



# Green Streets & GI Standards



**MWCOG**  
**Green Streets Workshop**  
**July 28, 2014**

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Stormwater Management Branch

# DDOT Green Street Update

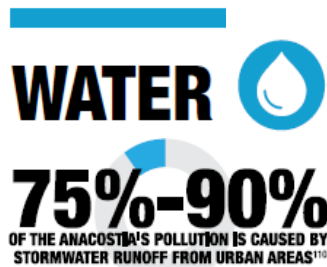
- Completed projects – Great Streets, Low Impact Development (LID) Streetscapes, Paving Removal
- New Requirements
  - DDOE Stormwater Retention Requirements (Effective January 15, 2014)
    - Retain 1.2 inches runoff to the Maximum Extent Practicable (MEP) in existing public ROW
  - MS4 Permit: Retrofit 1.5 million SF ROW 2011-16
  - Sustainable DC Plan (2013)



19<sup>th</sup> St NW Golden Triangle BID



37<sup>th</sup> St & Tunlaw St NW



Goal 2: Relieve pressure on stormwater infrastructure and reduce long-term flood risk.

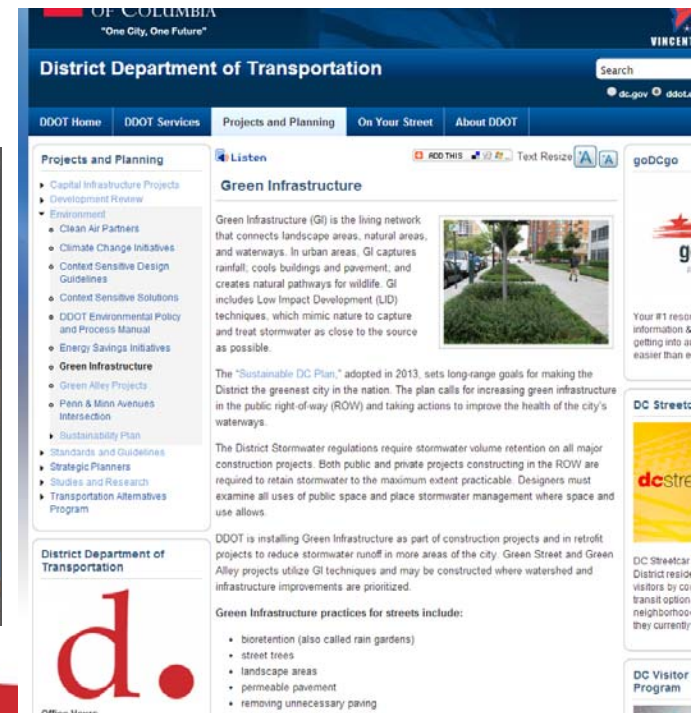
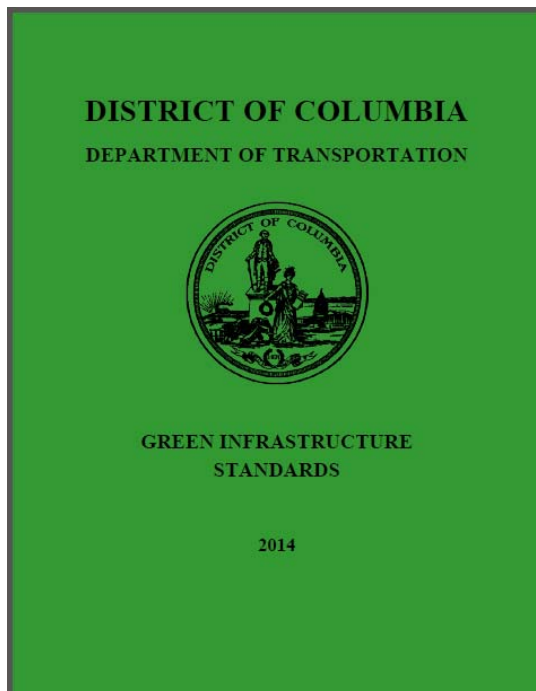
*Target: By 2032, use 75% of the landscape to capture rainwater for filtration or reuse.*

Action 2.2: Increase the use of green infrastructure along public rights of way. (Short Term)

Action 2.4: Build 25 miles of green alleys. (Long Term)

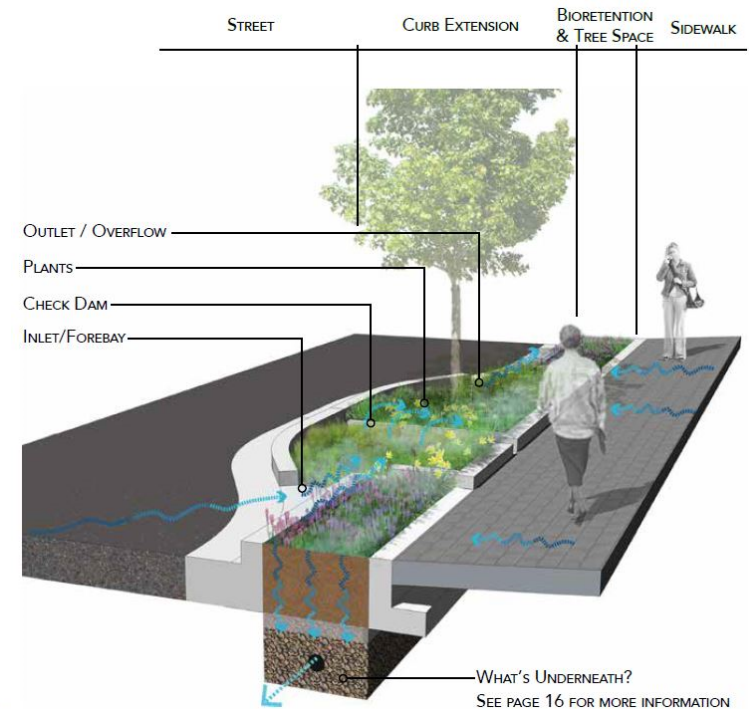
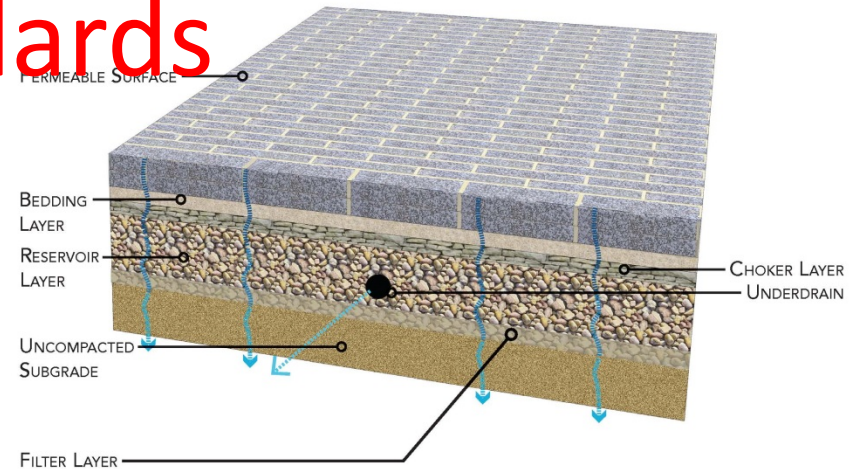
# Green Infrastructure Standards

