2013 North Carolina Association of Metropolitan Planning Organizations

Winston-Salem

Green Streets – Beyond the Streetscape

Thursday, May 16, 2013

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www.communitydesigngroupllc.com

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Definition of Street

1.a public thoroughfare, usually paved, in a village, town, or city, including the sidewalk or sidewalks.

2.such a thoroughfare together with adjacent buildings, lots, etc.: *Houses, lawns, and trees composed a very pleasant street.*

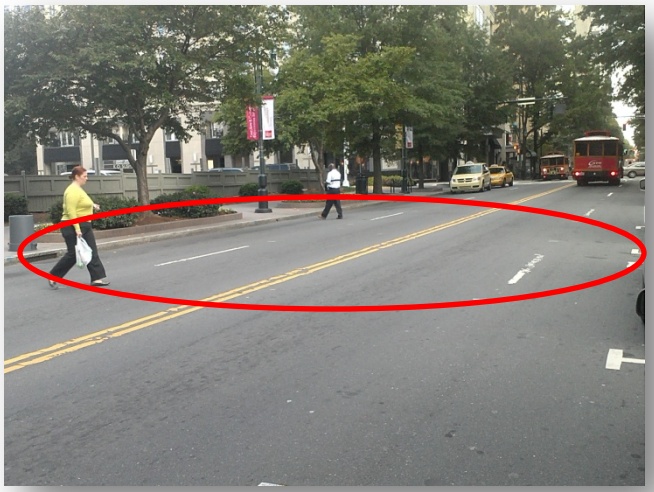
Function of Streets

- Transportation
- Movement of good and services
- Pedestrian and Vehicular Traffic
- Entertainment
- Social Gathering
- Live, Work, and Play
- ***People, Place and Profit***

Street Zone

Vehicle

- Travel lanes used by vehicles, and bikes, normally back of curb to back of curb.



Street Zone

Pedestrian

- Zone for pedestrians, street furniture, trees, landscaped medians, and normally from back of curb to right-of-way.

Street Zone

Building

•Zone adjacent to right of way and designated as other land uses.

2. Old Paradigm

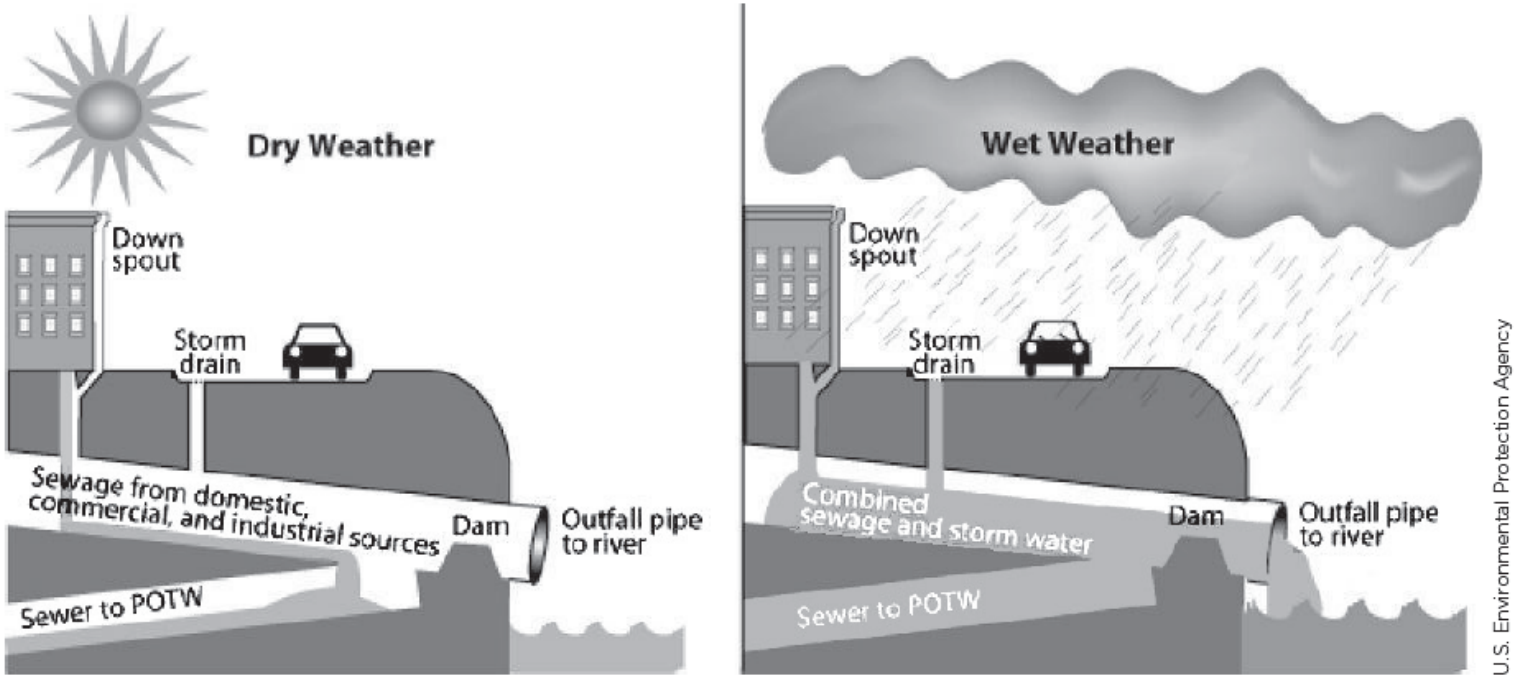
Design Approach

- Primary Function is Transportation (vehicles)
- Multi modes of travel not planned
- Cross section (swale/pipe, pavement, swale/pipe)
- Stormwater “management”(disposal), closed loop system
- Get the runoff as fast as possible –to lakes and other water bodies
- Combined Stormwater Sewer

2. Old Paradigm

Source: Equinox Environmental Consultation & Design

2. Old Paradigm – Combined Sewer System



U.S. Environmental Protection Agency

During rain storms, runoff can overwhelm the capacity of combined sewers, sending untreated sewage and runoff into local waters.

2. Old Paradigm

- First Flush Pollutants
- Poor Winter Performance
- High Maintenance
- Poor Life Cycle Costing
- Urban Heat Island
- Poor Aesthetic Value
- Unpredictable/Reduce Economic Value

Source: Equinox Environmental Consultation & Design

2. Old Paradigm

- In 1997, volume of stormwater runoff enough to supply average household needs between 1.5 to 3.6 million people in the City of Atlanta – *Paving our way to Water Shortages, How Sprawl Aggravates the Effects of Drought, American Rivers, NRDC and Smart Growth America, 2022*

- FEMA estimates 25% of $1 billion in annual damages by flooding are linked to stormwater – *Reducing Damaged from Localized Flooding: A Guide for Communities*

Source: Equinox Environmental Consultation & Design

2. Old Paradigm

Design Approach ***(Consequences)***

- Mismanagement of runoff
- More flooding, loss of lives, properties
- Threats to food supply
- Diseases and other health issues
- Water quality
- Cost of maintenance/remediation, etc.
- *Increase in obesity/diseases*
- *Increase vehicle speeds and accidents*
- *Increase in accident fatalities*
- *Eliminate walking or biking*

