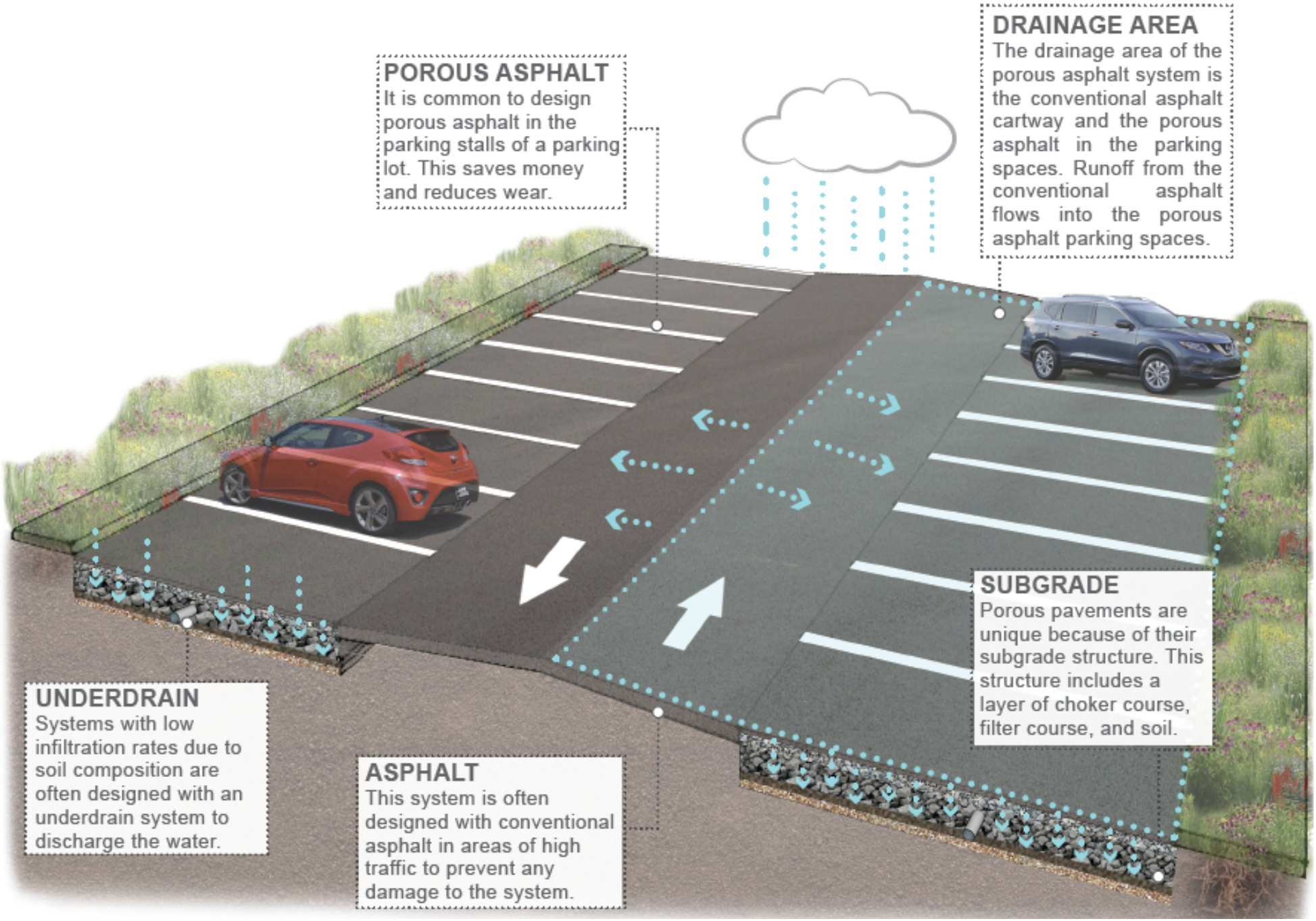
Curb Extensions



NOTE:
Graphic adapted f
Portland, OR Storm
Manual Details

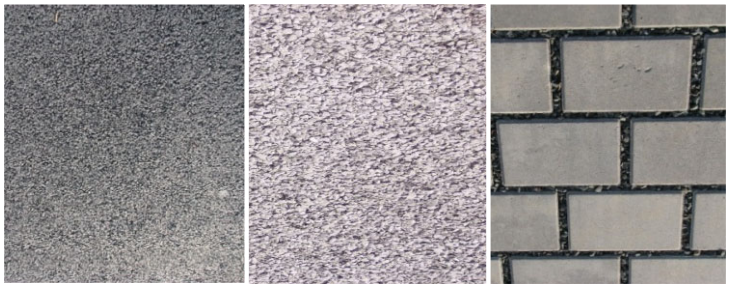

6"
3' (MIN)
6"
EDGE TREATMENT, SEE BC 1.1
EDGE TREATMENT, SEE BC 1.1
2" (MIN) FREEBOARD
SIDEWALK
ROADWAY WITHOUT PARKING
30" (MAX) UNLESS GUARD RAIL PROVIDED (TYP), SEE NOTE 3
2"-6"
2"-3" (TYP)
DESIGN PONDING ELEVATION
18" (MIN)
MULCH, SEE SPECIFICATIONS
BIORETENTION SOIL, SEE SPECIFICATIONS
BENCH FOR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

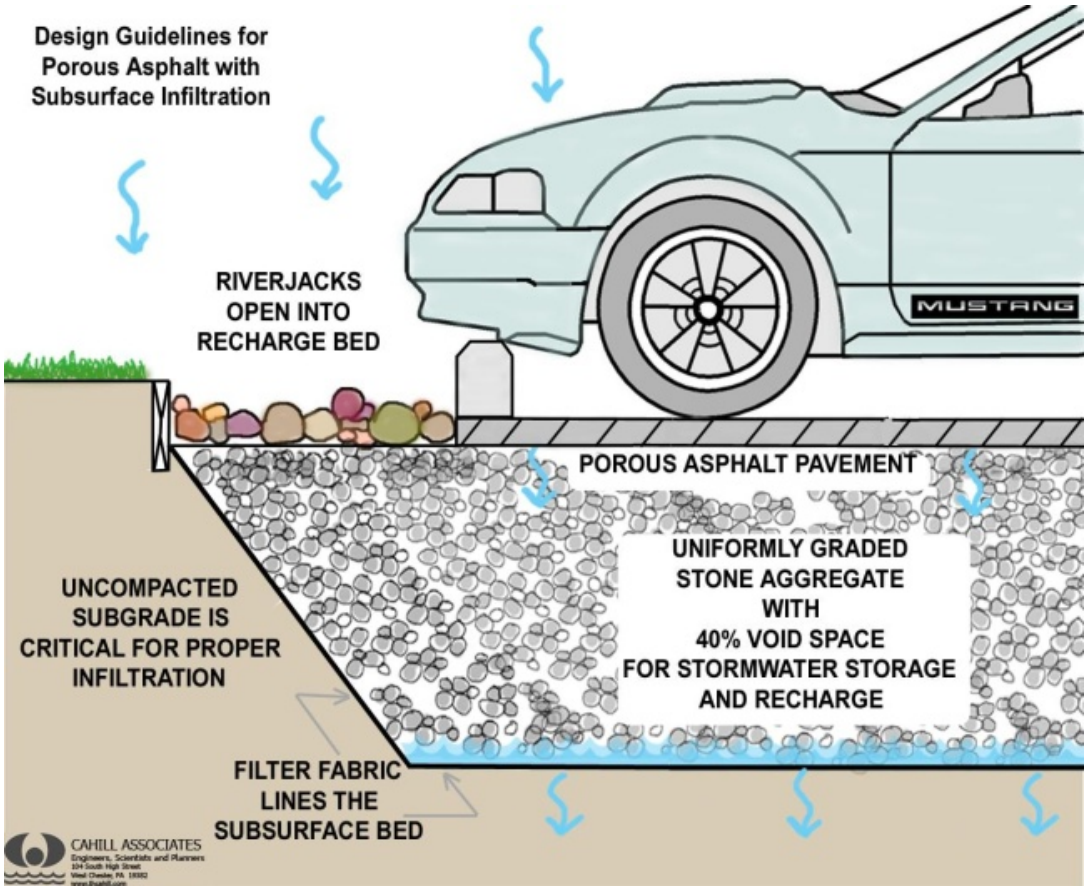
- Underlying stone reservoir
- Porous asphalt and pervious concrete are manufactured without "fine" materials to allow infiltration
- Grass pavers are concrete interlocking blocks with open areas to allow grass to grow
- Permeable paver systems are concrete pavers with infiltration between the spaces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



