

Using Green Infrastructure to Address Stormwater Regulations AND Build Resiliency

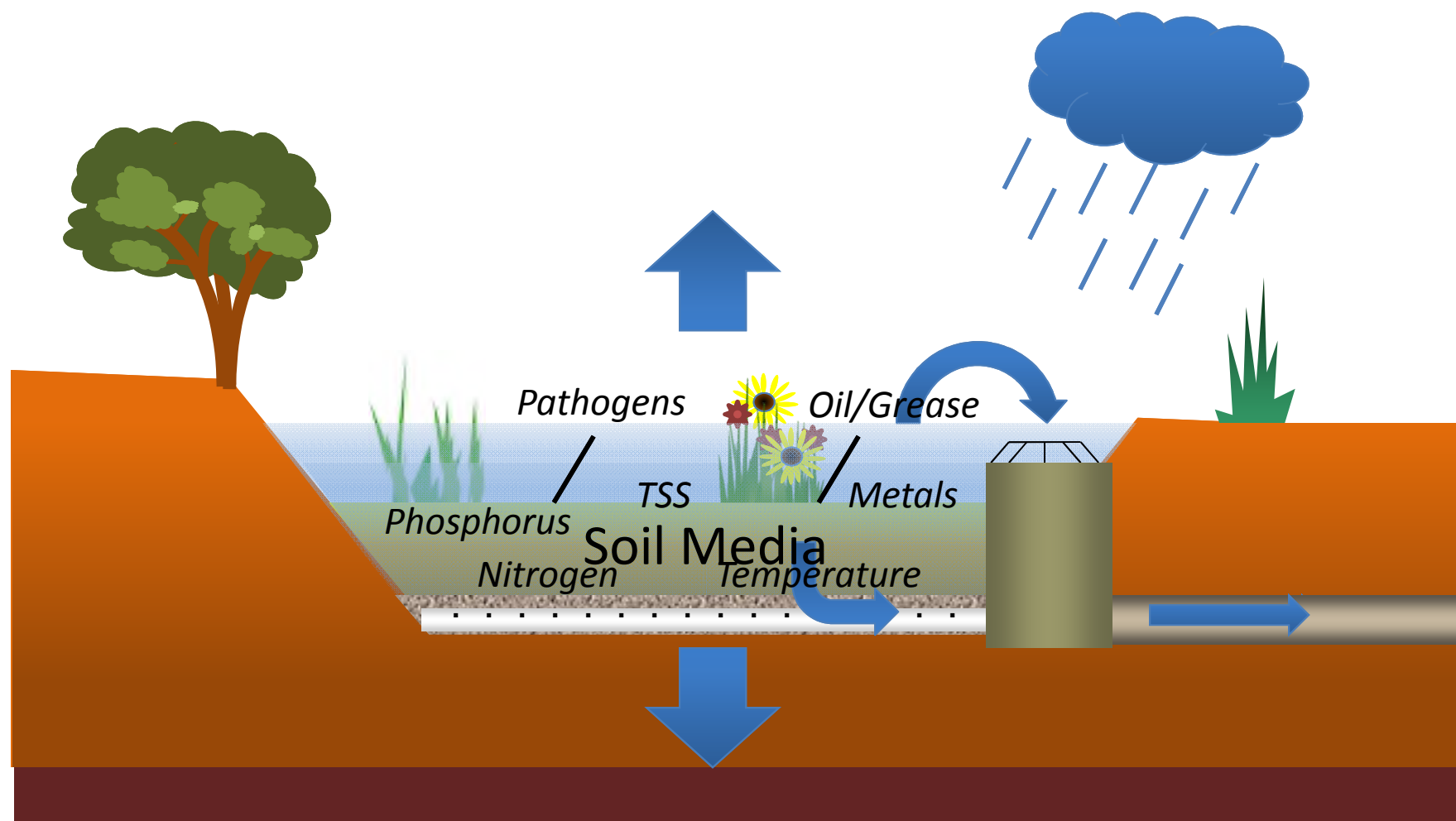
Developing Green Infrastructure
with Climate Change in Mind