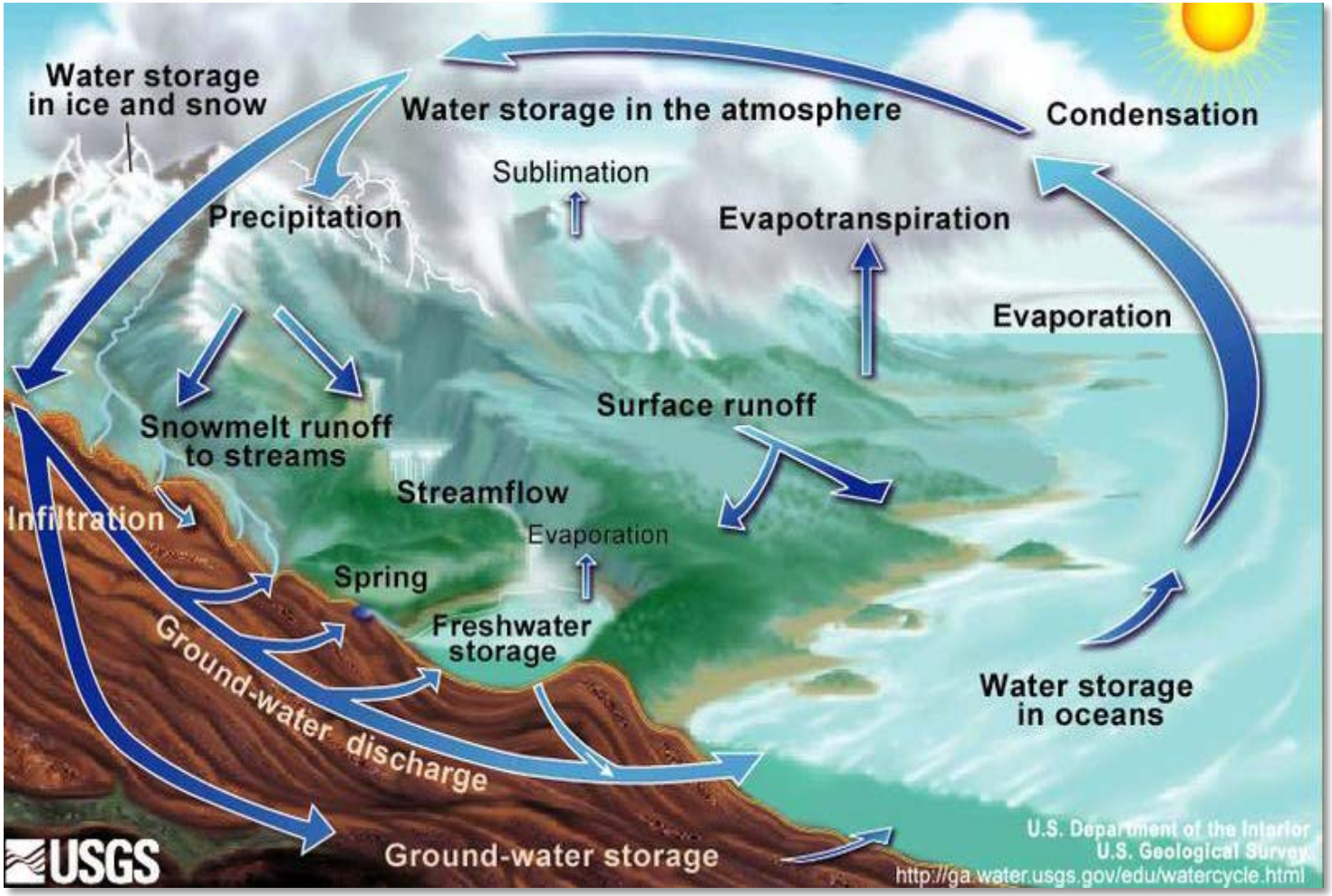
2. Old Paradigm

New Paradigm

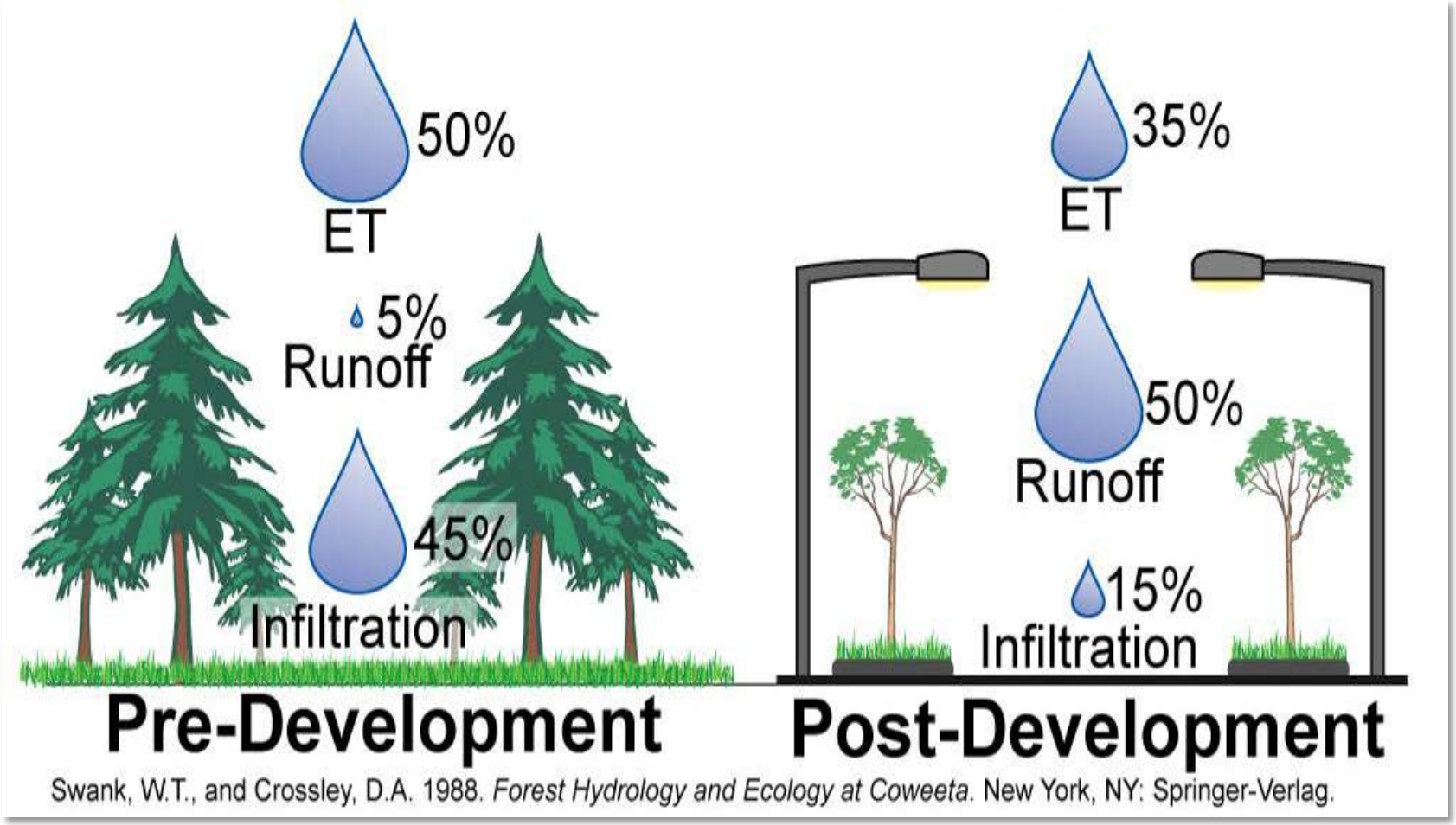
Design Approach

- Transportation and Land Use (Integrate)
- Multi modes of travel
- “Sustainable” throughout Cross section
- Stormwater “management” from the source
- Slow runoff to recharge groundwater

Green Streets



Green Streets



Swank, W.T., and Crossley, D.A. 1988. *Forest Hydrology and Ecology at Coweeta*. New York, NY: Springer-Verlag.

New Paradigm

*Design Approach (**Benefits)***

- Minimize health cost
- Physical activity
- Complete streets
- Safety and Mobility
- Reduce accident fatalities
- Meaningful public space

New Paradigm

*Design **(Benefits)***

- Stormwater Volume Control – capturing, ***naturally*** treating and infiltrating stormwater on site

  In Chicago – diverted 70 million gallons of stormwater in 2009 from the combined sewer overflow (cso) – *Forging the link: Linking Economic Benefits of Low Impact Development and Community Decision, Uni. Of New Hampshire Stormwater center, et. Al, 2011*

- New York, Kentucky and others to follow
- Portland, OR – integrated grey and green infrastructure in its CSO abatement program – cost effective analysis – downspout disconnections, curb extensions with vegetated swales, parking lot infiltration (most cost effective)

  cost – from $0.89 to $4.08 – *R.M. Roseen*

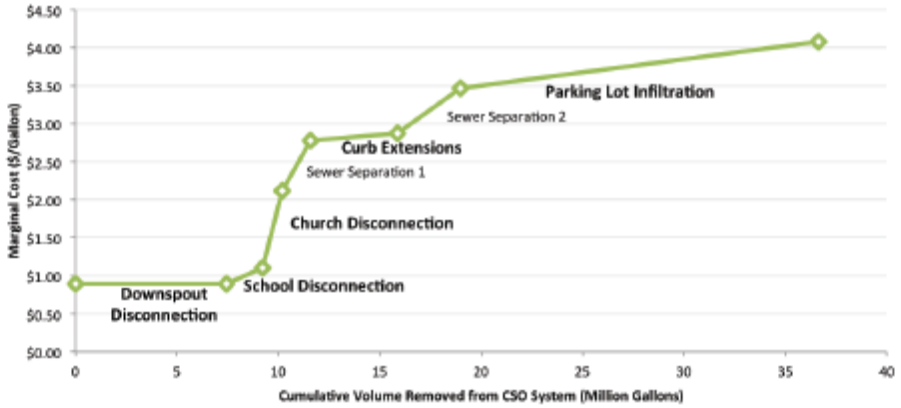


Figure 2. Costs and Cumulative Volume of Stormwater Removed from the CSO System through Various Grey and Green Strategies (Green in Bold). Source: ECONorthwest, with data from City of Portland 2005

© Environmental Services, City of Portland Oregon

The City of Portland, OR has been a leader in incorporating green infrastructure practices into its water management. This curb cut rain garden allows runoff from the street to flow into a rain garden where it can slowly infiltrate into the ground, rather than flowing directly into the storm sewer.

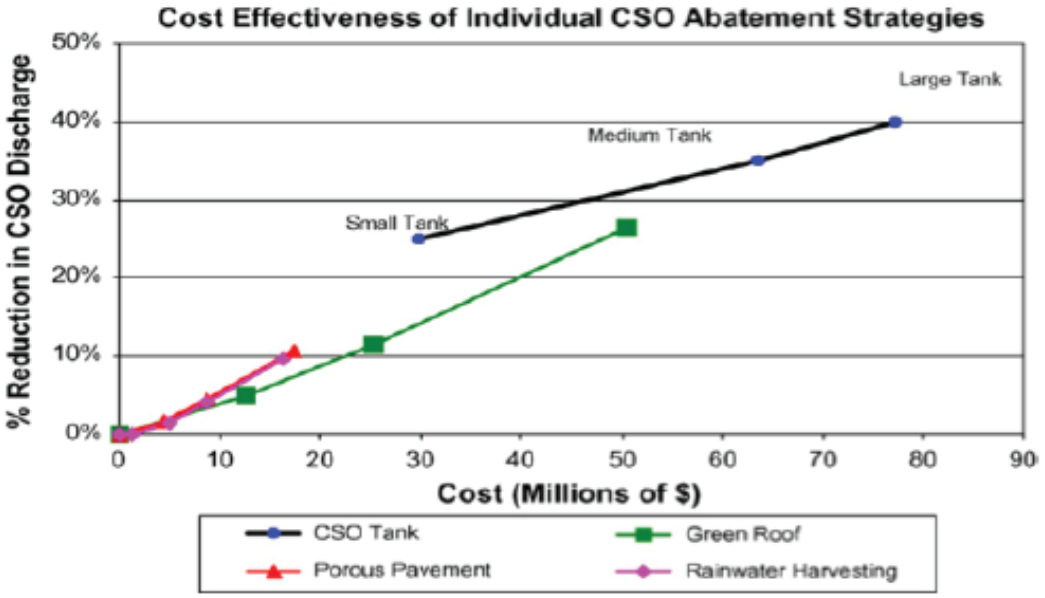


Figure 3. Comparison of General Green and Grey Options

Source: Montalto (2007)

- Porous pavement most cost-effective in diverting stormwater from the CSO system

What are Green Streets

"A Green Street is a street that uses natural processes to manage stormwater runoff ***at its source"***

Source: EPA.org

"Sustainable Streets"

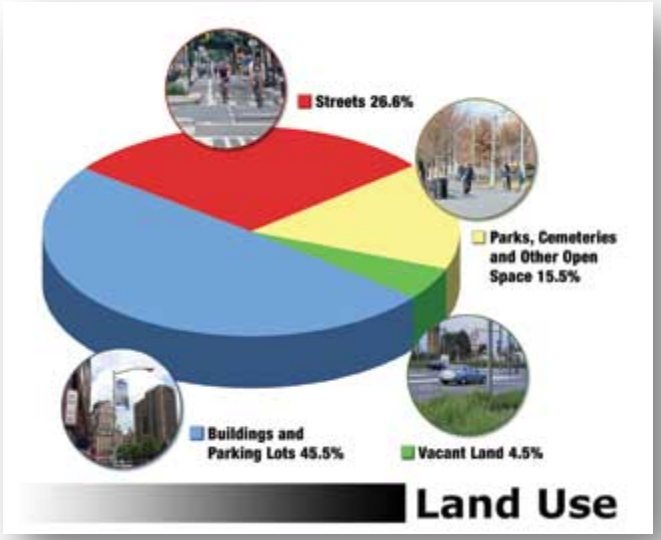
- A place for all modes (walk, bike, ride and drive) to co-exist
- A place to house softscape and streetscape elements
- A place for stormwater management and absorption

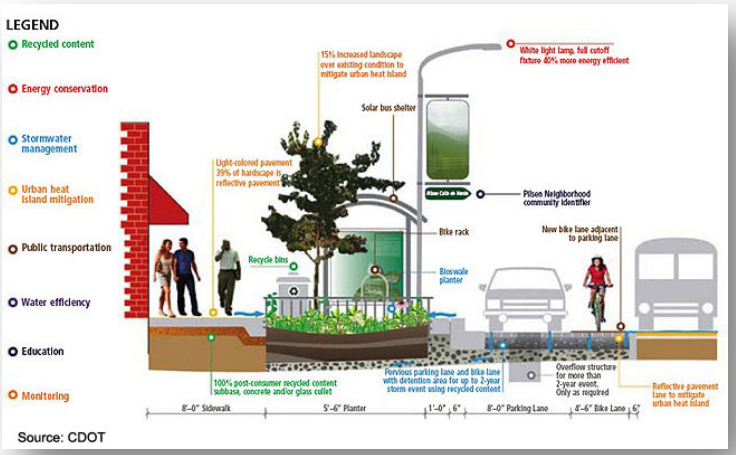
Green Streets

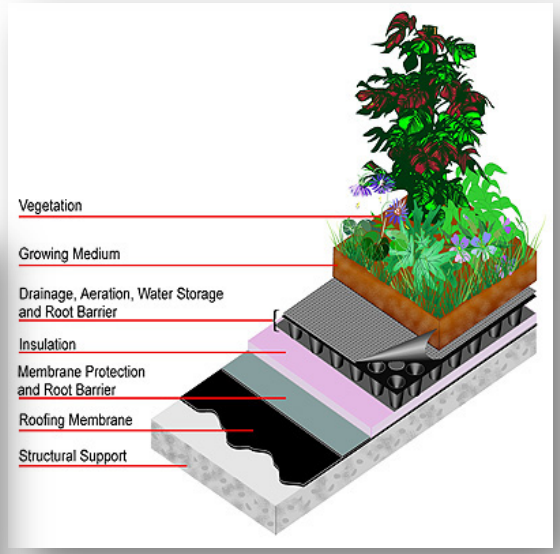
Design Features

- Wide sidewalks and planting strip
- Tight curb radii (and curb bulbs when there is on-street parking)
- Curb bulbs in locations where there is on-street parking
- Street trees and landscaping
- Driveways not encouraged in order to create a continuous sidewalk
- Pedestrian scaled lighting
- Street furniture
- Awnings and weather protection
- Bike route shared with motor vehicles

