Overview of 2013 Stormwater Rule and Stormwater Management Guidebook

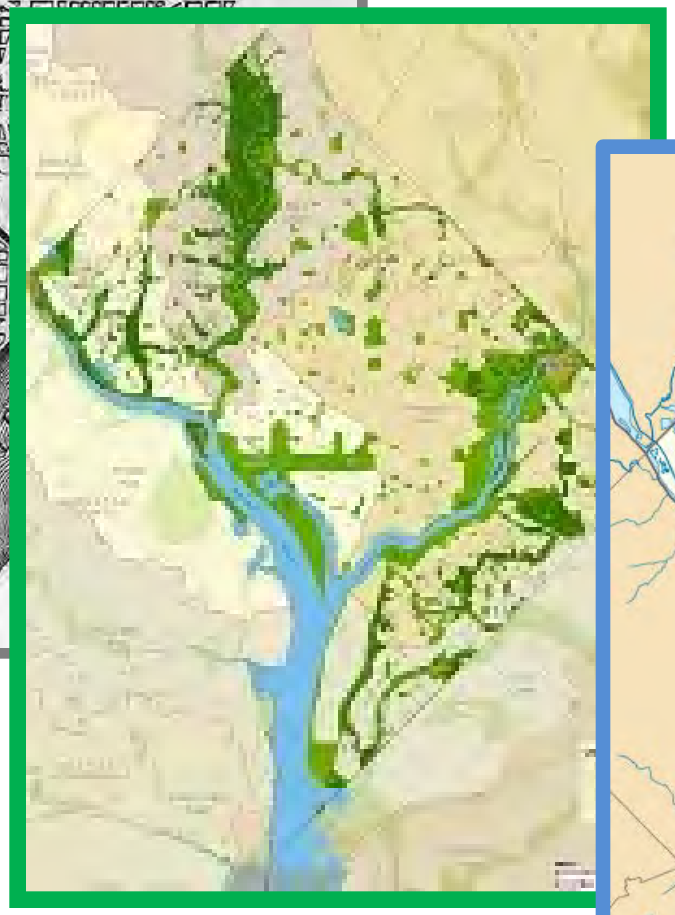


For more information, visit ddoe.dc.gov/swregs.

DISTRICT DEPARTMENT OF THE ENVIRONMENT

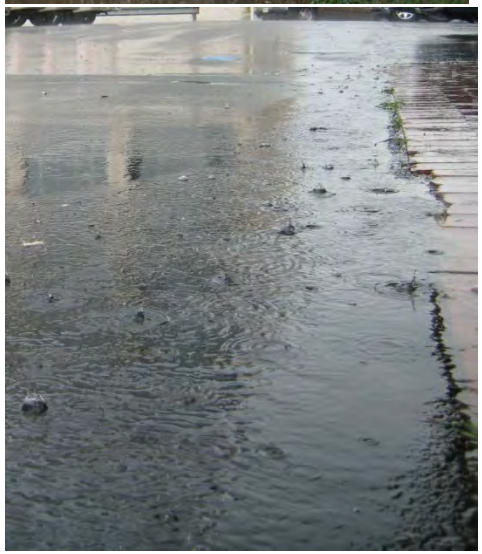
green forward

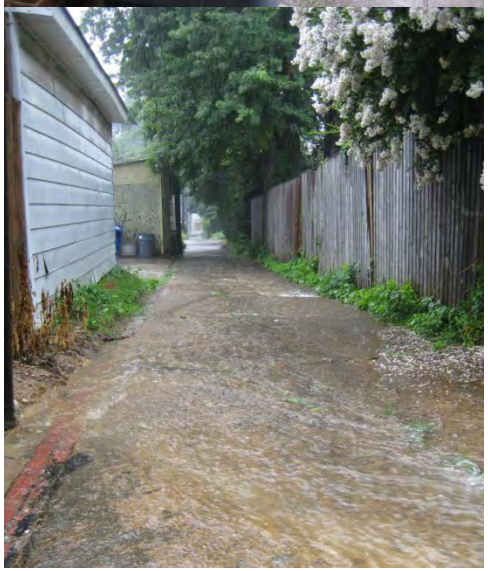

Plan
of the City of
Washingtc
POTOMAK RIVER



When it rains…

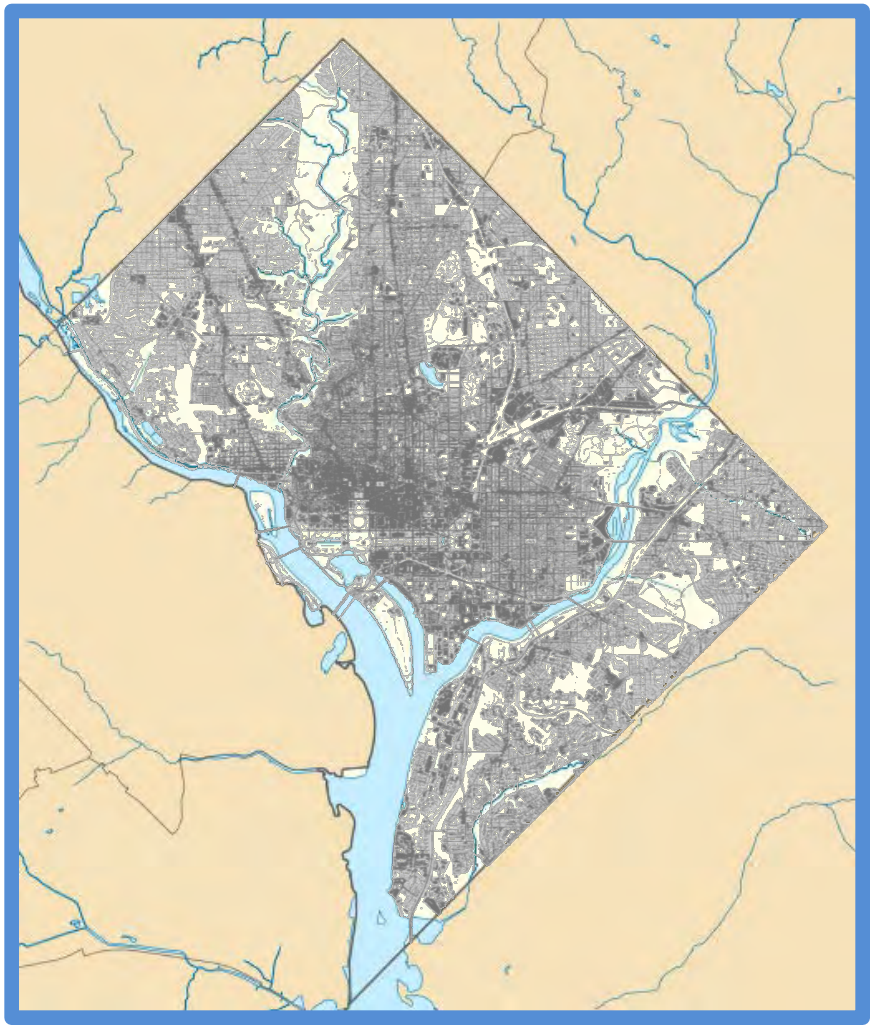
Stormwater washes off road ways, sidewalks, alleys, roofs, parking lots, and other "impervious surfaces"…





DID YOU KNOW….

- 43% of the District's land area is impervious.
- A single 1.2 inch storm falling on this area produces about 525 million gallons of stormwater runoff.

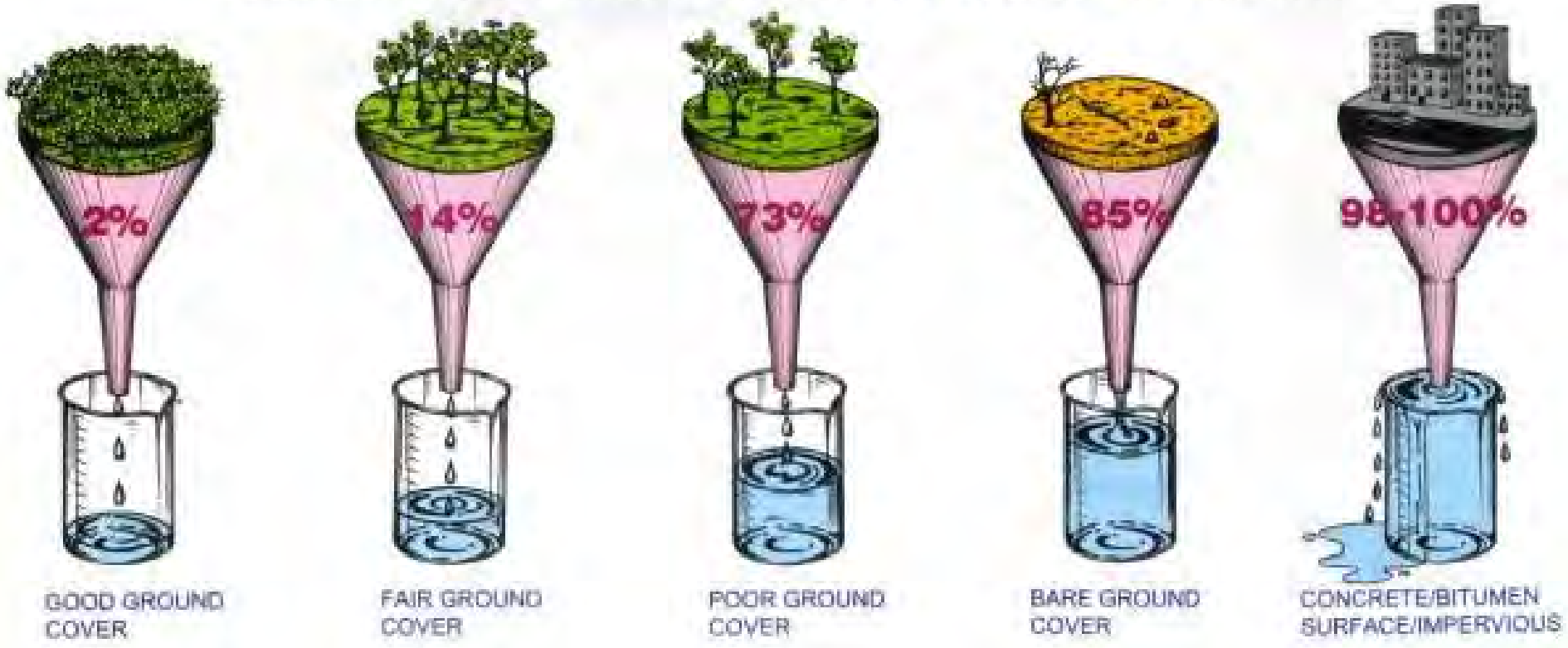


PROW Critical for Stormwater Management

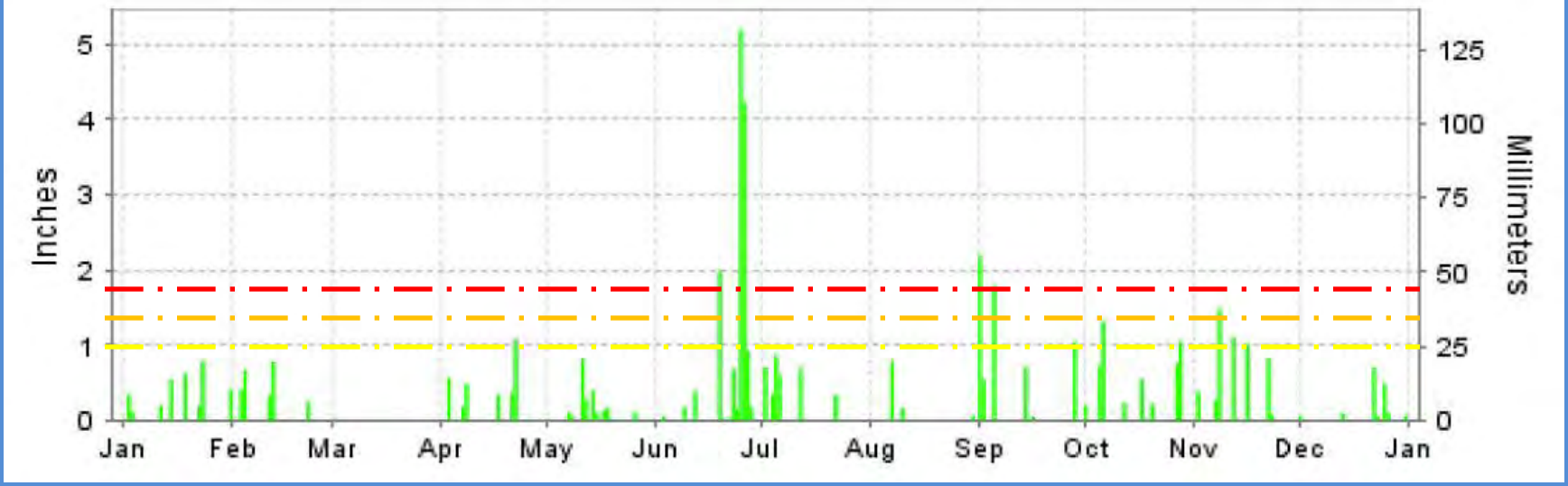
- PROW occupies approximately 25% of the impervious area of the District of Columbia

- One of the most significant sources of stormwater runoff impacting District water bodies

PERCENTAGE (%) OF SURFACE RUNOFF ON A VARIETY OF SURFACES



2006 Precipitation Washington DC



Federal Requirement EISA 95th Percentile Event = 1.7”
MS4 Requirement 90th Percentile Event = 1.2”
District Proposed Revision based on AWDZ = 1.0”

Precipitation Data, NOAA, Reagan National Airport, Arlington VA

Legal Requirements

- Clean Water Act
- Municipal Separate Storm Sewer System (MS4) Permit

2013 Stormwater Rule

- Effective July 19, 2013
- New requirements and provisions include,
  - Stormwater management performance standards
  - Erosion & sediment control (ESC) for land disturbance ≥ 50 square feet
  - Stormwater Retention Credit (SRC) certification and trading
- Transition plan
  - stormwater management performance requirements
- Effective immediately
  - ESC requirements
  - SRC provisions
  - All other components

Practical Approach: On-Site Flexibility

- Best Management Practice (BMP) toolbox includes
  - 13 types of BMPs
- Over control to retain more in area and less in another
  - Ceiling = 1.7 inches (95th percentile event)
  - Floor = 50% minimum of regulated event
- Harvested water treatment requirements
  - Risk associated with end use – not always maximum
- Shared BMPs
  - Project conveys stormwater water off-site

Practical Approach: Off-Site Flexibility

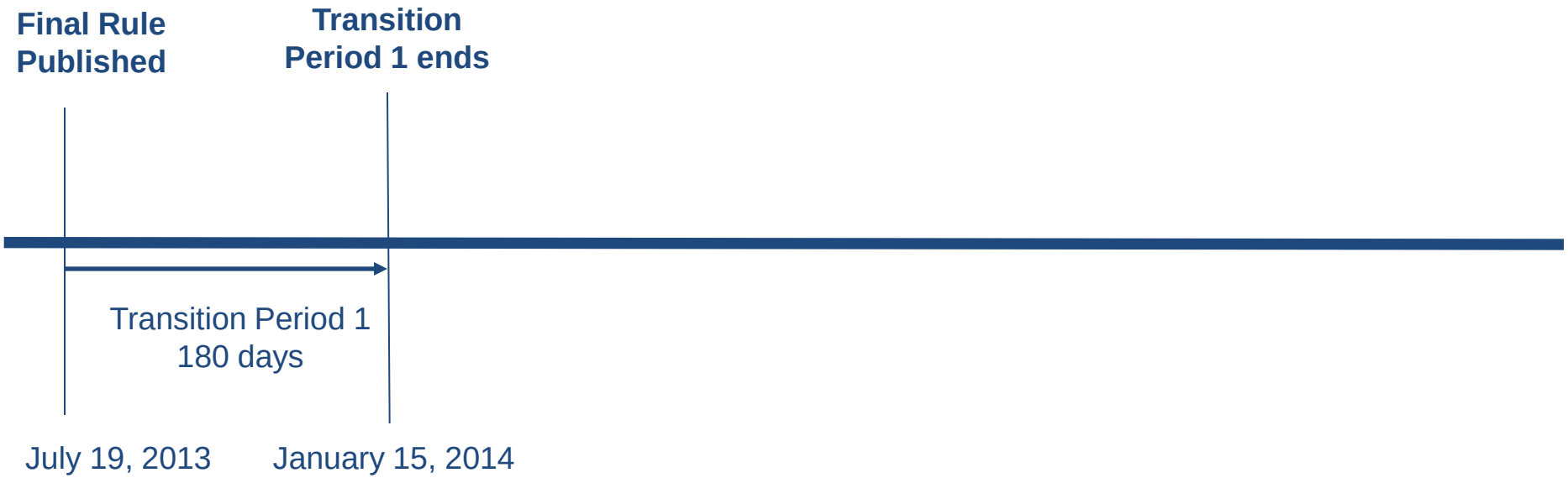
- Free to go off site after achieving minimum of 50% of required retention on site.
- Below 50% minimum, project must demonstrate that on-site retention is infeasible or environmentally harmful.

Practical Approach: Off-Site Flexibility

- Two off-site options:
  - In-lieu fee (ILF) payment to DDOE = $3.50/gallon/year.
  - Privately tradable Stormwater Retention Credits (SRCs).

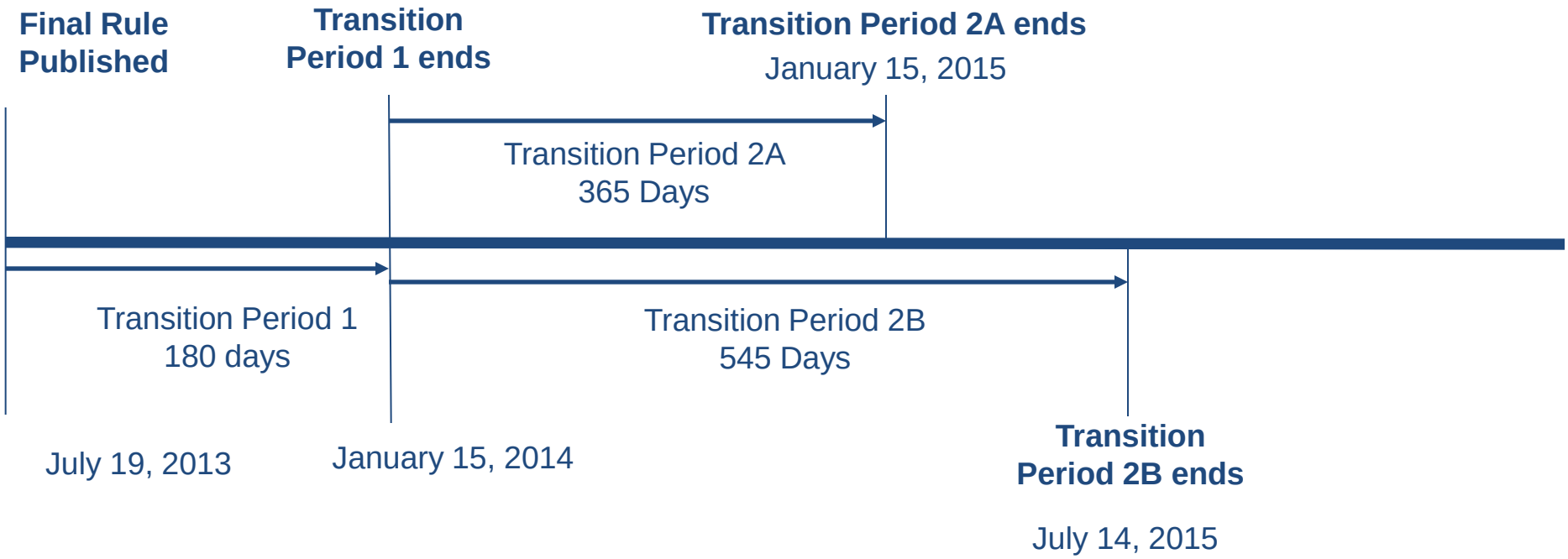
- Off-site volume is an ongoing obligation that can be:
  - Met on yearly or multi-year basis.
  - Met with a mix of ILF & SRCs and mix can change.
  - Reduced in the future by increasing on-site retention.

Transition Plan



- Transition Period 1
  - Regulated projects comply with existing regulations
  - Tied to submittal of first SW Management Plan as part of building permit application process

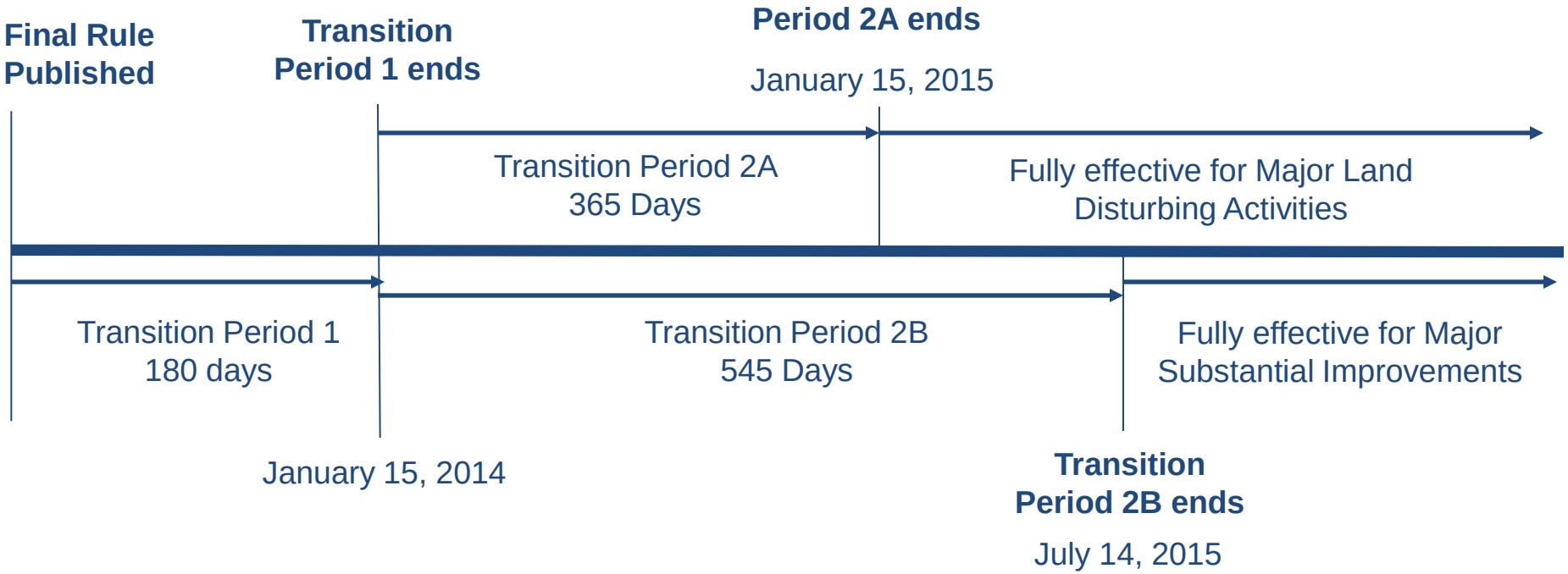
Transition Plan



- Transition Period 2A and 2B*
  - Minimum on-site retention requirement waived
  - Entire retention volume may be achieved off site

*(2A – Major Land-disturbing Activities; 2B – Major Substantial Improvement Activities)

Transition Plan



- Fully Effective – Except:
  - Certain projects ("Advanced Design") with unexpired approval by Zoning Com. or NCPC - Subject to TP when application submitted.
  - Additional grounds for on-site relief for projects with unexpired approval (from HPRB, CFA, BZA, DCOP, NCPC) that conflicts with on-site BMP – If application submitted prior to end of TP2A/TP2B.

Regulatory Triggers

- **Major land-disturbing activity**
  - Land disturbance ≥ 5,000 square feet
- **Major substantial improvement activity**
  - Renovation or addition to a structure that exceeds the following cost and size thresholds
    - Cost of project ≥ 50% of pre-project assessed value of structure
    - Combined footprint of structure(s) exceeding cost threshold and any land disturbance ≥ 5,000 square feet

SW Performance Requirements

- Major land-disturbing activity
  - Retain the first 1.2” of rainfall
    - on site
    - combination of on-site and off-site retention
  - Detention requirement to maintain peak discharge
    - 2-year storm to pre-development conditions (meadow standard used)
    - 15-year storm to pre-project conditions

SW Performance Requirements

- Major substantial improvement activity
  - Retain the first 0.8 inches of rainfall
    - on site
    - combination of on-site and off-site retention
  - No Detention requirements

SW Performance Requirements

- Public Right of Way (PROW) land-disturbing activity
  - Retention to Maximum Extent Practicable (MEP)
  - Detention to Maximum Extent Practicable (MEP)
  - AWDZ Sites Water Quality to Maximum Extent Practicable (MEP)

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ONE CITY

Overview of Stormwater Regulations

CENTER FOR WATERSHED PROTECTION

Definitions of Stormwater Management

1. Get rid of it!

Definitions of Stormwater Management

2. Hold on to it – for a little while.

Definitions of Stormwater Management

3. Hold on to it indefinitely, remove the pollutants, but don’t create flooding problems or let it be a nuisance.

New District Stormwater Retention Standard

Retain the first 1.2” of rainfall on site or through a combination of on-site and off-site retention.

Retention

- Shift focus from Pollutant Removal to **Runoff Reduction**

- Runoff Reduction
  - Reduces runoff volume
  - Reduces pollutant loads
  - Mimics pre-development hydrology
  - Groundwater recharge
  - Reduces flood flows


NE 35th Pl & Siskiyou St.


9. 26. 2001

District Methodology for Achieving Retention

- **Draws from Runoff Reduction Method**
  - **Technical Memorandum April, 2008**

Retention Percentages

Stormwater Management Practice	Runoff Reduction (%)
Green Roof	*45 to 60*
Rooftop Disconnection	*25 to 50*
Raintanks and Cisterns	*40*
Permeable Pavement	*45 to 75*
Grass Channel	*10 to 20*
Bioretention	*40 to 80*
Dry Swale	*40 to 60*
Infiltration	*50 to 90*
Soil Amendments	*50 to 75*
Sheetflow to Open Space	*50 to 75*
Filters	0
Dry Ponds	0 to 15
Wetlands	0
Wet Ponds	0

Runoff Reduction Tech Memo: www.cwp.org

Runoff Reduction Processes

Retention Requirement is not just infiltration!

- ✓ Infiltration
- ✓ Canopy Interception
- ✓ Evaporation
- ✓ Transpiration
- ✓ Rainwater Harvesting
- ✓ Extended Filtration

New District Stormwater Retention Standard

Retain the first 1.2” of rainfall on site or through a combination of on-site and off-site retention.

Stormwater Retention Volume

$$SWRv = P\ (Rv_I * \%I + Rv_C * \%C + Rv_N * \%N) * SA * 7.48 / 12$$

- SWRv = Volume required to be retained on site (gal)
- P = Precipitation (in)
- Rv_I = 0.95 (runoff coefficient for impervious cover)
- Rv_C = 0.25 (runoff coefficient for compacted cover)
- Rv_N = 0.0 (runoff coefficient for natural cover)
- %I = % of site in impervious cover
- %C = % of site in compacted cover
- %N = % of site in natural cover
- SA = Surface area (square feet)

Precipitation Depths:

$SWRv = P (Rv_I*\%I + Rv_C*\%C + Rv_N*\%N)* SA*7.48 / 12$

- For Major Land-Disturbing Activity: P = 1.2 inches
- For Major Substantial Improvement Activity (AWDZ): P = 1.0 inches
- For Major Substantial Improvement Activity (District-wide): P = 0.8 inches

Anacostia Waterfront Development Zone (AWDZ)

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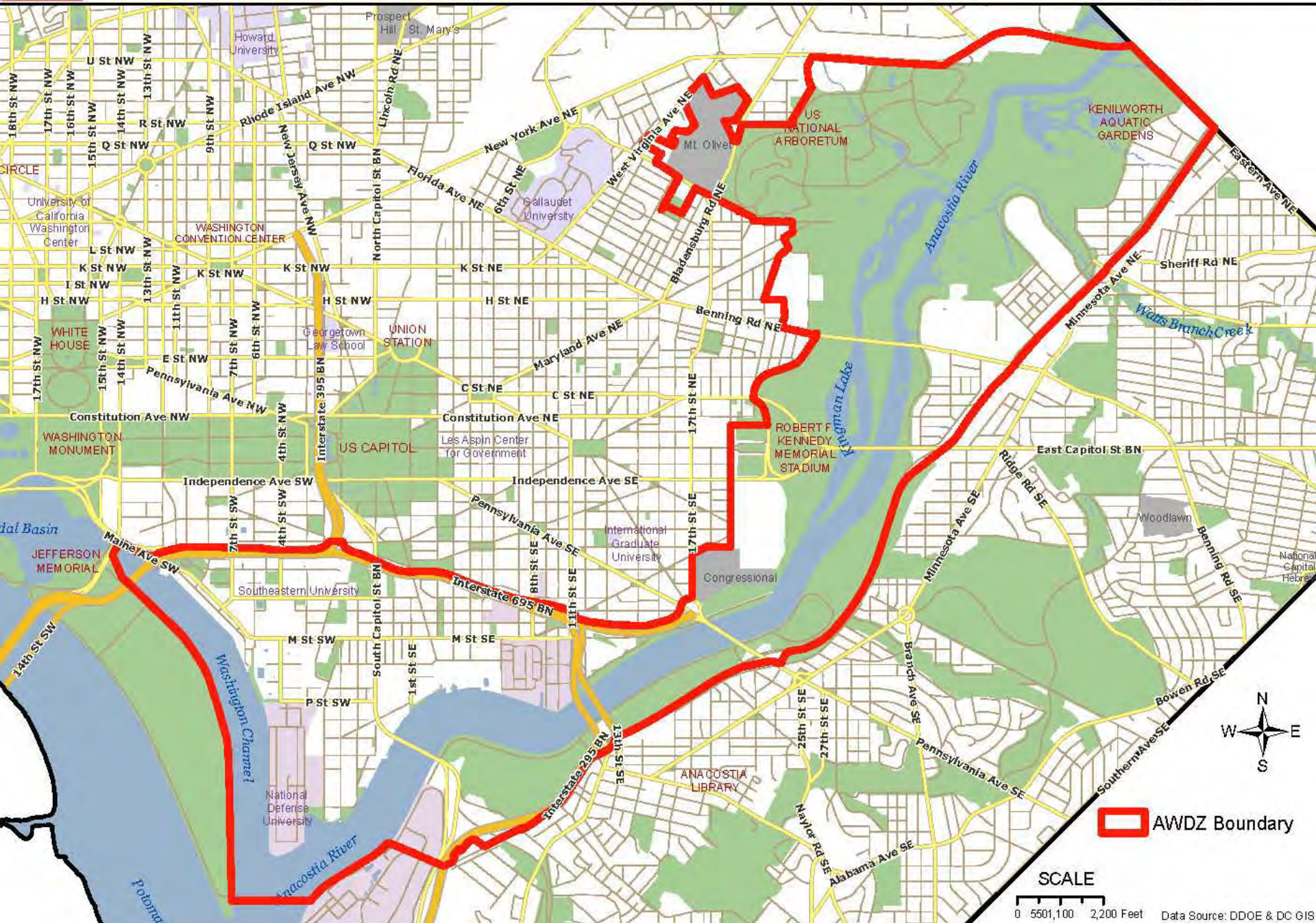
green forward



Water Quality Treatment Volume

$WQTv = P (Rv_I*\%I + Rv_C*\%C + Rv_N*\%N)* SA*7.48 / 12 - SWRv$

- WQTv = Volume required to be retained or treated, above and beyond the SWRv (gal)
- SWRv = Volume required to be retained on site (gal)
- P = Precipitation (in)
- Rv_I = 0.95 (runoff coefficient for impervious cover)
- Rv_C = 0.25 (runoff coefficient for compacted cover)
- Rv_N = 0.0 (runoff coefficient for natural cover)
- %I = % of site in impervious cover
- %C = % of site in compacted cover
- %N = % of site in natural cover
- SA = Surface area (square feet)

Quantity Control Requirements:

- 2-year storm: control peak discharge to pre-development conditions.
- 15-year storm: control peak discharge to pre-project conditions.