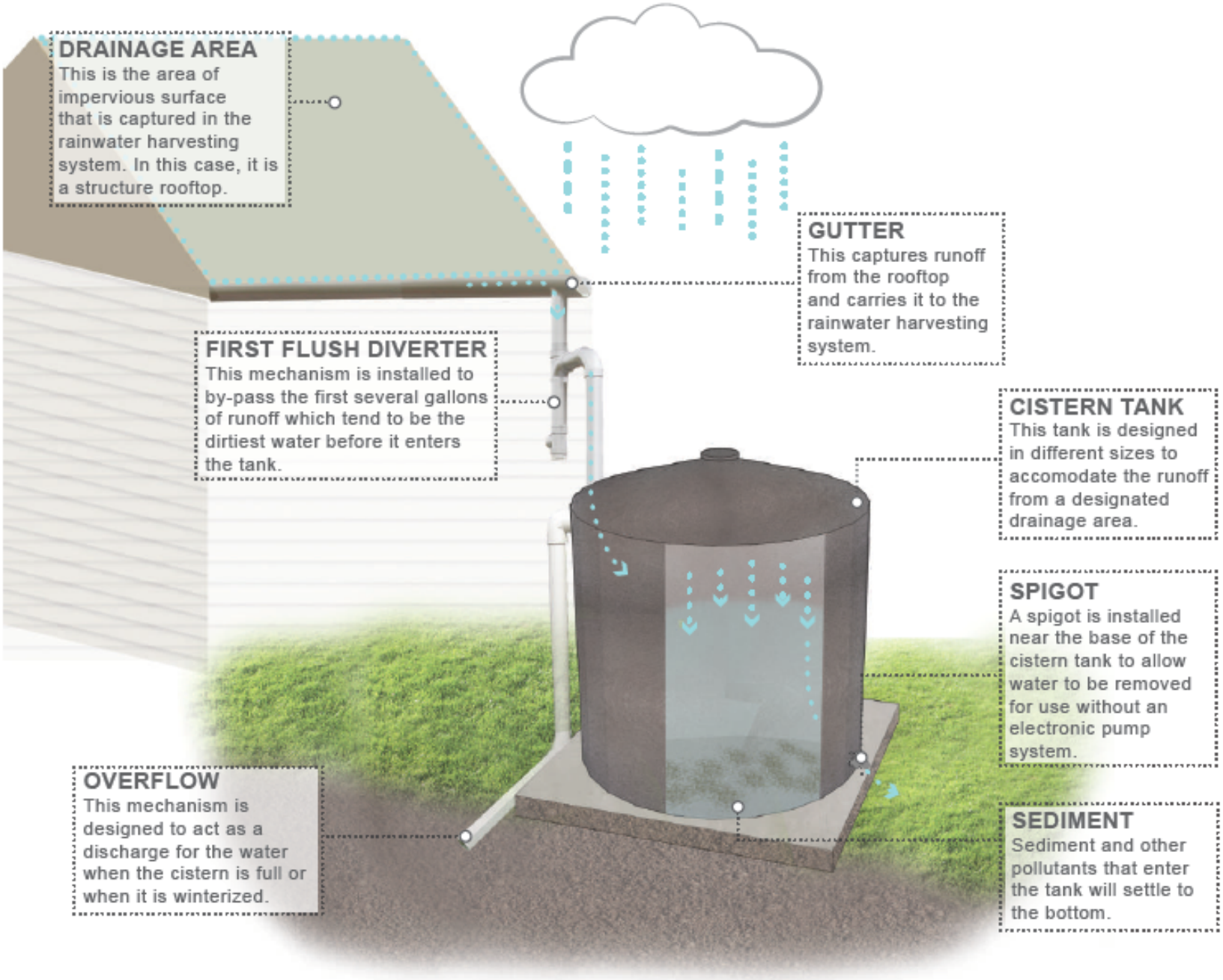
Porous Asphalt


Pervious Concrete


Permeable Pavers


Grass Pavers

Rainwater Harvesting Systems

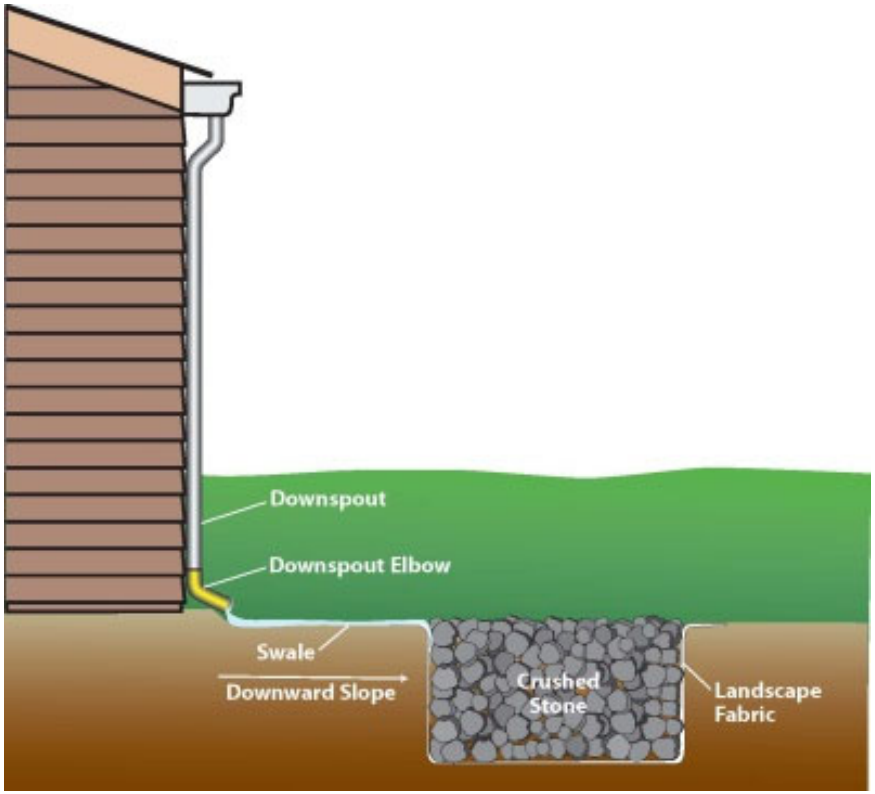


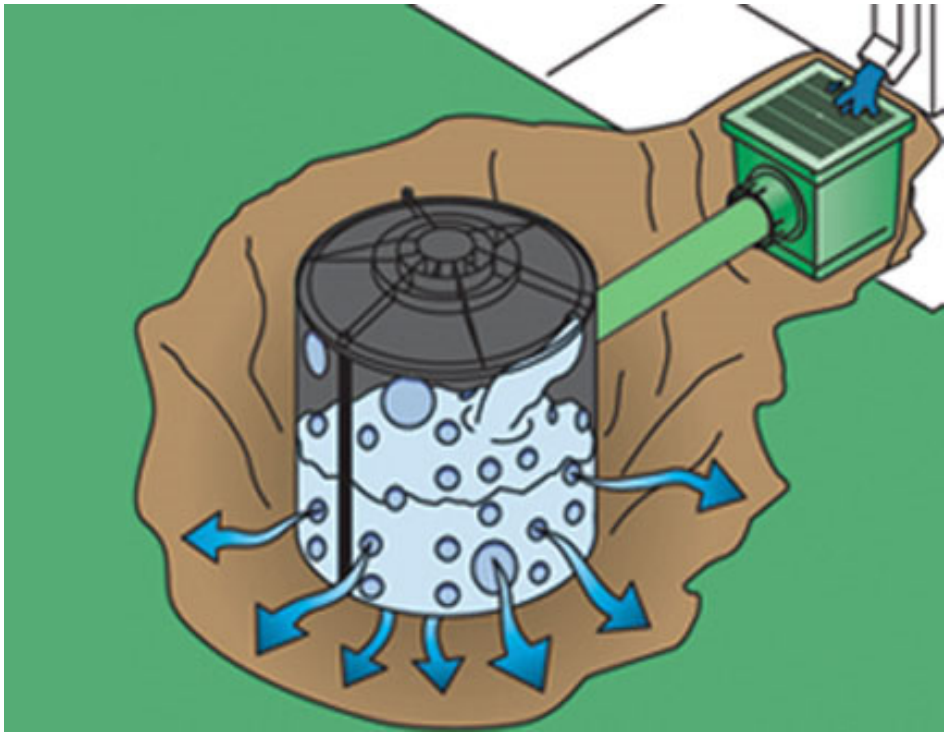
Rain Barrels

Cisterns