Green Streets



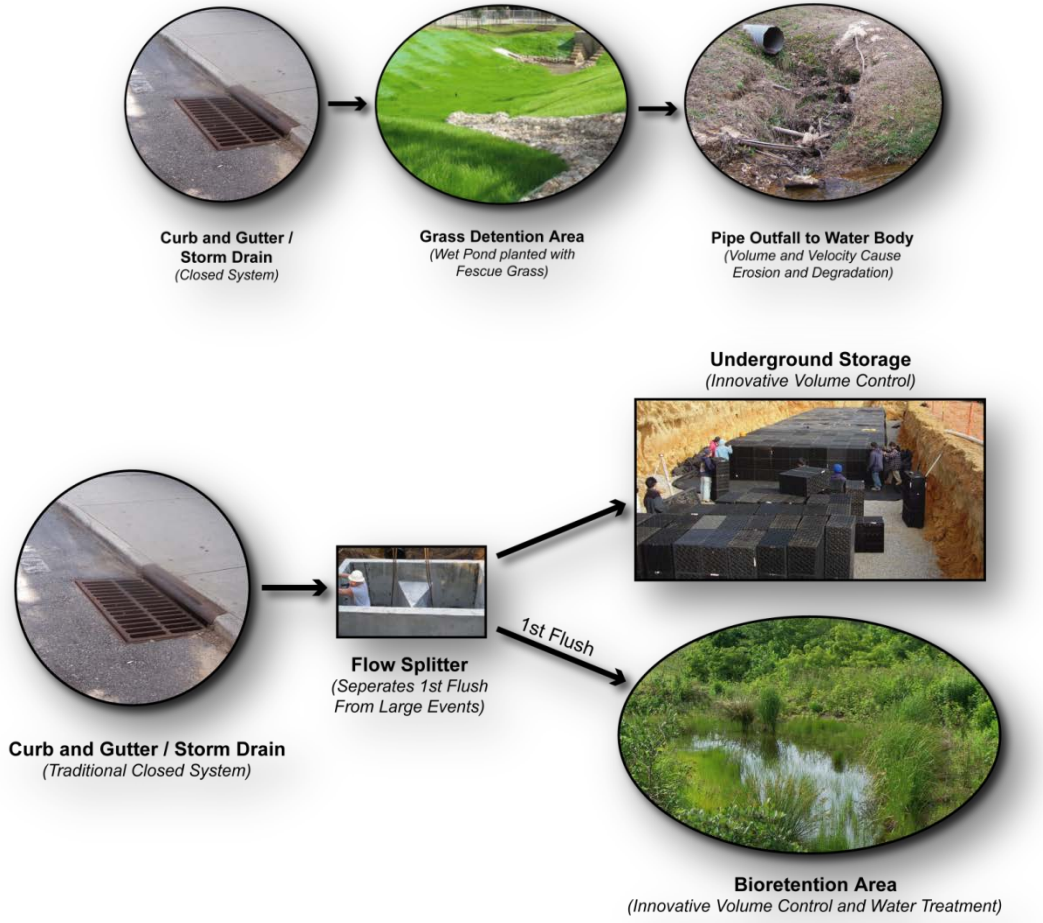




Green Streets

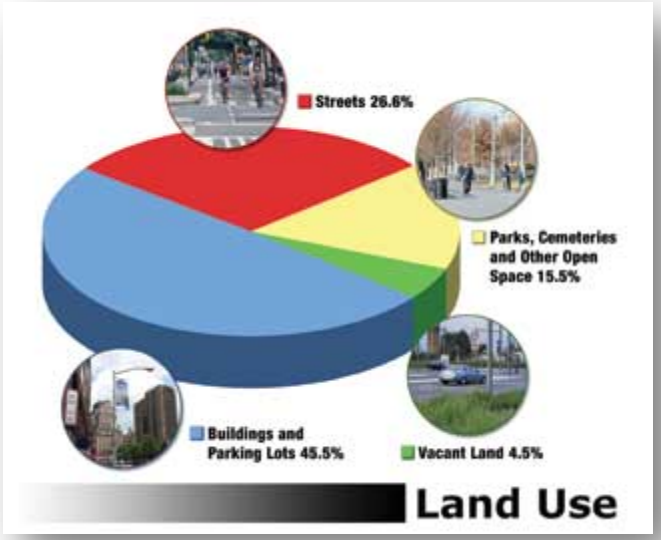
3. Concept Design of Green Streets

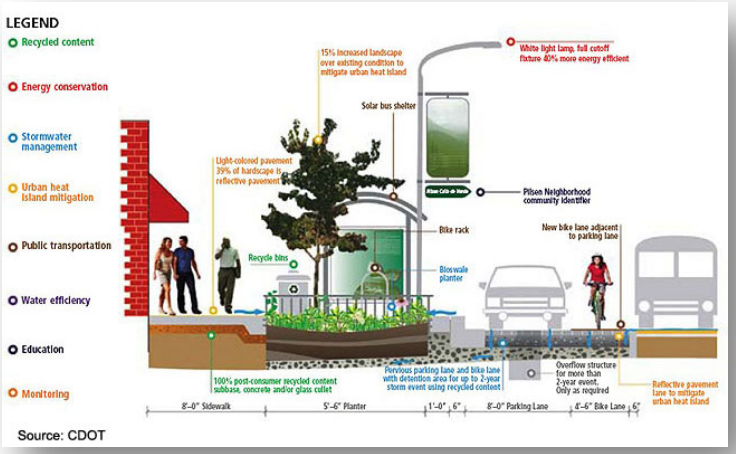
Integrated Stormwater Management



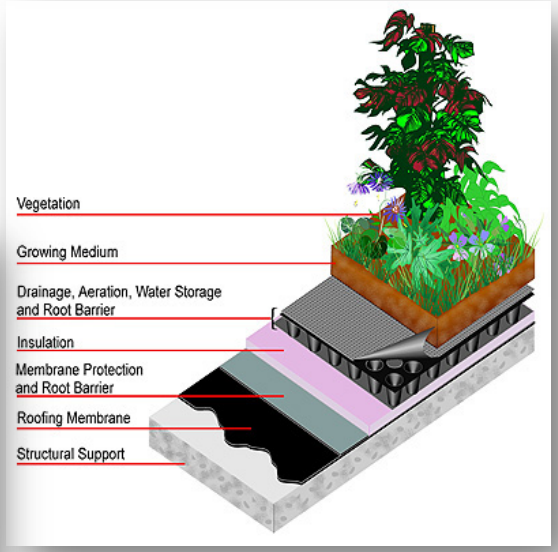
Source: Equinox Environmental Consultation & Design

Runoff at its Source





Source: CDOT



Runoff at its Source

- Green Roofs Incentives
- Reduced energy cost (av. $650 annual)
- Up to 60˚F cooler than black roof in summer – *A Temperature and Seasonal Energy Analysis of Green, White and Black Roofs, Columbia University, Center for Climate Systems Research, 2011.*

- Target Center Arena, Mpls. (113,000 SF) captures 1 million gallons of stormwater annually and green roof has cut energy cost by $300,000 annually – *Vegetated green roof completed on Minneapolis Target Center, AIArchitect, 2009*

- ASLA Headquarters Washington DC – retains about 80% of annual rainfall, reduces amount of nitrogen to the watershed, extra layer of insulation reduces building energy use by 10 percent during winter months and temperature on the roof is 59 degrees cooler than a conventional black roof.

- Energy savings –local and national levels.

- By 2035 110 billion SF of commercial real estate in US, an increase of 54% over 2003 levels – *Commercial Buildings Factsheets, Center fro Sustainable Systems at U of Michigan, 2011*

Stormwater Management







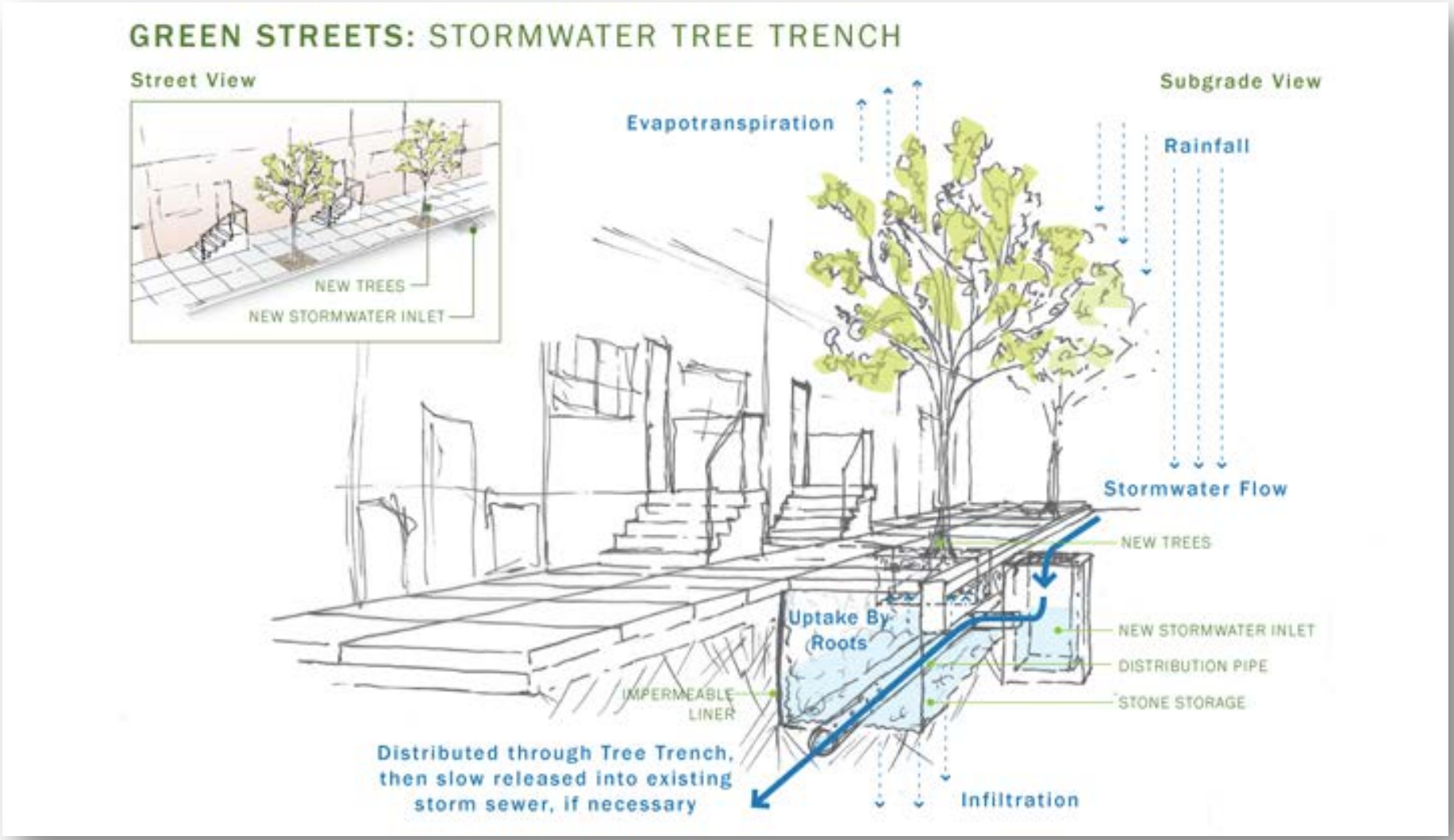


Source: Equinox Environmental Consultation & Design

Stormwater Management

Source: Equinox Environmental Consultation & Design

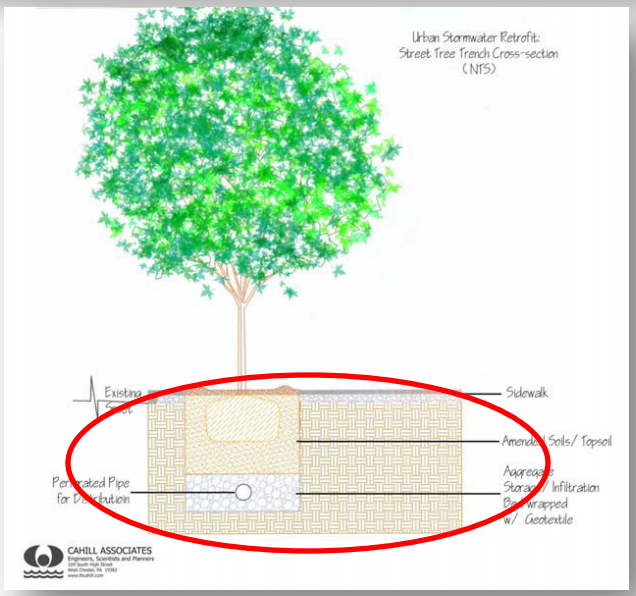
Stormwater Tree Trench



Stormwater Tree Trench

- Runoff from the street and sidewalk is diverted into a stormwater tree trench through modified inlet structures.
- Trees are planted in pockets of soil within a continuous stone trench that stores stormwater until it can infiltrate.
- Porous pavers replaced the brick sidewalk over the trench and allow runoff from the sidewalk to infiltrate into the trench.
- The continuous trench also provides the tree roots with better access to air and water.