- Green Infrastructure Standards (Green Book)
- Greening DC Streets (Non-technical Design Guide)
- Final released April 22, 2014
- Website: [ddot.dc.gov/GreenInfrastructure](http://ddot.dc.gov/GreenInfrastructure)



# Developing GI Standards

- Practices
  - Bioretention & variations
  - Permeable Paving
  - Tree Space Design - Soil Volume Requirement
- Process
  - Multi-disciplinary design team
  - LID Council of Experts
  - Research best practices, stakeholder interviews, local site inspections
  - Draft standards Issued for Public Review March 2013
  - Used in several projects
  - Final standards issued April 2014
- Products
  - Construction drawings & specifications
  - Design procedure
  - Maintenance Schedules, Plant lists



# Permeable Pavement Standards



Type / Application	Alley	Roadway*	Sidewalk	Covered Soil Volume for Plants	Trail
Porous Asphalt	•	•			•
Pervious Concrete	•	•	•	•	•
Permeable Interlocking Unit Pavers	•	•	•	•	
Other Unit Pavers **				•	
Porous Rubber Paving			•	•	•
Porous Bound aggregate			•	•	
Plastic Grid Pavers	•			•	

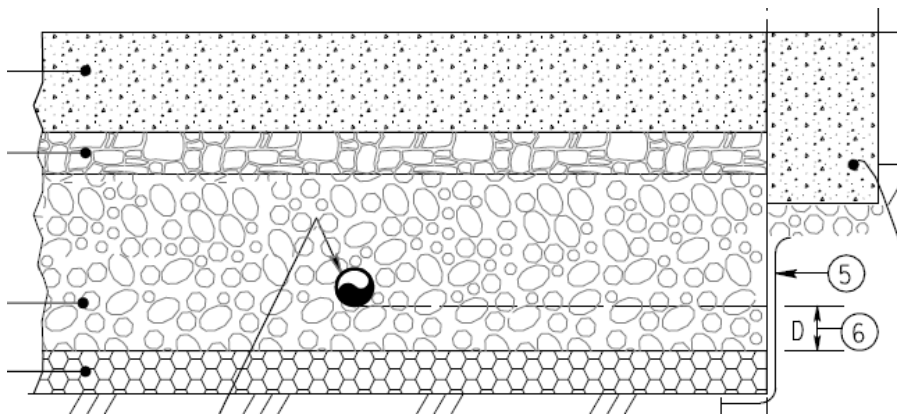
\* Appropriate for low volume roadways & dedicated parking lanes; Not currently allowed for collectors, arterials, and freeways.

\*\* Spaced to allow infiltration



# Permeable Pavement Design

- Pavement Strength, Traffic Loadings, Bearing Capacity
  - Standard drawings with pavement and base thicknesses
  - Stone thickness variable – *to be designed by geotechnical methods based on soil bearing capacity and traffic loadings*



**Permeable Concrete Section**

## MINIMUM PAVEMENT THICKNESSES

PAVEMENT ITEM	CLASS A	CLASS B
①	6"	8"
②	4'	4'
③	6", SEE NOTE 5	12", SEE NOTE 5
④	4'	4'