For PROW: These volumes are incorporated into the MEP process.

Figure 2.7: PROW Requirements

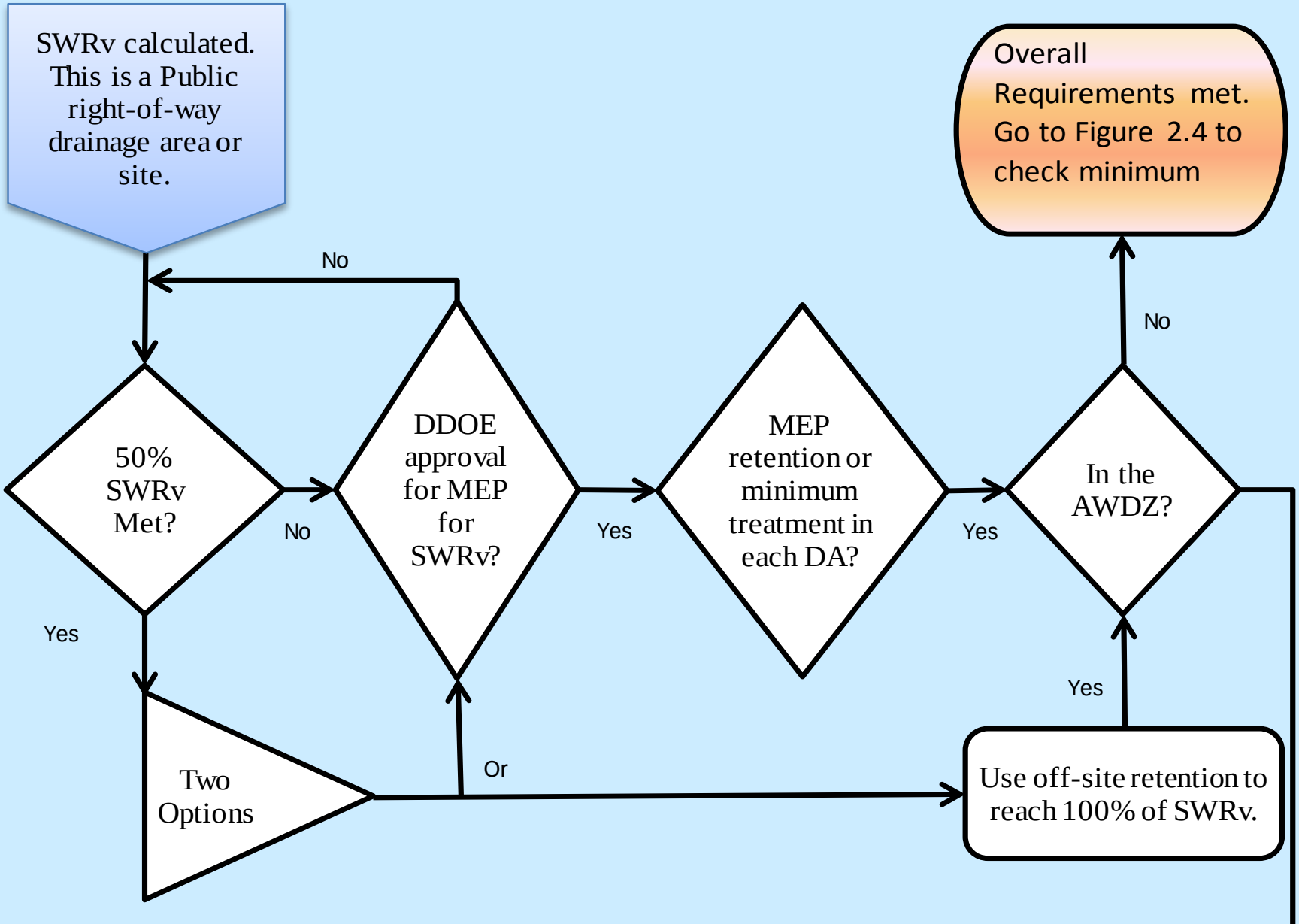
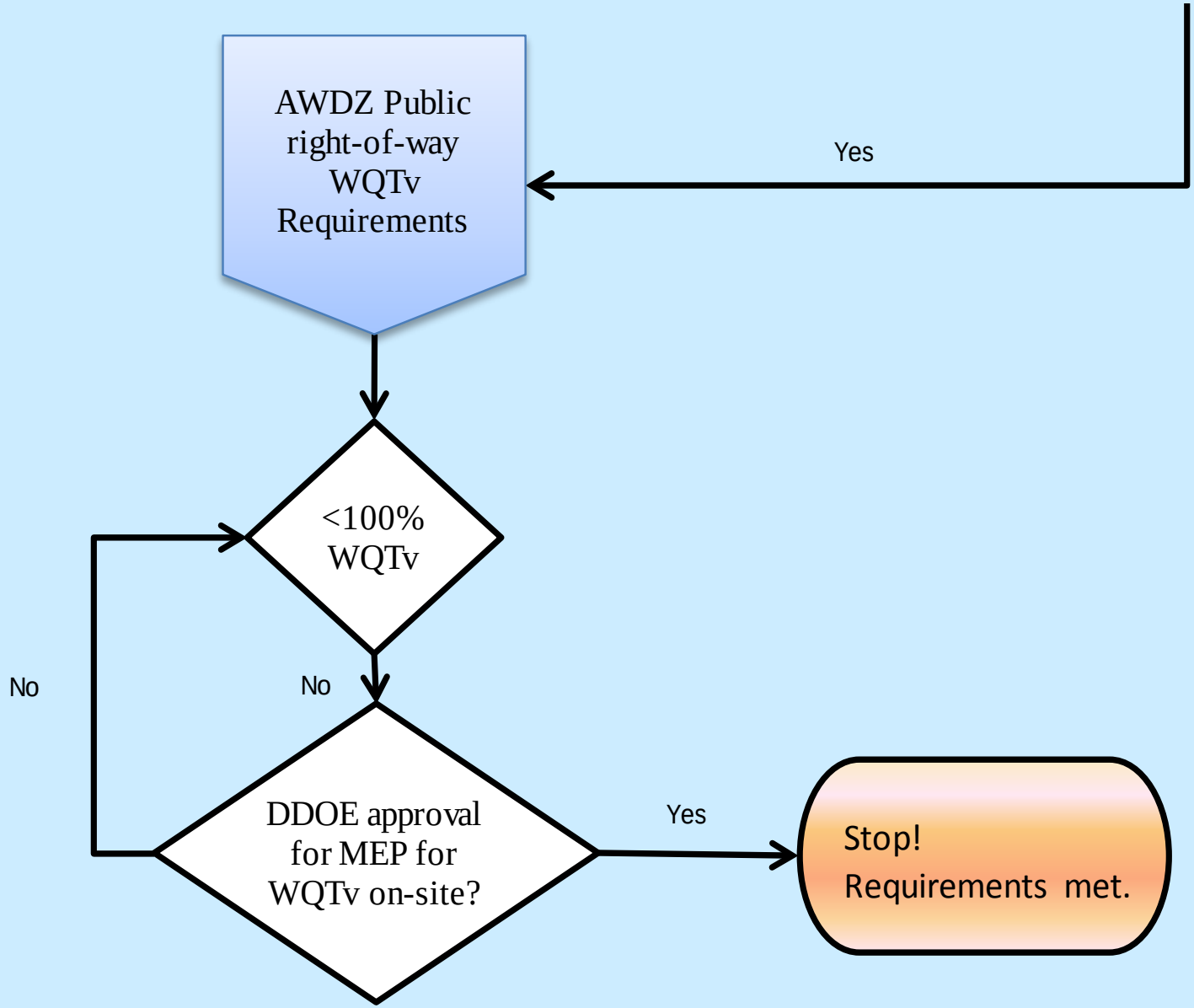


Figure 2.7: PROW Requirements



Stormwater BMP Options

CENTER FOR WATERSHED PROTECTION

Changes to the Stormwater Guidebook

New BMPs	Existing BMPs
3.2 Green Roof	3.7 Filtering Systems
3.3 Rainwater Harvesting	3.8 Infiltration
3.4 Impervious Surface Disconnection	3.9 Open Channels
3.5 Permeable Pavement	3.10 Ponds
3.6 Bioretention	3.11 Wetlands
3.13 Proprietary Practices	3.12 Storage Practices
3.14 Tree Planting and Preservation	

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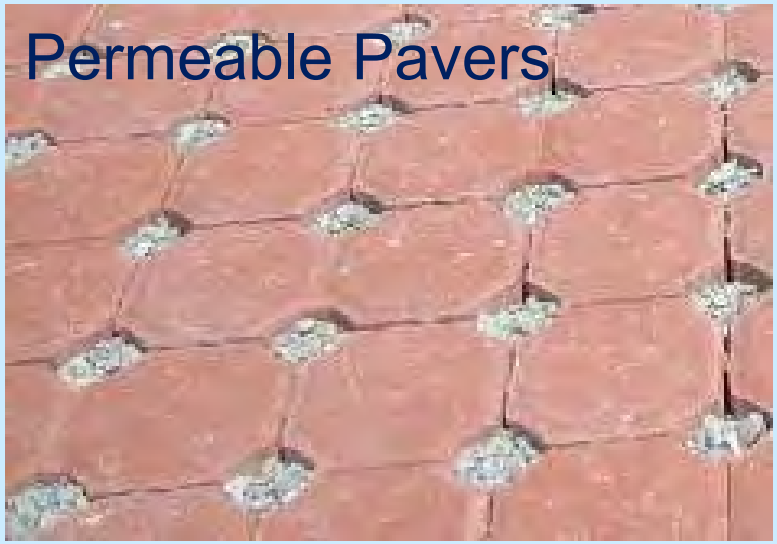
3.5 Permeable Pavement

Permeable Pavement

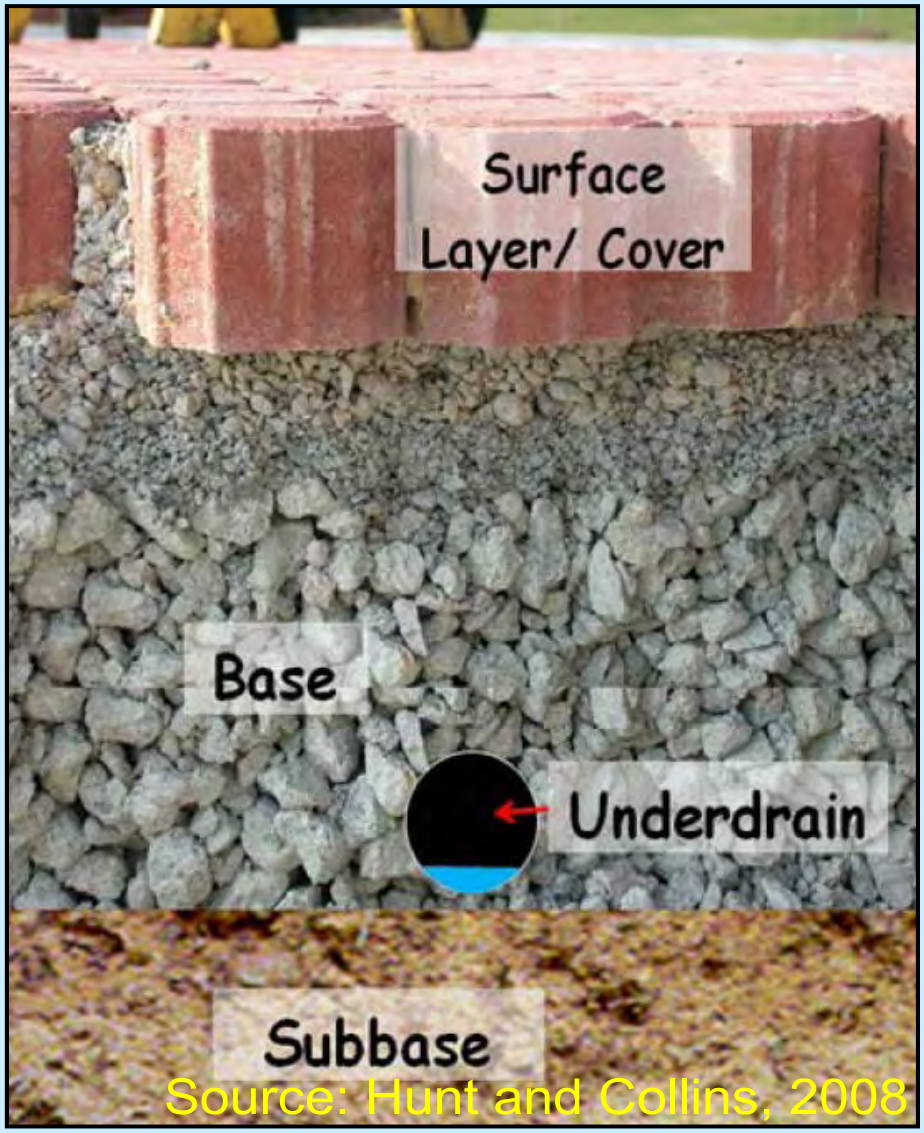
Permeable Pavers



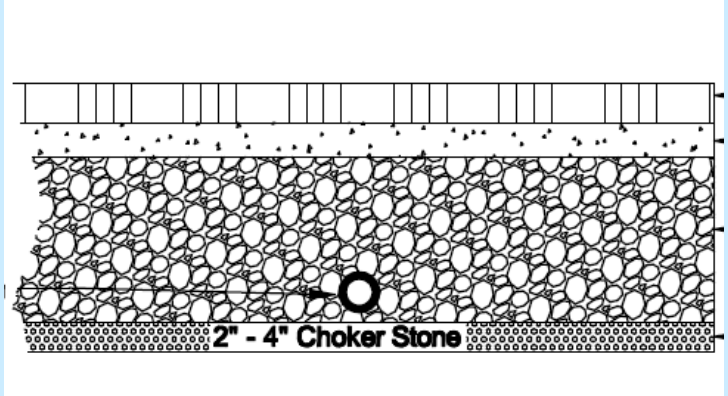
Pervious Concrete

Porous Asphalt

Permeable Pavement

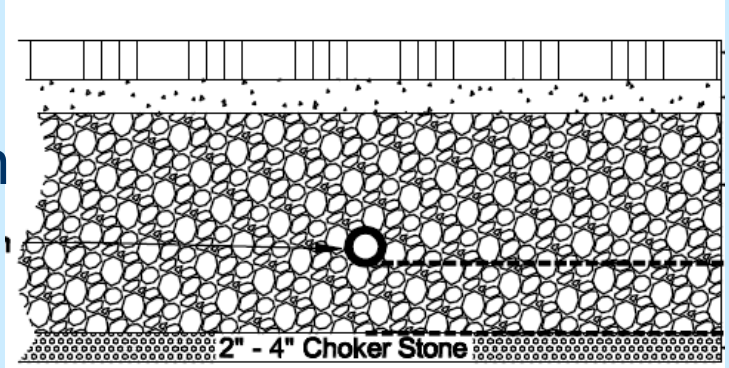


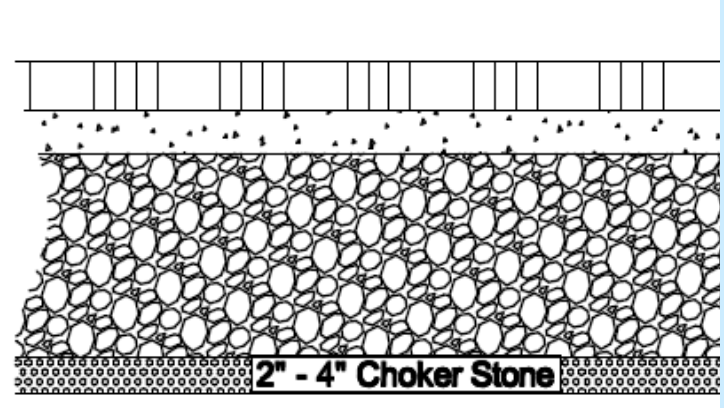
Permeable Pavement Versions



Standard

Enhanced with Underdrain





Enhanced without Underdrain

Permeable Pavement Feasibility Criteria

- Ratio of external contributing impervious surface to permeable pavement is **4:1**
- CDA should be impervious
- 2’ depth to seasonally high water table
- 5% maximum surface slope
- 10’ setback from buildings, unless a impermeable liner is used on edge
- Compaction or vehicle traffic must be avoided if possible.

Permeable Pavement Design Criteria

- Structural Design
  - Total traffic
  - In-situ soil strength
  - Bedding and reservoir layer design
- Hydraulic Design
  - Design volume

Permeable Pavement Design Criteria

Equation 3.2:

$$d_p = \frac{\left(\frac{P \times Rv_I \times DA}{A_p}\right) - \left(\frac{i}{2} \times t_f\right)}{\eta_r}$$

- d_p = Depth of the reservoir layer (or the depth of the infiltration sump, for enhanced designs with underdrains) (ft)
- DA = Total contributing drainage area, including the permeable pavement surface (sf.)
- A_p = Permeable pavement surface area (ft^2)
- P = The rainfall depth for the SWRv or other design storm (ft)
- Rv_I = Runoff coefficient for impervious cover (0.95)
- i = The field-verified infiltration rate for the subgrade soils (ft./day). If an impermeable liner is used in the design then i = 0.
- t_f = The time to fill the reservoir layer (day) – assume 2 hours or 0.083 day
- η_r = The effective porosity for the reservoir layer (0.35)

Permeable Pavement Design Criteria

Equation 3.3:

$$t_d = \frac{d_p \times \eta_r}{\left(\frac{i}{2}\right)} = \frac{d_p \times \eta_r \times 2}{i}$$

For enhanced design only

t_d = Time to drain (days) (must be < 2.0)

d_p = Depth of the reservoir layer (ft)

η_r = The effective porosity for the reservoir layer (0.35)

i = The field-verified infiltration rate for the subgrade soils (ft./day). If an impermeable liner is used in the design then $i = 0$

Equation 3.4:

$$Sv = A_p \times \left[\left(d_p \times \eta_r \right) + \left(\frac{i \times t_f}{2} \right) \right]$$

Sv = Storage Volume of Practice (ft^3)

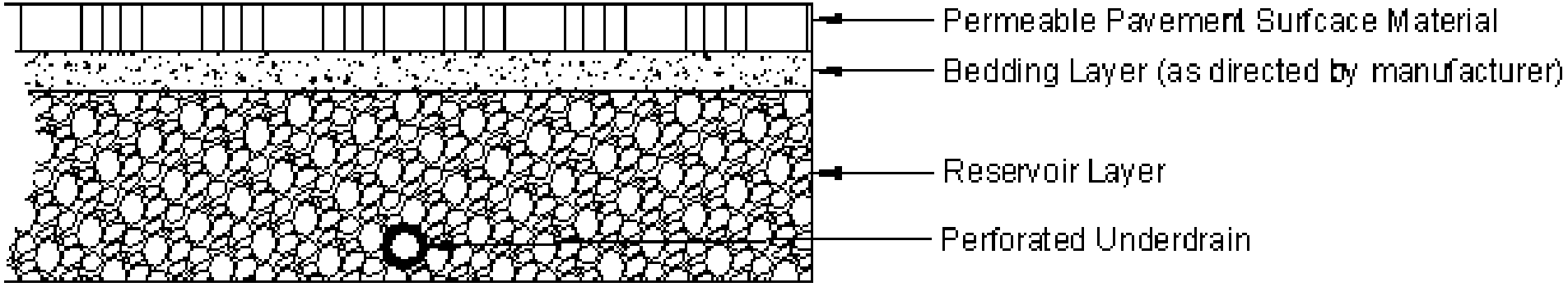
Ap = The permeable pavement surface area (ft^2)

t_f = The time to fill the reservoir layer (day) – assume 2 hours or 0.083 day

Permeable Pavement Retention Value Calculations

Standard Design

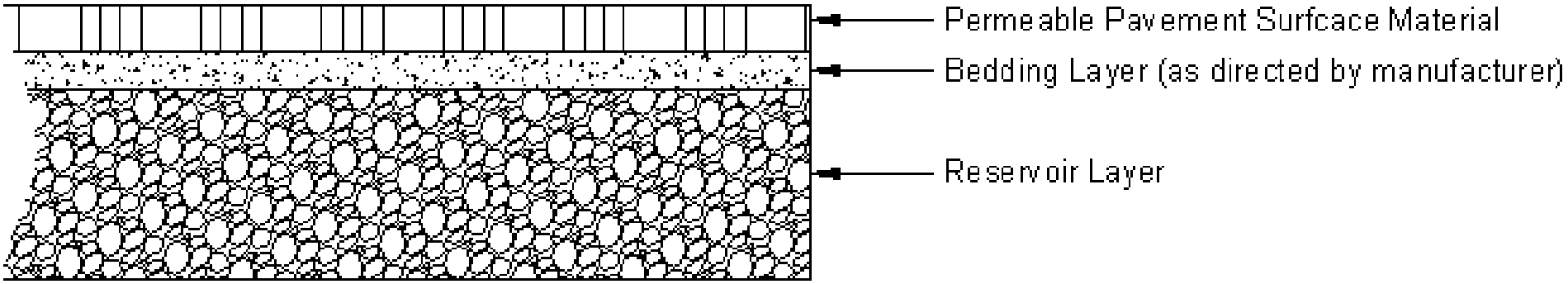
- Retention Value = 4.5 CF per 100 SF of practice area
  - ~ 45% volume reduction



Permeable Pavement Retention Value Calculations

Enhanced Design without Underdrain

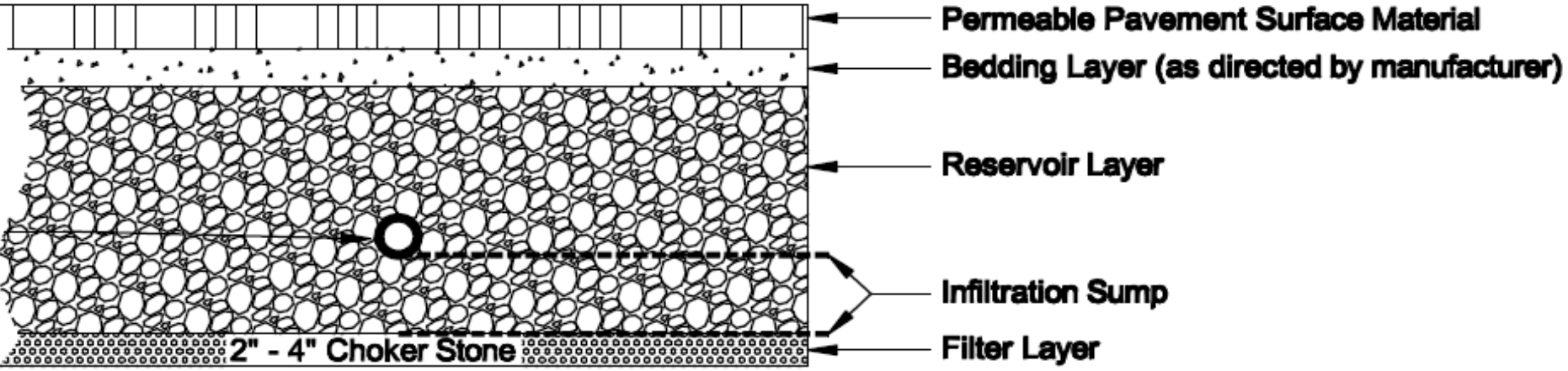
- Retention Value = 100% of Storage Volume in Reservoir Layer



Permeable Pavement Retention Value Calculations

Enhanced Design with Underdrain

- Retention Value = 100% of Storage Volume in Infiltration Sump Layer
- Additional 4.5 CF per 100 SF of practice area



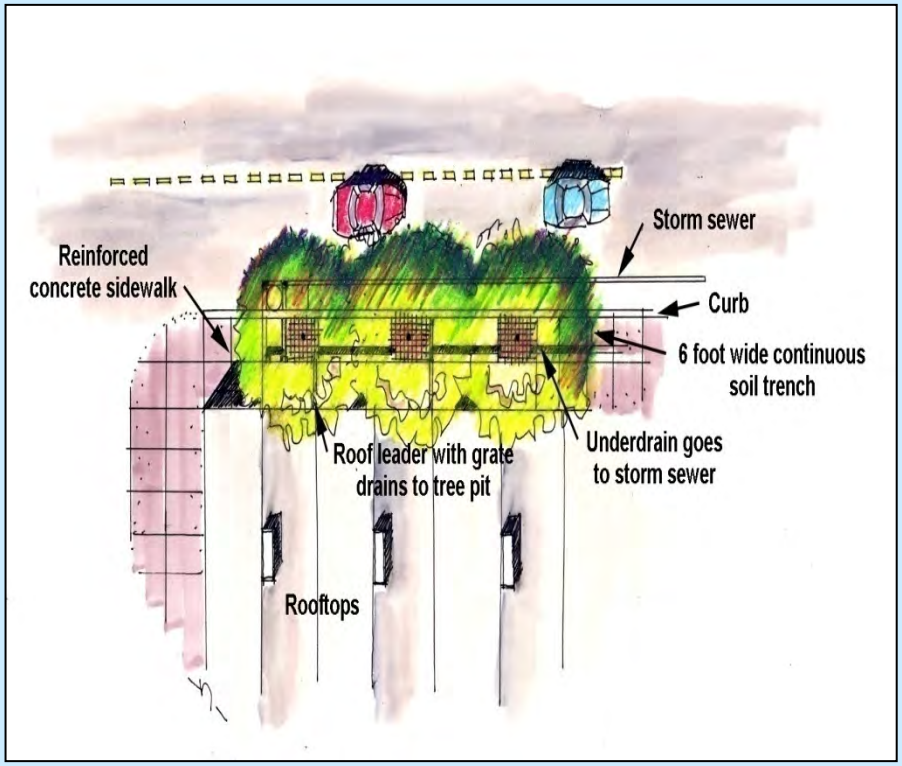
Questions?