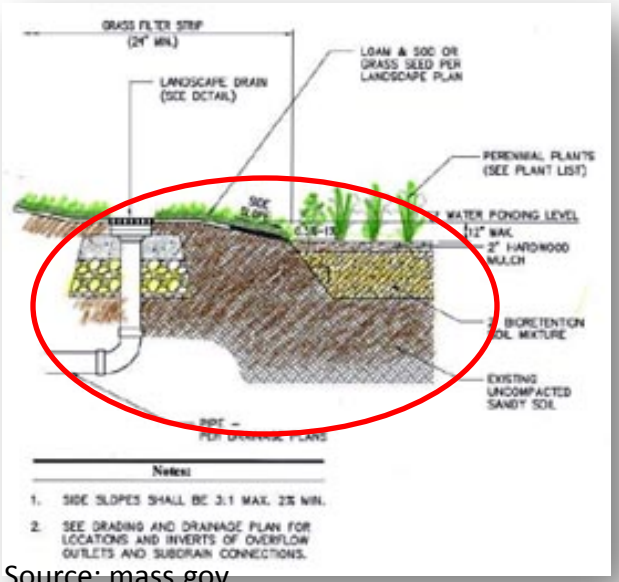
Stormwater Tree Trench



Rain Garden

- Collects runoff from impervious surfaces such as roofs, walkways, and parking lots, allowing water to infiltrate the ground.
- Bottom layer filled with stone so runoff can collect and pond within it.
- Used by the vegetation in evapotranspiration, and infiltrates into the subsurface stone storage and soil.

Rain Garden



Source: mass.gov


Source: Philadelphia Waters Dept


Source: Philadelphia Waters Dept

Rain Garden Benefits

- Sized to infiltrate the collected stormwater runoff within 72 hours.
- Flexible and easy to incorporate into many landscaped areas.
- Effective at removing pollutants and reducing stormwater runoff volume.

Porous Paving

- Allows water to infiltrate through the pavement and never become runoff.
- Provides the structural support, made up of a porous surface and an underground stone reservoir.

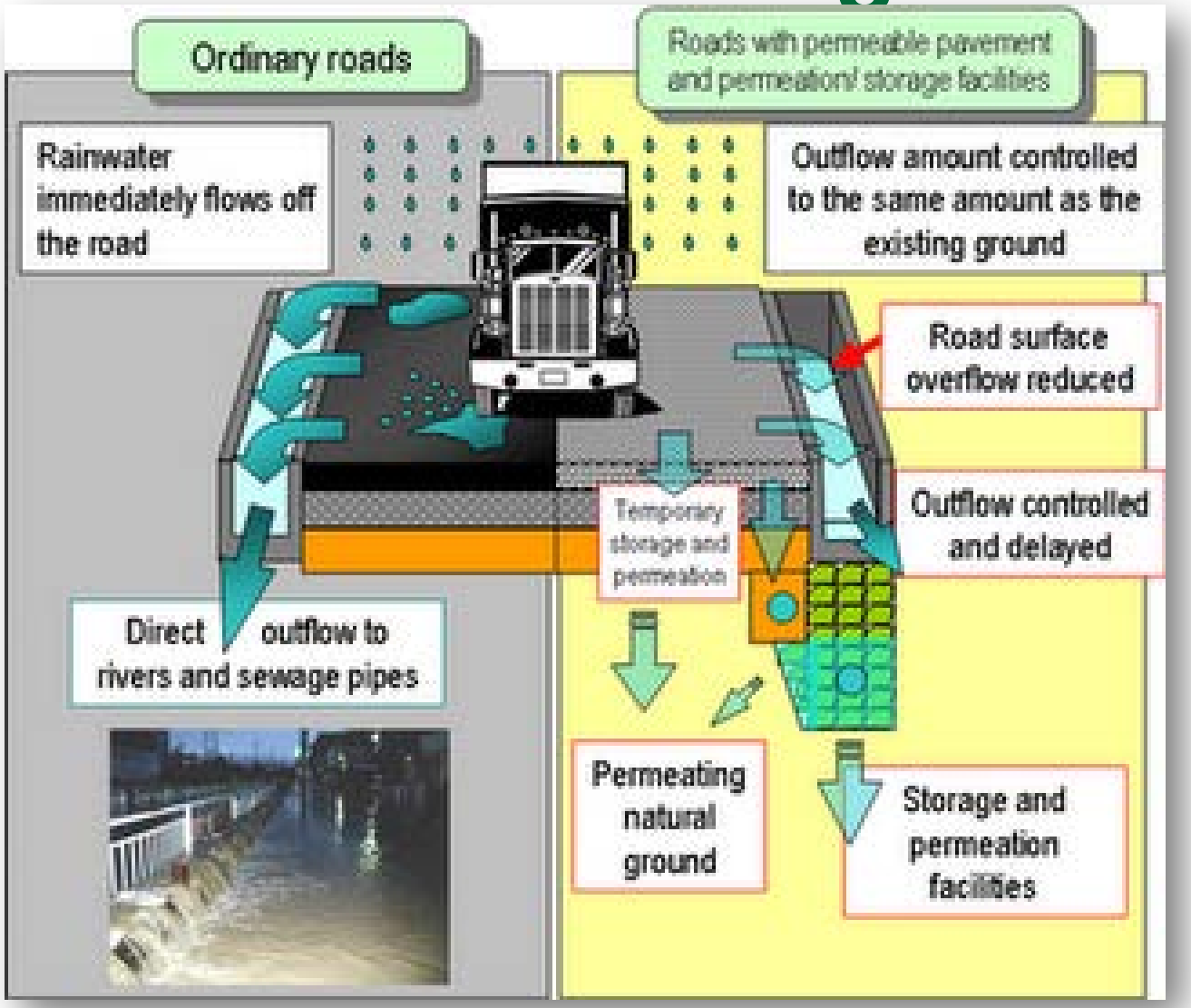
  (temporary storage before infiltration to soil)
- Types of porous surfaces:

  -pervious asphalt,

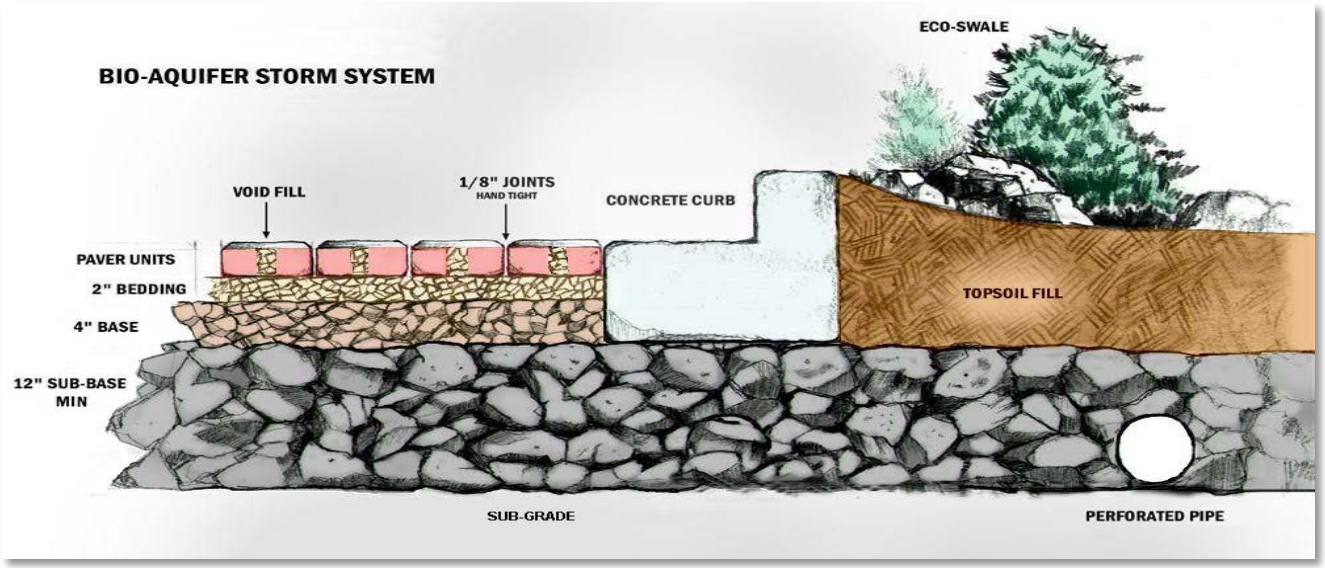
  -pervious concrete,

  -interlocking pavers.

Porous Paving



Permeable Paving



- Voids – capture stormwater runoff (comparable to pre-development)
- Cooling effect – Rapid absorption of first flush
- Layers of aggregate – Natural filtration & Mitigate first flush
- Break-down pollutants – Naturally occurring bacteria
- Stormwater detention in sub-base – designed for local ordinances
- Underground storage negates need for retention/detention ponds

Porous Paving

ITEM	PICP	CONCRETE	ASPHALT
Paving/SF	$ 2.25	$ 8.00	$ 3.00
Excavating/SF	$ 1.00	$ 1.00	$ 1.00
Stone/SF	$ 2.00	$ 1.50	$ 1.50
Installation/SF	$ 4.00	(in paving cost)	$ 1.50
Curbs	$ 1.50	$ 1.50	$ 1.50
Maintenance	$ 0.20		Not Know
Replacement	None	None	Every 12 Years
Detention/Retention required	None	Yes	Yes
Storm Sewer System/sf paving	None	$ 3.00	$ 3.00
Total/SF	$ 10.95	$ 14.00	$ 11.50
Total/linear foot-municipal street	$ 171.00	$ 218.00	$ 179.00
Total/linear ft for 30 ft wide street	$ 230.00	$ 280.00	$ 230.00

Source: Belgard, Inc.

Stormwater Bumpout

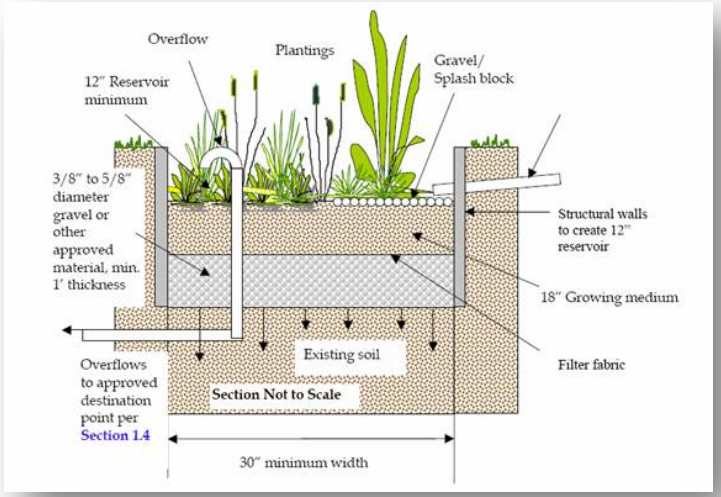
- A vegetated curb extension.
- composed of a layer of stone that is topped with soil and plants.
- An inlet or curb-cut directs runoff into the bumpout structure
- Stored, infiltrated, and taken up by the plants (evapotranspiration).
- Excess runoff is permitted to leave the system and flow to an existing inlet.
- Allows for open sight lines of traffic.
- Traffic-calming device.
- Pedestrian safety zone.

Stormwater Bumpout

- Philadelphia's first stormwater bumpouts
- reduce runoff and prevent combined sewer overflows into our rivers and streams
- 8 feet deep and range in length from 24 feet to 80 feet (in picture measures 8' by 60').
- Native grasses, perennials and trees.
- First inch of runoff from an acre of drainage area.
- Manages between 800,000 and 900,000 gallons of runoff each year.