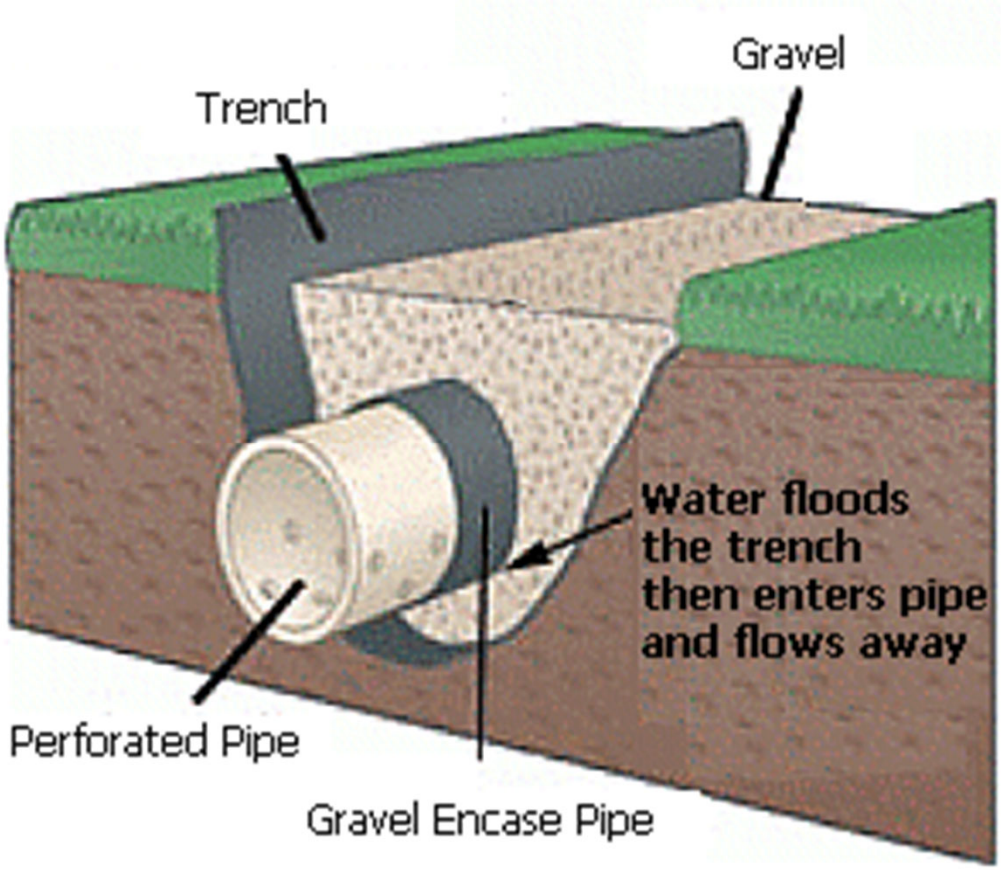

3M
Post-it

Dry Wells


Downspout
Downspout Elbow
Swale
Downward Slope
Crushed Stone
Landscape Fabric

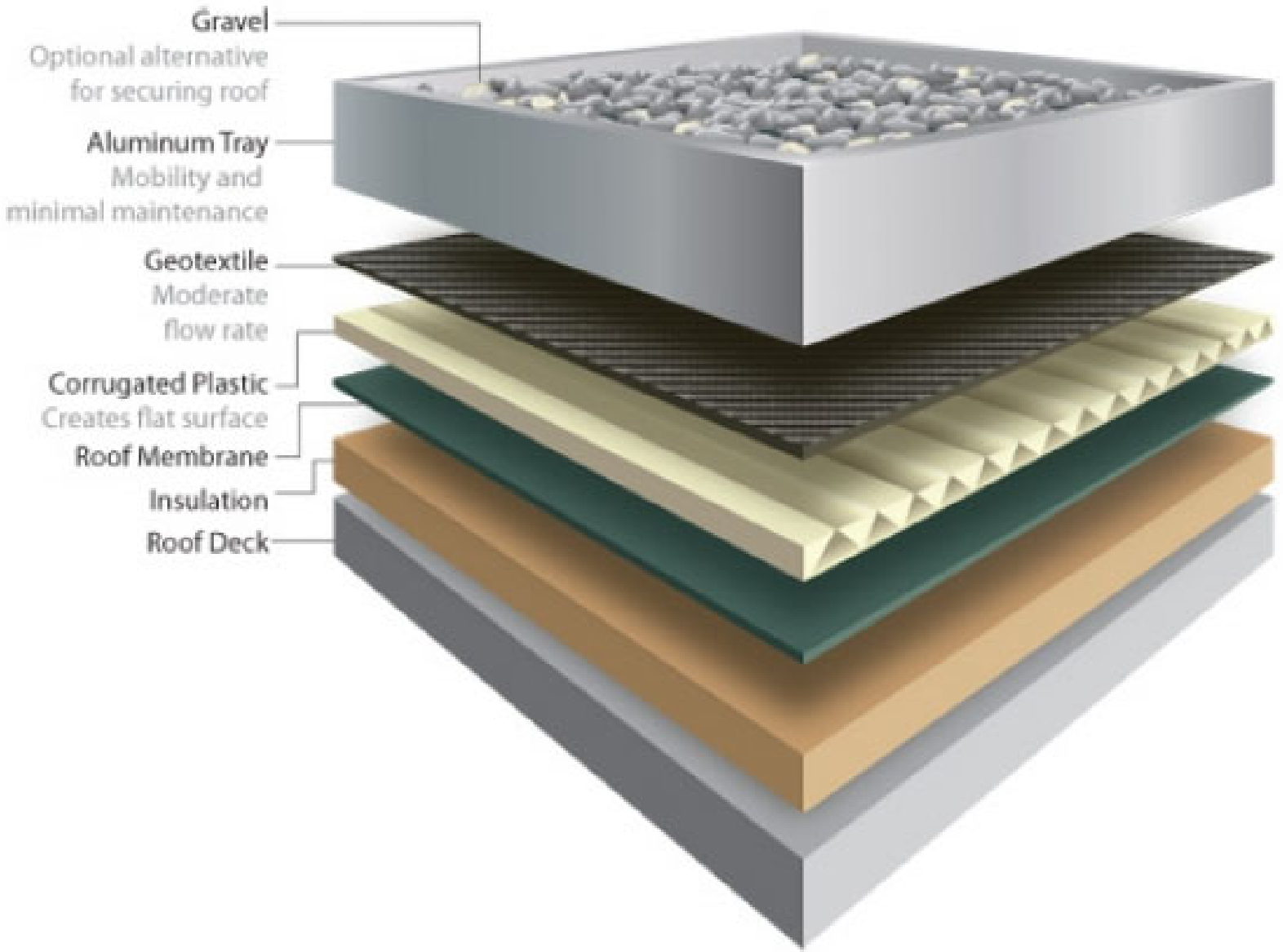


Infiltration Trench



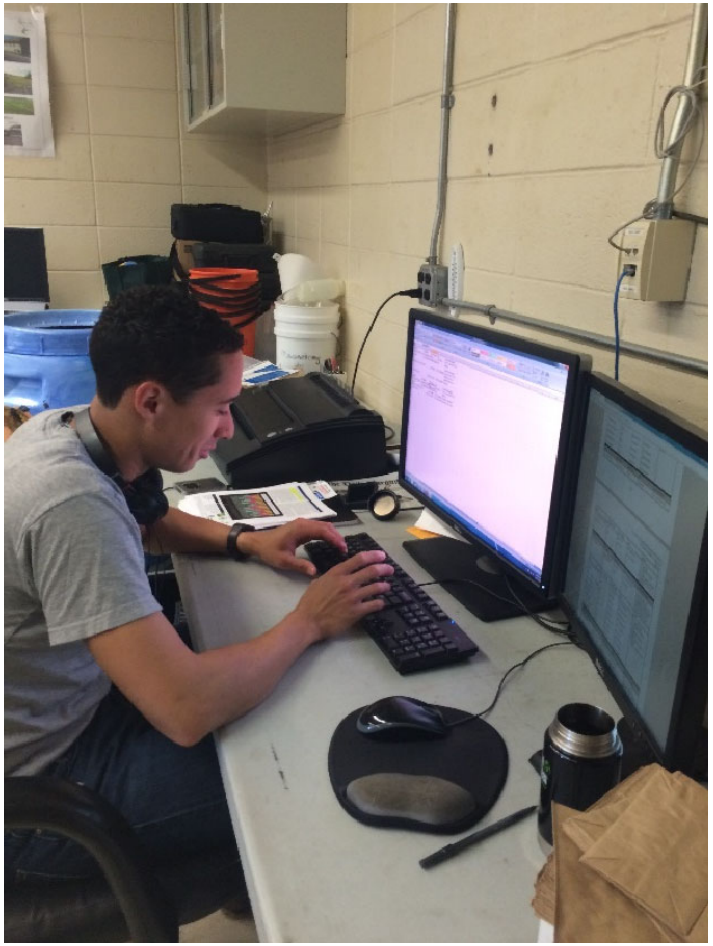
Rooftop Practices – Green Roof