3.6 Bioretention

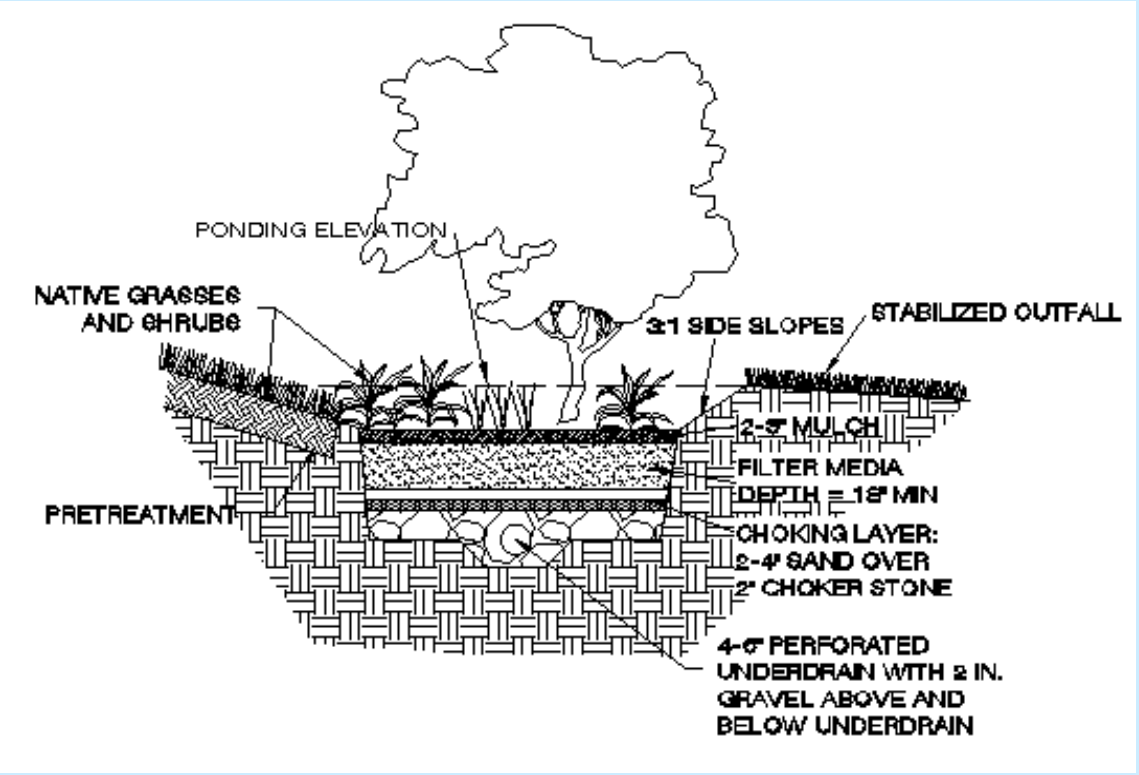
http://twicsy.com/i/GHbDxd

Curb Extension Bioretention

Bioretention Planter Adjacent to Roadway



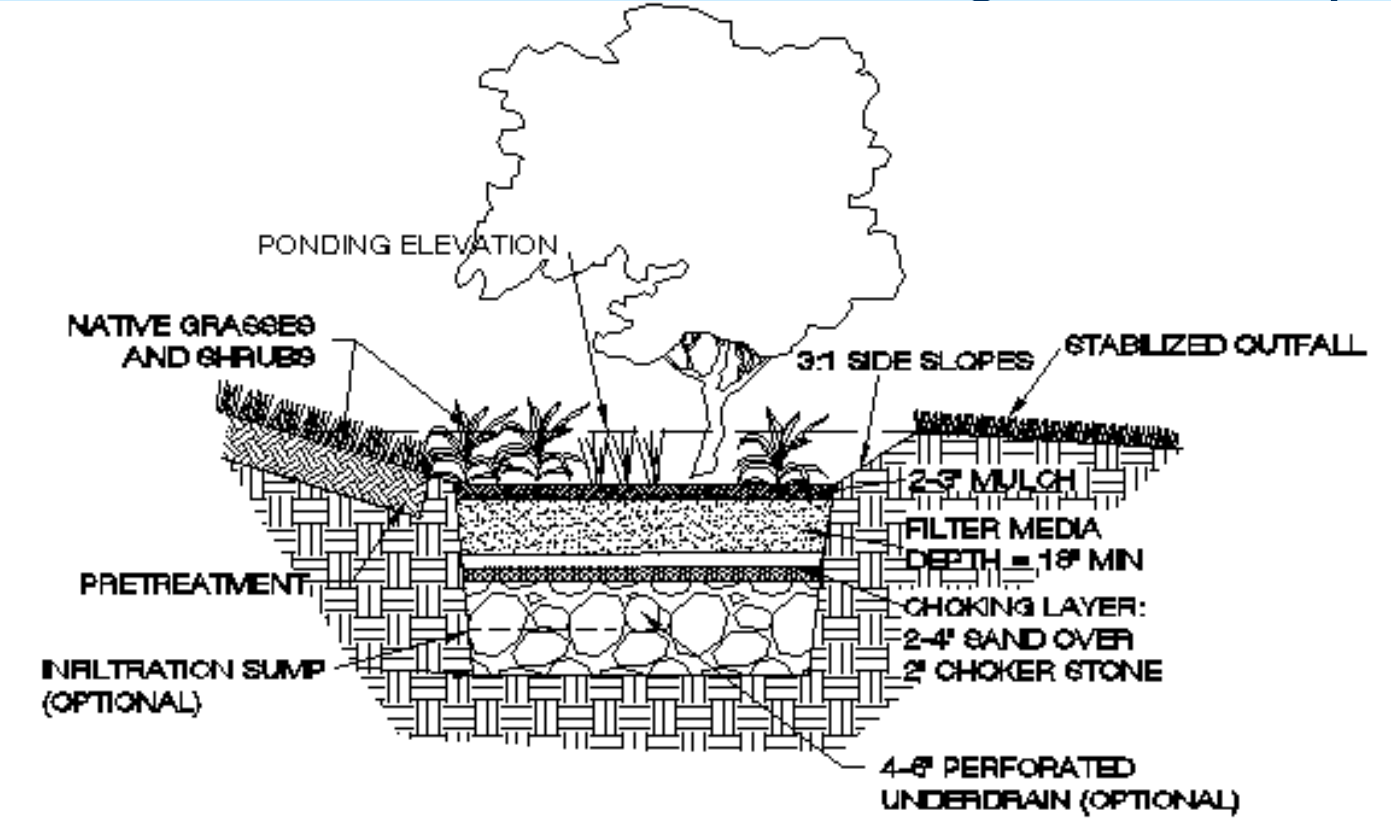
Standard Bioretention Design



- Underdrain designs without enhanced features
- < 24” media
- 60% retention value for the design storm captured
- Additional TSS removal
- Oversizing practice can result in meeting full criteria

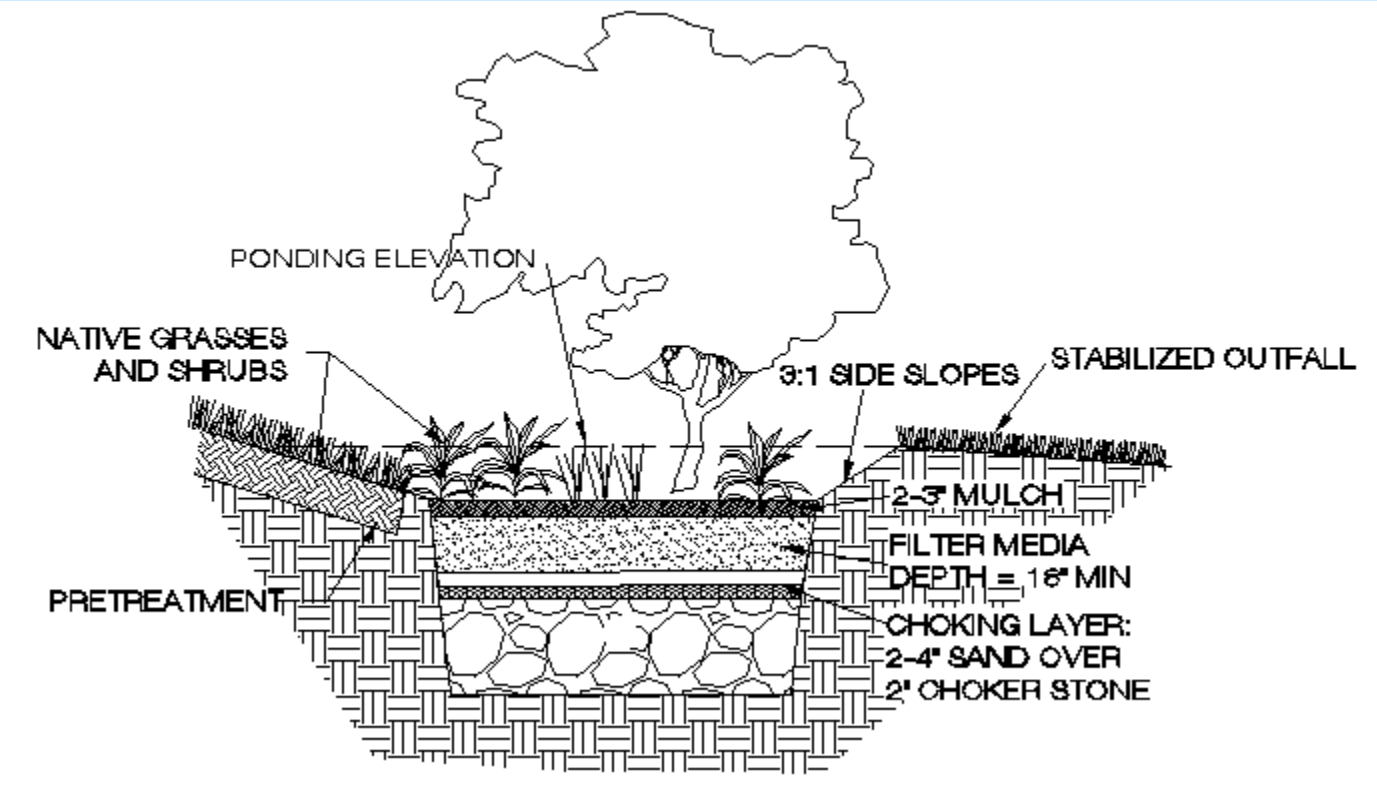
Enhanced Bioretention 1

- Underdrain designs with infiltration sump and 24” media
- 100% retention value for the design storm captured



Enhanced Bioretention 2 (Infiltration)

- For infiltration designs (storage volume must infiltrate within **72 hours**)
- Retention value for the design storm captured



Bioretention Feasibility Criteria

- 2 to 4 feet of head required
- 2’ depth to seasonally high water table
- 10’ setback from buildings
- Compaction/traffic traffic must be avoided if possible.

Conveyance Criteria and Pretreatment

- Conveyance: Off-line vs. On-line
  - On-line requires overflow device
- Pretreatment Required
  - Pretreatment Cell
  - Grass Filter Strips
  - Stone Diaphragm
  - Etc.

Bioretention Design Criteria

- Maximum ponding depth
  - 18” with 3:1 side slopes (if soil)
- Minimum filter depth
  - 24” for enhanced designs
  - 18” for standard designs
- Infiltration designs
  - Must infiltrate within 72 hours.

Bioretention Design Criteria

- Maximum filter media depth
  - The runoff coefficient of the CDA to the BMP (RvCDA)
  - The bioretention ratio of BMP surface area to the BMP CDA (SA:CDA) (in percent)
  - See Table 3.21

Table 3.21 Determining Maximum Filter Media Depth (feet)

Table 3.21Determining Maximum Filter Media Depth (feet)

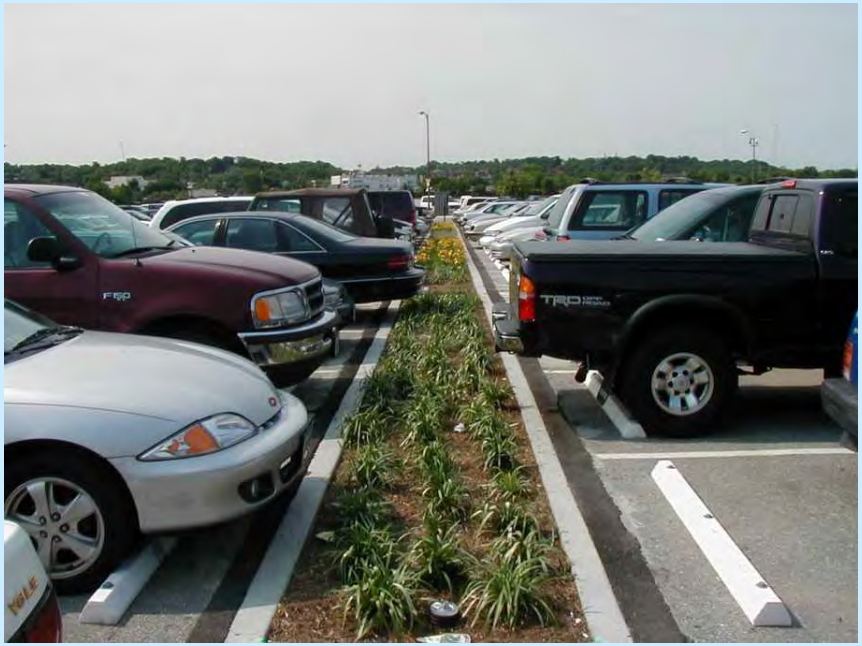
SA:CDA (%)	RvCDA								
	0.25	0.3	0.40	0.50	0.60	0.70	0.80	0.90	0.95
0.5%	6.5	6.5	6.5	6.5	6.5	6.5	6.5	6.5	6.5
1.0%	5.0	5.5	6.0	6.5	6.5	6.5	6.5	6.5	6.5
1.5%	3.5	4.0	5.0	6.0	6.0	6.5	6.5	6.5	6.5
2.0%		3.0	4.0	4.5	5.5	6.0	6.0	6.5	6.5
2.5%			3.5	4.0	4.5	5.0	5.5	6.0	6.0
3.0%				3.5	4.0	4.5	5.0	5.5	5.5
3.5%					3.5	4.0	4.5	5.0	5.0
4.0%					3.0	3.5	4.0	4.5	4.5
4.5%						3.5	3.5	4.0	4.0
5.0%							3.5	4.0	4.0
5.5%								3.5	3.5
6.0%								3.0	3.5
6.5%									3.0
7.0%									
7.5%									
8.0%									
8.5%									
9.0%									
9.5%									
10.0%									

Bioretention Design Criteria

- Filter Media Specifications
  - 80%-90% sand (at least 75% is classified as coarse or very coarse sand)
  - 10%-20% soil fines (silt and clay; maximum 10% clay)
  - 3%-5% organic matter (leaf compost)
  - P concentrations between 5 and 15 mg/kg (Mehlich I) or 18 and 40 mg/kg (Mehlich III)

Bioretention Design Criteria

- Surface Cover Options
  - Mulch and perennial vegetation
  - Turf
  - Stone with perennial vegetation



Bioretention Design Criteria

Sizing Equation

$$Sv = SA_{bottom} \times [(d_{media} \times \eta_{media}) + (d_{gravel} \times \eta_{gravel})] + (SA_{average} \times d_{ponding})$$

Where:

$Sv_{practice}$ = total storage volume of practice (ft^3)

SA_{bottom} = bottom surface area of practice (ft^2)

d_{media} = depth of the filter media (ft)

η_{media} = effective porosity of the filter media (typically 0.25)

d_{gravel} = depth of the underdrain and underground storage gravel layer (ft)

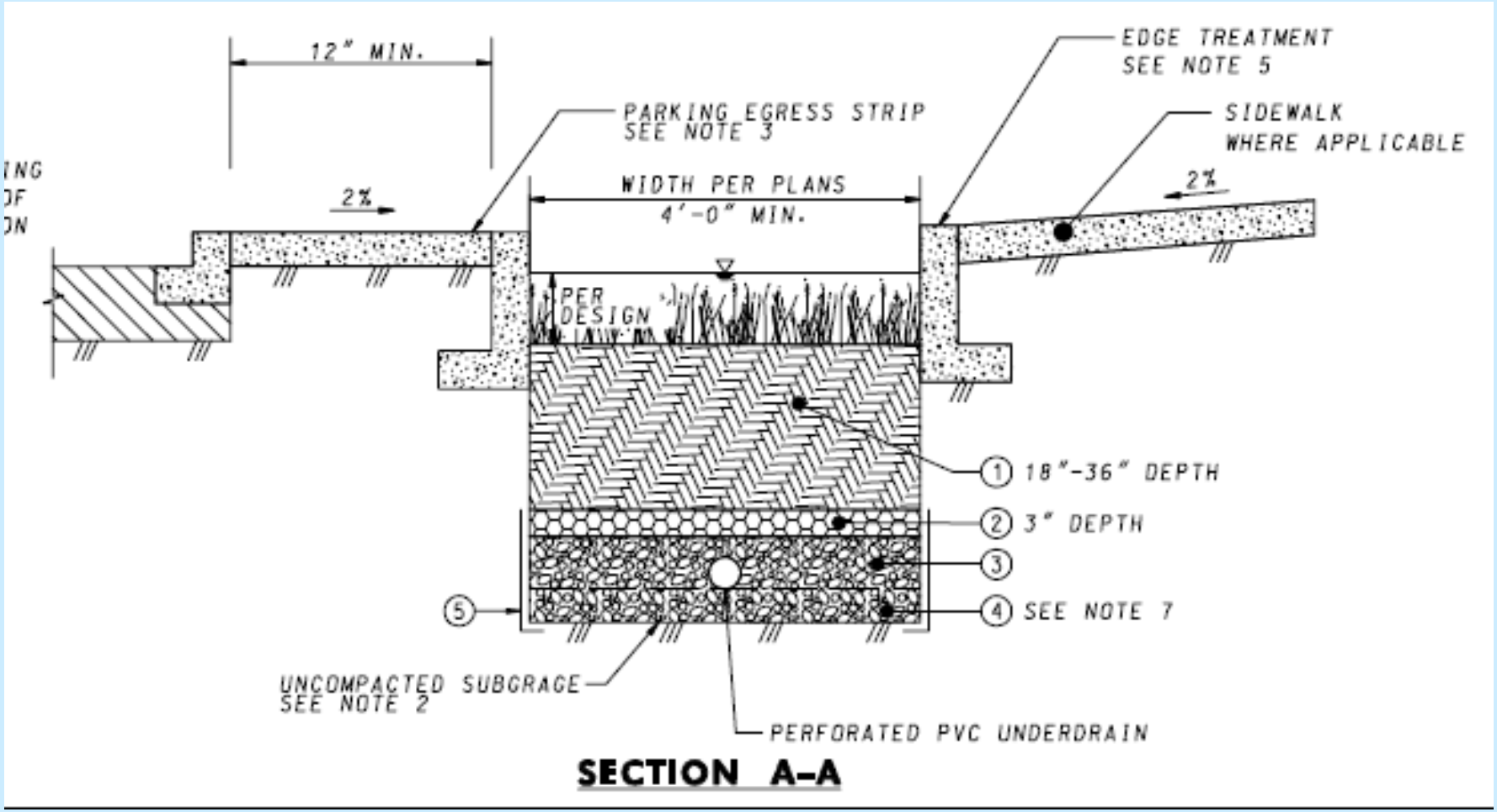
η_{gravel} = effective porosity of the gravel layer (typically 0.4)

$SA_{average}$ = the average surface area of the practice (ft^2)

$$SA_{average} = \frac{SA_{bottom} + SA_{top}}{2}$$

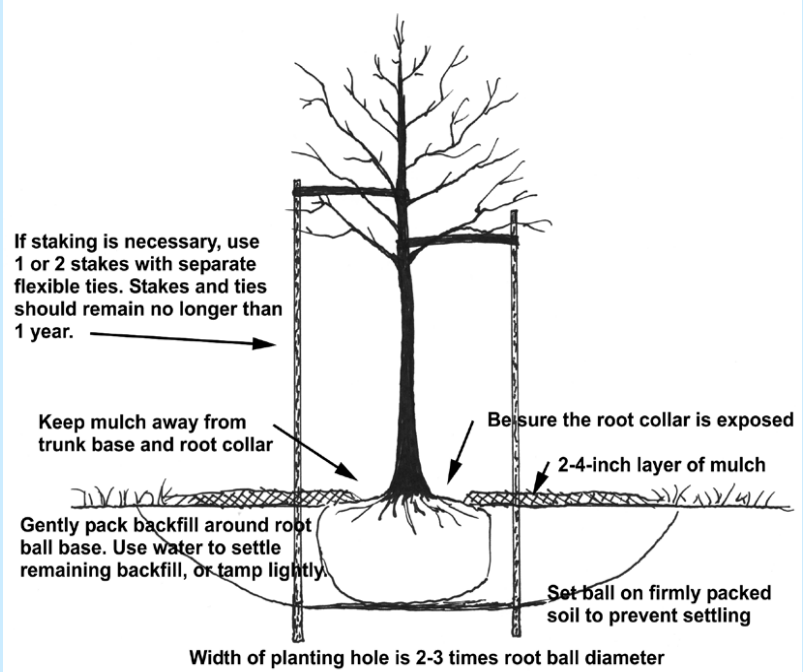
$d_{ponding}$ = the maximum ponding depth of the practice (ft).

Questions?


12" MIN.
EDGE TREATMENT
SEE NOTE 5
PARKING EGRESS STRIP
SEE NOTE 3
SIDEWALK
WHERE APPLICABLE
2%
2%
WIDTH PER PLANS
4'-0" MIN.
PER
DESIGN
1 18"-36" DEPTH
2 3" DEPTH
3
4 SEE NOTE 7
5
UNCOMPACTED SUBGRADE
SEE NOTE 2
PERFORATED PVC UNDERDRAIN
SECTION A-A

3.14 Tree Planting and Preservation

- 1,500 cf of soil volume per tree, or 1,000 cf per tree with shared rooting space
- Preserved trees get 20 cubic foot retention value
- New trees get 10 cubic foot retention value



Questions?

http://www.connectionnewspapers.com/news/2012/may/23/street-runs-through-it/

http://www.vaasphalt.org/

DDOT LID and GI Standards

BMPs for use in the PUBLIC ROW

December, 2013

BMP's for the Public ROW

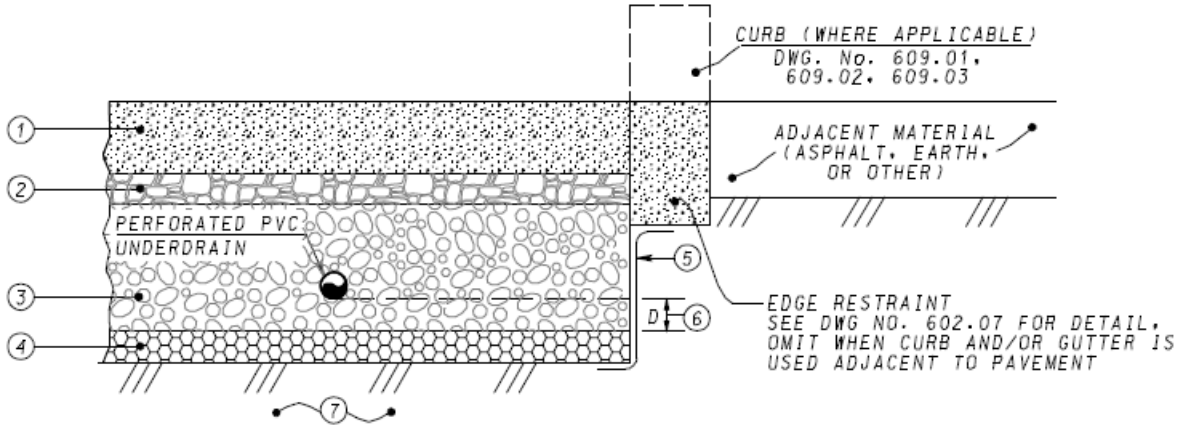
- **Permeable Pavements**
  - Porous Asphalt, Pervious Concrete, Pavers
  - Alleys, Sidewalks, Roads
- **Bioretention**
  - Curb Extension, Planter, Basin, Bio-swale
- **Street Trees w/Soil Volume**

BMPs for use in the PUBLIC ROW

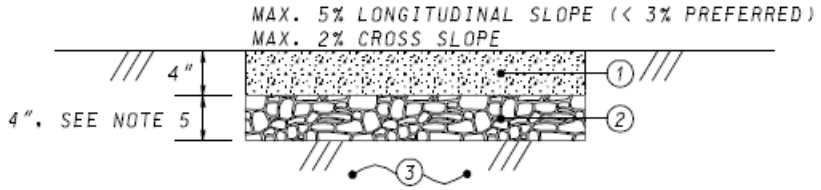
Permeable Pavement

BMP'S FOR THE PUBLIC ROW

Permeable Pav't – Pervious Concrete



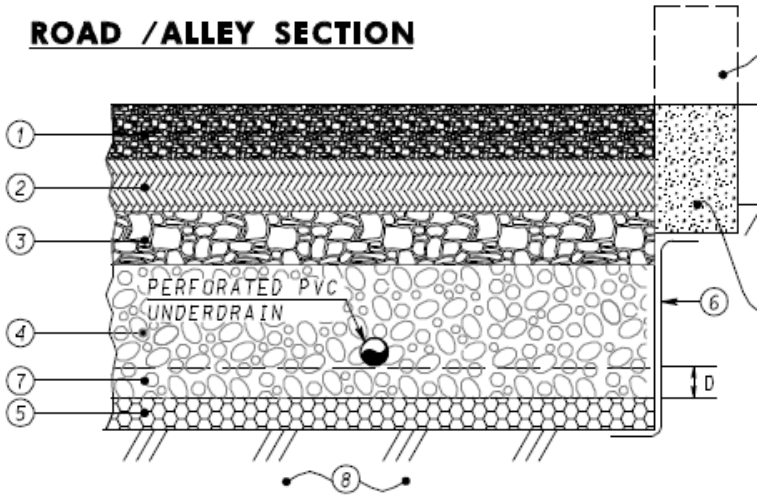
ROAD /ALLEY SECTION



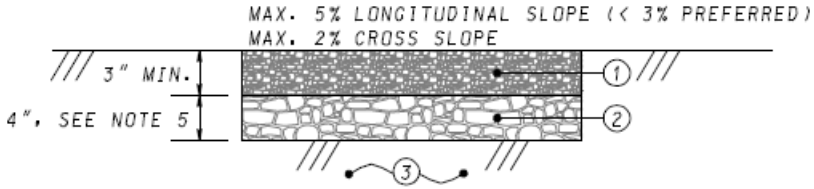
SIDEWALK SECTION

BMP'S FOR THE PUBLIC ROW

Permeable Pav't – Porous Asphalt



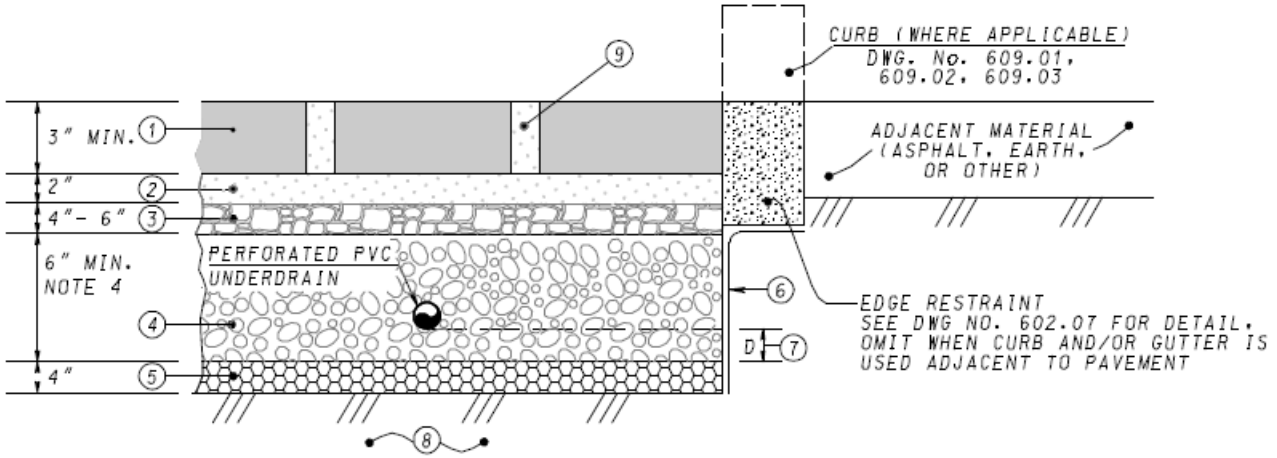
1. POROUS ASPHALT SURFACE COURSE
2. POROUS ASPHALT BASE COURSE
3. CHOKER LAYER, AASHTO #57, #8, OR APPROVED EQUIVALENT
4. RESERVOIR LAYER, AASHTO #3, #2, OR #57, OR APPROVED EQUI
5. FILTER LAYER (OPTIONAL, SEE NOTE 7), AASHTO #8 OR APPROVE
6. GEOTEXTILE CLASS 2, LOCATED ON SIDES OF PRACTICES ONLY
7. INFILTRATION SUMP. FOR STANDARD DESIGN, D = 0"
   FOR ENHANCED DESIGN, SEE NOTE 6
8. UNCOMPACTED SUBGRADE FOR AREAS DESIGNED FOR INFILTRATION



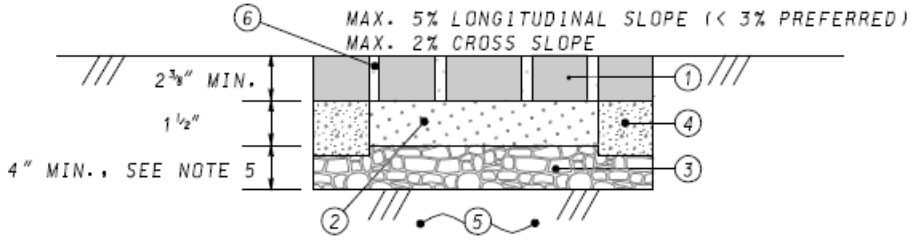
SIDEWALK SECTION

BMP'S FOR THE PUBLIC ROW

Permeable Pav't – Interlocking Pavers



ROAD /ALLEY SECTION



SIDEWALK SECTION

BMP's for the Public ROW

Permeable Pav't Design Considerations

- Traffic Loadings, Bearing Capacity
- Grade steepness
  - Steep slopes promote surface runoff
  - Steep slopes limit reservoir storage
- Contributing drainage area from pervious surfaces
- Depth to storm drain (for U.D. tie-ins)
- Location of utility lines (ex. and prop.)

BMP's for the Public ROW

Permeable Pavement – Strength

- Standard drawings developed for Local Street (class A) and Collector (class B)
- Stone thickness variable – *to be designed by geotechnical methods based on soil bearing capacity and traffic loadings*

Concrete Pavement Option

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

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

BMP's for the Public ROW

Permeable Pavement – Grades

- Best slopes are 2% or flatter
- Terraced bottom slopes can be used to increase storage volume
- Check dams needed when retained 2-year storm volume would surcharge

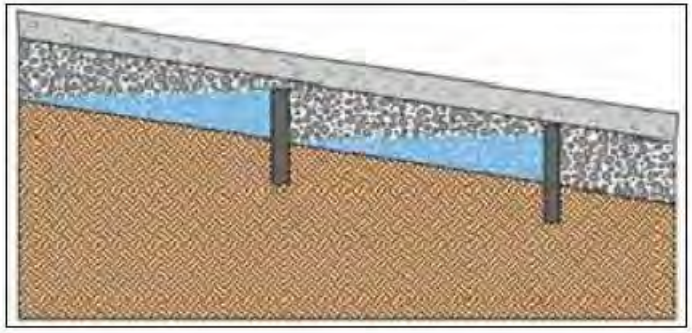


FIGURE 1A. A "CHECK DAM" APPROACH MAY BE USEFUL IN LONG, SLOPED PAVEMENTS.

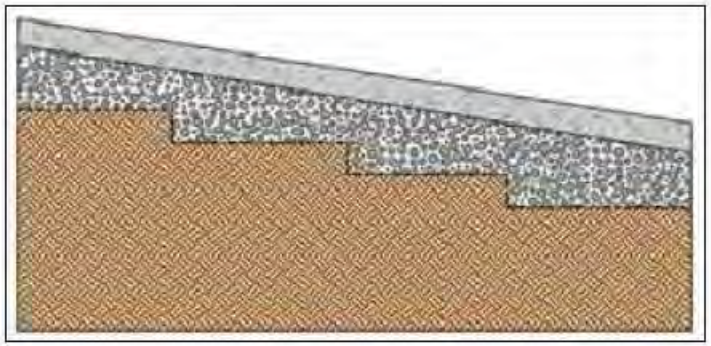


FIGURE 1B. TERRACES IN PERVIOUS CONCRETE PAVEMENT SYSTEM RECHARGE BED WITH LONG SLOPES.