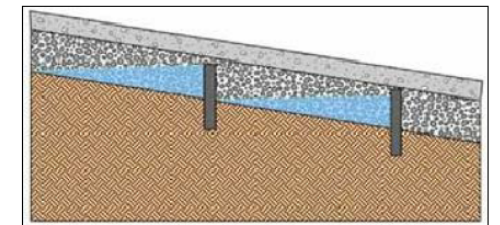
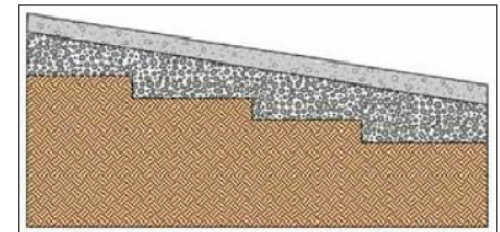
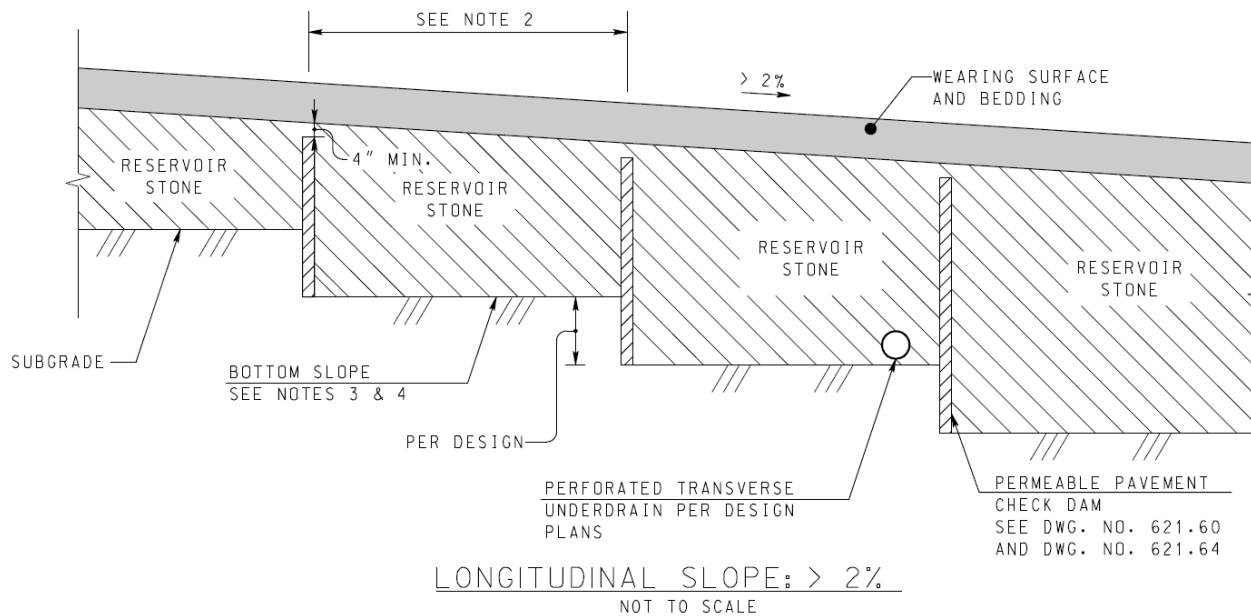
CLASS A: ALLEY, PARKING LANE, LOCAL STREET

CLASS B: COLLECTOR OR ARTERIAL (NOT CURRENTLY ALLOWED)

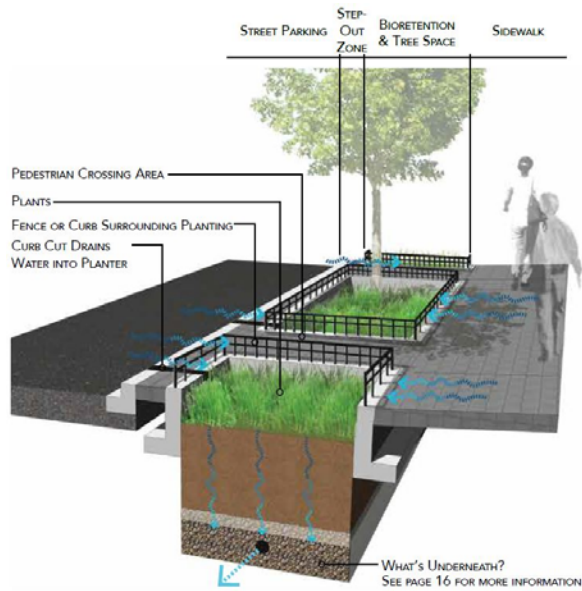
5. DEPTH OF RESERVOIR LAYER AS SHOWN ON DESIGN PLANS SHOULD BE SIZED TO ADDRESS STORMWATER MANAGEMENT REQUIREMENTS AND PAVEMENT STRUCTURAL DESIGN.

# Permeable Pavement Design

- Grade changes
  - Step-downs to promote infiltration, prevent runoff
  - Check dams to retain water, promote infiltration
    - Waterproof membrane, concrete, acrylic sheeting