Rooftop Practices – Blue Roof




Stormwater Wetlands

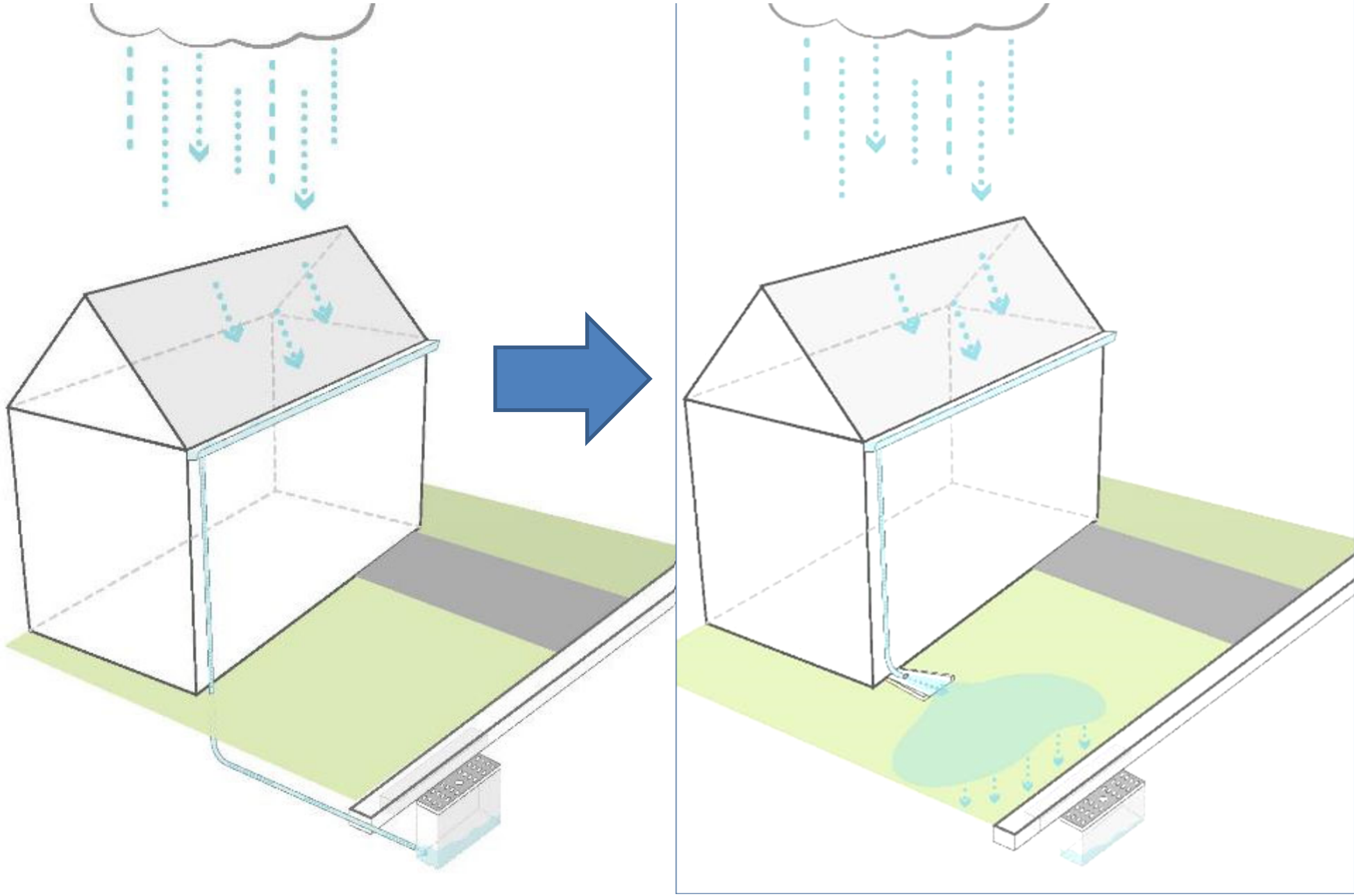
Identifying Sites for Green Infrastructure



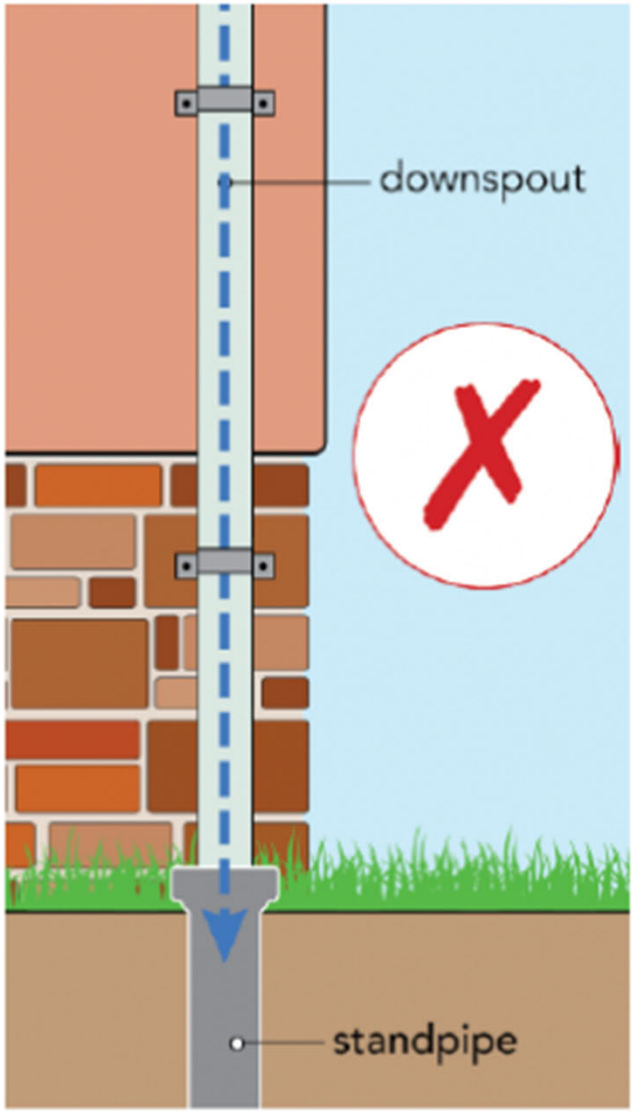
It is all about controlling runoff from impervious surfaces

Connected or Disconnected?