BMP's for the Public ROW

Permeable Pavement

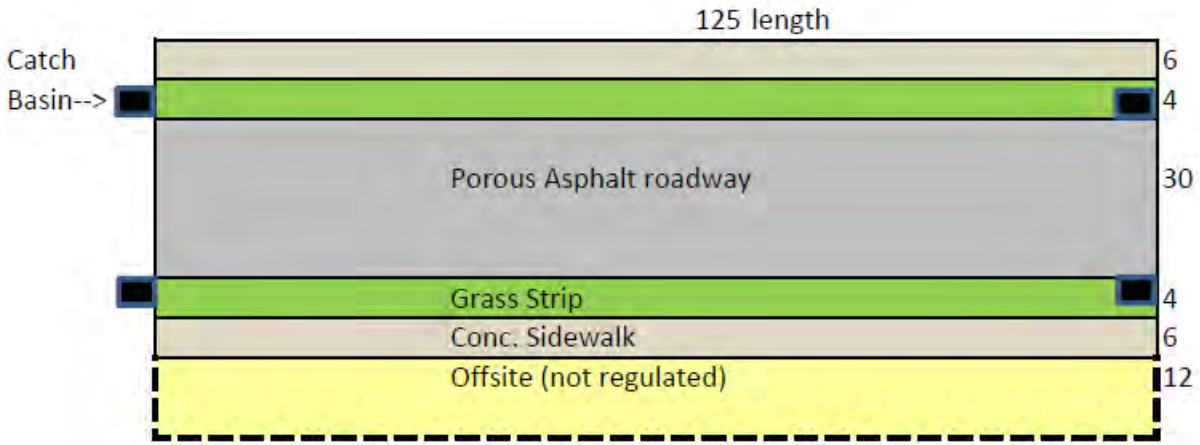
- **Check Dam Material Options**
  - Aggregate Dam w/Waterproof Membrane
  - Concrete
  - Acrylic Sheeting

- Final Details being developed

BMP's for the Public ROW

Permeable Pavement

- Dealing with Grades - *Example*



Contributing Drainage Area	impervious	1500
	pervious	1000
	BMP	3750
	Total	6250

Regulated Retention Volume:	524 CF
2 Year Storm (24 hours) Precip:	3.4 inches
2 Year Storm Volume:	1888 CF

BMP's for the Public ROW

Permeable Pavement

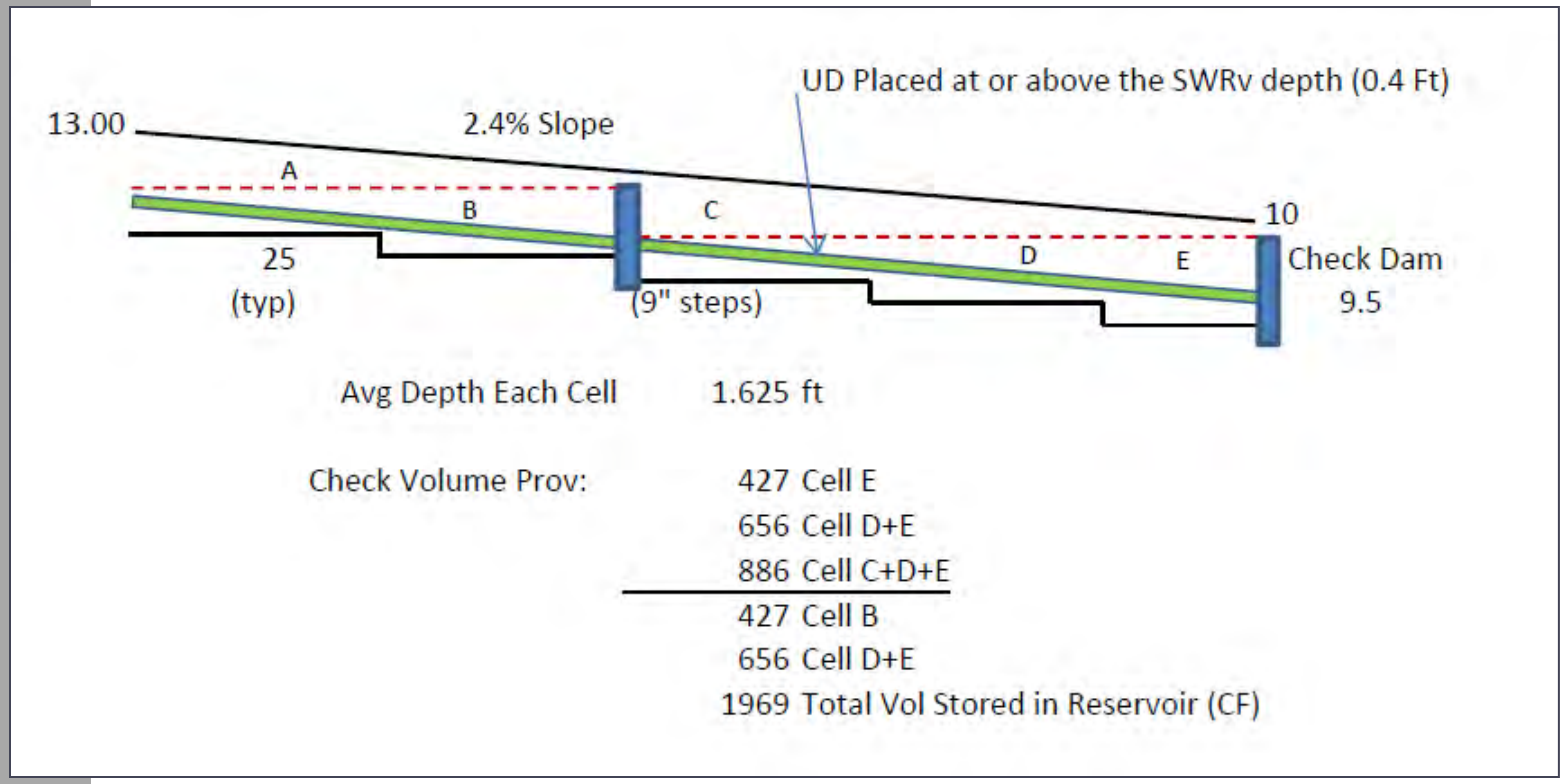
- Dealing with Grades - *Example*

Soil Infiltration Rate, i:	0.26	ft per day (0.13 in/hr)	
Use 2 underdrains, 6" diameter, 2% slope			
qu = flow rate thru UD = 100 ft/day X underdrain slope			
qu (ft/day) =	4	(1 for each UD)	
Total release rate from perm pav't:	4.26	ft per day	
Area of Practice:	3750	SF	
Void Ratio vr:	0.35		
Resv Depth needed for SWRv	0.40	Ft	
Check drawdown time (thru soil):	1.07	days	dp x vr/ 0.5i
Additional storage to hold 2 year, 24 hour storm	1.04	Ft	
Reduction due to UD outflow	0.38	Ft	
Total Depth (if uniform)	1.06	ft	

BMP's for the Public ROW

Permeable Pavement

- Dealing with Grades - *Example*



BMP's for the Public ROW

Permeable Pavement – Contributing Drainage Area

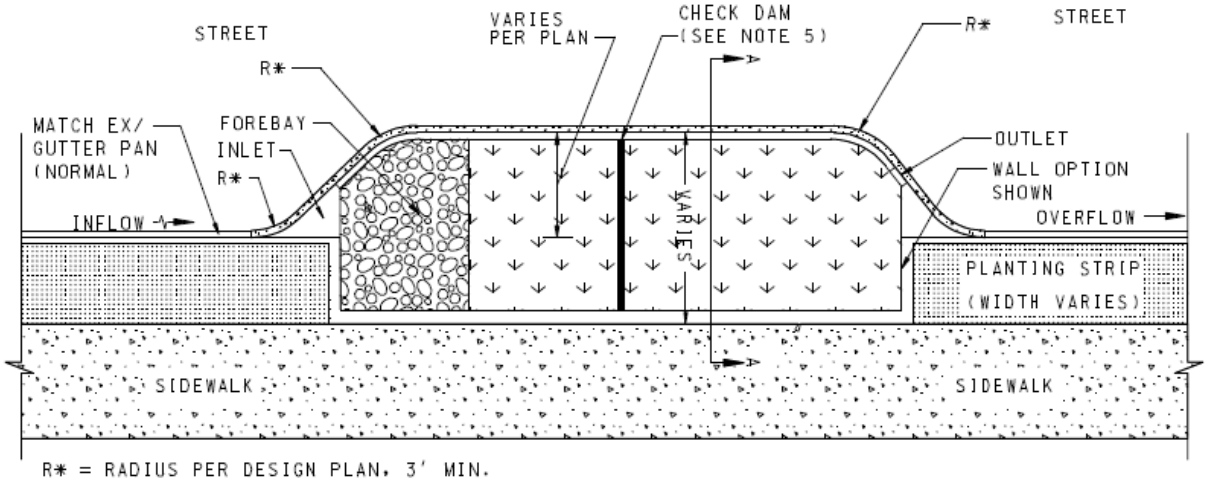
- Ideally, 90% or more of CDA is impervious
  - *Runoff from pervious surfaces contains fines, and can clog pavement*
- When not achievable, provide pretreatment and/or institute a more rigorous inspection and maintenance program

BMPs for use in the PUBLIC ROW

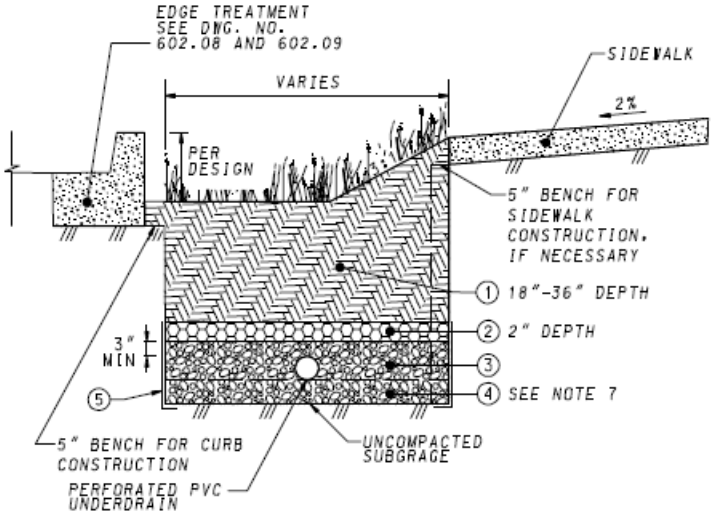
Bioretention

BMP's for the Public ROW

Bioretention – Curb Extension 1



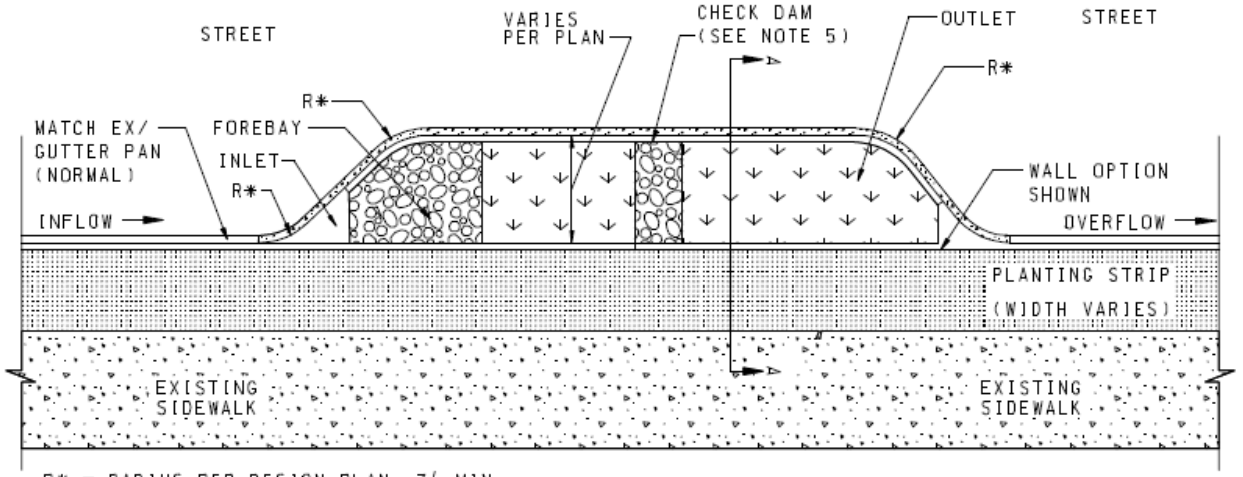
PLAN VIEW



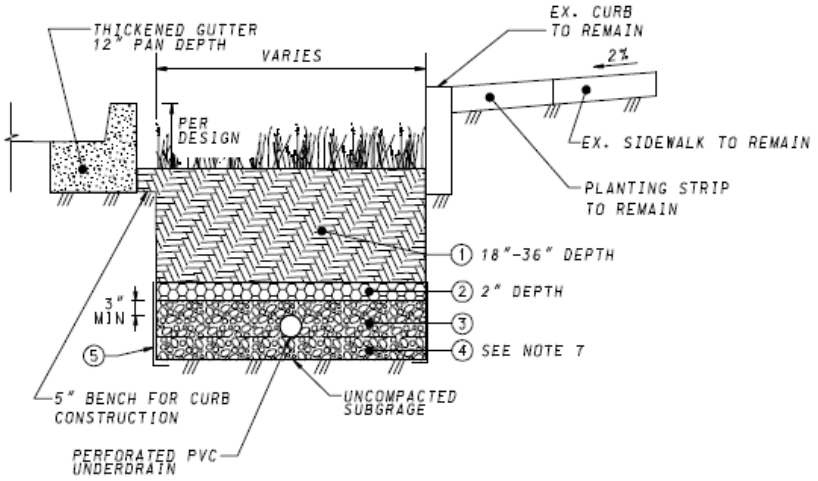
SECTION A-A (SLOPE OPTION)

BMP's for the Public ROW

Bioretention – Curb Extension 2



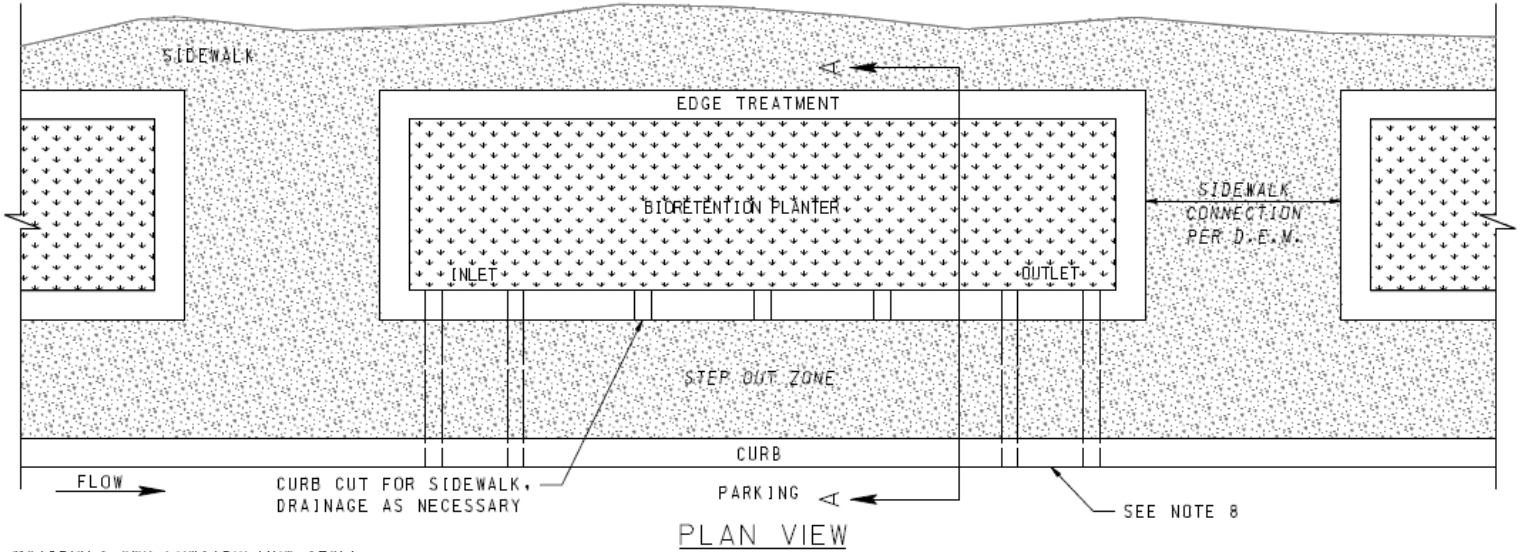
PLAN VIEW

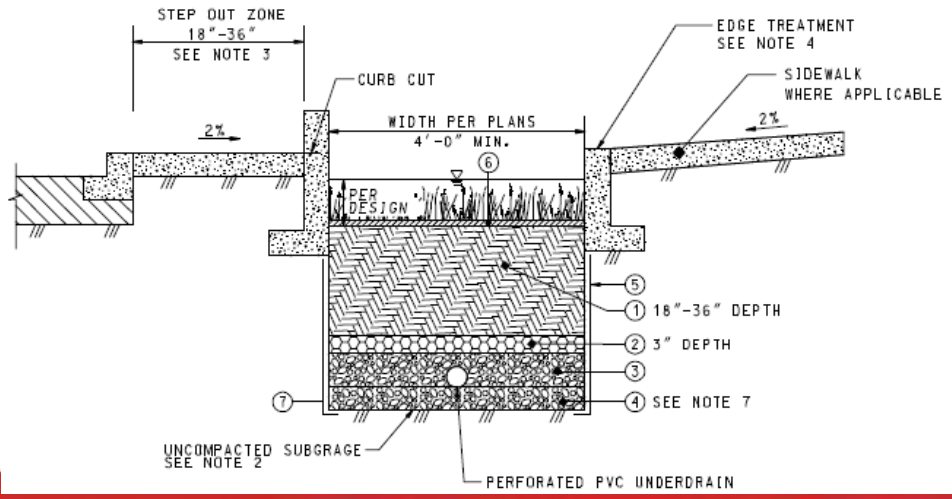


SECTION A-A

BMP's for the Public ROW

Streetscape Bioretention Planter

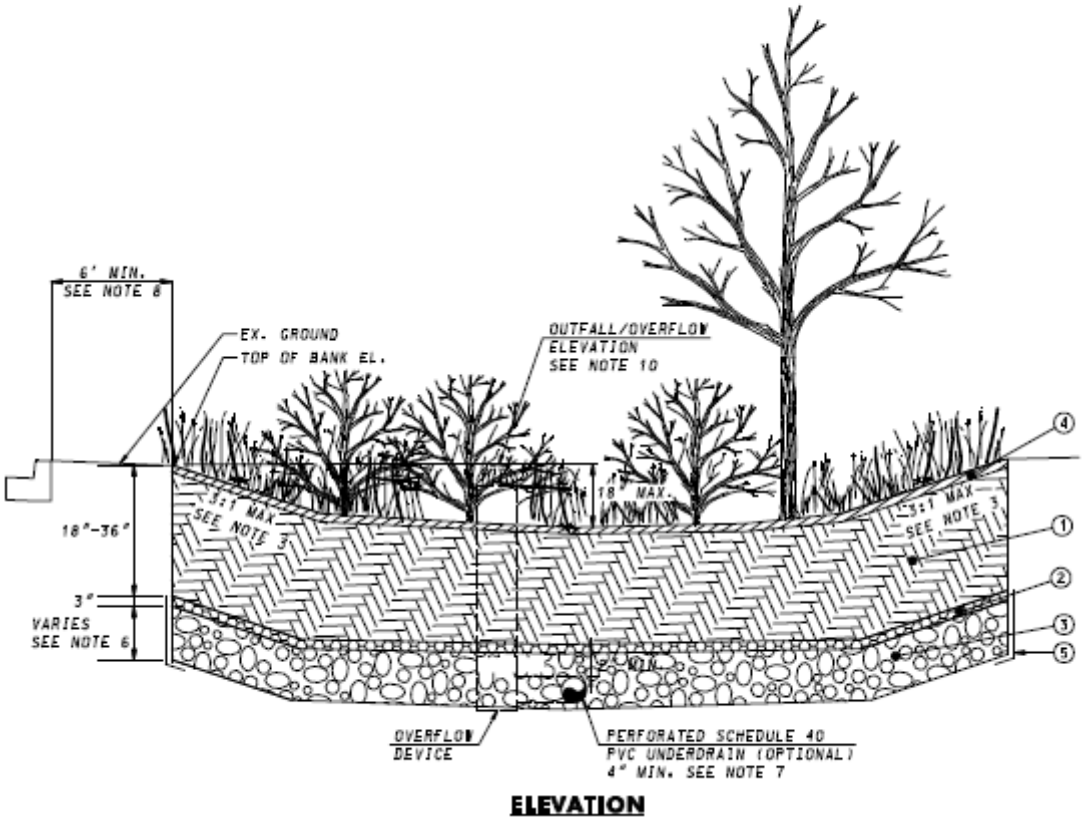




Option adjacent to parking lane

BMP's for the Public ROW

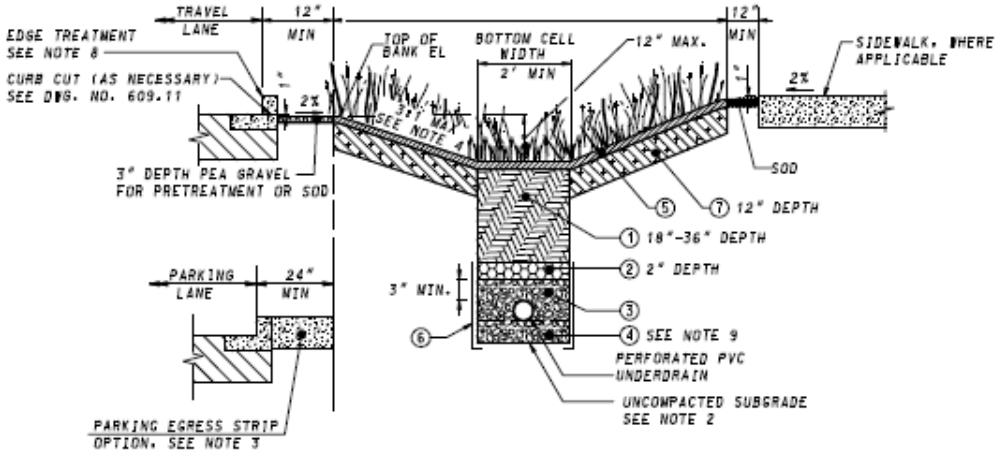
Bioretention in Open Area (basin)



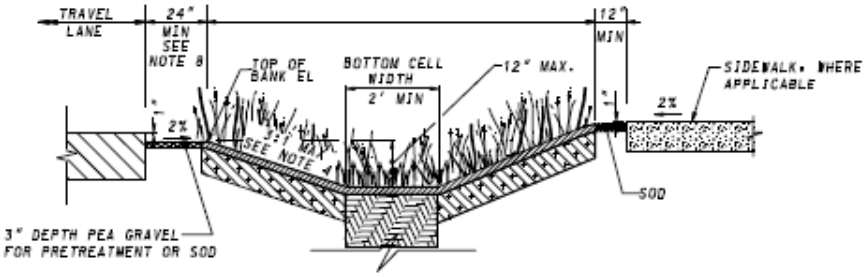
ELEVATION

BMP's for the Public ROW

Bio-Swale – *Design in accordance with Section 3.9, DDOE Stormwater Guidebook*



CLOSED SECTION



OPEN SECTION

BMP's for the Public ROW

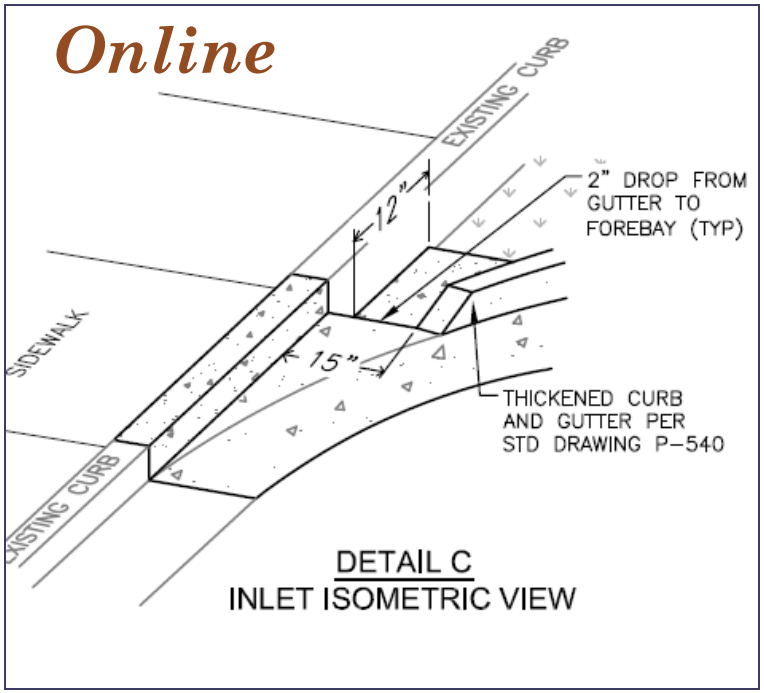
Bioretention Design Considerations

- Contributing Drainage Area (CDA)
- Safety and Access
  - Maximum Ponding Depth for Situation
  - Pedestrian Circulation
  - Vehicular
- Depth to storm drain (for U.D. and/or overflow tie-ins)
- Proximity of existing (and proposed) utility lines

BMP's for the Public ROW

Bioretention – Online vs. Offline

Online



Using Offline is a means to achieve "CDA" and hydraulic conveyance criteria in site-specific bioretention designs

Quasi-Offline

NOTES

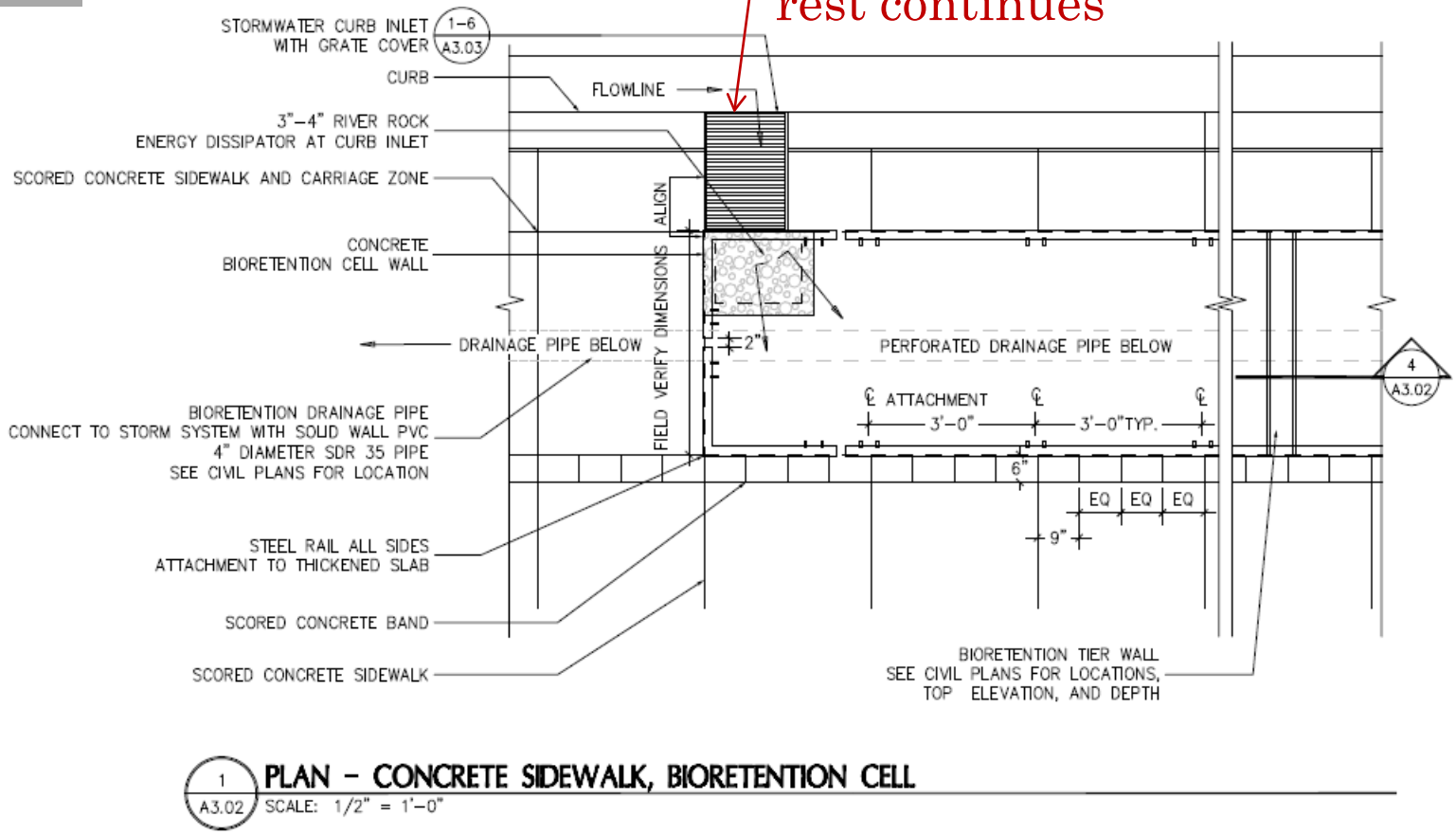
1. INLET MAY BE MODIFIED TO METER THE AMOUNT OF FLOW ENTRY TO STORMWATER FACILITY