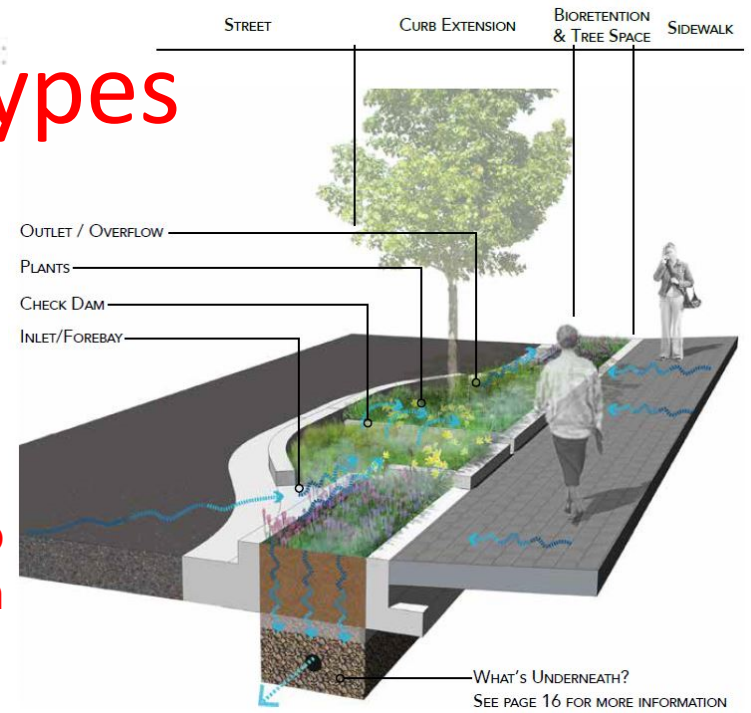


# Bioretention Standard Types



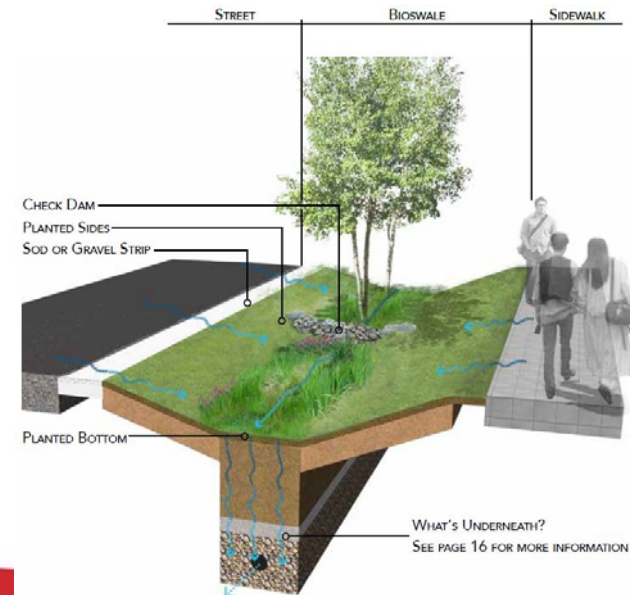
Planter  
Adjacent to  
Roadway

Curb  
Extension



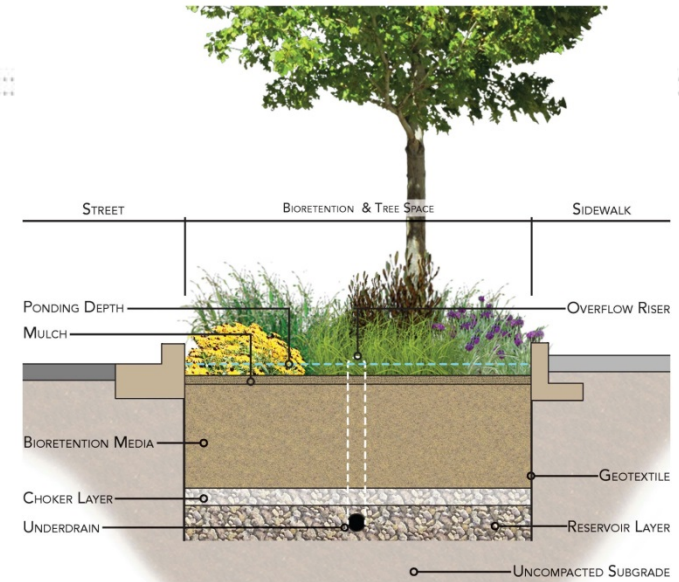
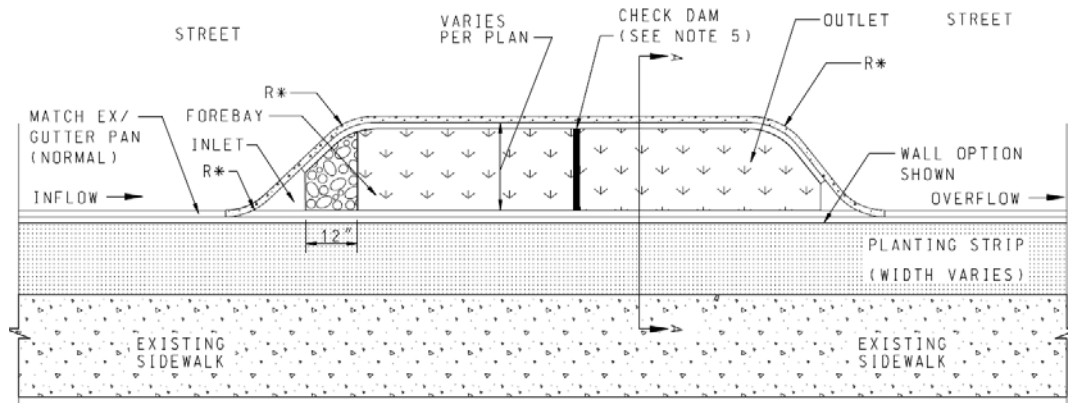
Open  
Area