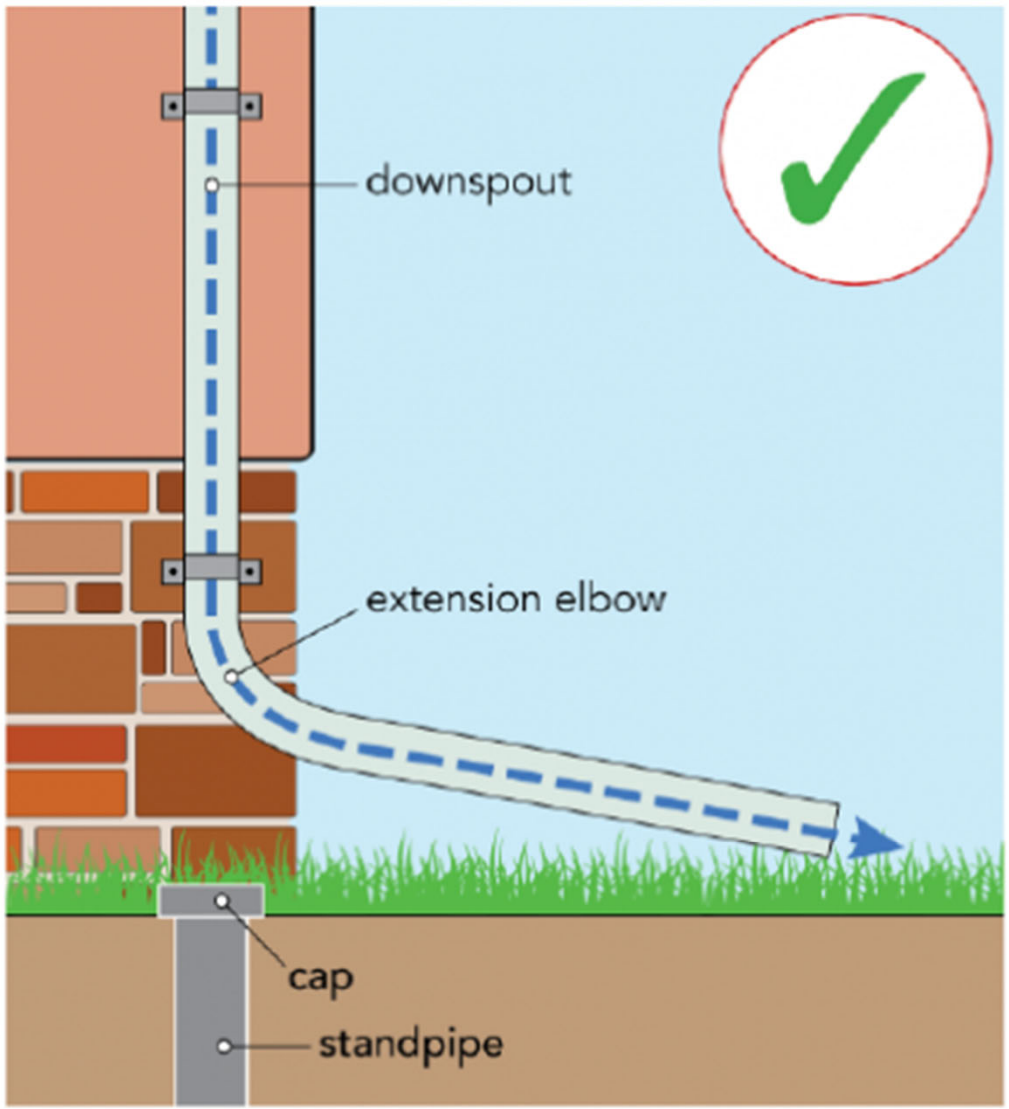
Simple Disconnection



Downspout Disconnection



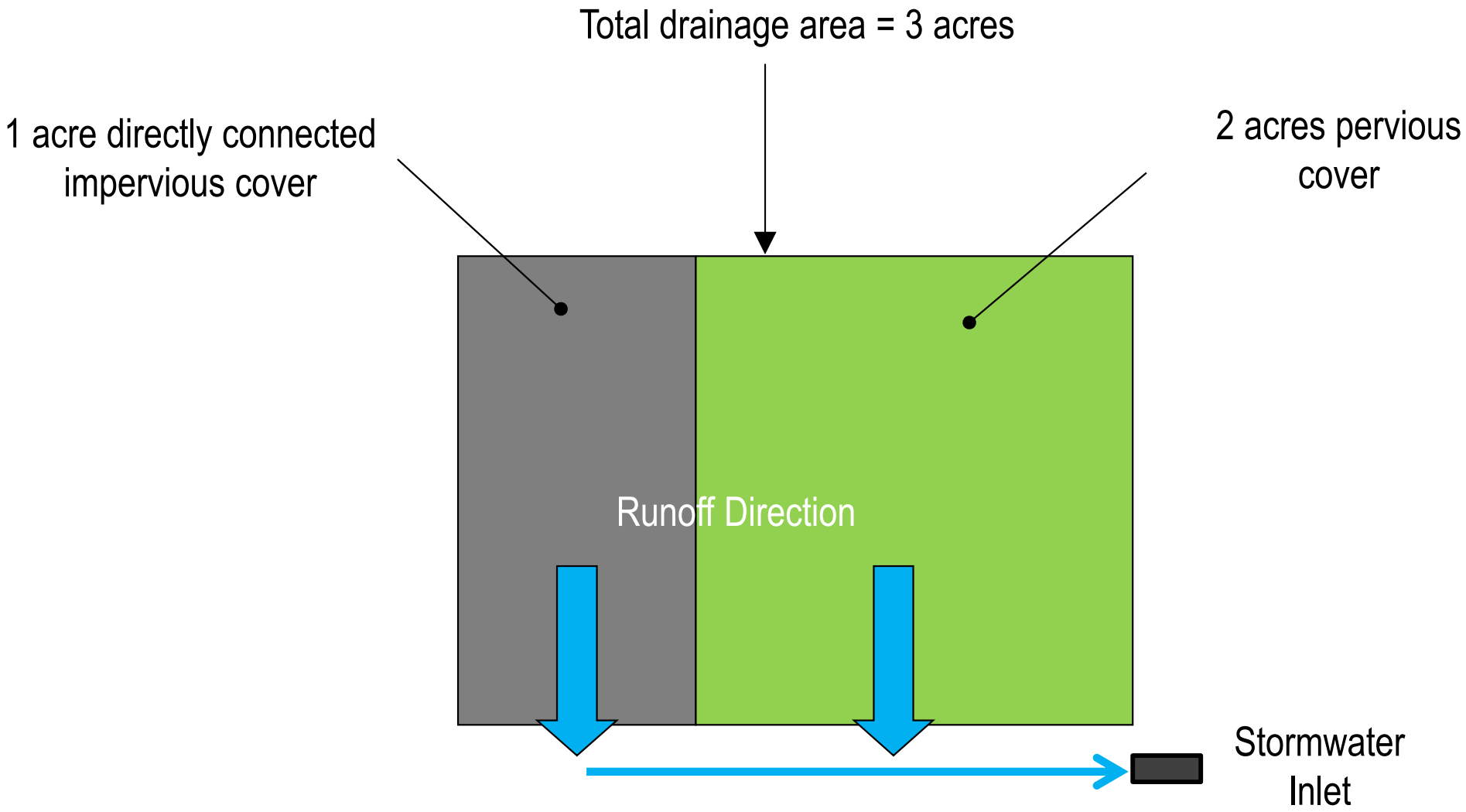
DOWNSPOUT CONNECTED TO SEWER SYSTEM



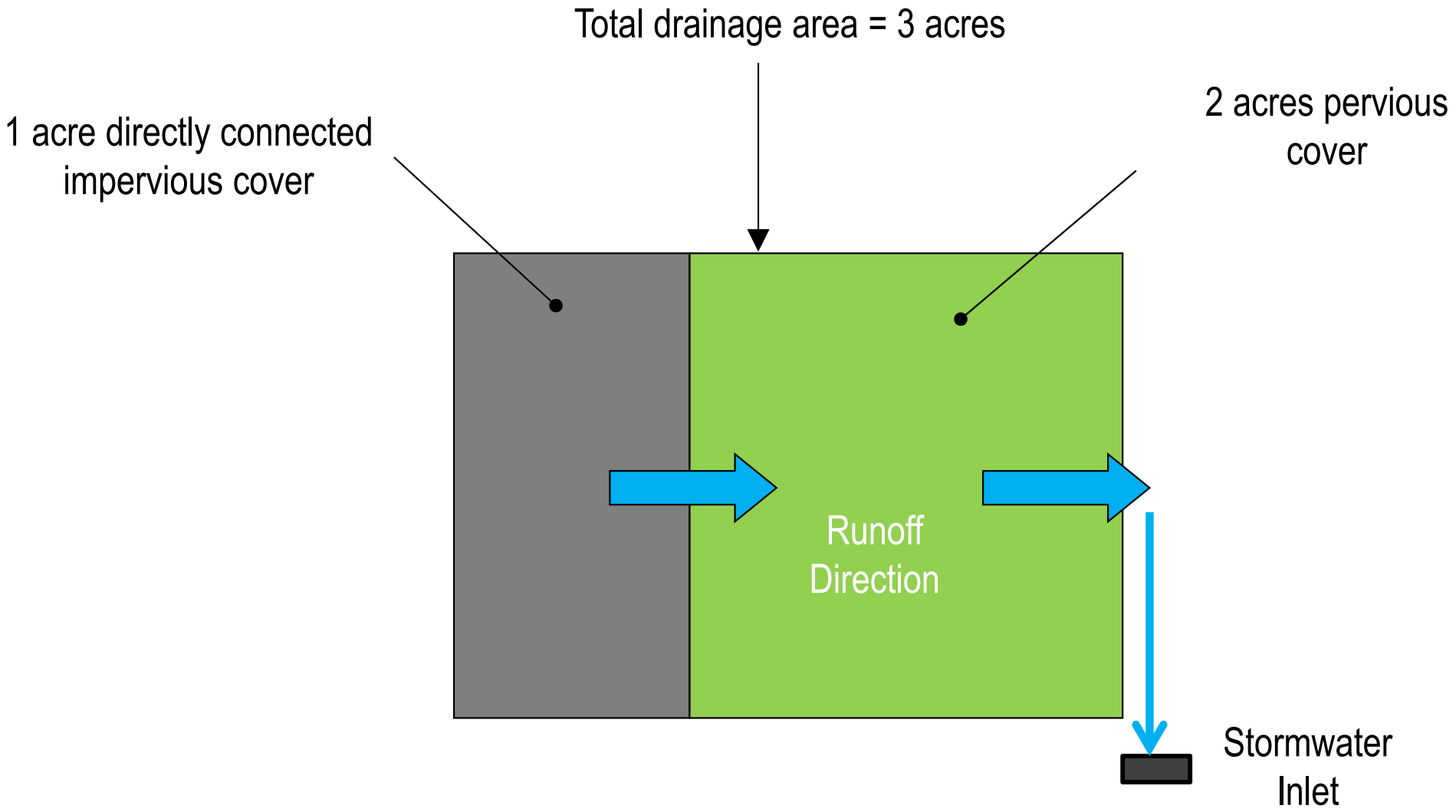
DOWNSPOUT DISCONNECTED FROM SEWER SYSTEM