BMP's for the Public ROW

Bioretention – Online vs. Offline

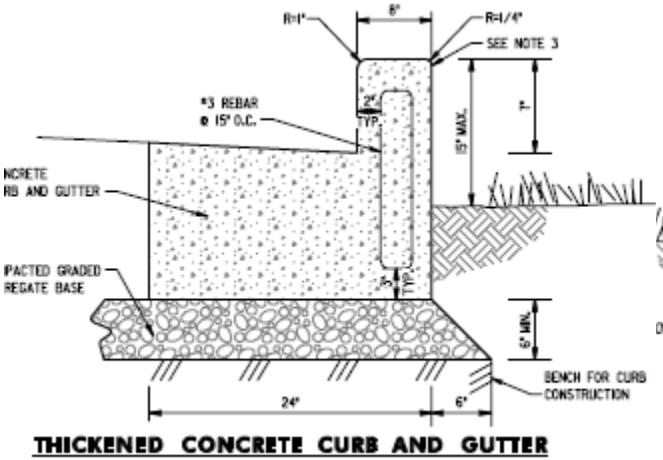
Offline

curb breaks allow some flow to enter from gutter line – the rest continues

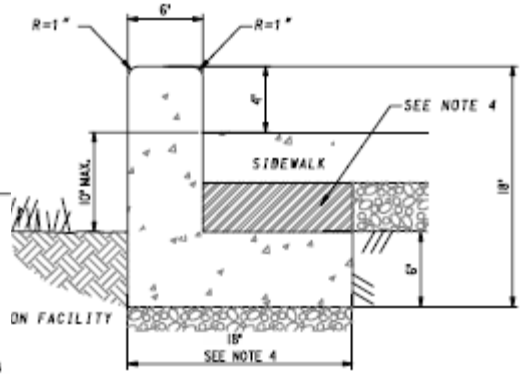


Bioretention: Curb Interface

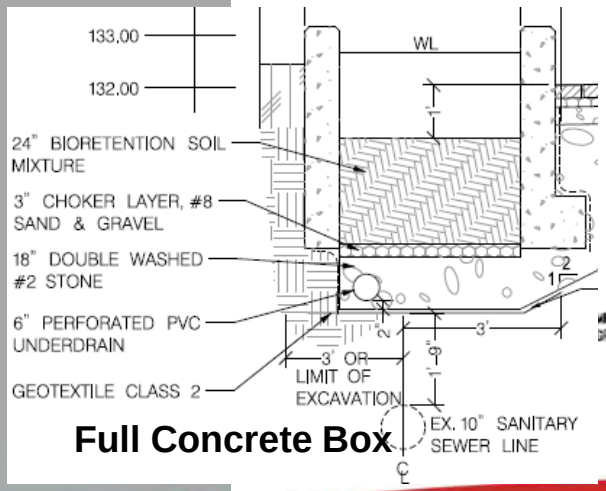
- Protect curb stability next to lightly compacted soil



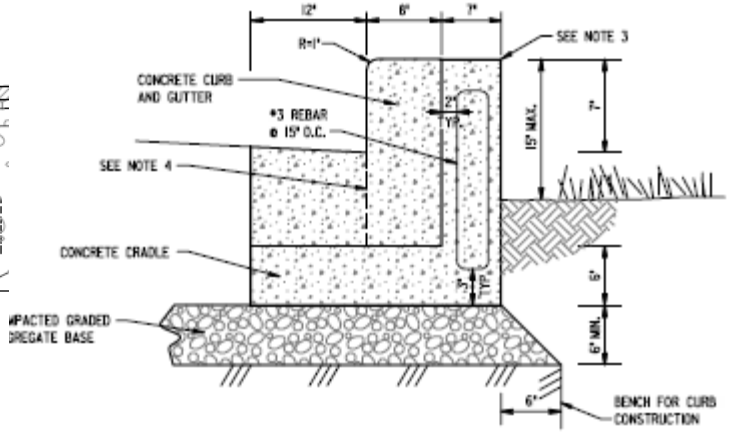
THICKENED CONCRETE CURB AND GUTTER



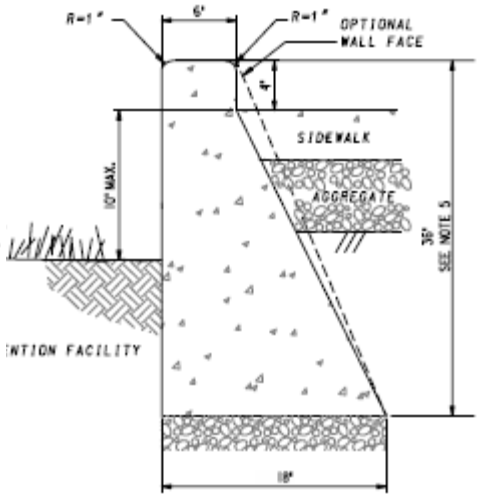
L-WALL (WITH REVEAL)



Full Concrete Box

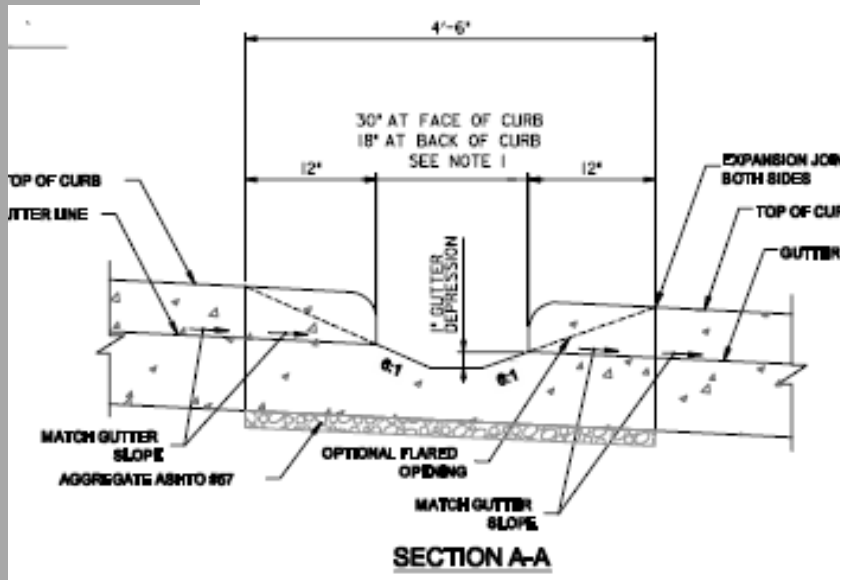


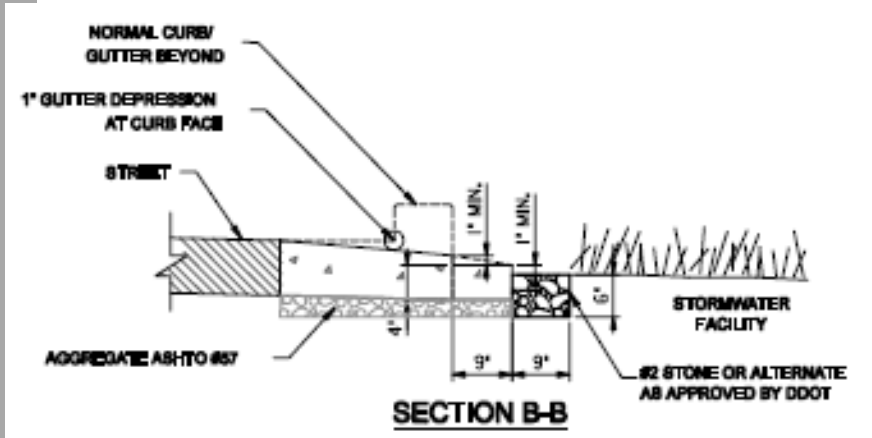
CURB WITH CONCRETE CRADLE

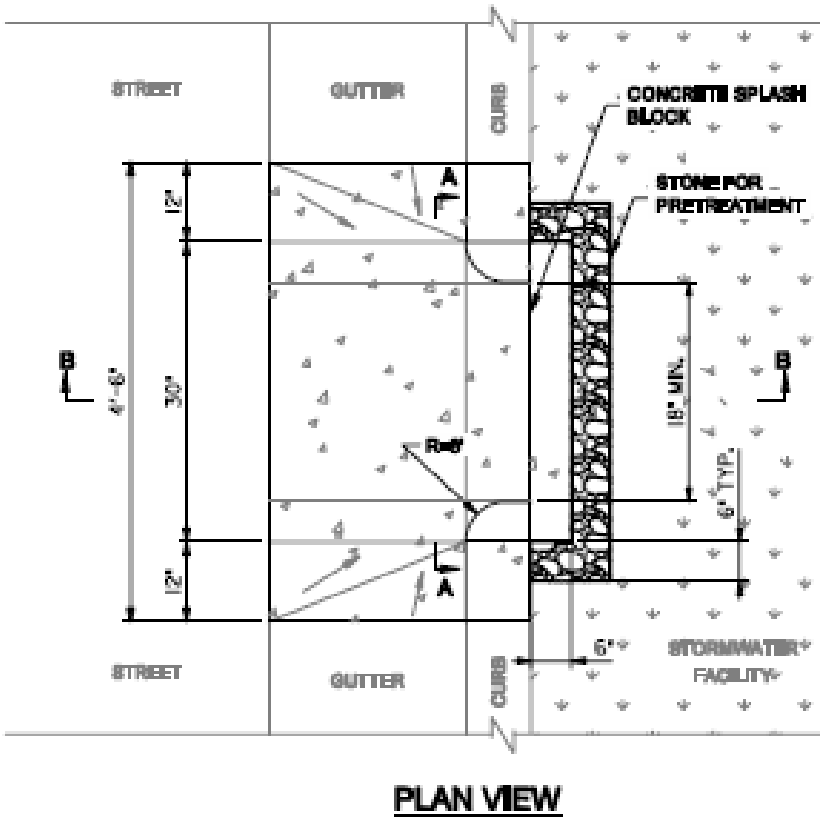


GRAVITY WALL (WITH REVEAL)

Design Challenge: Curb Cut Design



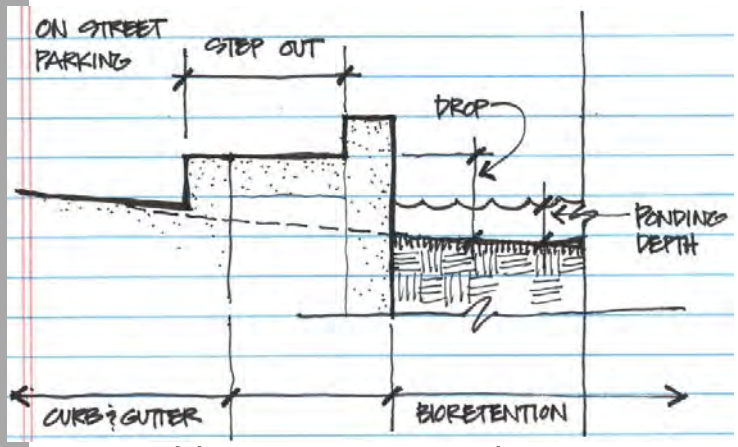




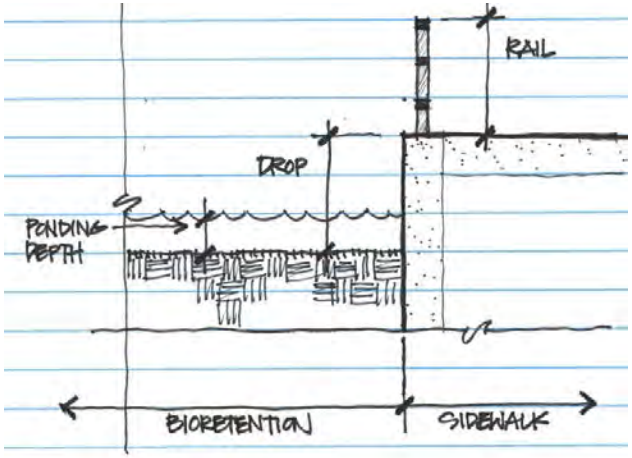
Design Challenge: Curb Cut Design

BMP's for the Public ROW

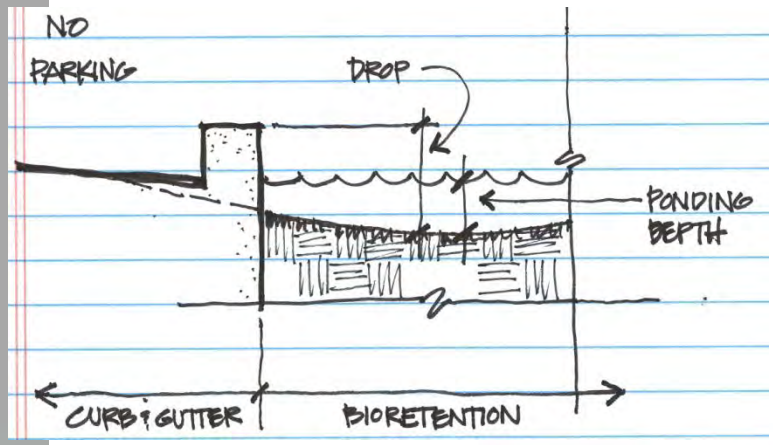
Bioretention – Safety and Access

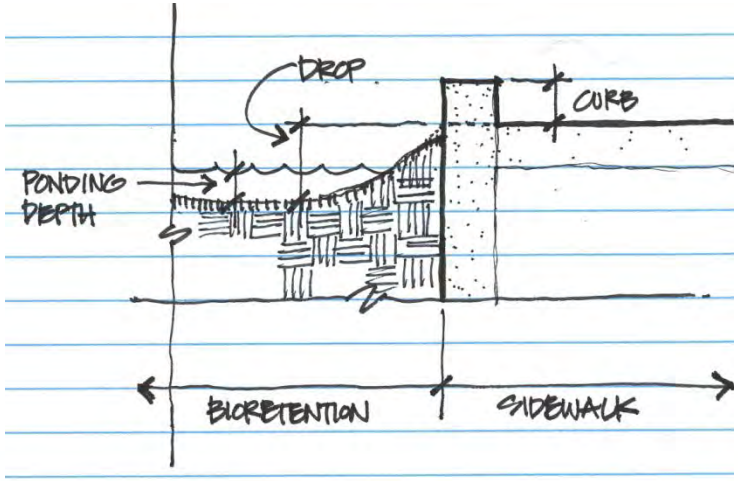


Streetside treatment - curb & step-out



Sidewalk treatment - curb & fence

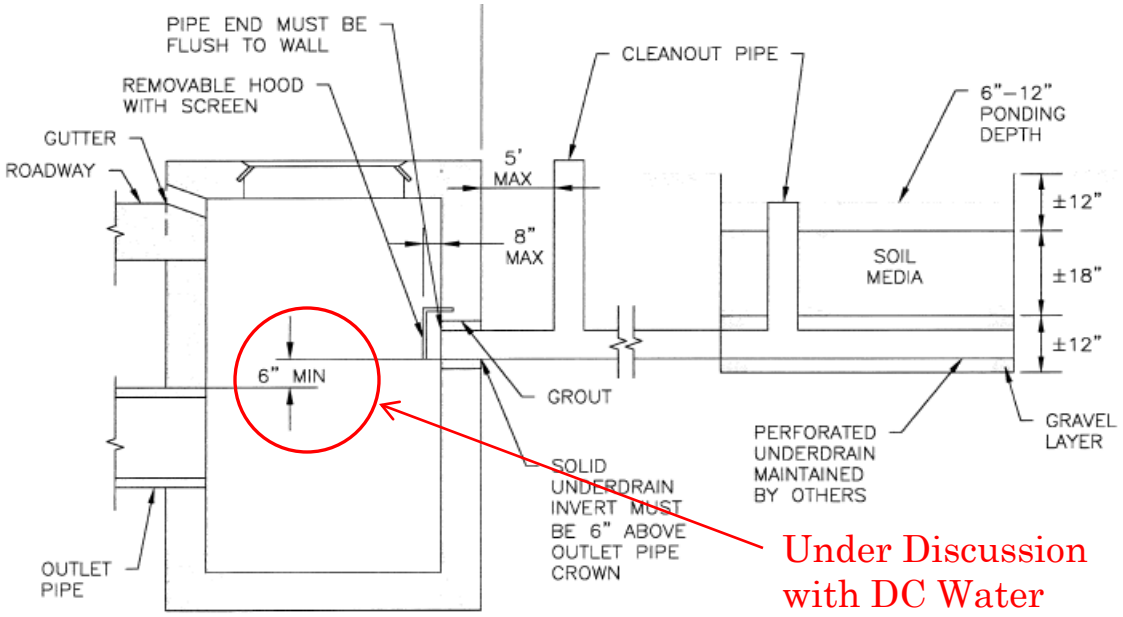




BMP's for the Public ROW

Underdrain Connections

- Catch Basins (meeting certain criteria)
- Storm Manholes (preferred by DC Water)
- Direct connect to separate storm sewer (tee connection)



BMP's for the Public ROW

Underdrain Connections

- Up-turned Elbow to provide "enhanced" design
- Check draw-down time

BMP's for the Public ROW

Underdrain Connection Req'ts

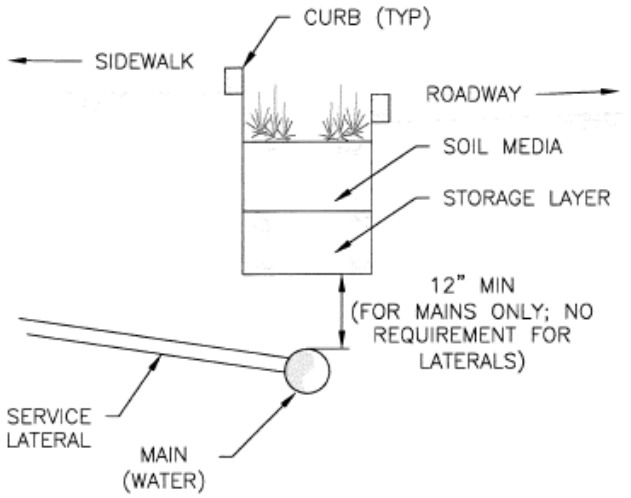
- Infiltration > 1 in/hr – No underdrain needed
- Infiltration < 1 in/hr - Underdrain
- Different connection options
  - Connect to catch basin - Lowest cost
    - Limited by Sewer Authority
  - Connect to existing manhole – Low to medium cost
  - Connect directly to sewer - High cost to trench street
  - Connect to new manhole - High cost to construct
- No sewer nearby – only install if good infiltration

BMP's for the Public ROW

Adjacent Utilities

- Adequate Clearance Available?

  12" clearance needed for most major utilities



- For crossings w/out needed clearance, layout cells to avoid, or create "saddle"
- Coordinate Check Dam Location w/utilities

BMP's for the Public ROW

Bioretention – Specification

- Special Provision for media which meets DDOE criteria and standardizes the mix to help with Quality Control and availability/ cost
- Special Provision will be posted on DDOT Website

BMPs for use in the PUBLIC ROW

Tree Space Design and Soil Volume Techniques

BMP'S FOR THE PUBLIC ROW

Trees Space Design/Soil Volume Techniques

Achieves DDOE Planted Tree Retention Value *(20 cf per tree)*

- Large Trees: 1,500 CF
- Medium Trees: 1,000 CF
- Small Trees: 600 CF
- Where soil volumes within the max. allowable radii for adjacent trees overlap, 25% of required soil volume per tree may be shared
- Open area connected to tree space can be considered part of required soil volume

BMP's for the Public ROW

Trees Space Design / Soil Volume Techniques

Options

- Structural Soils
  - Sand Based Structural Soil (SBSS)
  - Patented/Trademarked Soils: E.g. CU Soil™, STALITE Aggregate
- Suspended Pavements
  - E.g. Silva Cell

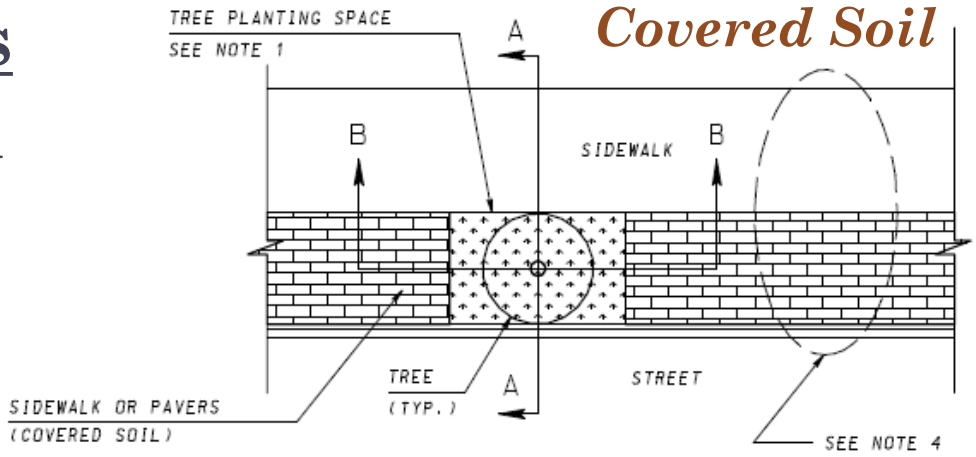
BMP's for the Public ROW

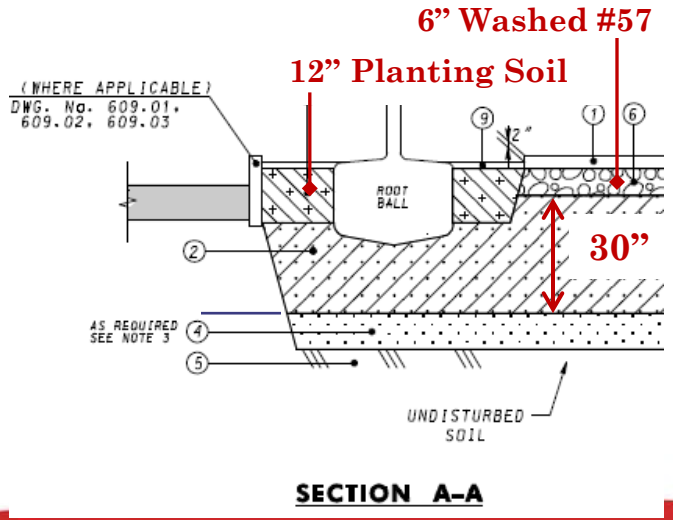
Tree Space Design/Soil Volume Techniques

Applications

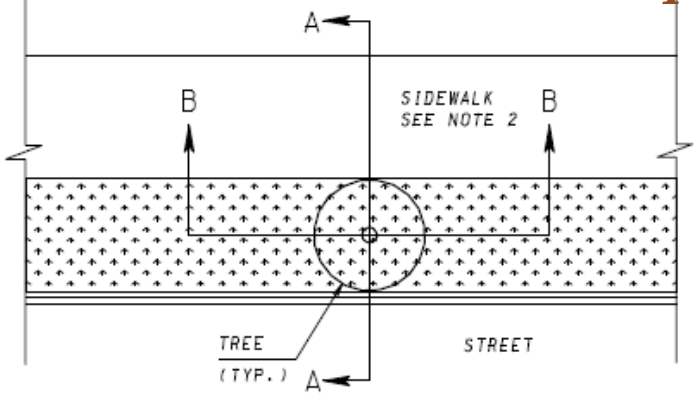
Layouts intended to achieve minimum soil rooting volumes

Covered Soil





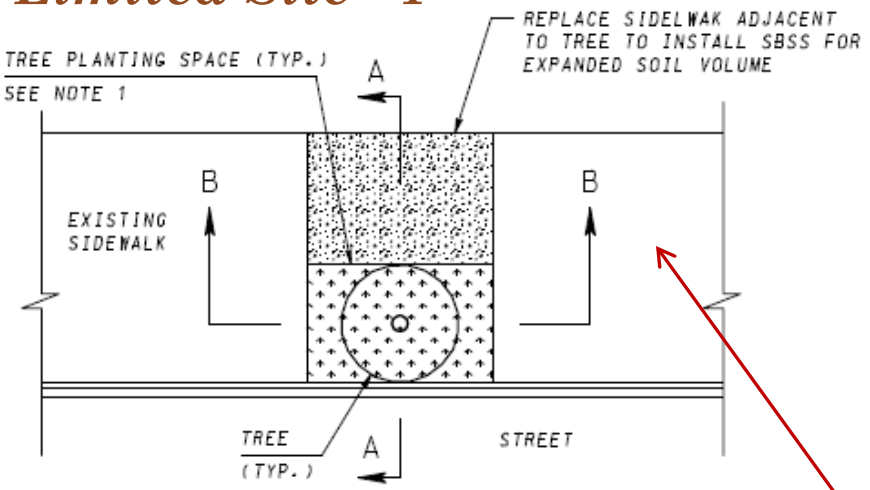
Continuous Green Strip



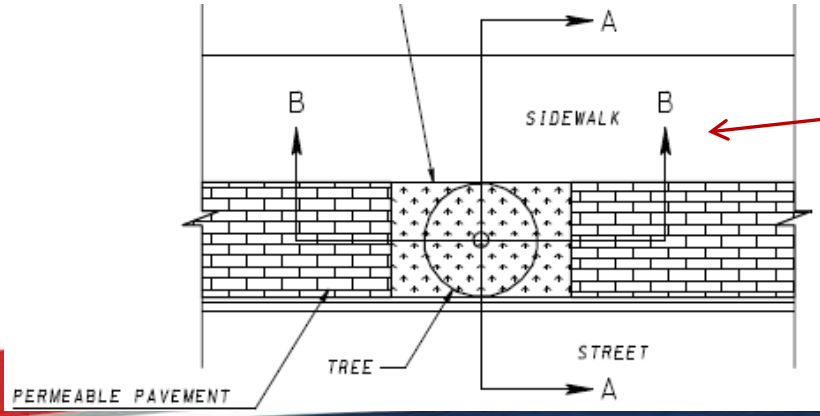
BMP's for the Public ROW

Tree Space Design/Soil Volume Techniques

Limited Site - 1



Limited Site - 2



Applications

Sites with significant constraints, as approved by DDOT

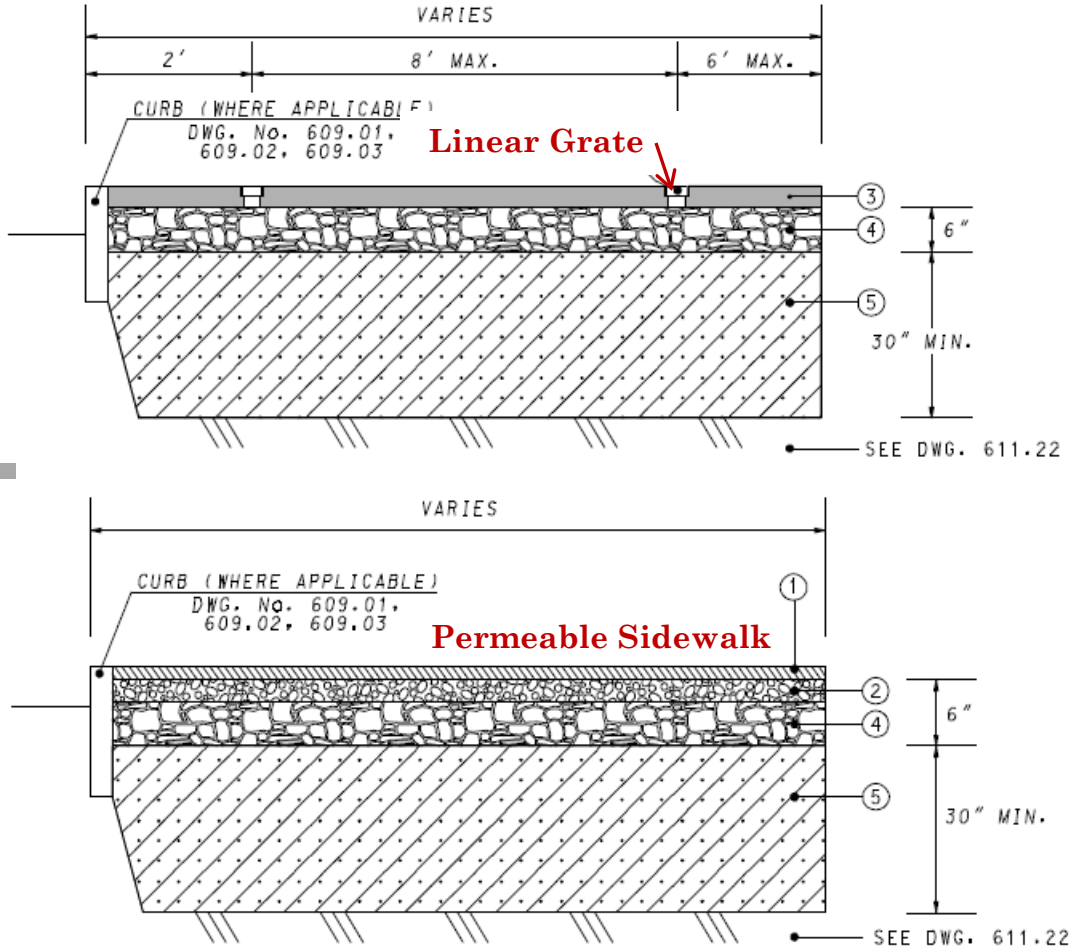
– *likely will not meet min. soil rooting volumes*

Conventional Sidewalk w/compacted ground

BMP's for the Public ROW

Tree Space Design/Soil Volume Techniques

Conveyance of water to soil



For covered soils, water must be conveyed for plant survivability:

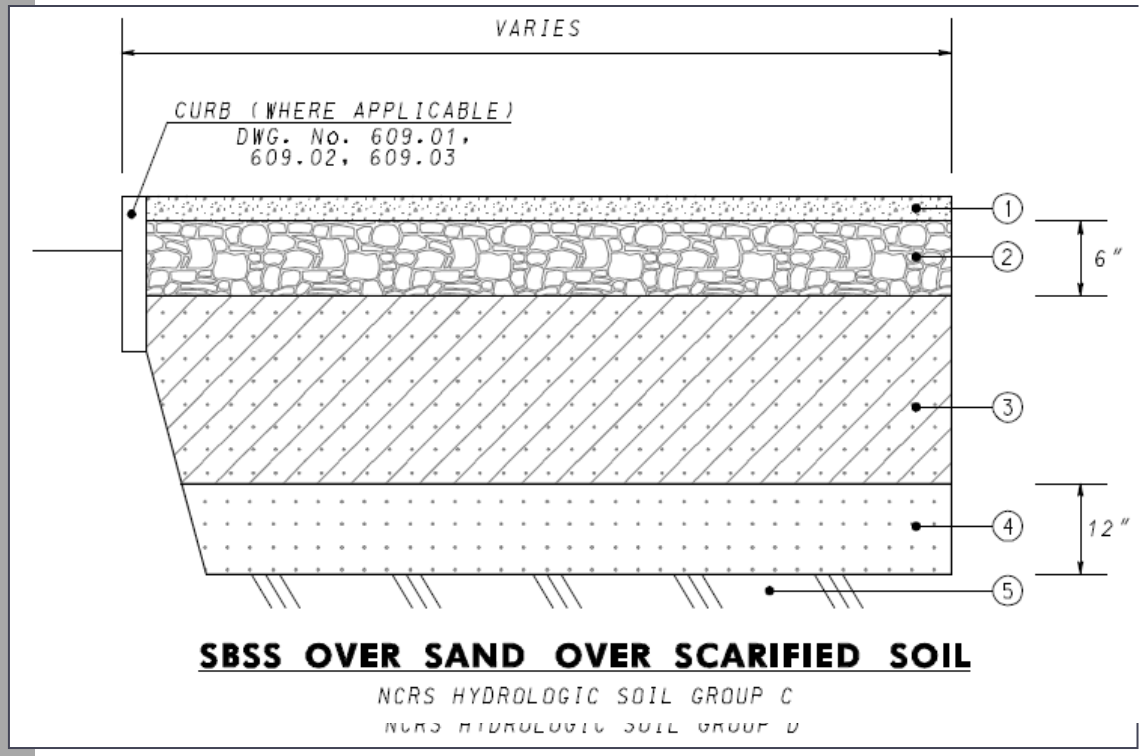
- *Impervious sidewalk ≤ 6', no special treatment*
- *Permeable Sidewalk*
- *Impervious Sidewalk w/linear grates or sidewalk catch basins*

BMP's for the Public ROW

Tree Space Design/Soil Volume Techniques

Subsurface Drainage Considerations

(Sand Based Structural Soil Shown)



- *For NCRS Soil Group C, Sand Layer on Bottom*
- *For NCRS Soil Group D, Sand Layer with Underdrain wrapped in filter sock*
- *For NCRS Soil Groups A/B, no special treatment*

BMP'S FOR THE PUBLIC ROW

Tree Space Design/Soil Volume Techniques

- **Access and Safety Barriers**
  - Parking Egress Strips: 18" to 36"
  - Pedestrian Crossings
  - Fencing/Railing to project soil
- **Retention Volume**: Can meet the requirements of the DDOE Bioretention type "Engineered Tree Box", whether designed as an enclosed plant bed with covered soil volume, or a continuous strip w/soil under adjacent sidewalk.