Bioswale

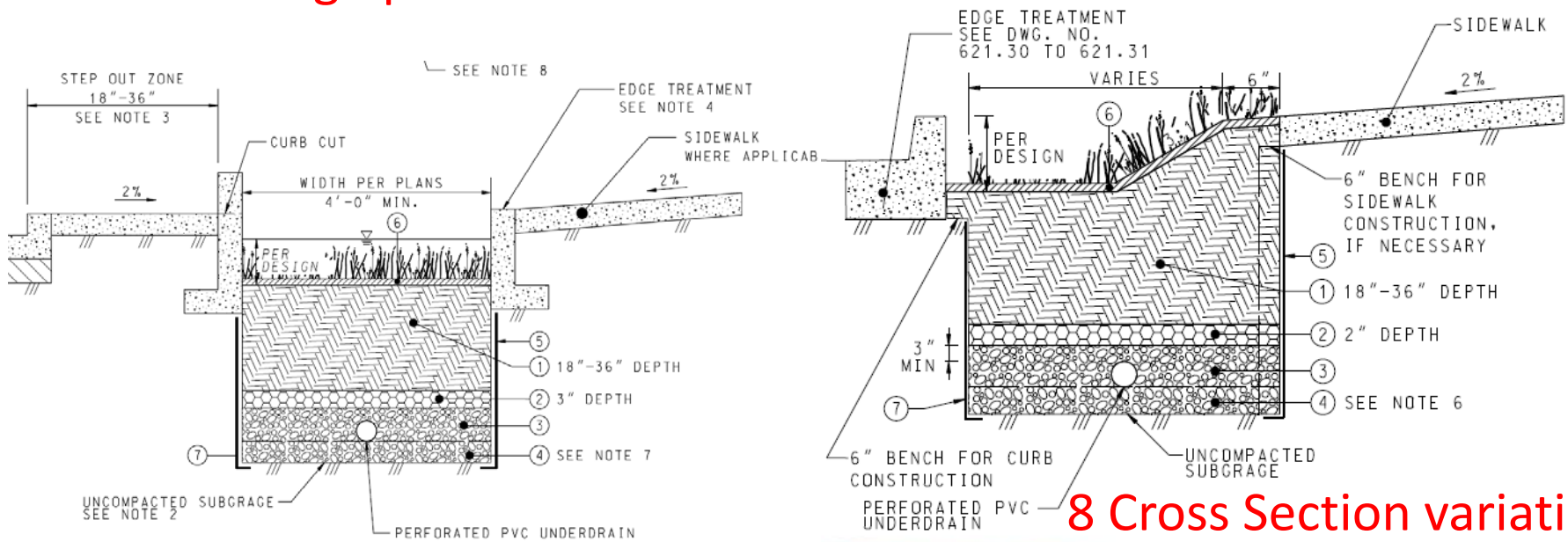




# Bioretention Standards



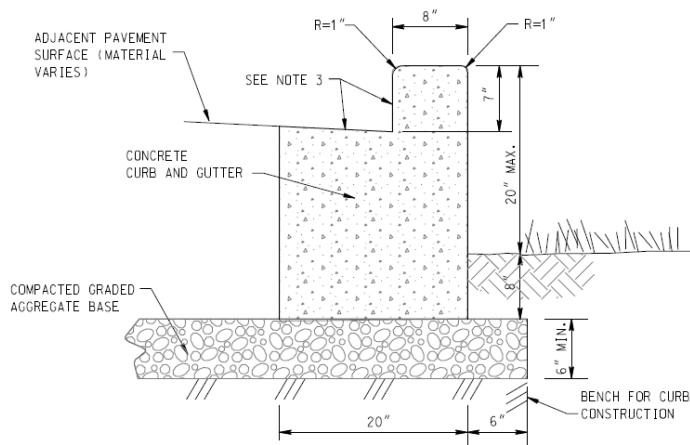
6 design plan variations



8 Cross Section variations

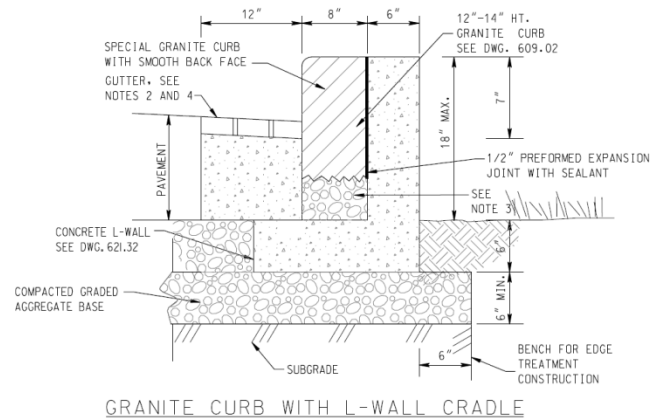
# Bioretention Curb & Walls

- Protect road curb stability next to bioretention soil
  - Curb & wall designs evaluated for stability against impact

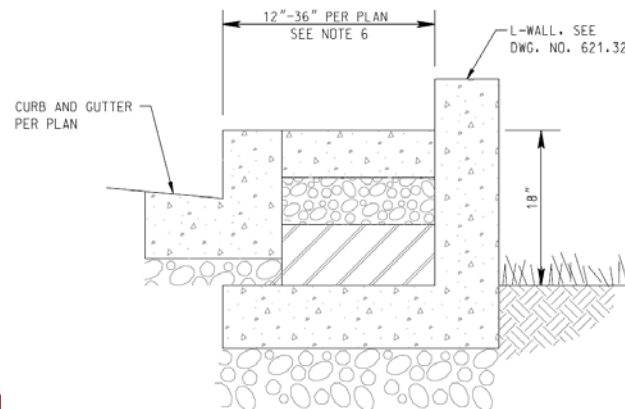


THICKENED CONCRETE CURB AND GUTTER

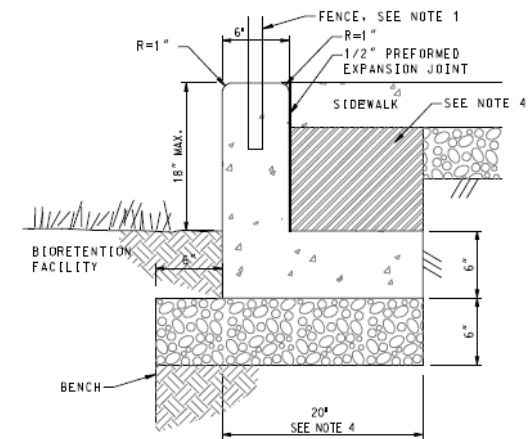
Curb walls  
next to road



GRANITE CURB WITH L-WALL CRADLE



L-WALL AND STEP OUT ZONE

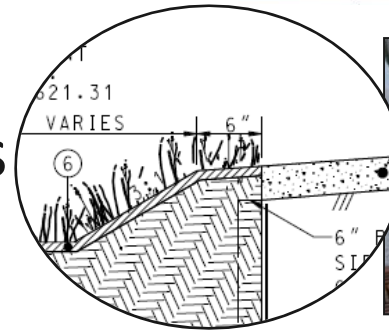
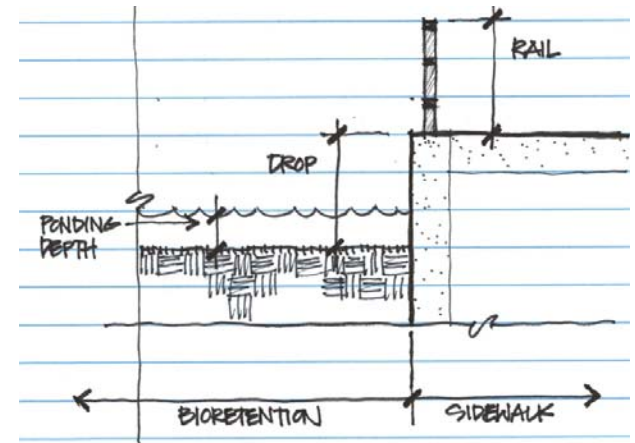