Another Example of Simple Disconnection

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

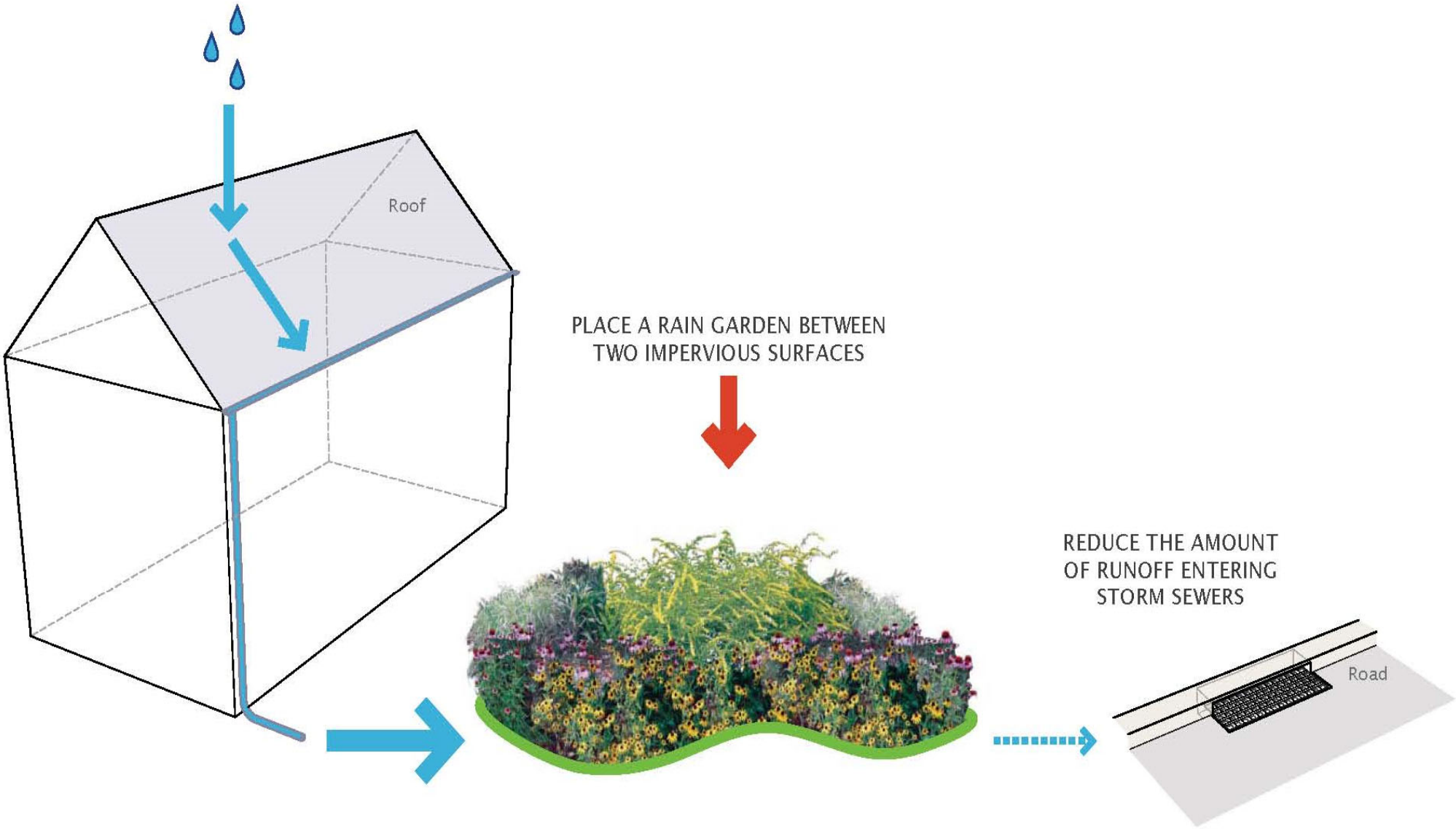


For 1.25 inch storm, 581 cubic feet of runoff = **4,360 gallons**

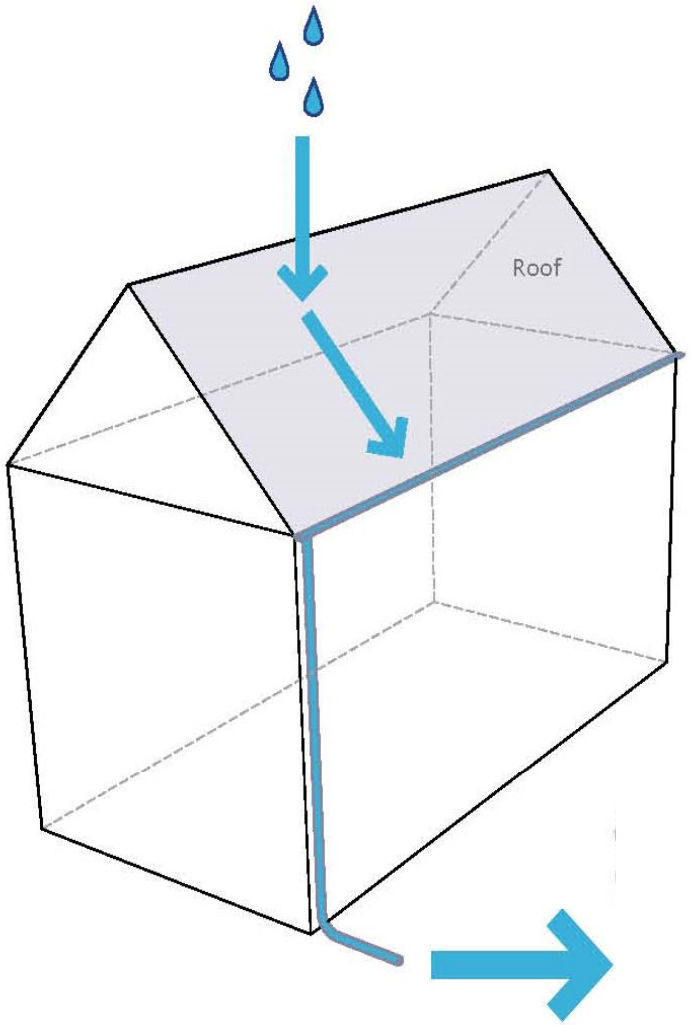


	Volume of Runoff		
Design Storm	**Connected (gallons)**	**Disconnected (gallons)**	**Percent Difference**
1.25 inches (water quality storm)	28,500	4,360	85%

Disconnect with a rain garden

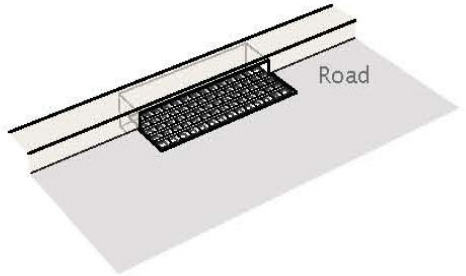


Disconnect to a Rain Barrel or Cistern



Disconnect your downspout by installing a rain barrel

REDUCE THE AMOUNT OF RUNOFF ENTERING STORM SEWERS



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

SITE SELECTION

What are good sites?

- Sites with impervious surfaces that are directly connected
- Sites with a lawn area that can be converted to accept stormwater runoff
- Sites with highly visibility – good educational opportunities
- Sites in impaired watersheds
- Sites on municipal owned land/public land
- Sites that provide partnership opportunities

WE LOOK HERE FIRST:

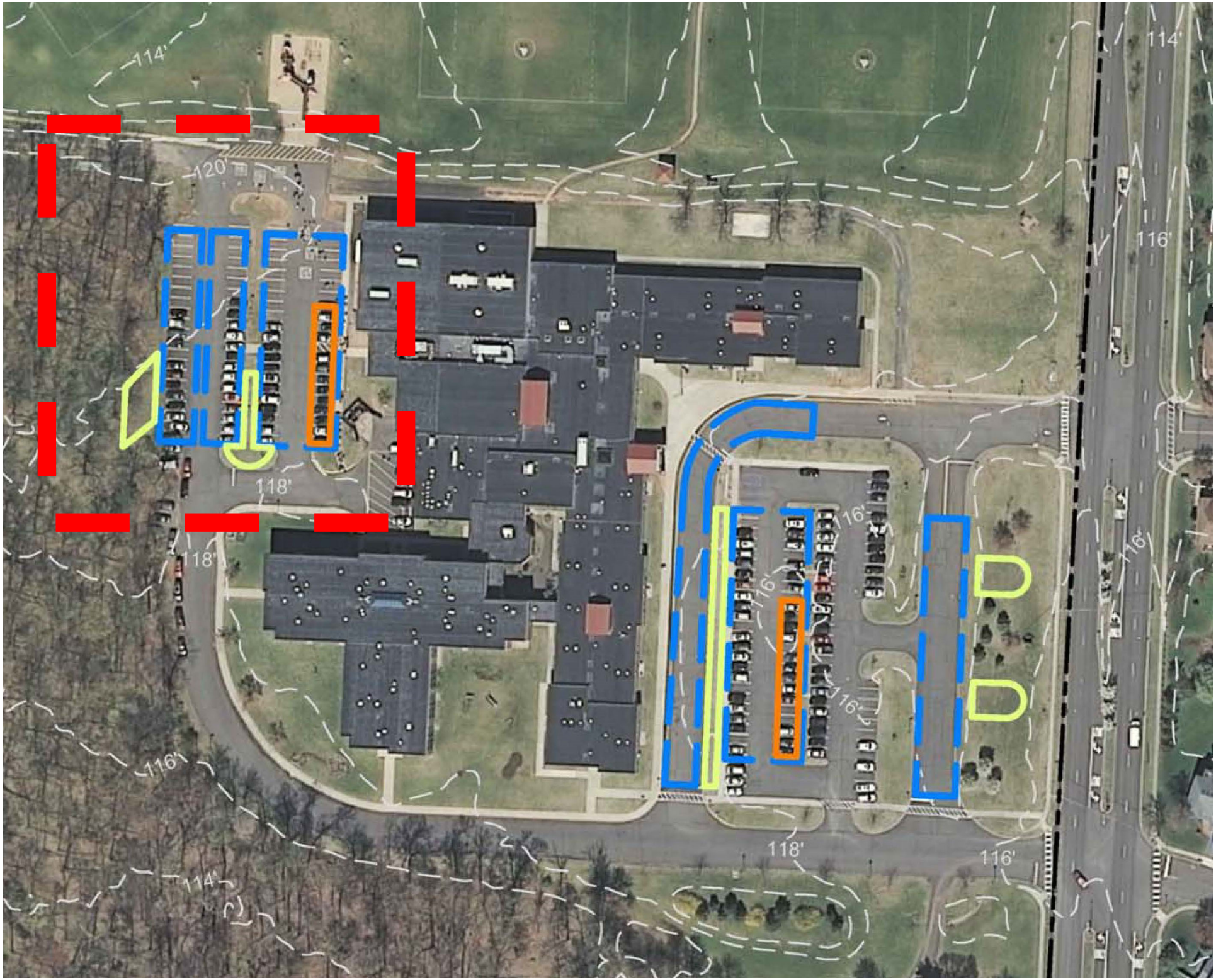
- ✓ Schools
- ✓ Places of Worship
- ✓ Libraries
- ✓ Municipal Building
- ✓ Public Works
- ✓ Firehouses
- ✓ Post Offices
- ✓ Elks or Moose Lodge
- ✓ Parks/ Recreational Fields