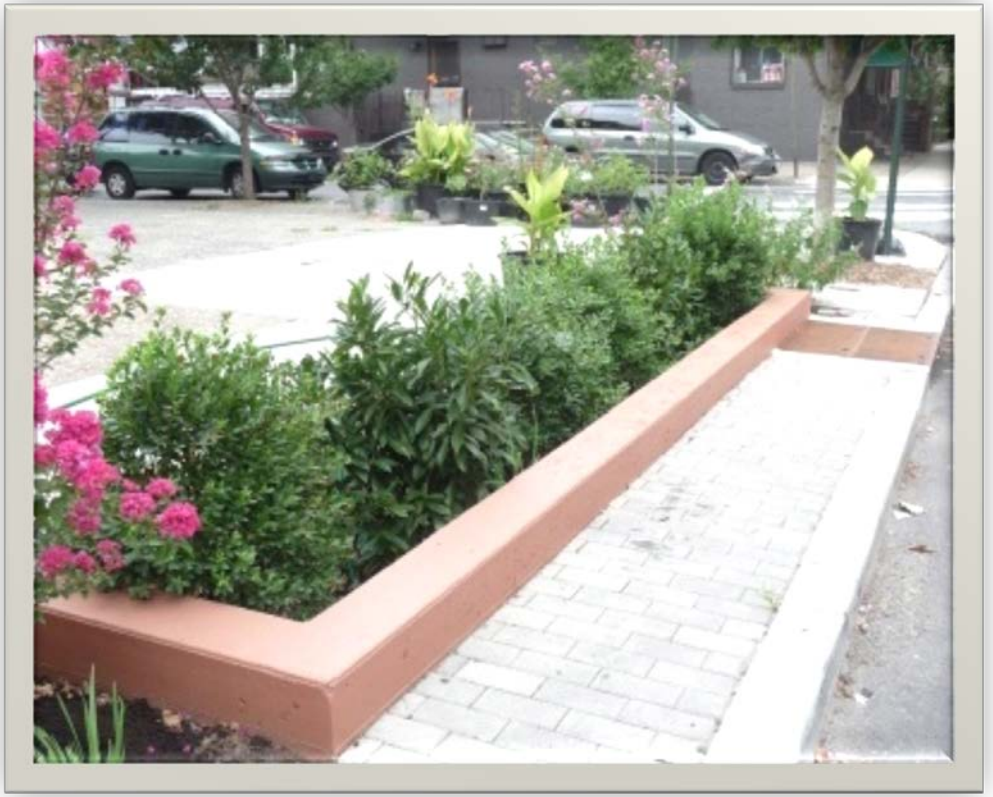
Stormwater Planter

- A specialized planter installed in the sidewalk area
- Manages street and sidewalk runoff.
- Lined with a permeable fabric, filled with gravel or stone, and topped off with soil, plants, and sometimes trees.
- Lower in elevation for runoff to flow into the planter through an inlet at street level.
- Provides storage, infiltration, and evapotranspiration.
- Excess runoff is directed into an overflow pipe connected to the existing system.



Stormwater Planter

- Instills community pride
- Enhances community aesthetics
- Reduces stormwater flows to streams, rivers, etc.



Infiltration/Storage Trench

- Below-ground storage filled with rocks designed to either infiltrate stormwater or slow its flow into the sewer system.
- Fills the voids between the rocks, seeps to the bottom of the trench, and soaks into the soil beneath.
- Excess water slowly released into the sewer system at a controlled rate.

Infiltration/Storage Trench

- A subsurface infiltration bed beneath a new basketball court.
- Designed to capture about 1.5” of rainfall.
- With well-drained soil, capture more stormwater.