L-WALL (FLUSH)

Walls next to  
sidewalk

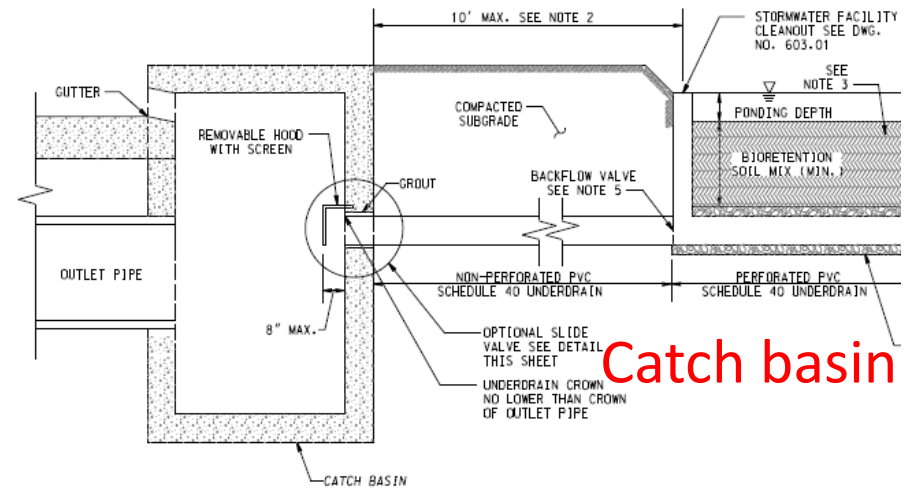
# Pedestrian Safety & Access

- Barrier to prevent falls for drop into bioretention
  - High volume area – 18" fence
  - Low volume area – curb
  - ADA, cane detection
- Sloped drops with flat areas
  - No barrier needed
- Step-out zone
  - 12-36 inches next to street parking



# Soil Infiltration & Underdrain Connections

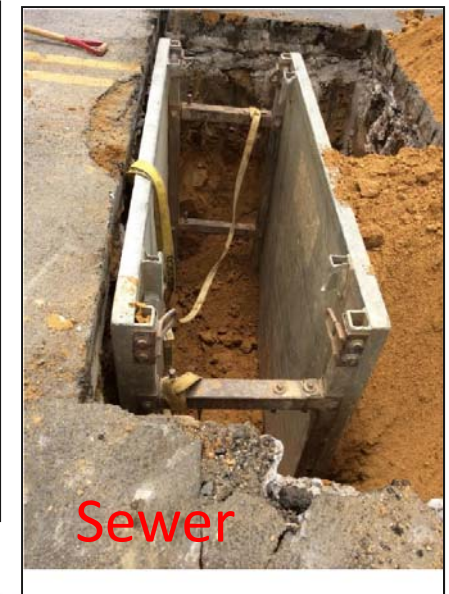
- Is underdrain needed?
  - Can soils infiltrate within required time?
  - Is sewer nearby?
- Underdrain connection options
  - Adjacent catch basin
  - Existing or new manhole
  - Direct connection to sewer
  - Evaluating best construction, maintenance, and cost option



Catch basin



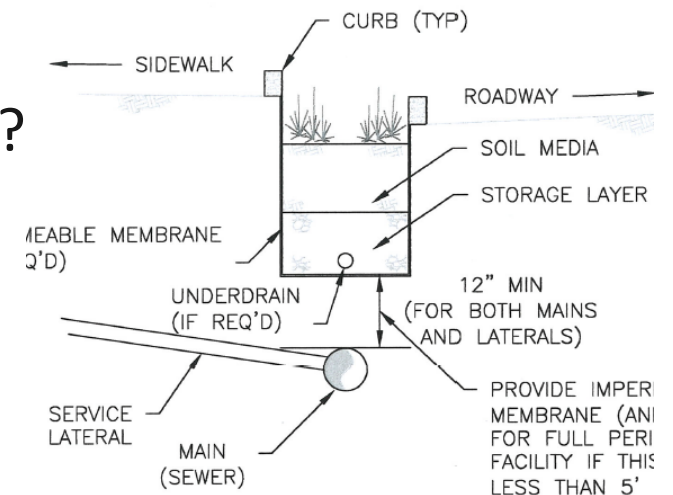
Manhole



Sewer

# Utility Coordination

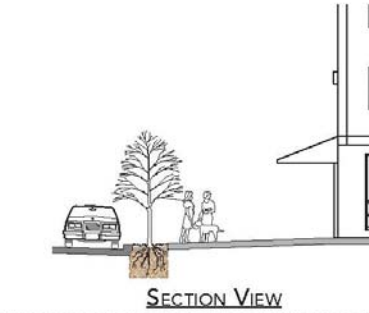
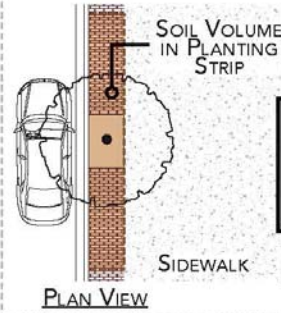
- **Coordination with Primary Utilities**
  - DC Water, Pepco, Washington Gas, Verizon, Comcast
- **Offsets and protection requirements**
  - Vertical & horizontal distance or protection for LID near/within utility lines - in DDOT GI Design Manual
  - What risk of infiltration into sewer lines?
- **Restoration** to existing conditions required after repair excavation per DC Regulations