- 20 to 40 sites are entered into a PowerPoint
- Site visits are conducted

Google or Bing Maps

- Go to Google or Bing Maps
- Type in address
- Aerial or birds eye view
- “Snip It” (MS Windows Accessory)
- Insert into PowerPoint
- “Crop It”

Auten Road School in Hillsborough, NJ
281 Auten Rd, Hillsborough Township, NJ 08844


114'
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120'
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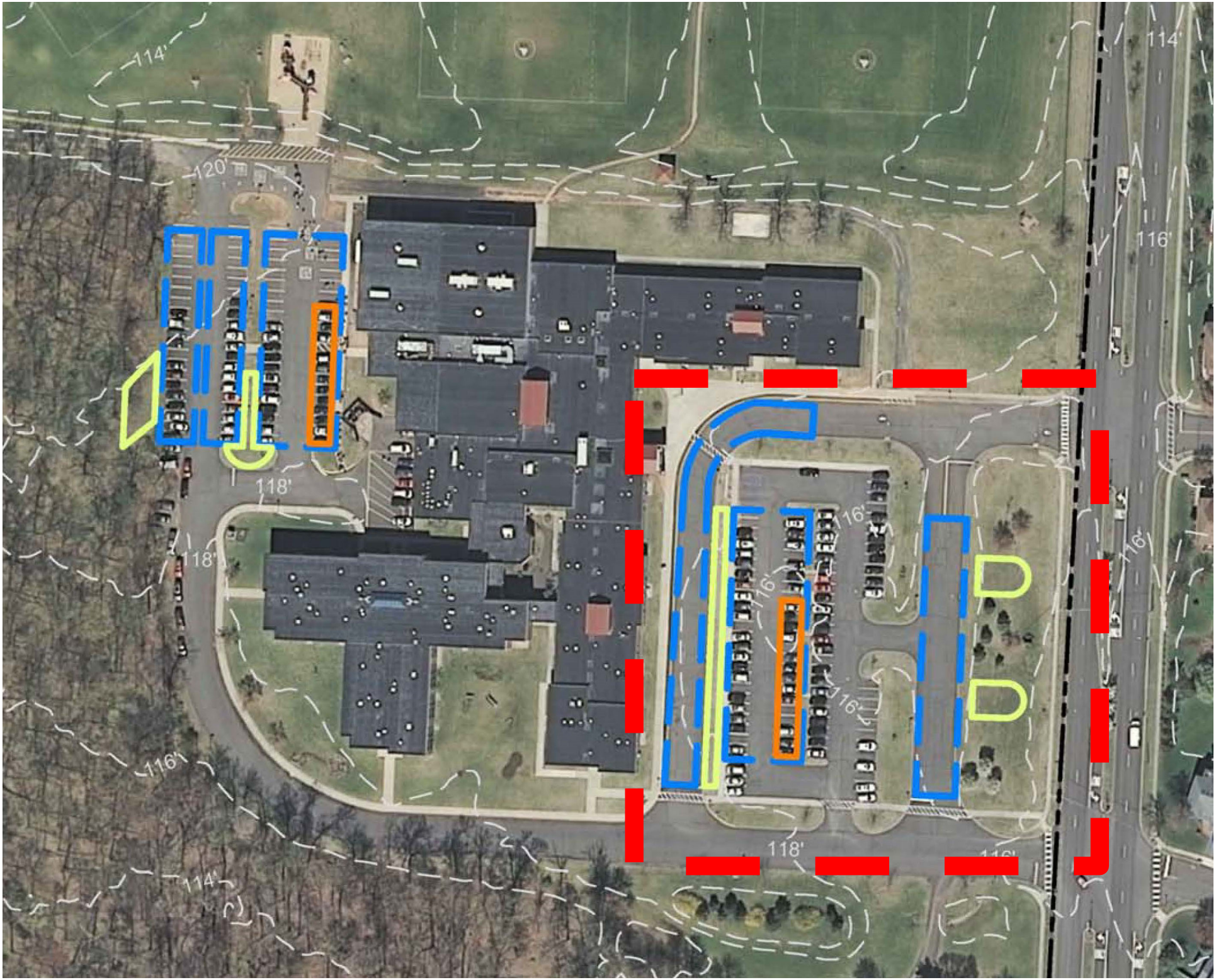
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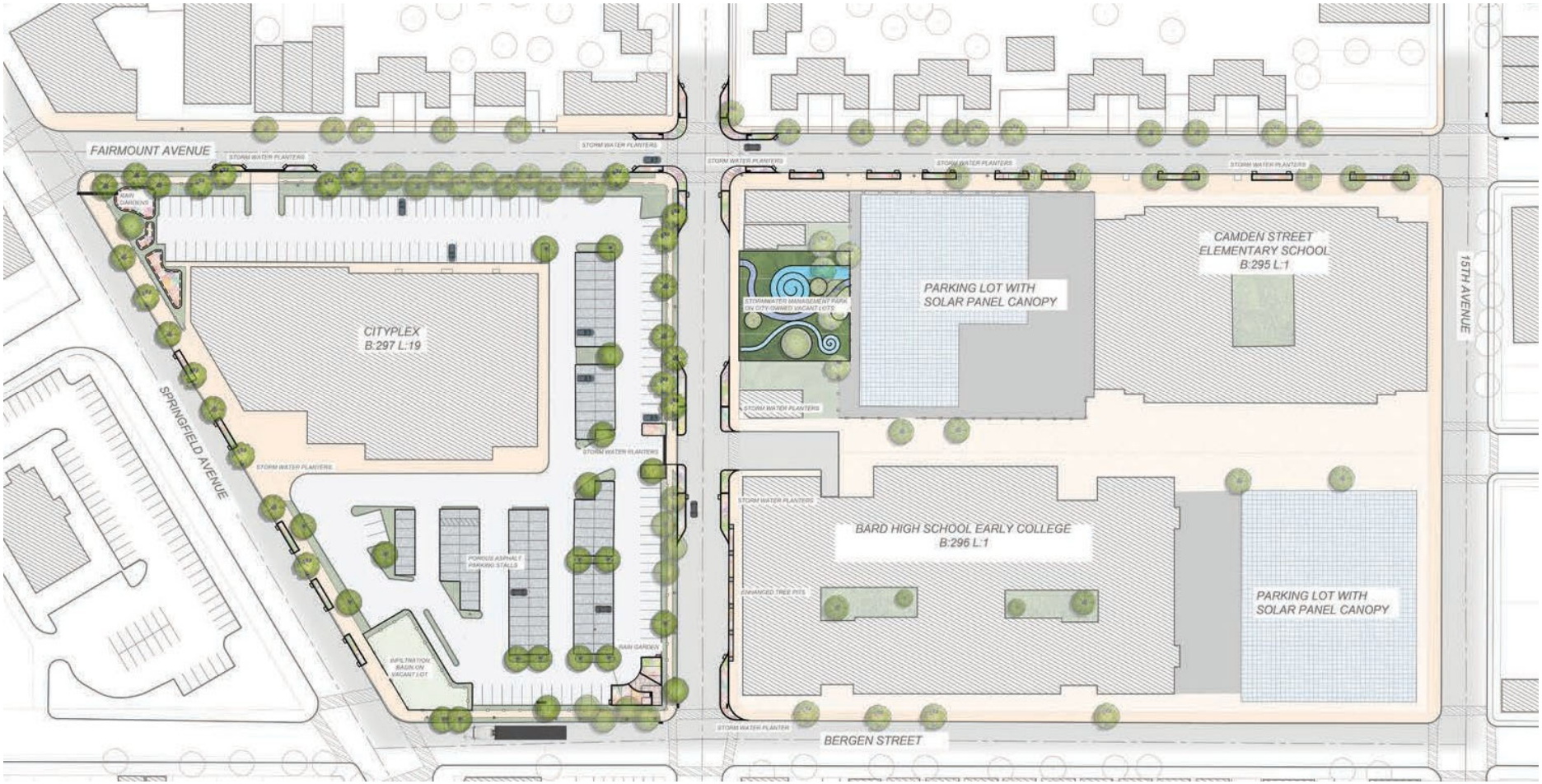