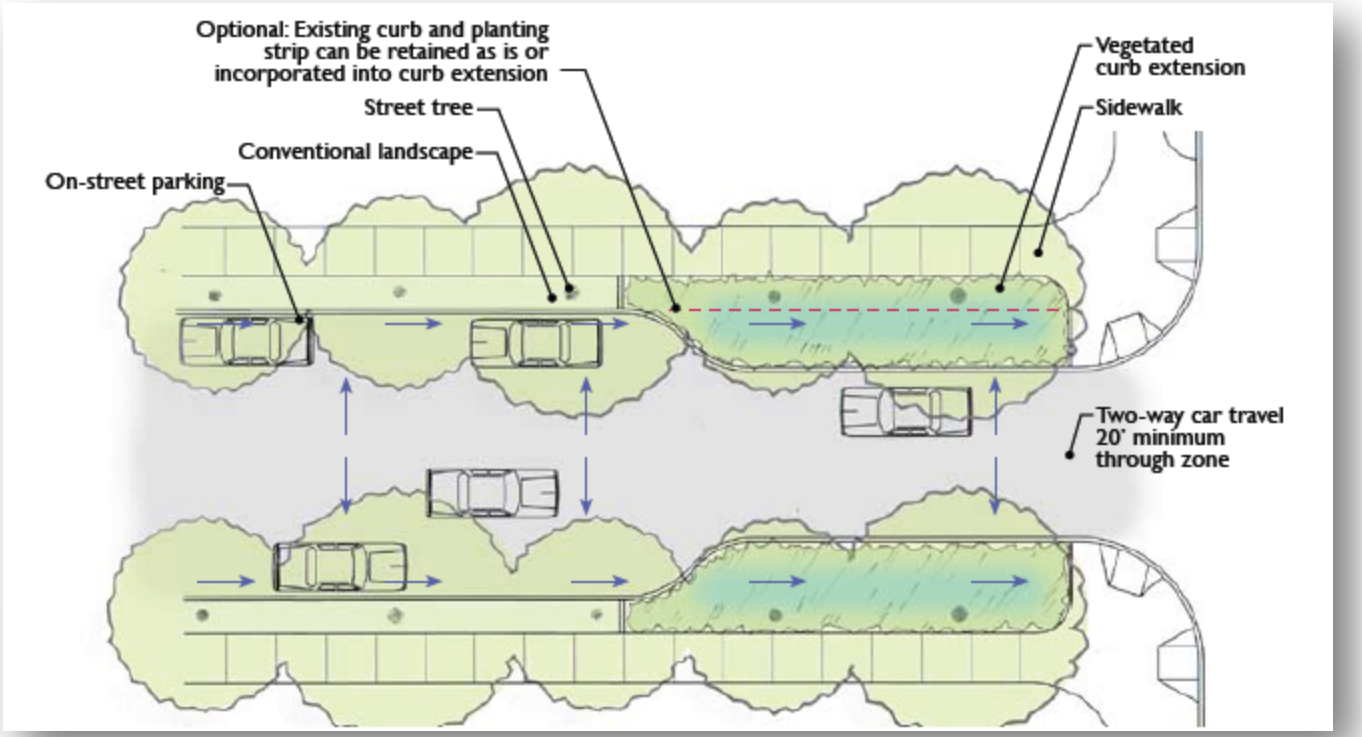
Green Residential Streets

- Stormwater Curb Extensions


TYPICAL STREET


OPPORTUNITY


IMPLEMENTATION



Source: EPA.org

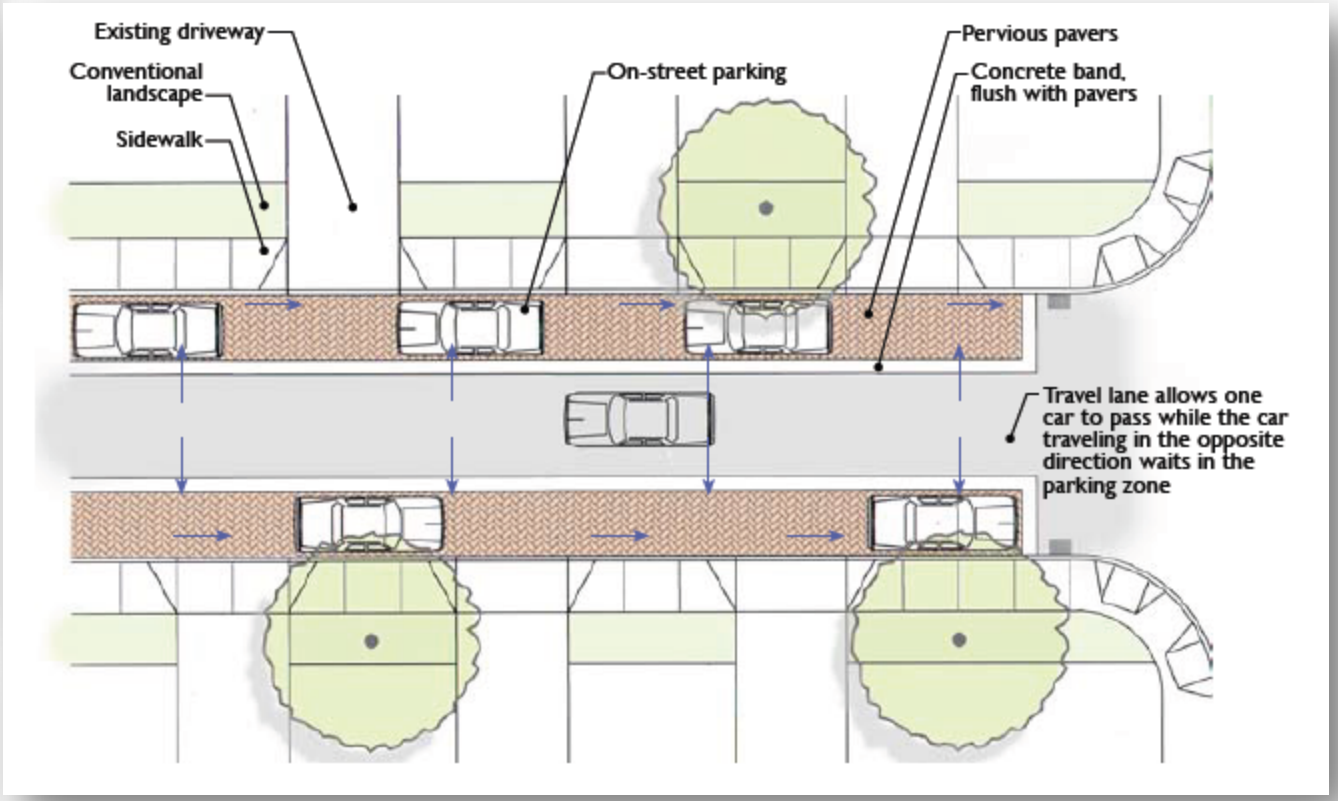
Green Residential Streets

Permeable Paving


EXISTING


OPPORTUNITY


IMPLEMENTATION



Source: EPA.org

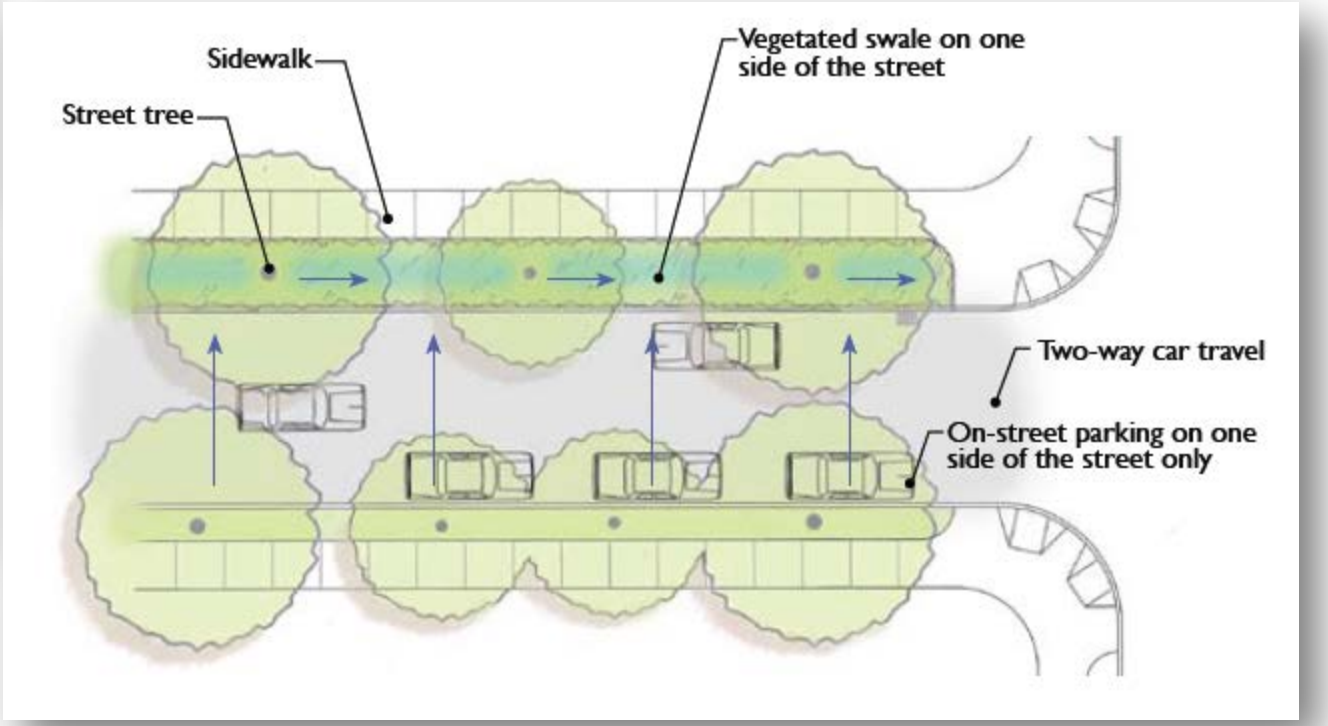
Green Residential Streets

Vegetative Swales


EXISTING


OPPORTUNITY


IMPLEMENTATION



Source: EPA.org

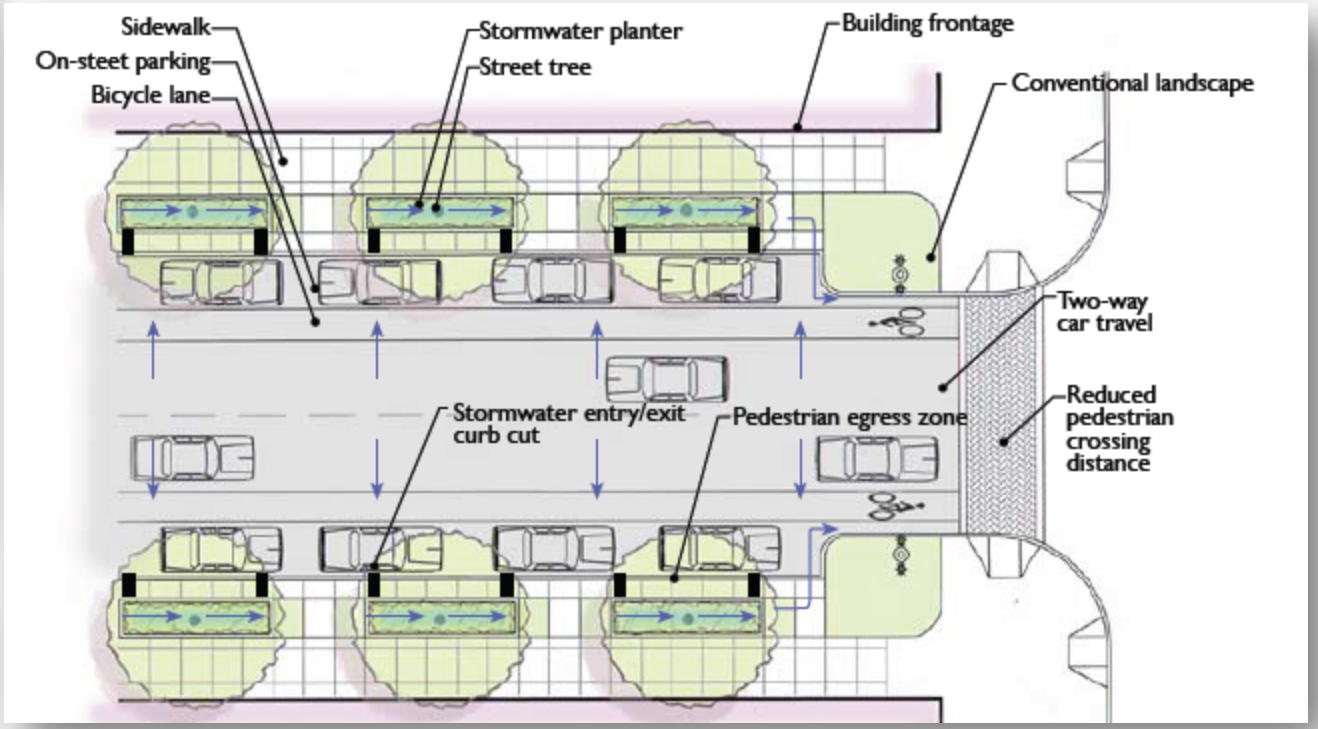
Green Commercial Streets

Stormwater Planters


TYPICAL STREET


OPPORTUNITY


IMPLEMENTATION



Source: EPA.org

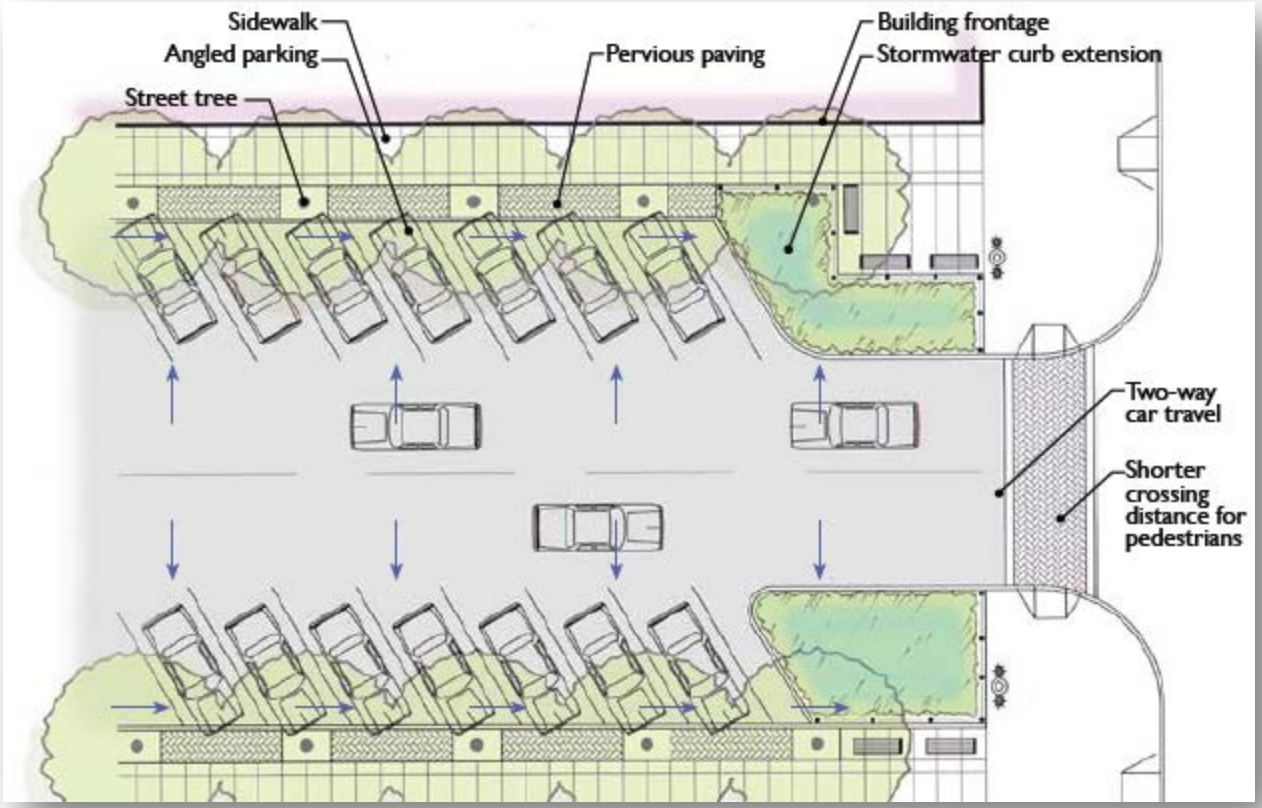
Green Commercial Streets

Stormwater Curb Extensions

EXISTING

OPPORTUNITY

IMPLEMENTATION



Source: EPA.org

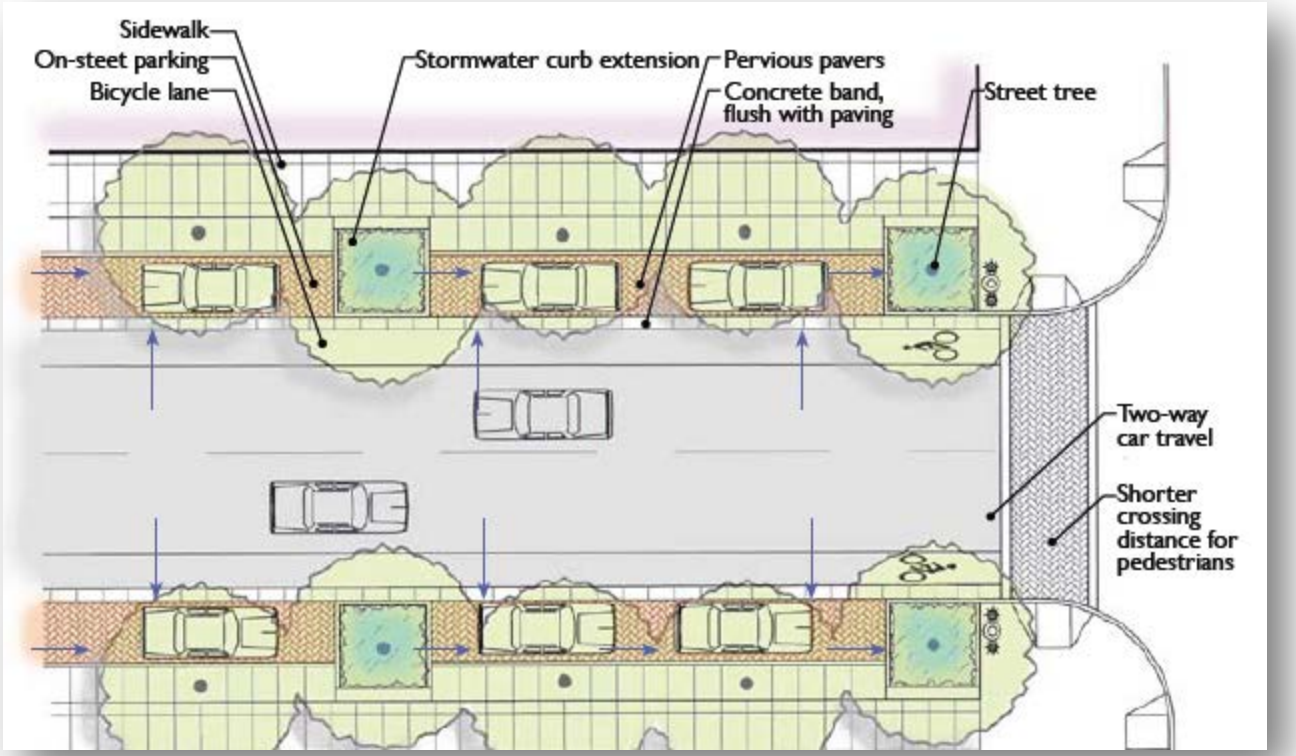
Green Commercial Streets

Permeable Paving


EXISTING


OPPORTUNITY


IMPLEMENTATION



Source: EPA.org

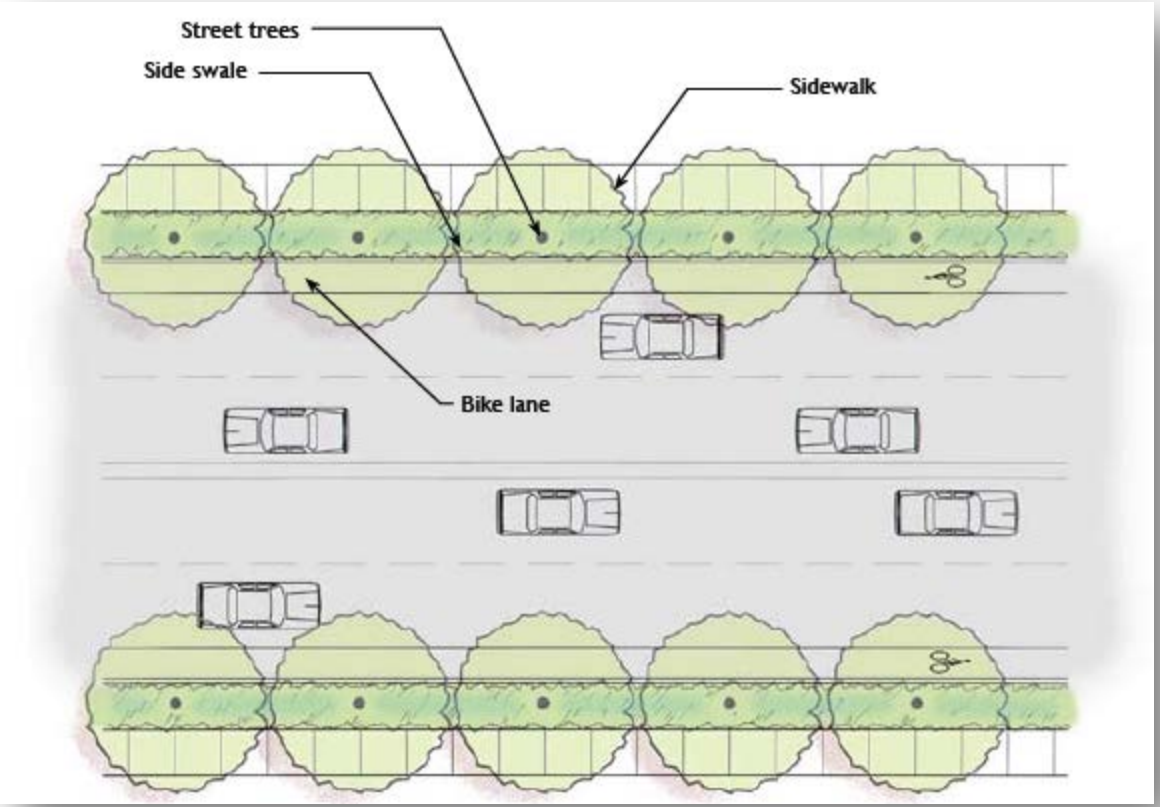
Green Arterial Streets

Vegetative Swales

TYPICAL STREET

OPPORTUNITY

IMPLEMENTATION



Source: EPA.org

Green Alley Streets

Vegetative Swales

TYPICAL ALLEY

OPPORTUNITY

IMPLEMENTATION

Source: EPA.org

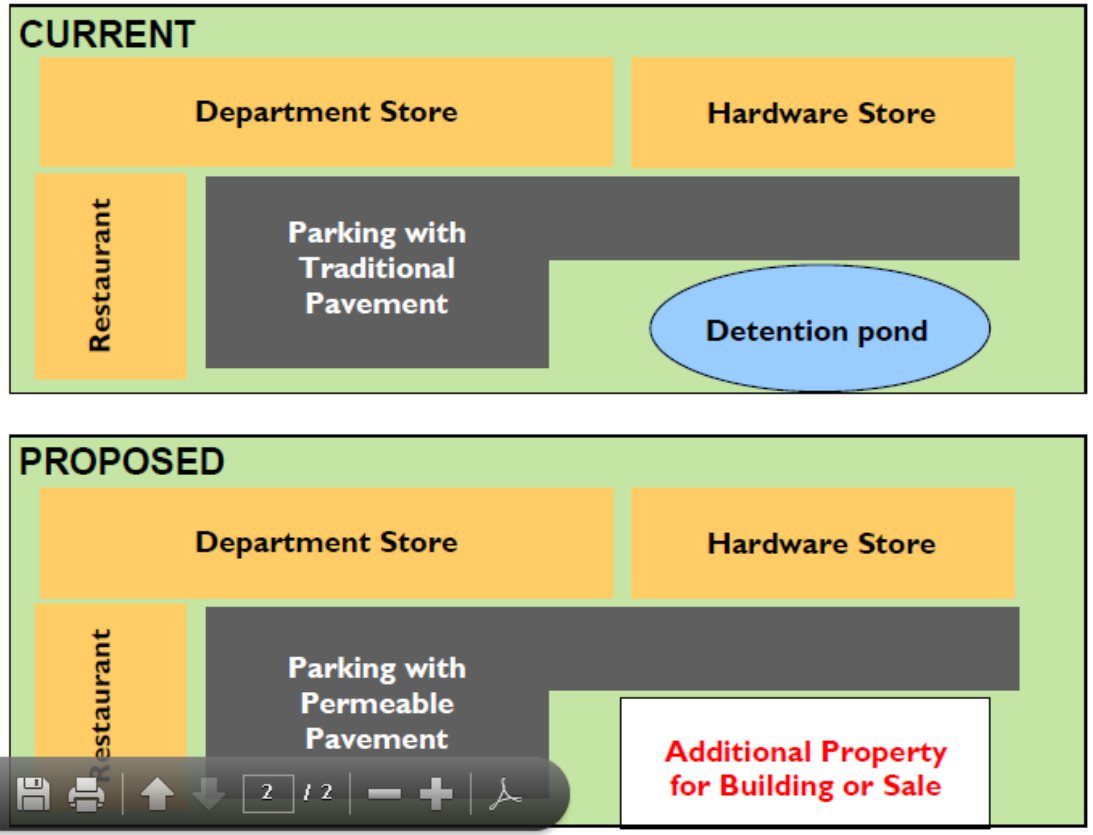
4. What others are doing

http://portal.ncdenr.org/c/document_library/get_file?uuid=c7469dc8-f7ff-41b6 | Comporium WebMail | ncdenr.org | Eat more 'superfoods' t...