# Tree Soil Volume Requirement

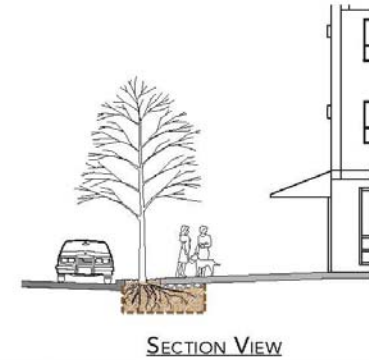
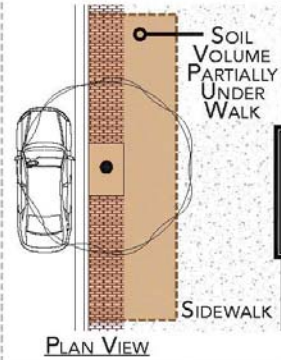
**SMALL**  
600 cubic feet

SMALL TREE  
VOLUME REQUIREMENTS:  
600 CUBIC FEET



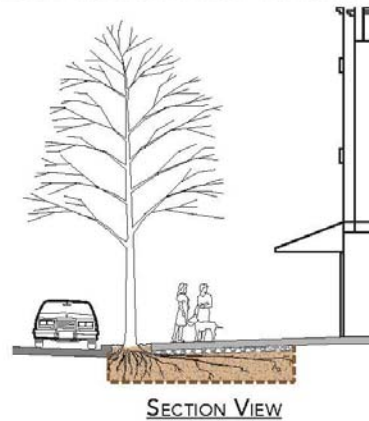
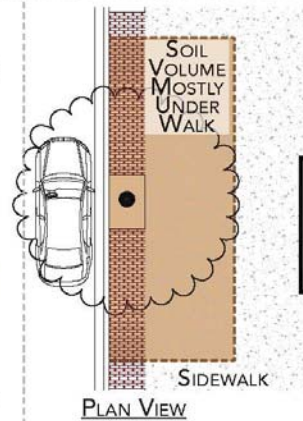
**MEDIUM**  
1,000 cubic feet

MEDIUM TREE  
VOLUME REQUIREMENTS:  
1,000 CUBIC FEET

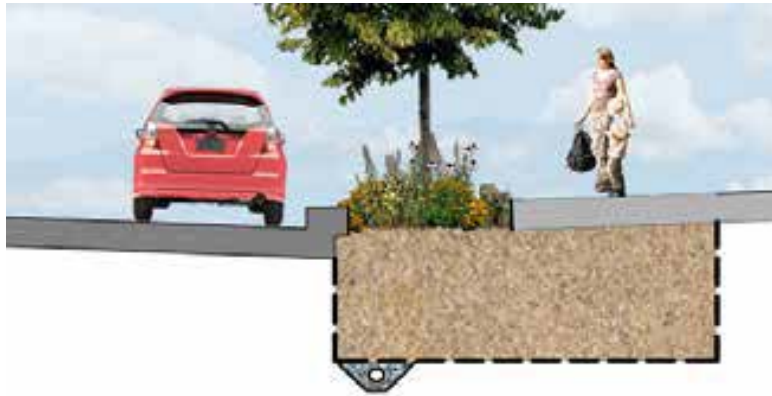


**LARGE**  
1,500 cubic feet

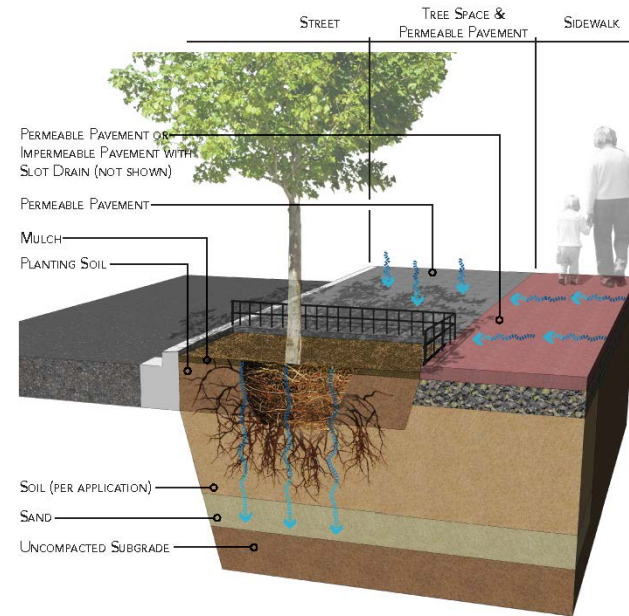
LARGE TREE  
VOLUME REQUIREMENTS:  
1,500 CUBIC FEET



# Tree Space Design Methods



Structural Soils



Structural Cells



Suspended Sidewalk

# GI Standard Plant List

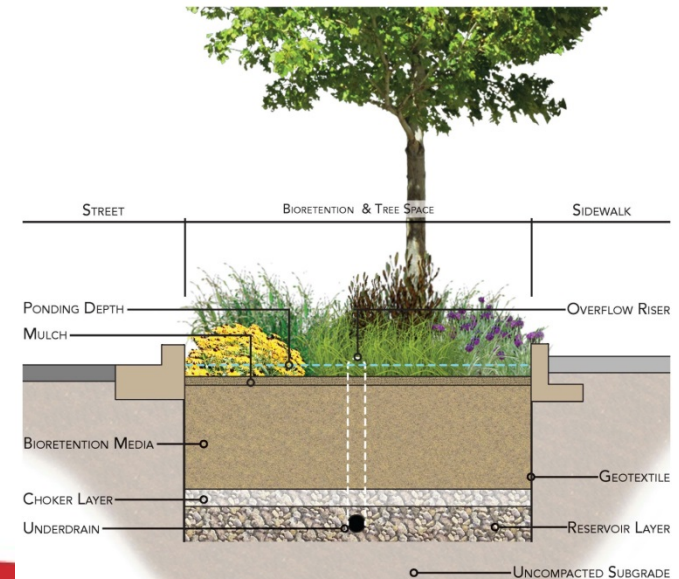
BIORETENTION - LOW LEVEL OF CARE													
DDOT GREEN INFRASTRUCTURE STANDARDS													
PLANTS FOR USE IN BIORETENTION													
Annual maintenance; no irrigation													
○ Full Sun                      ● Part Shade                      ● Full Shade L Low Salt Tolerance              M Moderate Salt Tolerance              H High Salt Tolerance ♪ Highly Tolerant      ♫ Tolerant      ♫♫ Somewhat Tolerant      ♫♫♫ Intolerant													
BOTANICAL NAME	HEIGHT (FT.)	SPREAD (FT.)	BLOOM COLOR	BLOOM TIME	SUN SHADE	SALT TOL.	DROUGHT TOL.	TYPE	NATIVE	ZONE	SPACING (FT.)	MINIMUM CONTAINER SIZE	OTHER NOTES
TREES													
<i>Amelanchier canadensis</i> Shadblow Serviceberry	6-20	10-20	White	Apr-May	○ ●	M	♫♫	Small Tree	X	Bottom Side	Per Plan	2" cal. OR Multi-stem by height: 8'-10'	Tolerates clay soil, wind, dry soil; fragrant flowers
<i>Amelanchier x grandiflora</i> Apple Serviceberry 'Autumn												2" cal. OR Multi-	
<i>Betula nigra</i>													