BMP's for the Public ROW

Soil Volume – Suspended Pavements

- Structural slabs that span between supports
- Commercially-available structural systems.

South Capital Street, SE DC

BMP's for the Public ROW

Soil Volume – Design Process Example

A. Base Information

1. Width of sidewalk
2. Slope of sidewalk
3. Associated contributing watershed area
4. Existing storm water infrastructure
   a. Inlet locations
   b. Pipe Invert elevations
5. Existing and planned underground utilities
   a. location and depth
   b. age, condition and need for protection against infiltration
6. Existing trees to remain
7. Abutting green space and potential soil rooting areas

BMP's for the Public ROW

Soil Volume – Design Process Example

B. Determine potential soil volumes

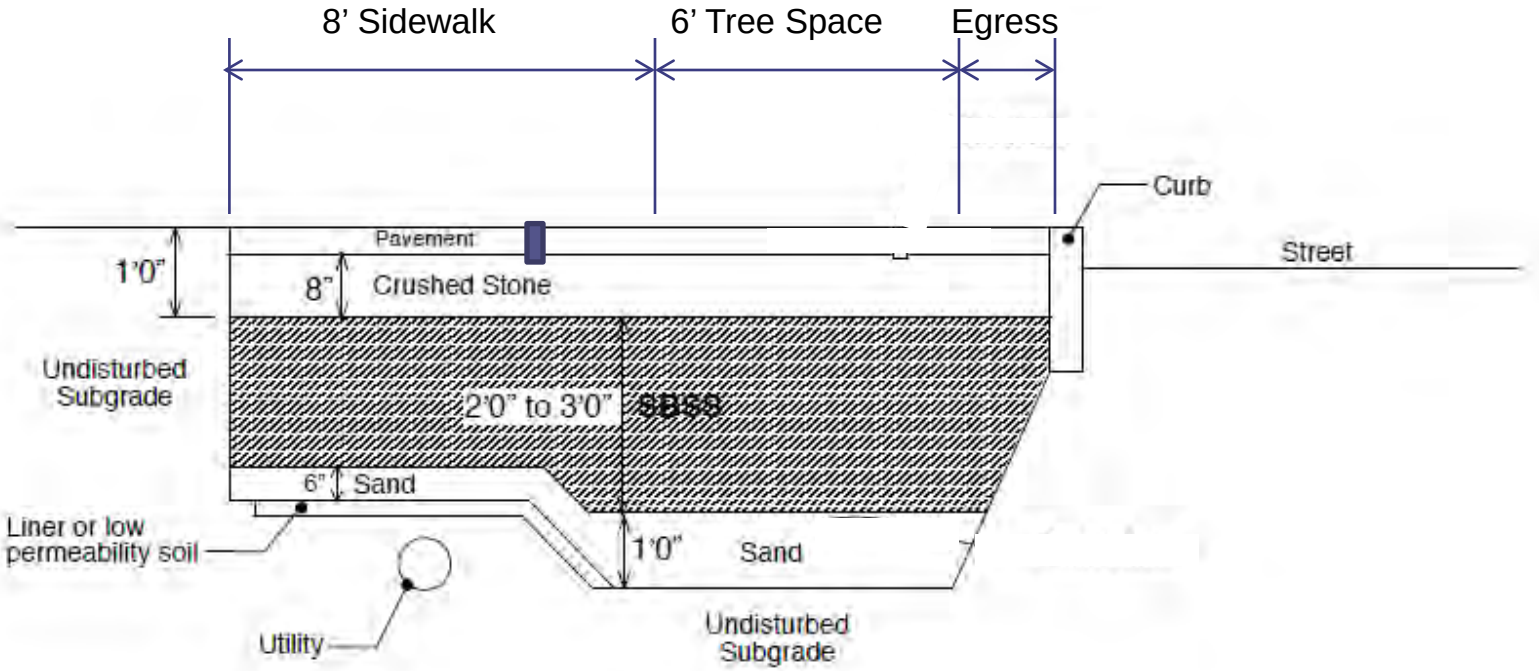
1. Determine storm water storage requirements and thickness of crushed stone to meet requirements.
2. Design subsurface drainage based on limitations of outfall elevations, limitations due to protection of existing utilities, and other constraints.
3. Determine maximum potential soil thickness, horizontal distribution and volume.

C. Streetscape Layout

1. Locate minimum six-foot wide walkway
2. Locate trees, determine potential soil volumes and then determine maximum size / species
3. Locate rain gardens, planting beds, permeable pavements, and storm water harvesting inlets

BMP's for the Public ROW

Soil Volume – Design Process Example



With Tree Spacing of 30':

Soil Vol = 30' x 2.6' (avg d) x 13.5' (avg w)

= 1053 CY

Suitable for Median Tree (1000 CY required)

BMP's for the Public ROW

Soil Volume Material Specifications

- SBSS: Performance Specification (which meets DDOE criteria for Bioretention); Will be posted on DDOT Website
- CU Soil™ - patented product to be obtained from certified supplier
- STALITE /Silva Cell – proprietary products to be obtained from official product distributors

BMP's for the Public ROW

Tools Available

- DDOT Design and Engineering Manual Supplement
- DDOT Standard Drawings Supplement
- DDOT Special Provisions
- Updated UFA Tree List

DDOT LID and GI Standards

BMPs for use in the PUBLIC ROW

Questions?

Overview of MEP

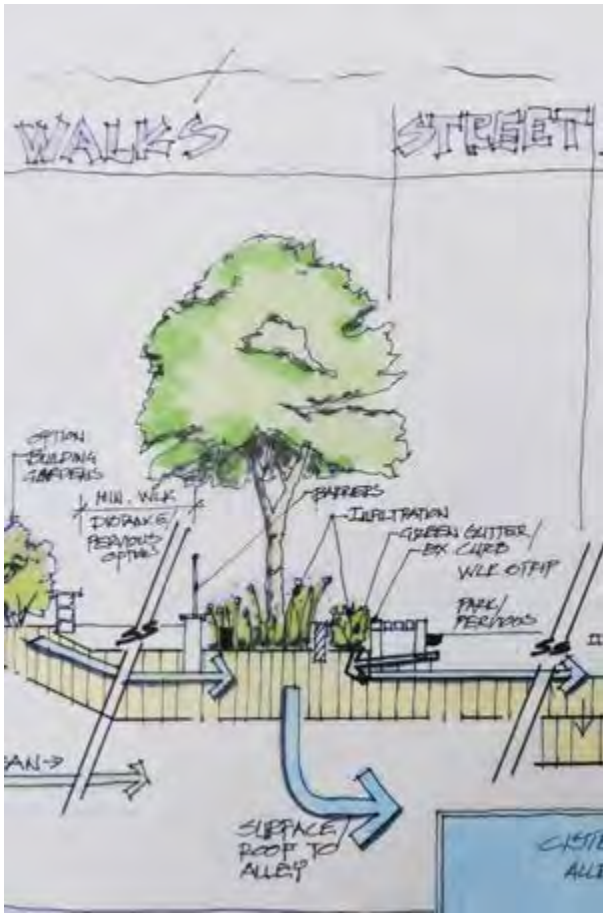
PUBLIC RIGHT OF WAY (PROW)

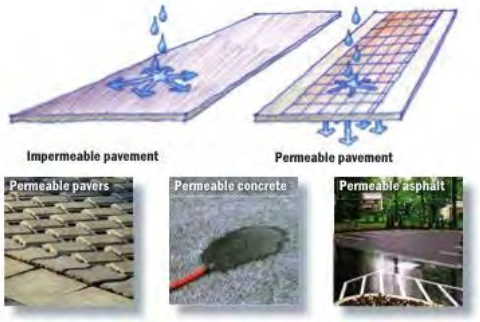
- Existing
- bridges, highways, commercial and residential streets, alleyways
- pedestrian walkways, bicycle trails, tunnels and railway tracks


AVEDA
BED BATH &
BEYOND
寢具·浴具·家用品
713


capital bikeshare

Rain gardens will reduce runoff from storms.





Options to achieve Retention of the Regulated Stormwater

- Manage volume of 1.2” event within each drainage area, volume calculated based on limits of disturbance.
- Over control up to the 1.7” event in some drainage areas, while under controlling a minimum 0.6” event in other drainage areas.
- Manage a minimum 0.6” event within each drainage area and the balance through off site retention.
- Establish technical basis to demonstrate MEP.

MEP: Maximum Extent Practicable

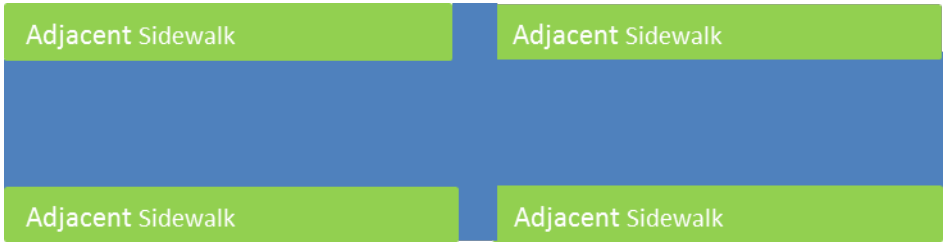
- Recognition that it will be technically infeasible, on many occasions, to achieve the regulated volume, even after going through the MEP process.

- Excluded from the requirement to use off site retention if the MEP is demonstrated.

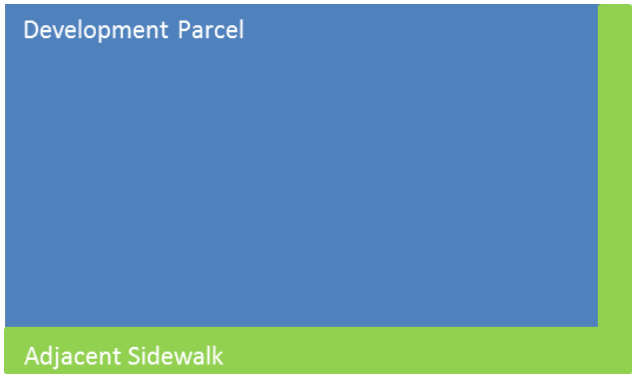
When PROW MEP applies…

Reconstruction of existing public right-of-way

- Type 1: federal or municipal
  - roads, alleys, sidewalks, trails, etc.



- Type 2: private development
  - adjacent sidewalks and alleys



When PROW MEP does **not** apply…

- A major regulated project that does not disturb the adjacent public right-of-way
- Voluntary retrofits of existing PROW
- PROW disturbance that is limited to
  - Trenches
  - Driveways
  - Utilities
  - Aprons
  - Minor disturbance

CONSTRAINTS IN THE PROW

- Unique site constraints that vary widely.
- Limited space outside of the roadway restricts opportunities for stormwater retention.
- In many cases the width of the roadway cannot be reduced to create additional space.
- Structural integrity of pavement is the prime concern. The weight and volume of traffic loads may limit the use of permeable pavements.

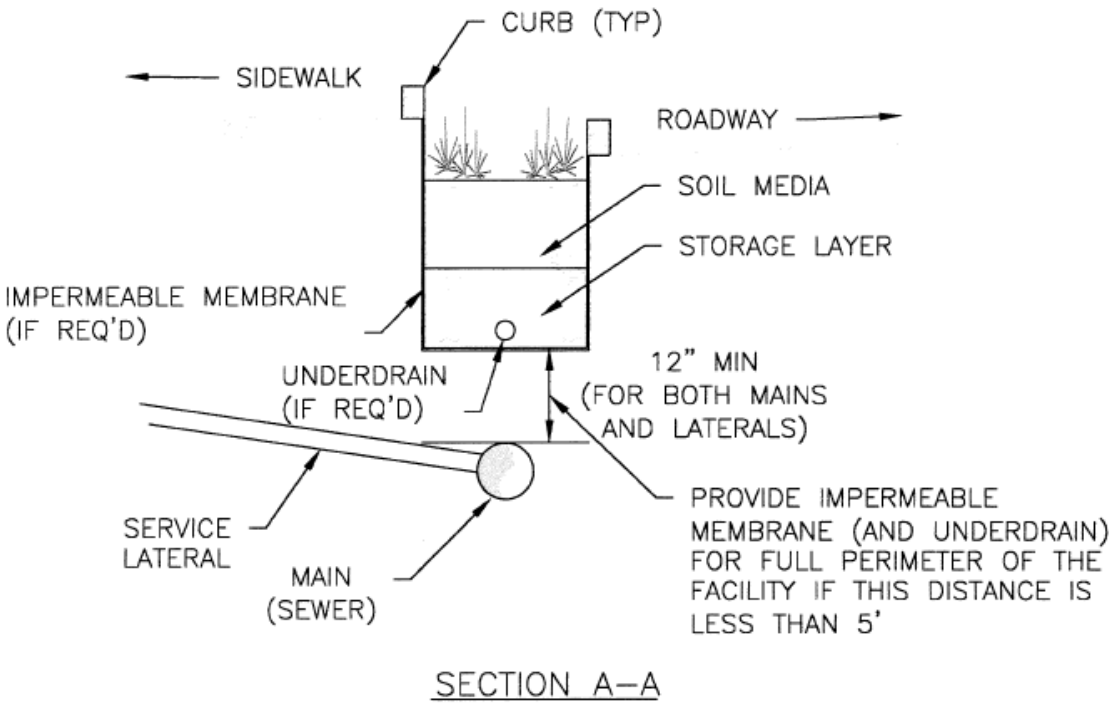
Accepted Conflicts

- Physical:
  - Low infiltration rate
  - Low head
  - Topography
  - Existing Shade Trees in Good Condition

Accepted Conflicts

- Pedestrian and Vehicle Traffic:
  - Sidewalk Width
  - Travel Lane Width
  - Pedestrian/Vehicle Traffic Volume
  - ADA Requirements
  - Building Entrance and Exits
  - Safety Issues and view lines
  - Other DDOT Standards and Guidelines

Accepted Conflicts: utilities



DC Water Green Infrastructure

Utility Protection Guidelines

Principles of PROW MEP include…

- Maximize BMP placement
- Maximize BMP sizing
- Innovate--integrate “green” with “grey” infrastructure
- Minimize impervious widths
- Maximize land cover types with little stormwater runoff
- Maximize tree canopy
  - planting or preserving trees, amending soils, increasing soil volumes and connecting tree roots with stormwater runoff
- Use impervious surface disconnection strategies
  - e.g., draining sidewalk area to continuous tree planting strip
- Manage comingled stormwater runoff
  - prioritize the conveyance and control of roadway runoff
  - over-control the roadway runoff beyond LOD to compensate for less retention elsewhere
- Use porous pavement or pavers for low traffic roadways, on-street parking, shoulders or sidewalks
- Integrate BMPs into traffic calming measures

MEP PROCESS: early stages

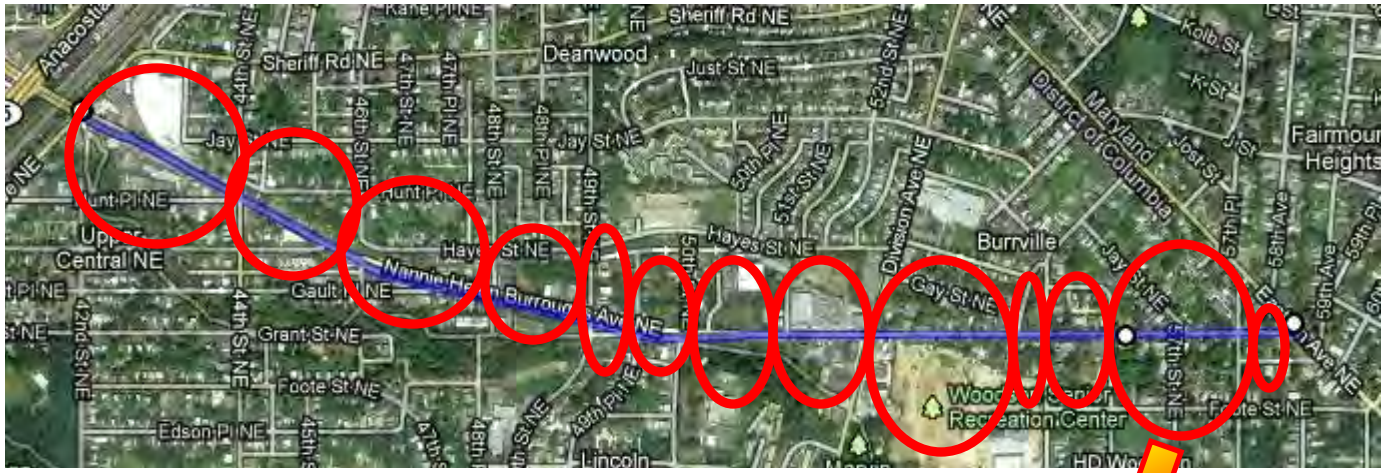
- Calculate SWRv
- Considerations:
  - adjacent public lands
  - drainage profile
  - integrating traffic calming measures
  - land cover conversions
  - All possible BMP placement
  - Sizing to manage adjacent public/private flows

MEP PROCESS: later stages

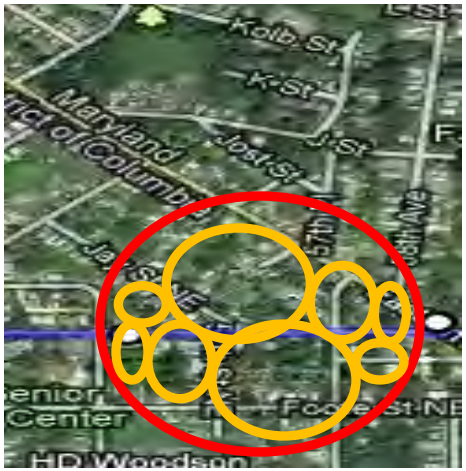
- Survey and Test Information Gathered:
  - infiltration test
  - find existing infrastructure
- Placement and sizing of BMPs
  - refined
  - constrained
  - elimenated

CALCULATING SWR_V

- Define the limits of disturbance (LOD)
- Delineate all drainage areas within the LOD
- Identify proposed land covers & runoff coefficients within LOD to calculate SWRv for total land disturbance and each drainage area
- Runoff Coefficients
  - Natural Cover: R_{NC} = zero
  - Compacted Cover: R_{CC} = 0.25
  - Impervious Cover: R_{IC} = 0.95



Individual drainage areas within “Limits of Disturbance” will require discrete analysis



Demonstrating Full Consideration of Opportunities - Infiltration

- Evaluate water table elevations for opportunities and restrictions of infiltration practices.
- Evaluate infiltration feasibility, to identify areas to be preserved and targeted for infiltration, and areas that will require amended soils and under drains.
- Identify any areas with known soil contamination where infiltration will be restricted.

Demonstrating Full Consideration of Opportunities – Existing Infrastructure

- Identify subsurface areas of potential conflict
- Identify the location and elevation of the existing storm drainage infrastructure
- Identify all existing trees to be preserved, areas available for additional tree planting and opportunities to increase soil volume

LAND COVER and BMP PLACEMENT

- Identify potential areas for land cover conversion and BMP locations
  - traffic islands,
  - triangle parks,
  - median islands,
  - paper streets, and
  - Excess street, alley, sidewalk and trail width.
- Evaluate opportunity to integrate BMPs with traffic calming measures.

Locating and Choosing BMPs

- Consider land conversion and BMP designations in adjacent public lands
- Consider altering the drainage profile if that alteration would increase BMP runoff capture
- Identify opportunities for land conversion or BMP location within LOD
- Select most appropriate BMP types for each area using guidance material

Demonstrating Full Consideration of Opportunities - adjacent volume

- Drainage areas contributing off-site stormwater runoff to the Project's LOD

- Off-site volume is not counted toward the site's regulated stormwater retention volume (SWRv) but if managed will count towards achieving that volume

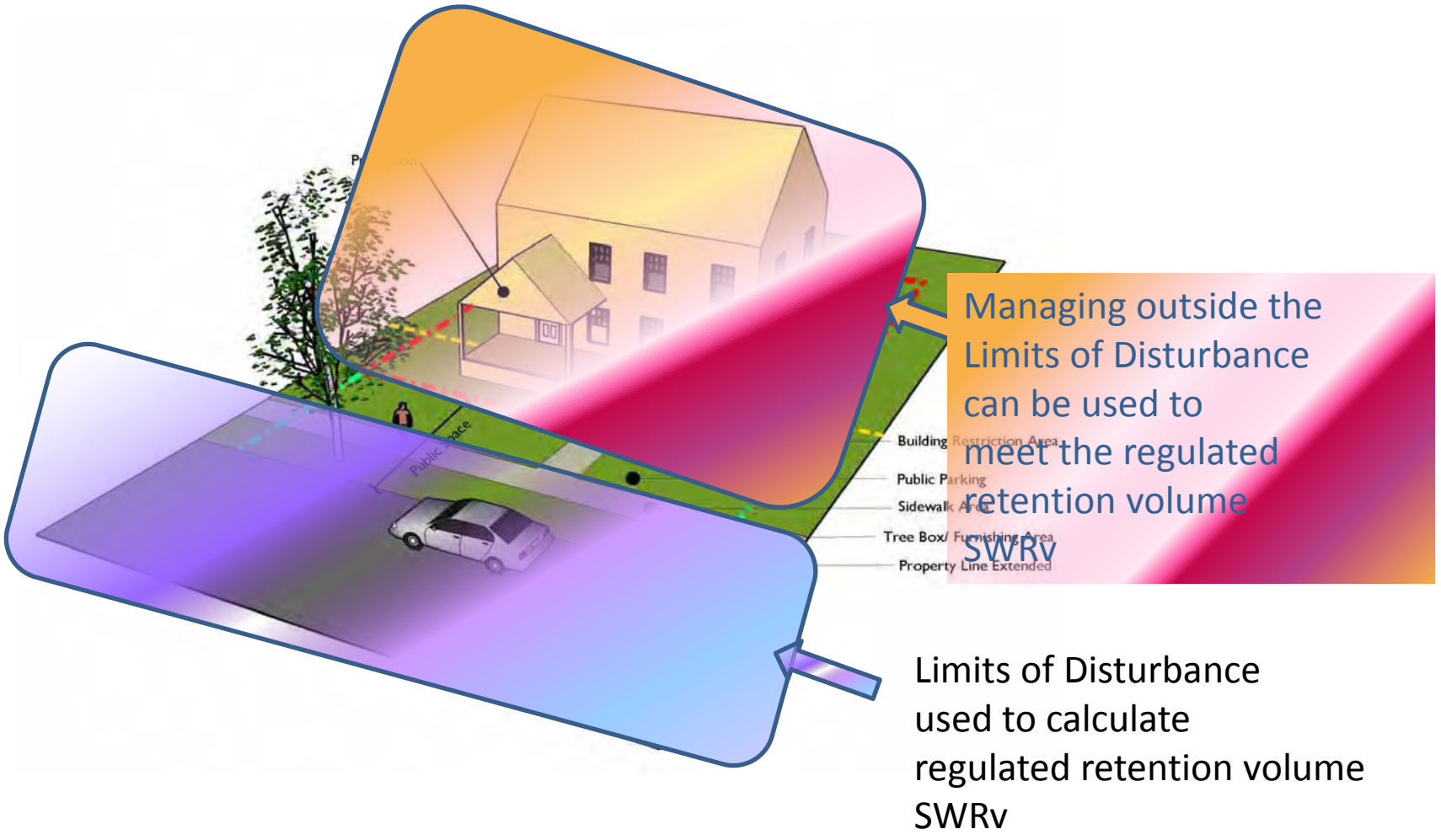


Figure N1. Diagram of typical residential Public Right-of-Way in the District of Columbia, (DDOT Public Realm Design Manual 2011).

Sizing BMPs

- Delineate full drainage areas to BMP locations
- Follow sizing and design methodology for selected BMPs using DDOE Chapter 3 and DDOT standards and specifications
- If sizing criteria cannot be achieved, document the constraints that override the application of BMPs, and provide the largest portion of the sizing criteria that can be reasonably provided given constraints.

Iterative MEP Process

- Sum retention values achieved with designed BMPs; compare to regulated stormwater retention volume (SWRv)
- Early design stage submissions indicate all possible options to achieve SWRv
- Later design stage submissions detail why BMP and land cover options not possible
- Comments and/or concurrence provided at each review stages

MEP PROCESS IN PUBLIC ROW

Procedure and Test Case

MEP PROCESS in PUBLIC ROW

- Design Process
  - Planning, 30%, 65%, Final
- Submittals
  - 30%, 65%, Final
    - Worksheet
    - Stormwater Management Map
    - Narrative
    - Design Plans
- Test Case

MEP PROCESS in PUBLIC ROW

Design Process

- Pre-Design
  - Level of Disturbance - *Do Requirements Apply?*
  - Adjacent Public Spaces
  - Paper Streets, etc.
  - Planning Level Analysis

MEP PROCESS in PUBLIC ROW

Design Process

- 30% Design
  - Project Survey
  - Available Space in Road Section
  - Pedestrian Circulation
  - Safe Access Issues
  - Impervious Surface Removal

MEP PROCESS in PUBLIC ROW

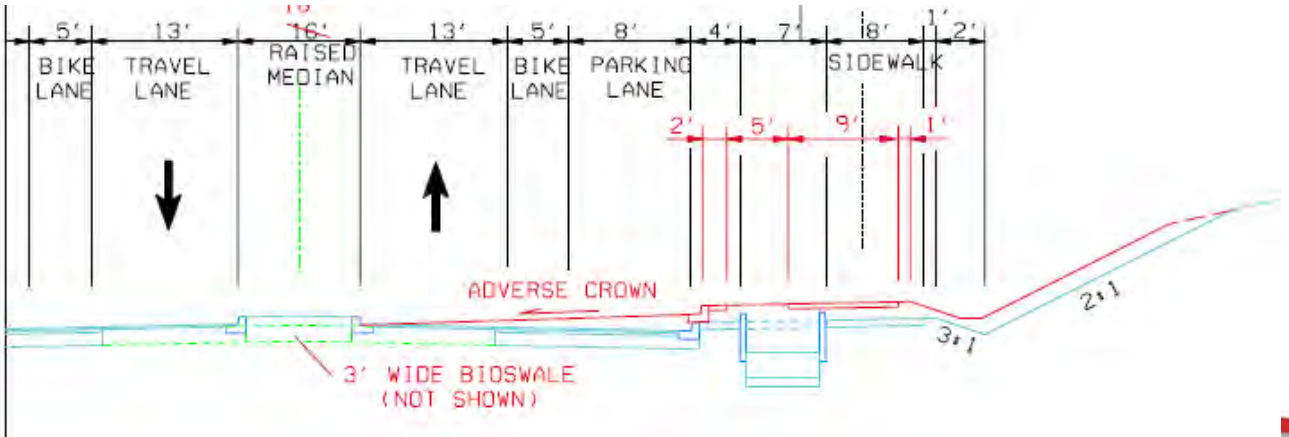
Design Process

- 30% Design – Cont.
  - Drainage Areas, Limits of Disturbance and SWRv
  - Existing Utilities/Storm Sewer
  - Existing Trees to retain
  - Soil Characteristics
    - *A, B, C, D, Urban Land*

MEP PROCESS in PUBLIC ROW

Design Process

- 30% Design – Cont.
  - Candidate BMP Locations
  - Candidate Land Conversions
  - Probable Deficit of BMP Sites?
    - *Street Profile Review*



MEP PROCESS in PUBLIC ROW

30% Design Submission

- Stormwater Management Map

  Survey; Contour lines; ROW;

  Limits of Disturbance; Hot Spots;

  Drainage Boundaries;

  Soil boundaries; Existing Trees;

  BMP/Land Conversion Candidates

MEP PROCESS in PUBLIC ROW

30% - Worksheet

Step 1: Drainage Area and Regulated Volumes

Number and list each drainage area within the project limits of disturbance (LOD). Identify the sq. foot of drainage area contributing runoff from within LOD and from outside LOD. Identify the regulatory SWRv required for each drainage area. Provide cooresponding drainage area identifications on SMM.

Drainage Area ID	Contributing Area								SWRv	
	Paved w-in LOD	Compacted w-in LOD	Natural w-in LOD	Total w-in LOD	Paved outside LOD	Compacted outside LOD	Natural outside LOD	Total outside LOD	w-in LOD	outside LOD
	SF	SF	SF	SF	SF	SF	SF	SF	CF	CF
				0				0	#DIV/0!	#DIV/0!
				0				0	#DIV/0!	#DIV/0!
				0				0	#DIV/0!	#DIV/0!