What are the environmental benefits?

- **Reduction in volume of stormwater discharged**
- **Higher level of pollutant removal than most BMPs**
- **Recharge to groundwater**
- **Provides year-round water for base flow of streams**

Traditionally, our state and local programs have relied on detention ponds and other devices to reduce stormwater impacts. This approach has served a valuable role in pollution reduction, but there are drawbacks. In addition to problems with insects and liability, these devices ultimately discharge nearly all collected stormwater to streams that cannot handle large volumes of flow.



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4. What others are doing

- *“Infill Philadelphia: Soak It Up” Competition*
- *28 entries, 3 winners ($10K each)*
- *Work with PWD to implement design.*

Source:www.infill.cdesignc.org

STORMWATER *re*STORE

INFILTRATION AND DISCHARGE

- Conservative Approach – Potentially Contaminated Soils
- Partial Infiltration – Conservatively Reduce Runoff Discharge Volume 75%

STORMWATER *re*STORE

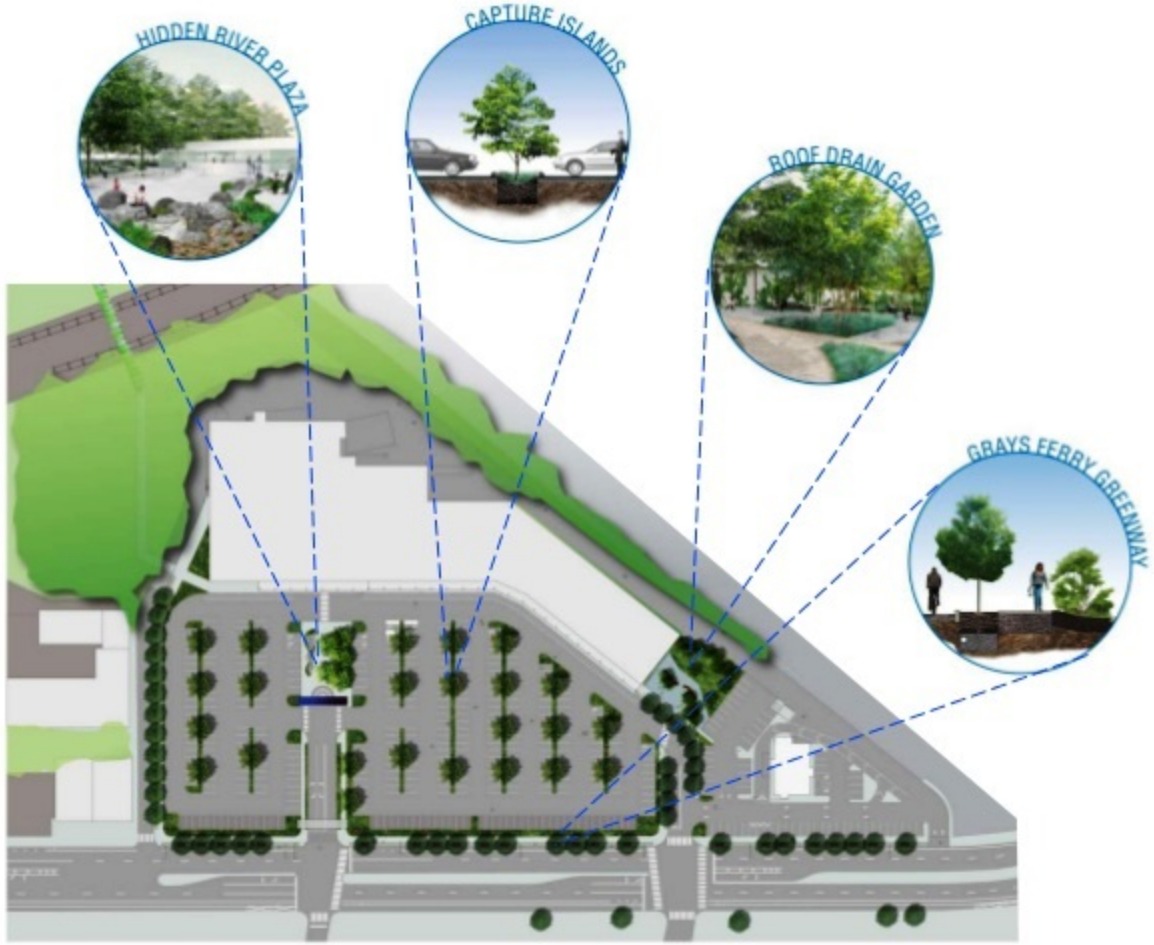
TODAY

- 441,437 SF Site Area
- 81,900 SF Roof Area
- 350,000 SF DCIA
- 481 Parking Spaces
- 5 Trees
- No Community Space
- Minimal Sustainability Features

$3,414 MONTHLY PWD STORMWATER BILL (in 7/2013)