BIORETENTION - HIGH LEVEL OF CARE													
DDOT GREEN INFRASTRUCTURE STANDARDS													
PLANTS FOR USE IN BIORETENTION													
Monthly maintenance; site is routinely watered													
○ Full Sun                      ● Part Shade                      ● Full Shade L Low Salt Tolerance              M Moderate Salt Tolerance              H High Salt Tolerance ♪ Highly Tolerant      ♫ Tolerant      ♫♫ Somewhat Tolerant      ♫♫♫ Intolerant													
BOTANICAL NAME	HEIGHT (FT.)	SPREAD (FT.)	BLOOM COLOR:	BLOOM TIME	SUN SHADE	SALT TOL.	DROUGHT TOL.	TYPE	NATIVE	ZONE	SPACING (FT.)	MINIMUM CONTAINER SIZE	OTHER NOTES
TREES													
<i>Aesculus flava</i> Yellow Buckeye†	50-75	30-50	Yellow	Apr-May	○	M	♫♫♫	Large Tree	X	Top Side	Per Plan	2" cal.	Messy, install away from sidewalks & walkways, best when planted in large areas
<i>Chionanthus virginicus</i> Fringe Tree	12-20	10-20	White	May-June	○ ●	L	♪	Small Tree	X	Bottom Side	Per Plan	8-10' height	Tolerates clay soil, air pollution; slightly fragrant
<i>Ilex decidua</i> Possumhaw	7-15	5-12	White	May	○ ●	M	♫♫♫	Small Tree	X	Bottom Side	Per Plan	2" cal.	Tolerates wet soil, clay soil, air pollution
<i>Liquidambar styraciflua</i> Sweetgum†	60-80	40-60	Yellow, Green	Apr-May	○	M	♫♫	Large Tree	X	Bottom Side	Per Plan	2" cal.	Tolerates rabbit, deer, clay soil, extended flooding; messy
<i>Oxydendrum arboreum</i> Sourwood	20-50	10-25	White	June-July	○ ●	M	♫♫♫	Small Tree	X	Bottom Side	Per Plan	2" cal.	Tolerates deer, dry soil; fragrant



# GI Specifications

- Paving materials – concrete, asphalt, PICP, porous rubber, grass paving
- Soil – planting soil, bioretention soil, sand based structural soil
- Geosynthetics
  - Geotextiles based on AASHTO standard
- Aggregates – double washed
- Drainage pipes, structures
- Soil rooting volume

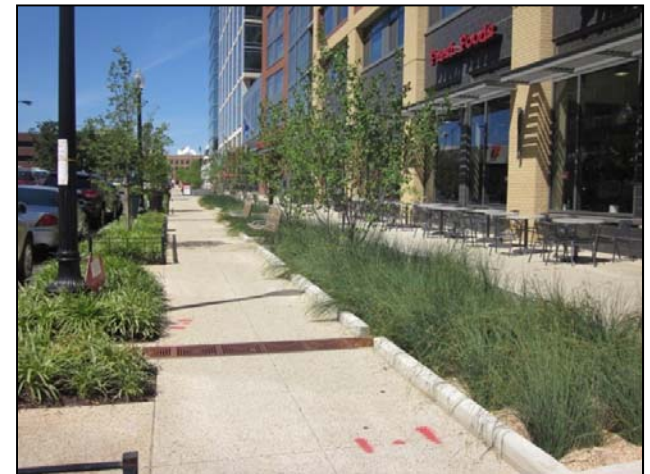


# Design Process to meet SW Regulations

- What design will meet Maximum Extent Practicable (MEP)?
  - A valid attempt to use all available space to manage stormwater
    - Tree Space, Parking lanes, public land open space
  - Work around accepted conflicts
    - Pedestrian zones, bike lanes, bus shelters, mature trees, sidewalk cafes
    - Utilities, surface & subsurface uses
- MEP Process (ROW construction)
  - Design submission at every phase
    - Planning – identify space & opportunities
    - 30% - plan layout of SWM, identify conflicts, calculate volume required
    - 65% - determine depths, infiltration, conflicts, volume achieved
    - 90% - final plan and volume achieved
    - DDOE provides concurrence at each phase
  - If required volume not achieved, permit will be issued by DDOE



Golden Triangle BID



Constitution Square

# Implementation & Challenges

- **Paradigm Shift**
  - Changing the urban landscape
- Design
  - Shift in Approach for Road Drainage
  - Fast Drainage → Capture
  - Treatment → Retention
- Construction
  - Building new standards & modifying
  - Quality assurance & quality control



# Implementation & Challenges

- Maintenance
  - Inventory all sites in GIS
  - Establishing routine
- Building capacity in design, construction and maintenance sectors and in-house staff
- Training & Certifications at all phases
- Public outreach & education





# Questions

<http://ddot.dc.gov/greeninfrastructure>

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