MEP PROCESS IN PUBLIC ROW

30% - WORKSHEET

Step 2: Consider Infiltration		Step 3: Evaluate Existing Infrastructure Constraints	
Use the numbered list of drainage areas to record soil type and hotspot concerns within the project limits of disturbance (LOD).		On SWM, depict utlity locations and invert/top elevations of ex. conveyance infrastructure to determine opportuntities for proposed land conversions and BMP placement. Delineate areas of potential conflict, and areas without conflict, including areas where minimum depths for BMPs can not be met. Delineate trees (size, species, condition).	
Hydro Soil Group	Hot Spot Concern Found? Describe	Preservation of Mature Trees which are in fair or better condition	
A, B, C, D or Urban Land	Y/N	# of trees	Ex. Tree Volume Credit (CF)
			0
			0
			0

MEP PROCESS IN PUBLIC ROW

30% - WORKSHEET

Step 4: Identify Land Conversion and BMP Placement Opportunities	
On SMM identify ex. prop. features (traffic islands, triangle parks, median islands, cul-de-sacs, etc) within each drainage area. Depict if they are chosen, or not, for land conversions or BMP placements. Provide the basis for the decision if these features are not used to improve land abstraction or stormwater retention BMPs. Decisions should use the information established in the previous two steps.	
Land Conversion or BMP Opportunity?	Describe obstacles to Land Conversion or BMP (Attach narrative if necessary)
Y/N	

MEP PROCESS in PUBLIC ROW

30% Design Submission

NARRATIVE

- Project Description
- Documentation of lane widths, sidewalk widths, etc.
- Description of known conflicts
- Summary of Hot Spots
- Qualitative Discussion of BMP and Land Conversion Space

MEP PROCESS in PUBLIC ROW

TEST CASE MEP PROCESS

MEP PROCESS IN PUBLIC ROW - 30% ASSESSMENT

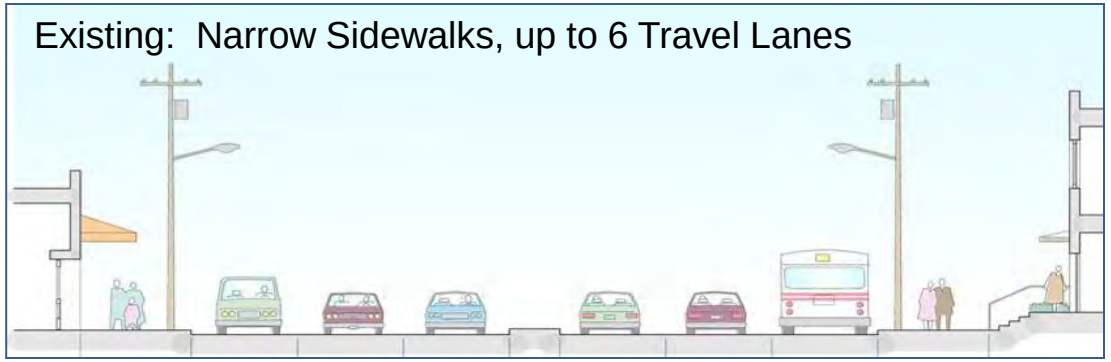
- *Road Cross Section*
- *Pedestrian Circulation*
- *Impervious Removal*

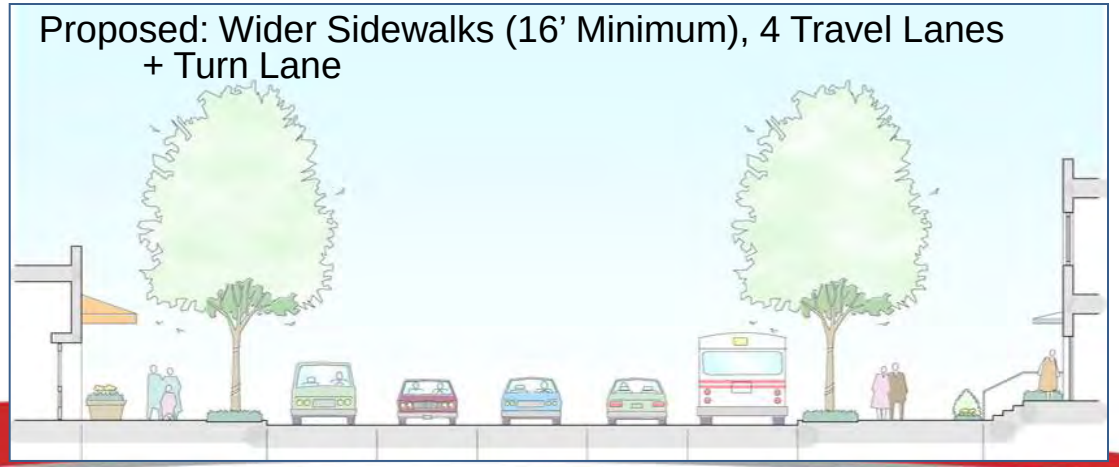
Great Street Goals

	Measures	Existing Conditions	30% Design
ENERGIZE	**Retailers**: Increase the number of possible retail storefronts in the corridor	# of stores in corridor?	Streetscaping will encourage new storefronts at the sidewalks rather than pushed back from the street. Design will make neighborhood more accessible and less cut off from neighborhoods to the south.
	Retail sales: Increase the average retail sales per square foot	Sales per square foot?	
	Jobs: Increase the number of jobs in the corridor	3,910 jobs in 10 surrounding Census Tracts per 2000 CTPP Part II	
	Investment: Attract private investments in improvements in the public realm.	SW width ranges from 11.5-19 ft	Minimum 8' effective width sidewalk throughout corridor
		No on-street parking	Two 8' parking lanes through main street corridor

MEP PROCESS IN PUBLIC ROW – 30% ASSESSMENT

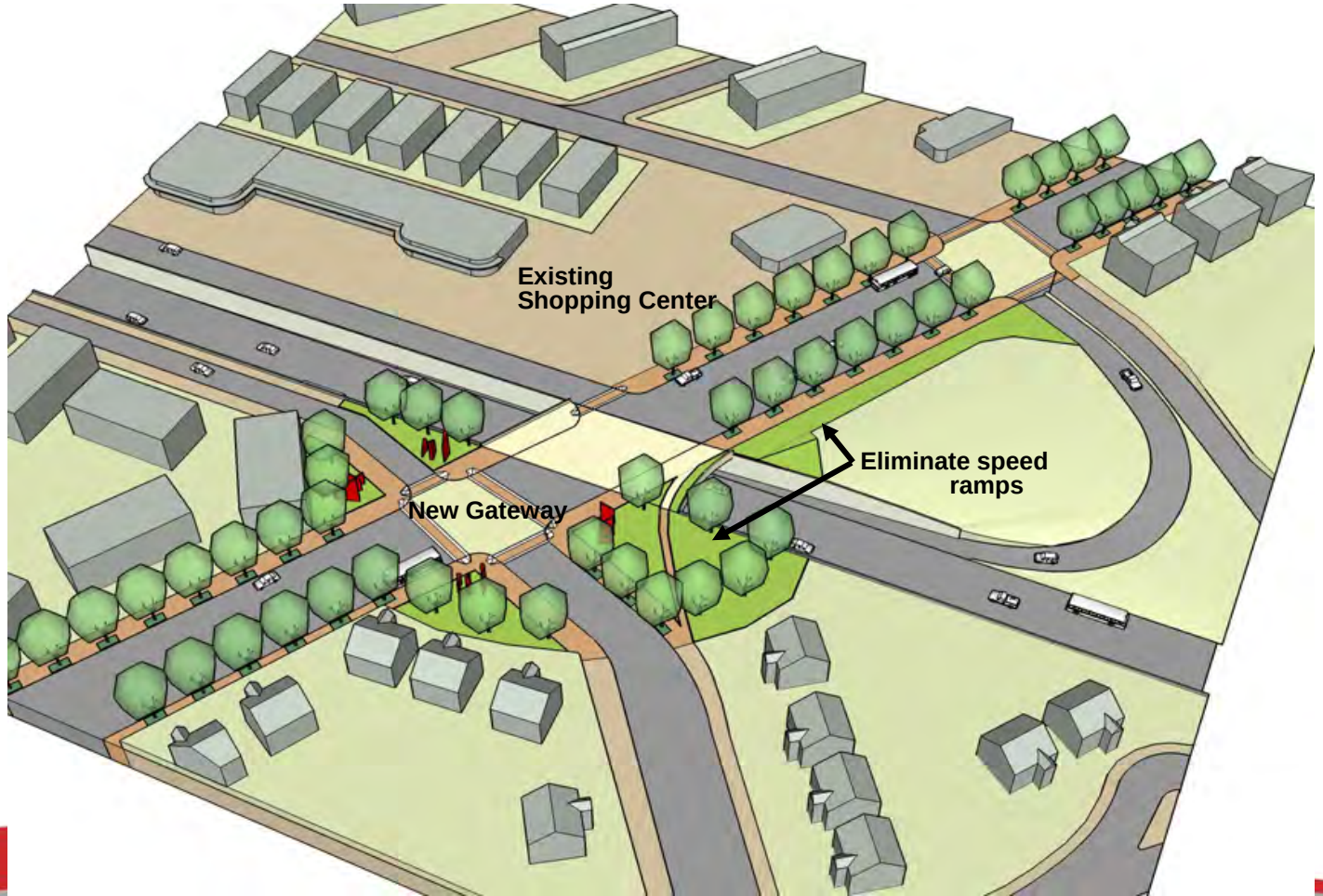
- *Road Cross Section*
- *Pedestrian Circulation*





MEP PROCESS IN PUBLIC ROW – 30% ASSESSMENT

- *Impervious Removal*



MEP PROCESS IN PUBLIC ROW - 30% ASSESSMENT

Candidate LID/BMP Locations:

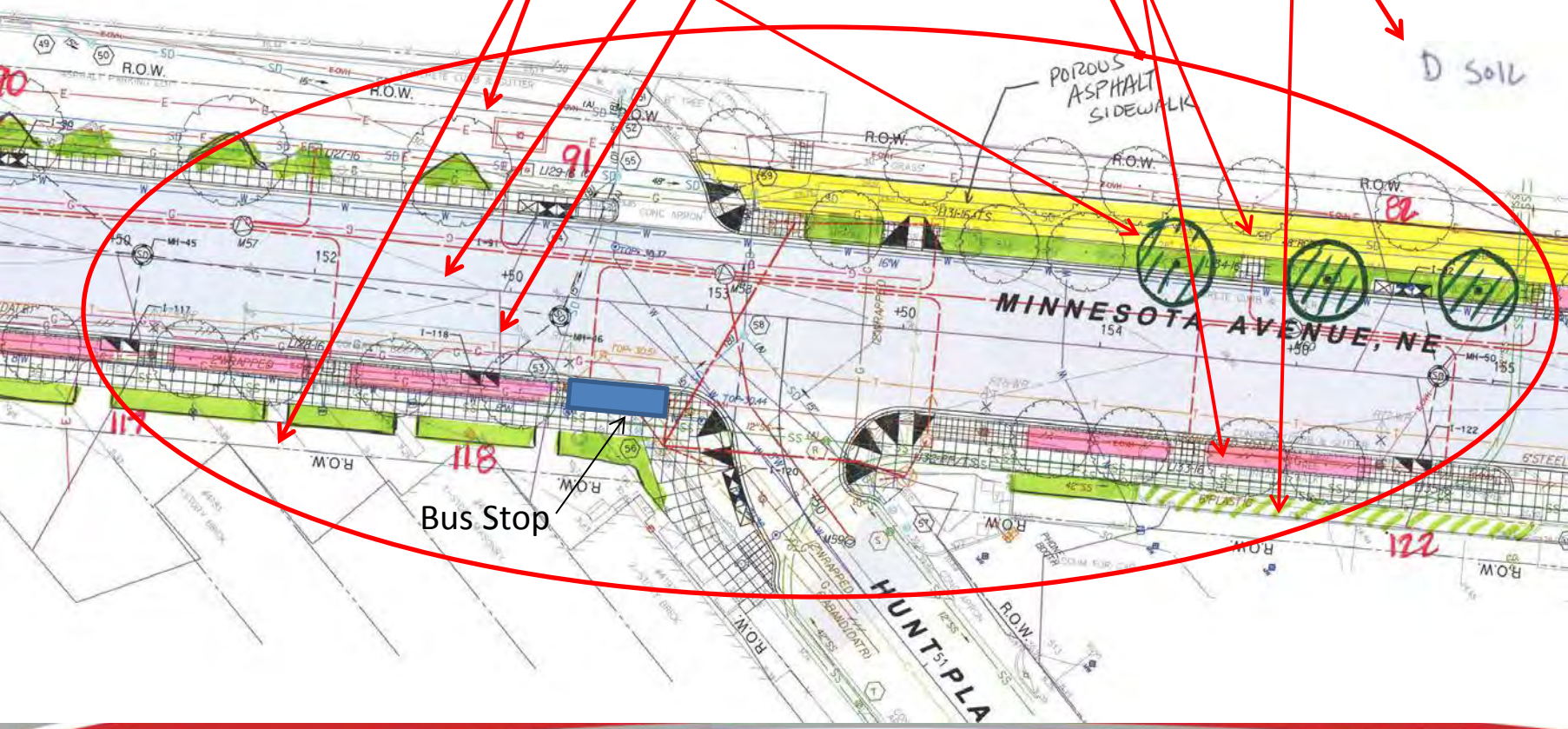
- Sidewalks – permeable
- Tree Space – bioretention, trees
- Parking lanes – permeable pav't
- Bump-outs around parking – bioretention

Ruled Out:

- Travel Lanes
- Bus Stop Areas, Driveways

MEP PROCESS in PUBLIC ROW - 30% Map / Assessment

- Drainage Boundary, Soil Type
- Existing Utilities, Survey Data, & Land Conv.



MEP PROCESS IN PUBLIC ROW - 30% ASSESSMENT

Apparent Deficit of SWRv Capture

- Limits of Disturbance is entire roadway (total reconstruction) so SWRv requirement is increased

Project Name:	Minnesota Ave Great Street Test Case		
Summary Data: 30% Design Phase			
		Regulated Retention Volume (1.2"):	19,812 CF
Disturbance Area (ac.):	5.10	Retention Volume retained:	TBD
No. of Drainage Areas:	33	Deficit:	TBD

Total Reconstruction

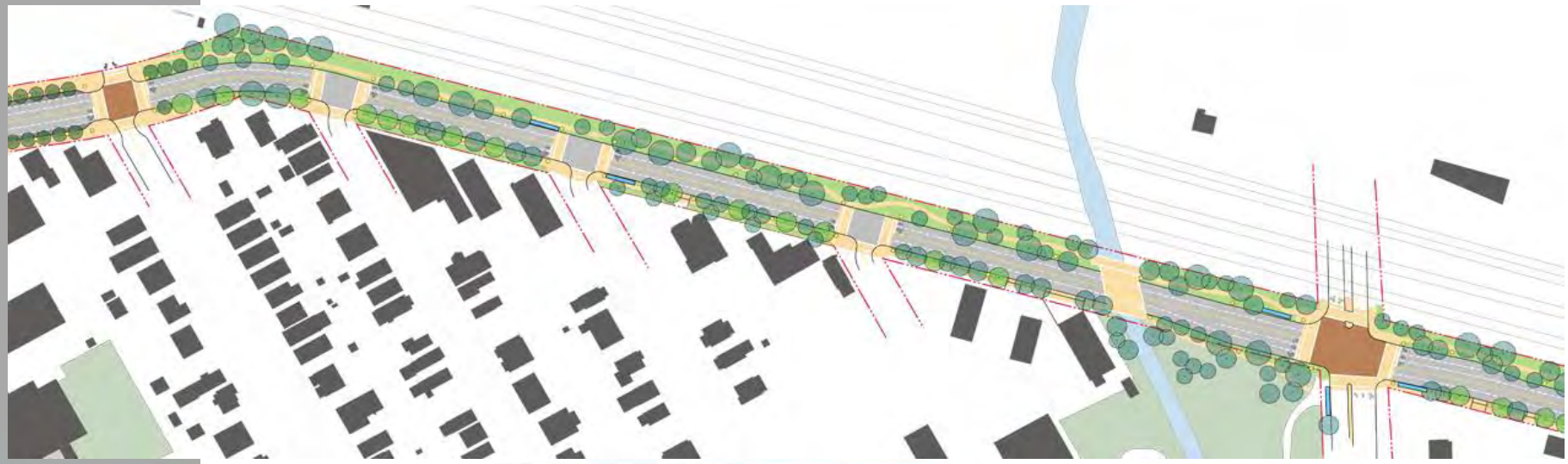
Project Name:	Minnesota Ave Great Street Test Case		
Summary Data: 30% Design Phase			
		Regulated Retention Volume (1.2"):	11,611 CF
Disturbance Area (ac.):	3.12	Retention Volume retained:	TBD
No. of Drainage Areas:	33	Deficit:	TBD

If it were Mill & Resurface…

MEP PROCESS IN PUBLIC ROW - 30% ASSESSMENT

Apparent Deficit of SWRv Capture

- Is Drainage Profile change possible? Not likely:
  - Minimal Raised Medians
  - Significant Number of Existing Utilities in street



MEP PROCESS IN PUBLIC ROW - 30% WORKSHEET

Summary Data: 30% Design Phase

Disturbance Area (ac.): 5.10
No. of Drainage Areas: 33

Regulated Retention Volume (1.2"): 19,812 CF
Retention Volume retained: TBD
Deficit: TBD

Instructions
Blocks in the worksheet that are not shaded are data entry fields for the designer.
All shaded blocks are computations internal to the worksheet and should not be edited.

Step 1: Drainage Area and Regulated Volumes	Step 2: Consider Infiltration	Step 3: Evaluate Existing Infrastructure Constraints	Step 4: Identify Land Conversion and BMP Placement Opportunities
Number and list each drainage area within the project limits of disturbance (LOD). Identify the sq. foot of drainage area contributing runoff from within LOD and from outside LOD. Identify the regulatory SWRv required for each drainage area. Provide cooresponding drainage area identifications on SWMP.	Use the numbered list of drainage areas to record soil type and hotspot concerns within the project limits of disturbance (LOD).	On SWM, depict utility locations and invert/top elevations of ex. conveyance infrastructure to determine opportunities for proposed land conversions and BMP placement. Delineate areas of potential conflict, and areas without conflict, including areas where minimum depths for BMPs can not be met. Delineate trees (size, species, condition).	On SMM identify ex. prop. features (traffic islands, triangle parks, median islands, cul-de-sacs, etc) within each drainage area. Depict if they are chosen, or not, for land conversions or BMP placements. Provide the basis for the decision if these features are not used to improve land abstraction or stormwater retention BMPs. Decisions should use the information established in the previous two steps.

Drainage Area ID	Contributing Area								SWRv		Hydro Soil Group	Hot Spot Concern Found? Describe	Preservation of Mature Trees which are in fair or better condition		Land Conversion or BMP Opportunity?	Describe obstacles to Land Conversion or BMP (Attach narrative if necessary)
	Paved w-in LOD	Compacted w-in LOD	Natural w-in LOD	Total w-in LOD	Paved outside LOD	Compacted outside LOD	Natural outside LOD	Total outside LOD	w-in LOD	outside LOD			# of trees	Ex. Tree Volume Credit (CF)		
	SF	SF	SF	SF	SF	SF	SF	SF	CF	CF	A, B, C, D or Urban Land	Y/N			Y/N	
57	6,910	170		7,080	1,097			1,097	661	104	A/D			0		
58	6,689	349		7,037	745			745	644	71	Urban Land	N		0	N	Water line prevents vegetated BMP
61	6,860	100		6,960	120	2,083		2,203	654	63	Urban Land	N		0	Y	
68	5,720	650		6,370	3,000			3,000	560	285	A/D	N		0	Y	
82	6,820	1,440		8,260		342		342	684	9	D	N	2	40	Y	
86	8,441	240		8,682					808	0	A/D	N		0	Y	
88	6,117	304		6,421					589	0	A/D	N		0	Y	
89	10,685	1,225		11,909					1046	0	D	N		0	Y	
90	6,682			6,682					635	0	Urban Land	N		0	Y	
91	2,797			2,797		1,469		1,469	266	37	Urban Land	N		0	N	Existing Kiss n Ride adjacent to sidewalk-likely high trash load, Multiple utilities.
100	10,500	150		10,650					1001	0	D	N		0	N	
101	4,560	200		4,760	2,716	4,253		6,969	438	364	A/D	N	1	20	Y	
102	4,300	150		4,450	1,755	2,383		4,138	412	226	D	N		0	Y	
103	4,915	100		5,015	1,202	4,281		5,483	469	221	D	N		0	Y	
104	6,043	280		6,323	682	7,897		8,579	581	262	A/D	N	1	20	Y	
108	8,917	800		9,717	170	1,554		1,724	867	55	A/D	N	1	20	Y	
109	4,945	217		5,162	270			270	475	26	D	N		0	Y	
112	9,653	980		10,633	1,133	404		1,537	942	118	D	N		0	Y	
113	4,559			4,559	320	3,770		4,090	433	125	D	N		0	Y	
116	5,846	100		5,946		1,550		1,550	558	39	D	N		0	Y	
117	5,485	490		5,975	150	1,337		1,487	533	48	D	N		0	Y	
118	3,655	700		4,355	1,750	630		2,380	365	182	D	N		0	Y	
122	6,242	783		7,025	1,460			1,460	613	139	Urban Land	N		0	Y	
123	6,094	523		6,617	2,100			2,100	592	200	Urban Land	Y-Gas Station		0	Y	
124	5,746			5,746	1,800			1,800	546	171	Urban Land	N		0	Y	
125	9,428			9,428					896	0	Urban Land	N		0	Y	
127	8,094	2,400		10,494					829	0	Urban Land	N	1	20	Y	
128	5,018	3,000		8,018					552	0	Urban Land	N		0	Y	
129	5,541	601		6,142					541	0	Urban Land	N		0	Y	
130	5,020	560		5,580	4,562	3,981		8,543	491	533	Urban Land	N	1	20	N	See narrative
131	5,488	318		5,807	705			705	529	67	Urban Land	Y-Gas Station		0	Y	
132	3,543	495		4,038	635			635	349	60	Urban Land	N		0	Y	
EX-61	2,310	1,400		3,710					254	0	D	N	1	20	Y	
			DA_{TOTAL}	222,346				62,306	19,812	3,404			8	160	Y	

MEP PROCESS IN PUBLIC ROW - 30% WORKSHEET

Preliminary Results:

- Disturbed Area = 5.1 ac.
- Prelim. Regulated Retention Volume (SWRv) = 19,812 CF
- Some areas of possible A Soil
- 8 Trees to be retained
- 4 out of 33 Drainage Areas w/no opportunity for BMP/Land Conv.

MEP PROCESS in PUBLIC ROW

Design Process

- 65% Design
  - Updates to issues from 30% based on refined design
  - Vertical location and design of storm drains & utilities (TH's)
  - Geotechnical Analysis
  - Select and Size BMP's

MEP PROCESS in PUBLIC ROW

65% Design Submission

Geotechnical / Infiltration Tests

- First identify testing needs based on candidate BMP locations beyond “D” soil areas
- Review results and refine BMP locations, types, sizes
- When necessary, update/ finalize at 90% design

MEP PROCESS in PUBLIC ROW
65% Design Submission

- Geotechnical testing quantities
  - 1 test / 1K SF BMP practice
  - 3 tests/ 10K SF BMP practice (1 each 5K add'l)
- Test 2 ft below bottom of practice
- Acceptable Testing methods (per DDOE)
  - **Well Permeameter Method (USBR 7300-89)**
  - Tube Permeameter Method (ASTM D 2434)
  - Double-Ring Infiltrometer (ASTM D 3385)
  - Other constant head permeability tests that utilize in-situ conditions and are accompanied by a recognized published source reference

MEP PROCESS in PUBLIC ROW

65% Design Assessment

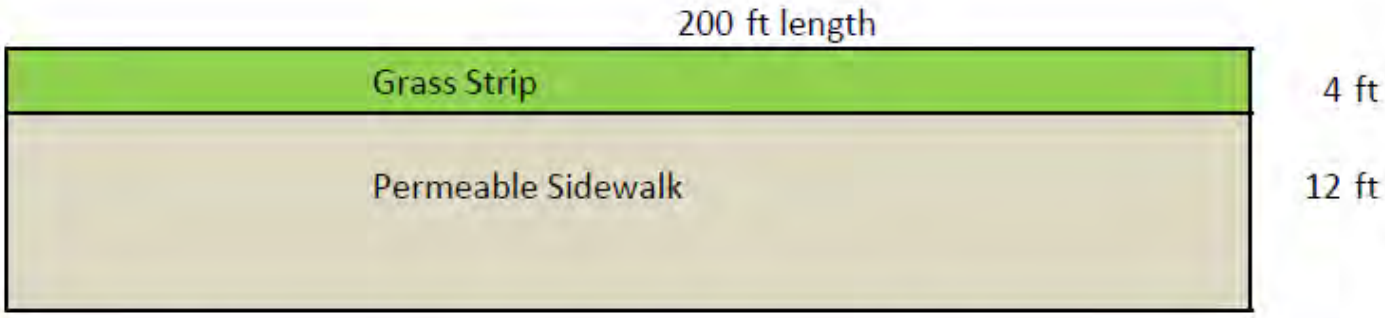
Geotechnical

- Infiltration tests candidate BMP Required D soils for this 5 ac. project of which about half is D Soils

Drainage Area ID	Drainage Area ID	Hydro Soil Group	Bioretention Opportunity Areas	Permeable Pavement Opportunity Areas	Hot Spot Concern Found?	Borings
		A, B, C, D or Urban Land	SF	SF	Y/N	Each
57	57	A/D	0	0		
58	58	Urban Land	150	0	N	1
61	61	Urban Land	450	1,290	N	2
68	68	A/D	0	930	N	1
82	82	D	0	1,870	N	
86	86	A/D	225	0	N	0.5
88	88	A/D	220	0	N	0.5
89	89	D	1,650	0	N	
90	90	Urban Land	0	0		
91	91	Urban Land	0	0		
100	100	D	880	3,900	N	
101	101	A/D	160	1,350	N	2
102	102	D	0	1,750	N	
103	103	D	225	820	N	
104	104	A/D	160	1,190	N	2
108	108	A/D	255	1,880	N	2
109	109	D	0	980	N	
112	112	D	420	2,100	N	
113	113	D	480	1,000	N	
116	116	D	240	945	N	
117	117	D	300	608	N	
118	118	D	400	736	N	
122	122	Urban Land	480	1,776	N	2
123	123	Urban Land	0	448	Y-Gas	
124	124	Urban Land	300	800	N	2
125	125	Urban Land	480	760	N	2
127	127	Urban Land	0	0	N	
128	128	Urban Land	0	0		
129	129	Urban Land	0	0	N	
130	130	Urban Land	300	1,152	N	2
131	131	Urban Land	0	264	Y-Gas	
132	132	Urban Land	0	0		
EX-61	EX-61	D	350	770	N	

MEP PROCESS IN PUBLIC ROW - 65% CALCULATIONS

BMP Sizing – Permeable Pav't



Contributing Drainage Area	impervious	0 SF
	pervious	800 SF
	BMP	2400 SF
	Total	3200 SF
Regulated Retention Volume SWRv:		248 CF
Ceiling Volume (1.7")		351 CF

MEP PROCESS IN PUBLIC ROW - 65% CALCULATIONS

BMP Sizing – Permeable Pav't

Area of Practice:	2400	SF	
Void Ratio vr:	0.35		
Resv Depth needed for SWRv	0.30	Ft	
Field infiltration rate, i:	0.2	ft/day	(0.1 in/hr)
Check drawdown time (thru soil):	1.03	days	dp x vr/ 0.5i

Use 4" Aggregate (0.33 ft) and check volume achieved on sloped sidewalk

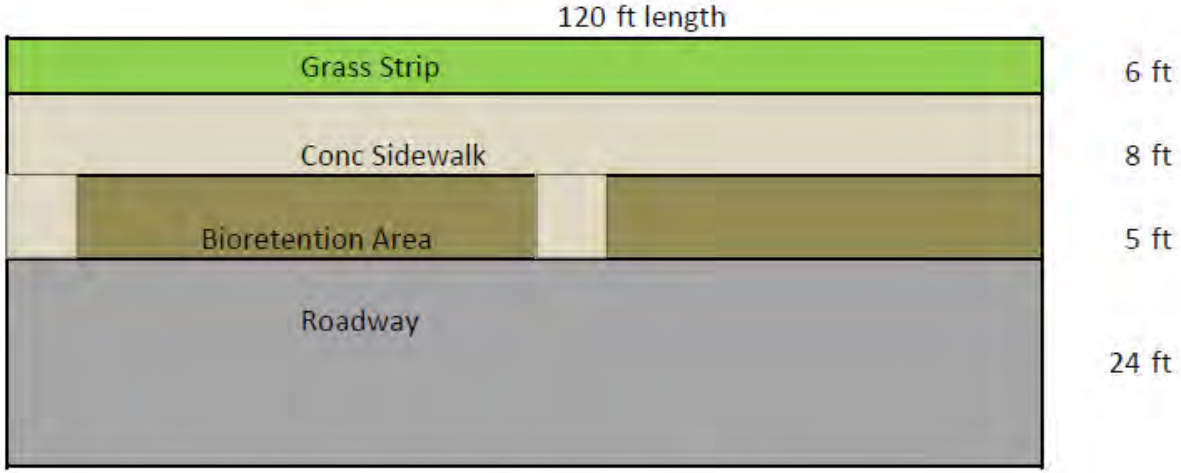
Avg Depth Each Cell	0.375	ft	(4.5 inches)

Check Volume Prov:	32	CF in a single 20' long "step"
	315	CF in 10 steps (200')

Additional capacity can be used to offset deficits in other areas

MEP PROCESS IN PUBLIC ROW - 65% CALCULATIONS

BMP Sizing – Bioretention



Contributing Drainage Area	impervious	3840 SF
	pervious	720 SF
	BMP	600 SF
	Total	5160 SF
	Rv	*0.85*

Regulated Retention Volume SWRv:	440 CF
Ceiling Volume (1.7")	623 CF
Area of Practice (subtract ped crossings):	520 SF

MEP PROCESS IN PUBLIC ROW - 65% CALCULATIONS

BMP Sizing – Bioretention

Size Iteration 1:

Use 24" deep media	260 CF
Use 9" deep stone layer	137 CF
Assume 3" Avg. ponding depth	130 CF
	527 CF

Check Filter Media Depth

SA to CDA Ratio:	10%
On DDOE Table 3-21	Max depth = 18"

Size Iteration 2:

Use 18" deep media	195 CF
Use 9" deep stone layer	137 CF
Assume 4" Avg. ponding depth	172 CF
	503 CF

Additional capacity can be used to offset deficits in other areas

MEP PROCESS in PUBLIC ROW

65% Design Submission

- Stormwater Management Map

  Proposed catch basins, proposed utilities; BMP's on site and adjacent public land; sub-drainage boundaries; proposed trees; soil boring locations; vertical data (e.g. test hole results; storm sewer elev.)