Source:www.infill.cdesignc.org

STORMWATER *re*STORE



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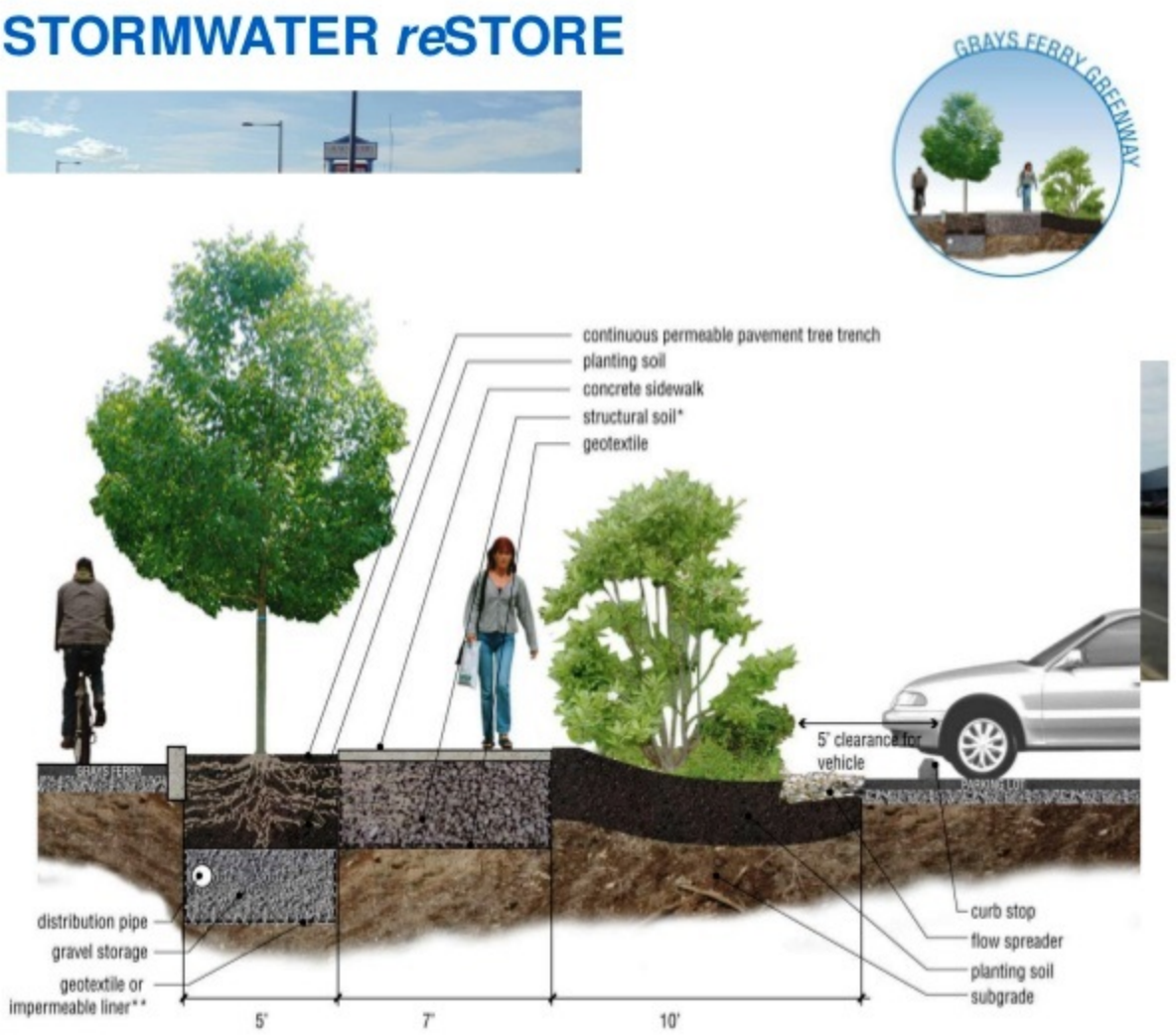
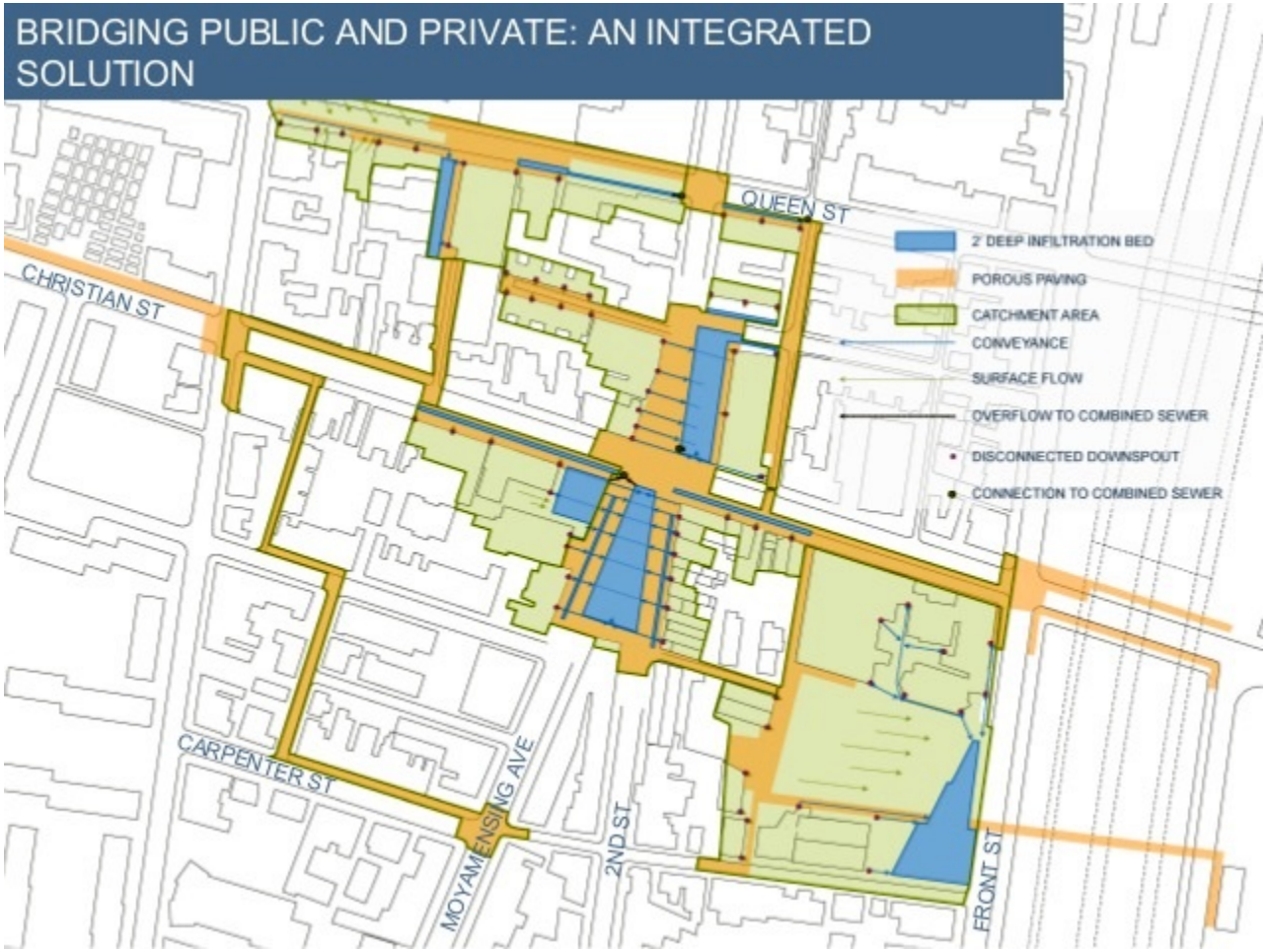


Source:www.infill.cdesignc.org

STORMWATER *re*STORE

3,600 SF of Community Space Created with Educational Opportunities

Source:www.infill.cdesignc.org



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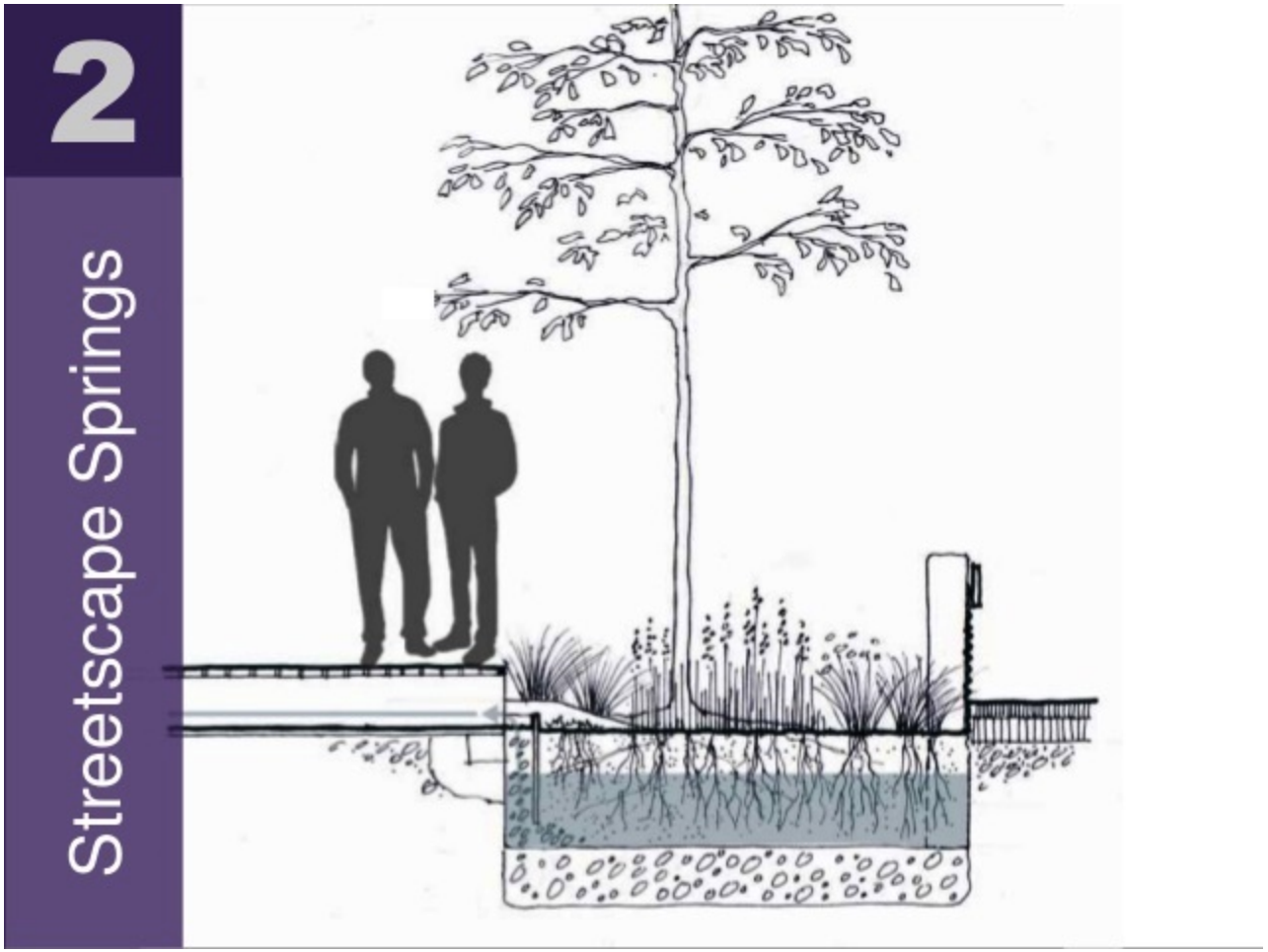

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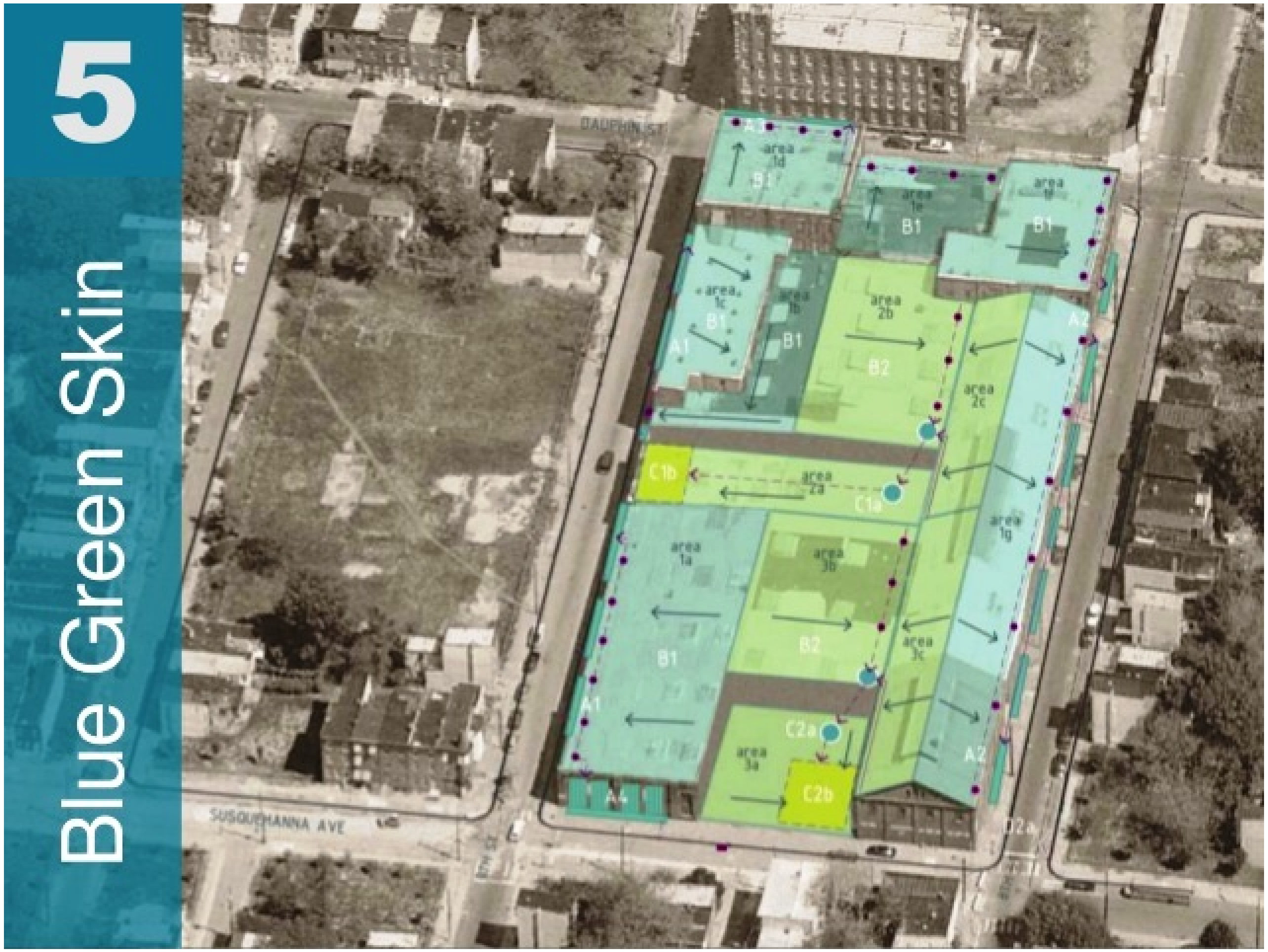

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In Summary…

1. Street Characteristics
2. Old and New Paradigm of Street Design
3. Concept Design of Green Streets
4. What Others are Doing?

When the well's dry, we know the worth of water.
- Benjamin Franklin