FAIRMOUNT AVENUE GREEN STREET CONCEPT PLAN

FAIRMOUNT AVENUE, 16TH AVENUE, SPRINGFIELD AVENUE, CITYPLEX 12 NEWARK, ESSEX COUNTY, NEW JERSEY

CITYPLEX 12 RAIN GARDEN

CITYPLEX 12, 16TH AVENUE, BERGEN STREET NEWARK,
ESSEX COUNTY, NEW JERSEY

16TH AVENUE STORMWATER PLANTERS

16TH AVENUE, CITYPLEX 12, BARD HIGH SCHOOL EARLY COLLEGE NEWARK, ESSEX COUNTY, NEW JERSEY

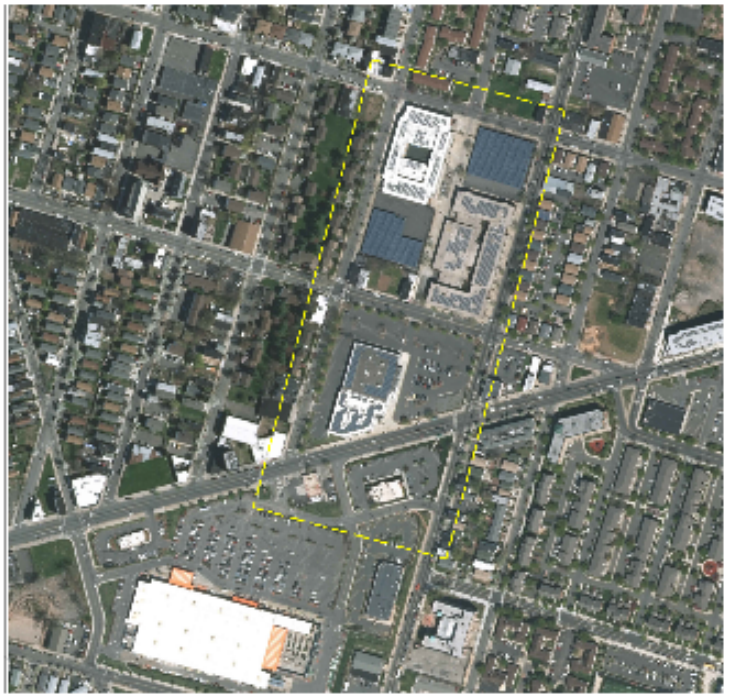
FAIRMOUNT AVENUE GREEN STREET

GREEN INFRASTRUCTURE IMPLEMENTATION PROJECT
360-394 SPRINGFIELD AVENUE, NEWARK
ESSEX COUNTY, NEW JERSEY
BLOCK: 297 LOT: 19

PROJECT DESCRIPTION:

VARIOUS RAIN GARDENS AND STORMWATER PLANTERS CAN BE INSTALLED THROUGHOUT FAIRMOUNT AVENUE, 16TH AVENUE, AND SPRINGFIELD AVENUE. A TOTAL OF 73,630 S.F. OF IMPERVIOUS COVER CAN BE TREATED BY 6,245 S.F. OF BEST MANAGEMENT PRACTICES INCLUDING STORMWATER PLANTERS, RAIN GARDENS, AND TREE PITS.

LOCATION MAP:



LEGEND:

- EXISTING DRAINAGE AREA
- EDGE OF PAVEMENT
- EXISTING CENTERLINE
- EXISTING FENCE
- EXISTING TREELINE
- EXISTING TREE/SHRUB
- EXISTING BUILDING
- EXISTING MANHOLE
- EXISTING FIRE HYDRANT
- EXISTING UTILITY POLE
- EXISTING LIGHT POLE
- EXISTING CATCH BASIN
- PROPERTY LINES
- PROPOSED GREEN INFRASTRUCTURE

LIST OF DRAWINGS:

SHEET NAME	TITLE
COVER	COVER SHEET
P-1	EXISTING CONDITIONS
P-2	OVERVIEW PLAN
P-3 TO P-12	SITE PLANS 1-10
DT-1	STORMWATER PLANTER DETAILS
DT-2	RAIN GARDEN DETAILS
DT-3	CURB CUT DETAILS
DT-4	SOIL EROSION & SEDIMENT CONTROL DETAILS
DT-5	TREE PIT AND STREET PLANTING DETAILS

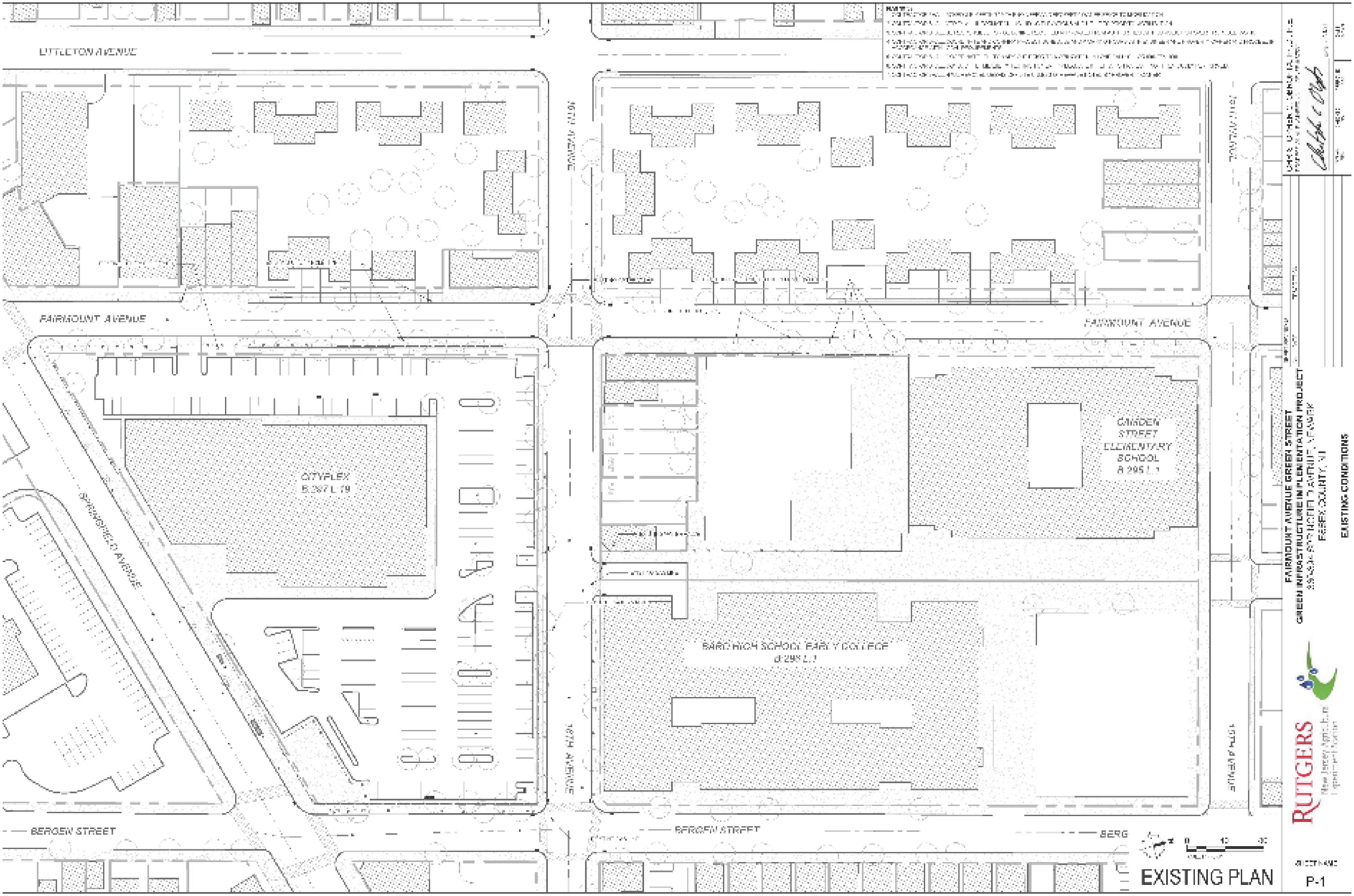
GENERAL NOTES:

1. SURVEY CONDUCTED BY RUTGERS COOPERATIVE EXTENSION WATER RESOURCES PROGRAM. ALL ELEVATIONS ARE RELATIVE TO THE 100.00' BENCHMARK POINT.
2. EXISTING SOILS ARE URBAN LAND - BOONTON SUBSTRATUM WHICH ARE CLASSIFIED AS AN UNRANKED HYDROLOGICAL SOIL GROUP BASED ON THE NRCS WEB SOIL SURVEY (websoilsurvey.sc.egov.usda.gov). AN INFILTRATION TEST IS RECOMMENDED PRIOR TO MOBILIZATION VIA ENGINEERS DISCRETION.
3. ANY OVERHEAD AND UNDERGROUND UTILITIES SHOWN ARE FROM FIELD OBSERVATIONS AND ARE NOT A COMPLETE REPRESENTATION. A UTILITY MARKOUT NEEDS TO BE CONDUCTED PRIOR TO MOBILIZATION BY THOSE RESPONSIBLE FOR EXCAVATION. NJ ONE CALL: 811 OR 800.272.1000

FAIRMOUNT AVENUE GREEN STREET
GREEN INFRASTRUCTURE IMPLEMENTATION PROJECT
360-394 SPRINGFIELD AVENUE, NEWARK
ESSEX COUNTY, NJ
COVER SHEET

RUTGERS
New Jersey Agricultural Experiment Station

COVER


LITTLETON AVENUE
FAIRMOUNT AVENUE
FAIRMOUNT AVENUE
16TH AVENUE
CITYPLEX
B 297 L 19
SPRINGFIELD AVENUE
CAMDEN
STREET
ELEMENTARY
SCHOOL
BARD HIGH SCHOOL EARLY COLLEGE
BERGEN STREET
BERGEN STREET
BERG
FAIRMOUNT AVENUE GREEN STREET
GREEN INFRASTRUCTURE IMPLEMENTATION PROJECT
ESSEX COUNTY, NJ
EXISTING CONDITIONS
RUTGERS
EXISTING PLAN
P-1

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