MEP PROCESS IN PUBLIC ROW

65% - WORKSHEET

Step 2: Consider Infiltration					Step 3: Evaluate Existing Infrastructure Constraints	
Use the numbered list of drainage areas to record water table, bedrock concerns, infiltration rate, and hotspot concerns within the project limits of disturbance (LOD).					On SMM, depict utlity and conveyance infrastructure to confirm/adjust opportuntities for land conversions and BMP's. Delineate areas of potential conflict, and areas without conflict, including areas where minimum depths for BMPs can not be met. Delineate trees (size, species, condition) and tree protection.	
Hydro Soil Group	Water Table OK?	Bedrock elev OK?	Infiltration Rate	Hot Spot Concern Found?	Preservation of Mature Trees which are in fair or better condition	
A, B, C, D or Urban Land	Y/N	Y/N	in-hr	Y/N	# of trees	Ex. Tree Volume Credit (CF)
						0
						0
						0

MEP PROCESS IN PUBLIC ROW

65% - WORKSHEET

Step 4: Identify Land Conversion and BMP Placement Opportunities

For land conversion and BMP opportunities already defined at 30%, and for new opportunities added, provide the area measurements below. **Land Conversion and BMP surface areas within the LOD must be reflected in the SWRv computation - update those colums as necessary.** Additional allowable BMP's such as impervious surface disconnect, swales, and infiltration should also be considered and described in narrative. **Describe reason** for eliminated Land Conv./BMP locations

Land Conversion Area		Bioretention Opportunity Areas		Permeable Pavement Opportunity Areas	
within	adj	within	adj	within	adj
SF	SF	SF	SF	SF	SF

MEP PROCESS IN PUBLIC ROW

65% - WORKSHEET

Step 5: Size BMP's and Compute Achieved Retention Volumes

Delineate the drainage area to the BMP locations and compute the ceiling runoff volume reaching them. Aggregate the total maximum possible BMP volume that can be handled by the BMP's at their locations..

Compute and total the total maximum possible BMP capacity based on size of the facilities. Total the number of proposed trees meeting the required soil volume to be considered acceptable for retention volume. Total the maximum retention volume capacity of all facilities, and compare to the regulated volume. If a deficit exists, review BMP placements/sizes to determine if additional volume can be captured.

BMP Drainage Area (total for all w-in DA - see separate sizing comps)		1.7" (Ceiling) SRC Reaching All Proposed BMPs		Max. Storage Vol. Bioretention Based on Size (Total in DA - See separate sizing comps)	Max Storage Vol. Perm. Pav't Based on Size (Total in DA - See separate sizing comps)	Maximum "Other" Storage Vol- (Total in DA - See separate sizing comps)	No. of prop. trees meeting 2 CF soil per cannopy inch	Total Sv Practice - Maximum Retention Volume Achievable (BMP's and Trees)	Overage / (Deficit) Volume (as compared to SWRv)
within	adj (1)	within	adj (1)						
SF	SF	CF	CF	CF	CF	CF	EA	CF	CF
		#DIV/0!	#DIV/0!					#DIV/0!	#DIV/0!
		#DIV/0!	#DIV/0!					#DIV/0!	#DIV/0!
		#DIV/0!	#DIV/0!					#DIV/0!	#DIV/0!

MEP PROCESS in PUBLIC ROW

65% Design Submission

Narrative, *amended to add:*

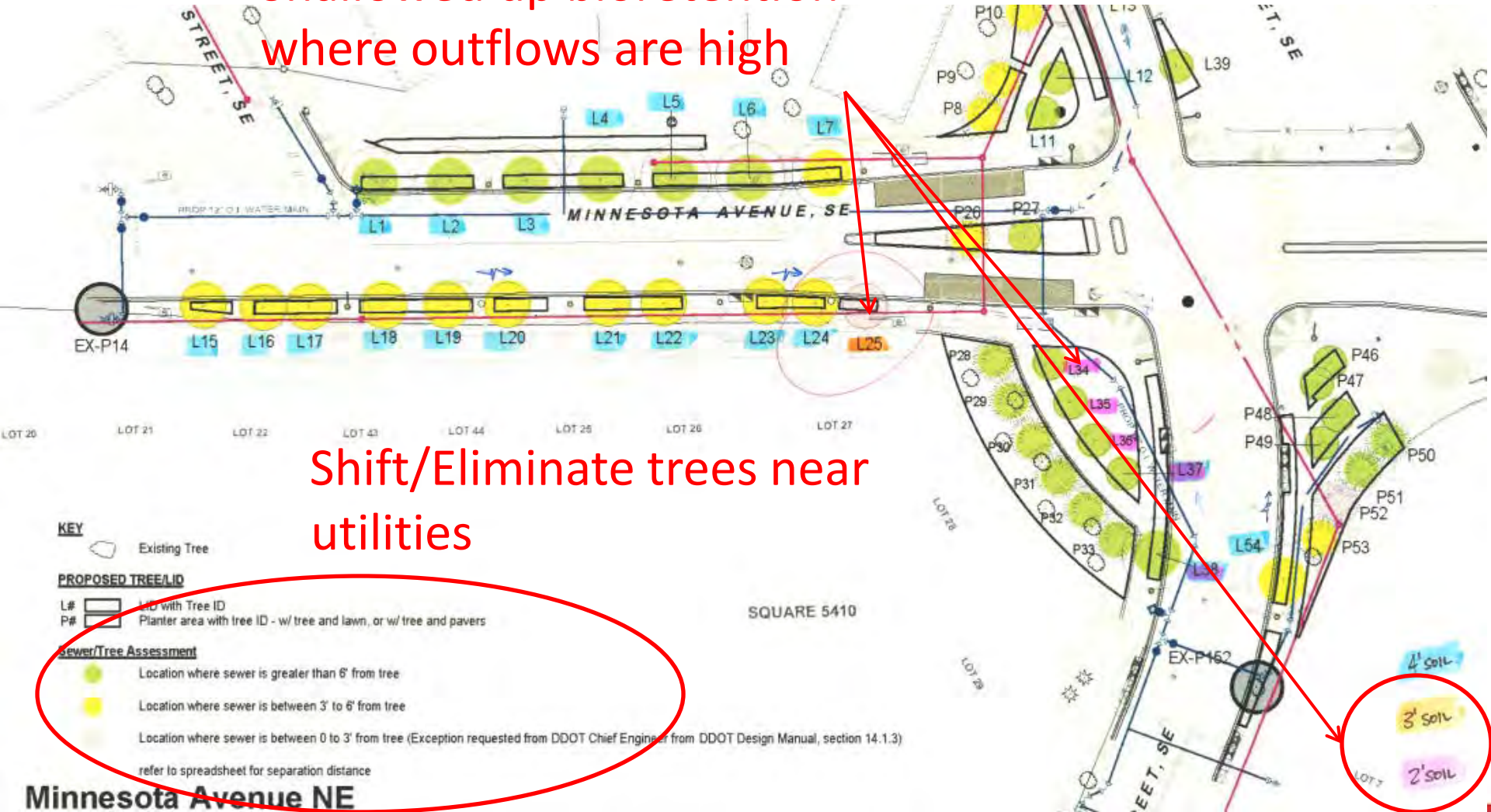
- Description of Conflict Areas that emerged during design
- Why public lands were eliminated as BMP options
- Soil boring results
- Supporting info on BMP design

MEP PROCESS in PUBLIC ROW

TEST CASE MEP PROCESS

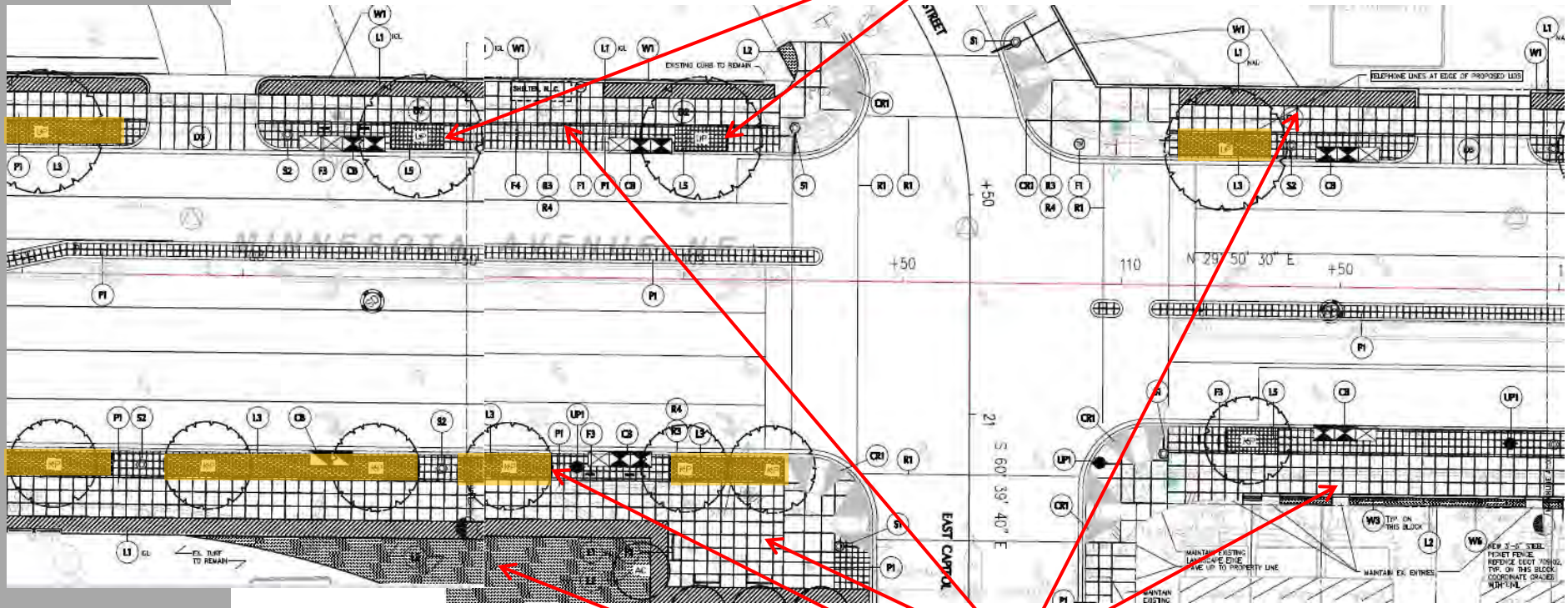
MEP PROCESS IN PUBLIC ROW - 65% ASSESSMENT

Shallowed up bioretention where outflows are high



Shift/Eliminate trees near utilities

MEP PROCESS IN PUBLIC ROW - 65% MAP



DRAINAGE STRUCTURE TABLE					
STR. NO.	CLASSIFICATION	STATION	OFFSET	TOP ELEV.	INV. ELEV.
MINNESOTA AVENUE, N.E.					
I-12	STD. DOUBLE BASIN	108+20.44	39.5' RT.	54.24	41.00
I-13	STD. SINGLE WQ BASIN	108+85.93	39.5' RT.	54.03	46.40
I-17	STD. DOUBLE WQ BASIN	108+22.15	28.5' LT.	54.70	45.90
I-18	STD. SINGLE WQ BASIN	108+89.69	28.5' LT.	54.11	47.86

MEP PROCESS IN PUBLIC ROW - 65% ASSESSMENT

Detailed Design:

- Infiltration infeasible in most areas
- Some BMP's eliminated due to extensive utilities
- 36 new trees meeting soil vol req't
- 8,000 SF Bioretention & 27,000 SF permeable pavement opportunities (in 5.1 acres)

MEP PROCESS IN PUBLIC ROW - 65% WORKSHEET

	Step 4: Identify Land Conversion and BMP Placement Opportunities						Step 5: Size BMP's and Compute Achieved Retention Volumes									
	For land conversion and BMP opportunities already defined at 30% ,and for new opportunities added, provide the area measurements below. **Land Conversion and BMP surface areas within the LOD must be reflected in the SWRv computation - update those colums as necessary.** Additional allowable BMP's such as ipervious surface disconnect, swales, and infiltration should also be considered. Describe reason for eliminated Land Conv./BMP locations						Delineate the drainage area to the BMP locations and compute the ceiling runoff volume reaching them. Aggregate the total maximum possible BMP volume that can be handled by the BMP's at their locations..				Compute and total the total maximum possible BMP capacity based on size of the facilities. Total the number of proposed trees meeting the required soil volume to be considered acceptable for retention volume. Total the maximum retention volume capacity of all facilities, and compare to the regulated volume. If a deficit exists, review BMP placements/sizes to determine if additional volume can be captured.					
Drainage Area ID	Land Conversion Area		Bioretention Opportunity Areas		Permeable Pavement Opportunity Areas		BMP Drainage Area (total for all w-in DA - see separate sizing comps)		1.7" (Ceiling) SRC Reaching All Proposed BMPs		Max. Storage Vol. Bioretention Based on Size (Total in DA - See separate sizing comps)	Max Storage Vol Perm. Pav't Based on Size (Total in DA - See separate sizing comps)	Maximum "Other" Storage Vol- (Total in DA - See separate sizing comps)	No. of prop. trees meeting 2 CF soil per cannopy inch	Total Sv Practice - Maximum Retention Volume Achievable (BMP's and Trees)	Overage / (Deficit) Volume (as compared to SWRv)
	within	adj	within	adj	within	adj	within	adj (1)	within	adj (1)						
	SF	SF	SF	SF	SF	SF	SF	SF	CF	CF	CF	CF	CF	EA	CF	CF
57															0	(661)
58	210		150				7,037	745	913	100	154				154	(490)
61			450		1,290		6,264	1,993	834	81	461	226			687	33
68					930		930	3,000	116	404		163		2	136	(424)
82					1,870		1,870	342	219	12		315		8	339	(345)
86			225				5,209		687	0	231			2	251	(557)
88			220				3,210		417	0	226			1	236	(353)
89			1,650				6,550		815	0	1,691			3	845	(201)
90									0	0				3	30	(605)
91									0	0				2	20	(246)
100			880		3,900		7,988		1,064	0	902	683		5	1,114	113
101			160		1,350		3,570	5,227	466	387	164	236		1	430	(8)
102					1,750		1,750	4,138	230	321	0	306		4	270	(143)
103			225		820		4,513	4,935	598	282	231	144			374	(95)
104			160		1,190		1,790	8,579	233	371	164	208			253	(328)
108	240		255		1,880		7,773	1,724	983	78	261	329		1	620	(247)
109					980		980	270	128	36	0	172		3	158	(317)
112			420		2,100		9,570	1,537	1,200	167	431	368			798	(144)
113			480		1,000		4,103	4,090	552	177	492	175			552	119
116			240		945		4,459	1,183	593	41	246	165		1	421	(136)
117			300		606		5,676	1,413	718	64	308	106			414	(119)
118			400		736		4,137	2,261	491	245	410	129			491	126
122			480		1,776		6,674	1,387	824	187	492	311			803	190
123					448		448	1,280	57	170	0	78			57	(535)
124			300		800		5,458	1,710	735	230	308	140			448	(98)
125			480		760		8,956		1,205	0	492	133			625	(271)
127				1,320			9,445	4,400	1,057	0	1,353				1,077	248
128				720			7,216	2,400	703	0	738				703	152
129							5,528		690	0					0	(541)
130			300		1,152		5,022	7,689	626	679	308	202			529	38
131					264		264	282	34	38		46			34	(495)
132	495								0	0					0	(349)
EX-61			350		770		2,597		252	0	359	147			272	18
															13,140	(6,672)

MEP PROCESS IN PUBLIC ROW - 65% WORKSHEET

Detailed Design Results:

- Possible 13,000 CF Retention Volume (19,800 CF Req'd)
- 3 Drainage Areas with Zero Retention
- Adjacent Public Land (School, Metro) – options to explore

MEP PROCESS in PUBLIC ROW

Design Process

- 90% Design
  - Updates to issues from 65% based on final design, utility test holes, etc.
  - *Drainage Areas w/Zero Retention:* Within MS4, water quality catch basins or other treatment technologies must provide WQ treatment for the SWRv

MEP PROCESS in PUBLIC ROW

90% Design Submission

- Stormwater Management Map
- Plans
- Worksheet
- Narrative
- Supporting Calculations

All updated to reflect latest design and address DDOE Comments

MEP PROCESS in PUBLIC ROW

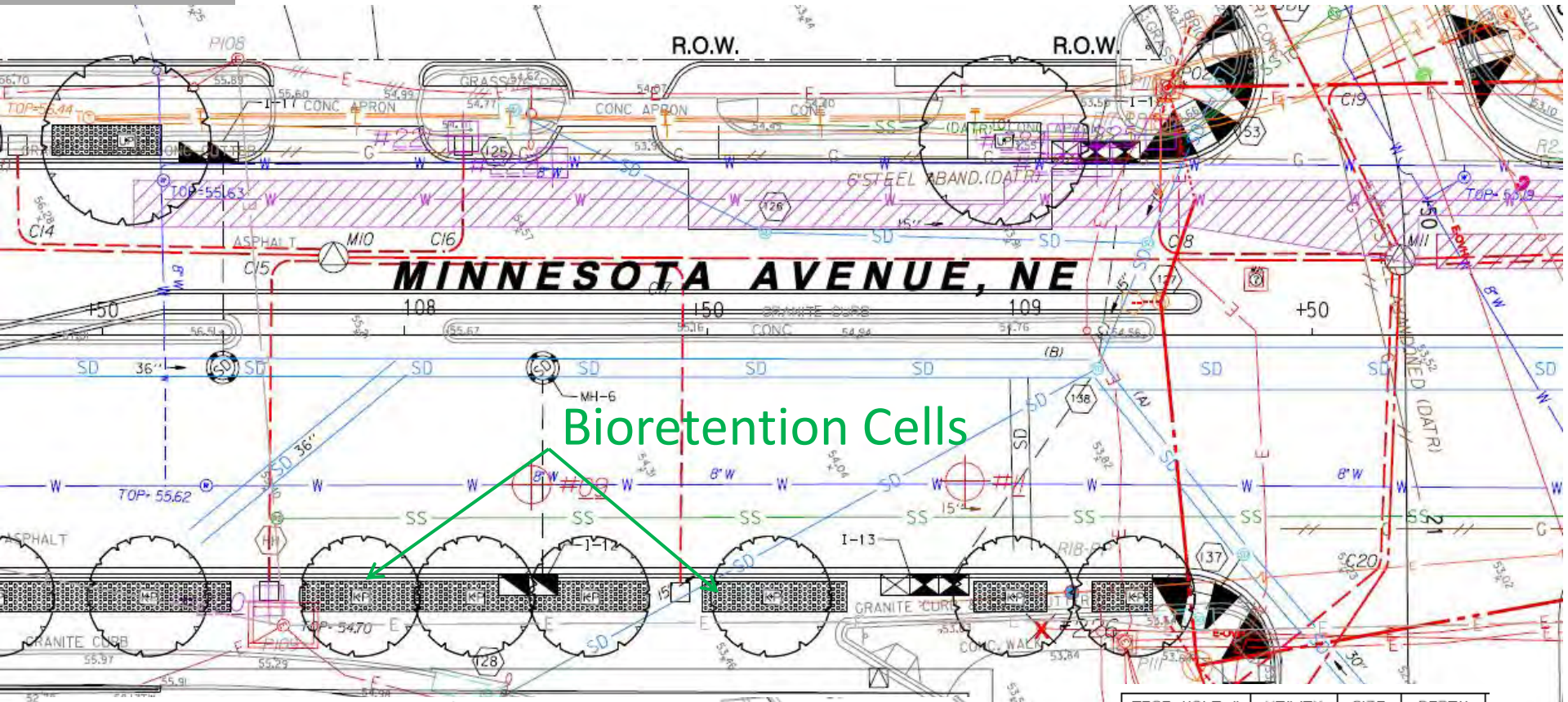
TEST CASE MEP PROCESS

MEP PROCESS IN PUBLIC ROW - 90% ASSESSMENT

Final Design:

- Proposed utility relocations, test holes to locate existing utilities
- Final signal, lighting, storm drain, landscape design
- Public Lands Option explored, no additional BMP's feasible

MEP PROCESS IN PUBLIC ROW - 90% MAP



DRAINAGE STRUCTURE TABLE

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MINNESOTA AVENUE, N.E.					
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I-13	STD. SINGLE WQ BASIN	108+85.93	39.5' RT.	54.03	46.40
I-17	STD. DOUBLE WQ BASIN	108+22.15	28.5' LT.	54.70	45.90
I-18	STD. SINGLE WQ BASIN	108+89.69	28.5' LT.	54.11	47.86

TEST HOLE #	UTILITY	SIZE	DEPTH
9	WATER	8.62"	4.86'
11	WATER	8.62"	4.64'
14	TELEPHONE	-	3.8'
15	GAS	7"	3.46'
16	WATER	8.5"	4.06'
17	WATER	9"	4.22'
18	GAS	-	7.96'
18A	GAS	3"	4.66'

MEP PROCESS IN PUBLIC ROW - 90% WORKSHEET

Project N: **Project Name:** Minnesota Ave Great Street Test Case **Proj. No:** 0

Summary Data: 90%/Final Design Phase

Disturbance Area (ac.):	5.10	Regulated Retention Volume (1.2"):	19,812 CF
No. of Drainage Areas:	33	Retention Volume retained:	10,077 CF
		Deficit:	9,735 CF

Step 4: Identify Land Conversion and BMP Placement Opportunities

For land conversion and BMP opportunities already defined at 30% ,and for new opportunities added, provide the area measurements below. **Land Conversion and BMP surface areas within the LOD must be reflected in the SWRv computation - update those colums as necessary.** Additional allowable BMP's such as Ipervious surface disconnect, swales, and infiltration should also be considered. Describe reason for eliminated Land Conv /BMP locations

Step 5: Size BMP's and Compute Achieved Retention Volumes

Delineate the drainage area to the BMP locations and compute the ceiling runoff volume reaching them. Aggregate the total maximum possible BMP volume that can be handled by the BMP's at their locations..

Compute and total the total maximum possible BMP capacity based on size of the facilities. Total the number of proposed trees meeting the required soil volume to be considered acceptable for retention volume. Total the maximum retention volume capacity of all facilities, and compare to the regulated volume. If a deficit exists, review BMP placements/sizes to determine if additional volume can be captured.

Drainage Area ID	Land Conversion Area		Bioretention Opportunity Areas		Permeable Pavement Opportunity Areas		BMP Drainage Area (total for all w-in DA - see separate sizing comps)		1.7" (Ceiling) SRC Reaching All Proposed BMPs		Max. Storage Vol. Bioretention Based on Size (Total in DA - See separate sizing comps)	Max Storage Vol. Perm. Pav't Based on Size (Total in DA - See separate sizing comps)	Maximum "Other" Storage Vol- (Total in DA - See separate sizing comps)	No. of prop. trees meeting soil vol req't.	Total Sv Practice - Maximum Retention Volume Achievable (BMP's and Trees)	Overage / (Deficit) Volume (as compared to SWRv)
	within	adj	within	adj	within	adj	within	adj (1)	within	adj (1)						
	SF	SF	SF	SF	SF	SF	SF	SF	CF	CF	CF	CF	CF	EA	CF	CF
57															0	(661)
58	210		150				7,037	745	913	100	92				92	(552)
61			0		1,290		6,264	1,983	834	81	0	226			226	(428)
68					930		930	3,000	116	404		163		2	136	(424)
82					1,870		1,870	342	219	12		316		8	339	(345)
86			225				5,209		687	0	138			2	158	(650)
88			220				3,210		417	0	135			1	145	(443)
89			1,000				6,550		489	0	1,025			3	519	(527)
90									0	0				3	30	(605)
91									0	0				2	20	(246)
100			750		1,500		7,988		638	0	769	683		5	688	(313)
101			160		1,350		3,570	5,227	2,794	387	98	236		1	365	(74)
102					1,750		1,750	4,138	230	321	0	306		4	270	(143)
103			225		820		4,513	4,935	598	282	138	144			282	(188)
104			160		1,190		1,790	8,579	140	371	164	208			160	(421)
108	240		255		1,880		7,773	1,724	983	78	157	329		1	516	(351)
109					980		980	270	128	36	0	172		3	158	(317)
112			420				9,570	1,537	1,200	167	431	368			798	(144)
113			480		1,000		4,103	4,090	552	177	492	175			552	119
116			240		945		4,459	1,163	593	41	246	165		1	421	(136)
117			300		608		5,676	1,413	718	64	308	106			414	(119)
118			400		736		4,137	2,261	491	245	410	129			491	126
122			480		1,776		6,674	1,387	824	187	492	311			803	190
123					448		448	1,260	57	170	0	78			57	(535)
124			300		800		5,458	1,710	735	230	308	140			448	(98)
125			100		760		8,958		1,205	0	103	133			236	(660)
127				1,320			9,445	4,400	634	0	1,353				664	(175)
128				720			7,216	2,400	422	0	738				422	(130)
129							5,528		690	0					0	(541)
130			300		1,152		5,022	7,689	626	679	185	202			406	(85)
131							0	282	0	38		46			0	(529)
132	495								0	0					0	(349)
EX-61			350				2,597		252	0	359	147			272	18
															10,077	(9,735)

MEP PROCESS IN PUBLIC ROW - 90% WORKSHEET

Final Design Results:

- Achieved 10,000 CF Retention Volume
- 4 Drainage Areas with Zero Retention
  - Provide WQ Basins (MS4 Area)

MEP PROCESS IN PUBLIC ROW

- Remember this project included total reconstruction of roadway (more then 2 acres) ?
- If existing road was salvageable, we'd have achieved 86% of SWRv

Project Name:	Minnesota Ave Great Street Test Case			
Summary Data: 30% Design Phase				
		Regulated Retention Volume (1.2"):	11,611	CF
Disturbance Area (ac.):	3.12	Retention Volume retained:	TBD	
No. of Drainage Areas:	33	Deficit:	TBD	

If it were Mill & Resurface…

MEP PROCESS in PUBLIC ROW

Tools Available

- DDOT Design and Engineering Manual Supplement
- DDOT Worksheet Template
- DDOE Guidebook

MEP PROCESS IN PUBLIC ROW

Questions?




Stormwater Regulations Process Overview

SW Reg & LID Std Training
October 22, 2013

Meredith Upchurch
LID Team Lead
District Department of Transportation
Infrastructure Project Management Administration
Stormwater Management Branch

Planning Phase

- Identify opportunities and limitations
  - Adjacent public space
  - Lane reduction, pavement removal, sidewalk widths
  - Traffic calming need
- Existing conditions
  - Soil Analysis – NRCS Soil type
  - Utility locations – id conflicts?
  - Mature Trees
- Identify space for SWM
  - Identify drainage areas, slope
  - Bioretention - Tree space, parking lane, open are
  - Permeable pavement - sidewalk, tree, parking lane, alley
- Identify scope of design project
  - Geotechnical testing requirements

Design to 30%

- Design Start
  - Survey of Drainage areas, existing conditions
  - Utility locations – Quality level C
  - Calculate volume requirement for LOD
  - Plan layout of BMP candidate areas
- Stormwater Management Plan (SWMP)
  - MEP Submission: Map, Worksheet, & Narrative
- Initial Submission of SWMP & SESC Plan to DDOE
  - Apply for DCRA Building Permit
  - “0” street address
  - Pay Initial Plan Review Fee ($4K – $7K)
- DDOE assigns plan review #
  - 10-30 business days for review
  - DDOE provides concurrence on plan or request for more BMP areas identified

Design to 65%

- Geotechnical testing performed
  - locations identified from 30% plan
  - determine infiltration capacity for detail BMP design
- Design depths of BMPs
  - ID utility conflicts
  - Calculate volumes of practices and total achieved
- 65% MEP Submission of SWMP to DDOE
  - Submit through DCRA; Include DDOE plan review #
  - MEP Submission: Map, Worksheet, & Narrative
  - No Interim Plan Review Fee
- DDOE Review - 10-30 business days for review
  - DDOE provides concurrence on plan and comments about 65% changes

Design to 90%

- Plan layout and BMP design modified as needed
- Identify changes and any new opportunities or conflicts
- Revise volumes of practices and total achieved
- 90% MEP Submission of SWMP & SESC to DDOE
  - Submit through DCRA; Include DDOE plan review #
  - MEP Submission: Map, Worksheet, & Narrative
  - No Interim Plan Review Fee
- DDOE Review - 10-30 business days for review
  - DDOE provides final approval of SWMP if MEP Process followed and plan
  - If full volume requirement not achieved, permit will be issued

Final Submittal

- Maintenance Agreement - DDOT Chief Engineer signs
- Design Certification – DC PE signs & stamps
- Final SWMP & SESC Submission to DDOE
  - Submit through DCRA
  - DDOE will approve the sets and return to applicant through DCRA
  - Final plan review fees paid to DCRA ($3K – $15K)

Construction

- Pre-Construction meeting
  - Request DDOE Inspector for project
- Close Coordination with DDOE Inspector during construction
  - Requirement: Notification to DDOE 3 days prior to construction stage of any BMP.
  - DDOT Implementation: Weekly schedule to DDOE Inspector
  - Notify Inspector of any changes to plans or schedules
- Substantial changes to plan require resubmission of SWMP to DDOE
- As-built drawings submitted at construction completion
  - DDOT submits as-builts certified by Officer of Construction Company per DDOT Standard Spec

What's Next

- Issue Final GI Standards
  - Drawing details
  - Material & construction specifications
  - Design Procedures & MEP Procedure
  - Plant Lists
  - Illustrative LID & GI Manual

- Additional Materials
  - Maintenance procedures
  - Lifecycle Analysis Cost
  - Performance Metrics

Questions

http://ddot.dc.gov/GreenInfrastructure

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