Case Studies

Funding Options for Green
Infrastructure

Discussion

Green Infrastructure Practices – Bioretention



Source: NCSU BAE

Green Infrastructure Practices – Bioretention

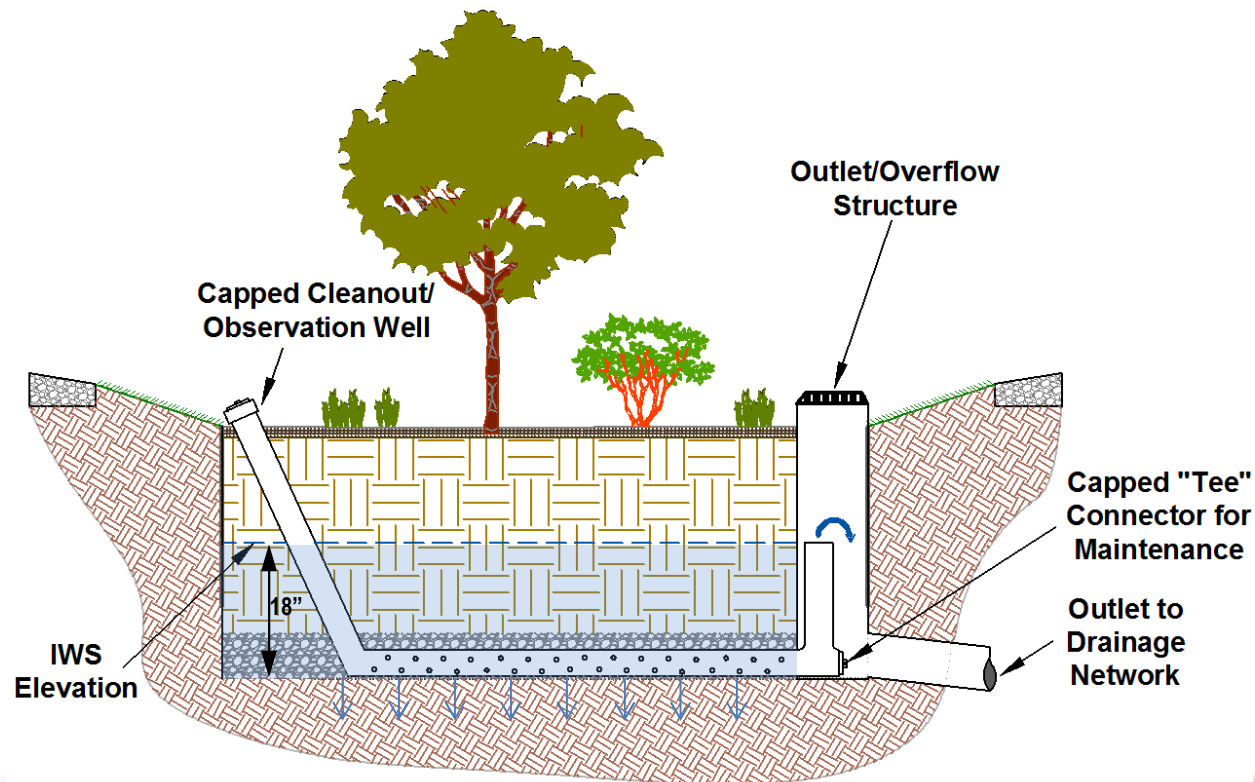


Landscaped Areas/Open Space

Green Infrastructure Practices – Bioretention

Internal water storage (IWS)

If using underdrain and infiltration, elevate the outlet to create a sump for additional moisture retention to promote plant survival and enhanced treatment. Top of IWS should be greater than 18 inches below surface.



Green Infrastructure Practices – Bioretention

Internal water storage (IWS)

If using underdrain and infiltration, elevate the outlet to create a sump for additional moisture retention to promote plant survival and enhanced treatment. Top of IWS should be greater than 18 inches below surface.



Raleigh, North Carolina. Source: Tetra Tech



Rocky Mount, North Carolina. Source: NCSU BAE

Green Infrastructure Practices – Bioretention

- Mulch and Vegetation
 - Double or triple shredded hardwood mulch



Green Infrastructure Practices – Bioretention

- Mulch And Vegetation
 - Hardwood Mulch fades and breaks down in intense sunlight
 - Landscaping stone an alternative



Photos courtesy Watershed Management Group

Green Infrastructure Practices – Bioretention

- Mulch and Vegetation
 - Drought tolerant vegetation
 - Periodic inundation
 - Native species
- Consider size and appearance at maturity



Green Infrastructure Practices – Bioretention

- Vegetation
 - Drought tolerant native vegetation
 - Phreatophytes
 - Large deep tap roots (> 100 ft)
 - Root system 4 to 9 times above ground biomass
 - Scrub Oak and Mesquite

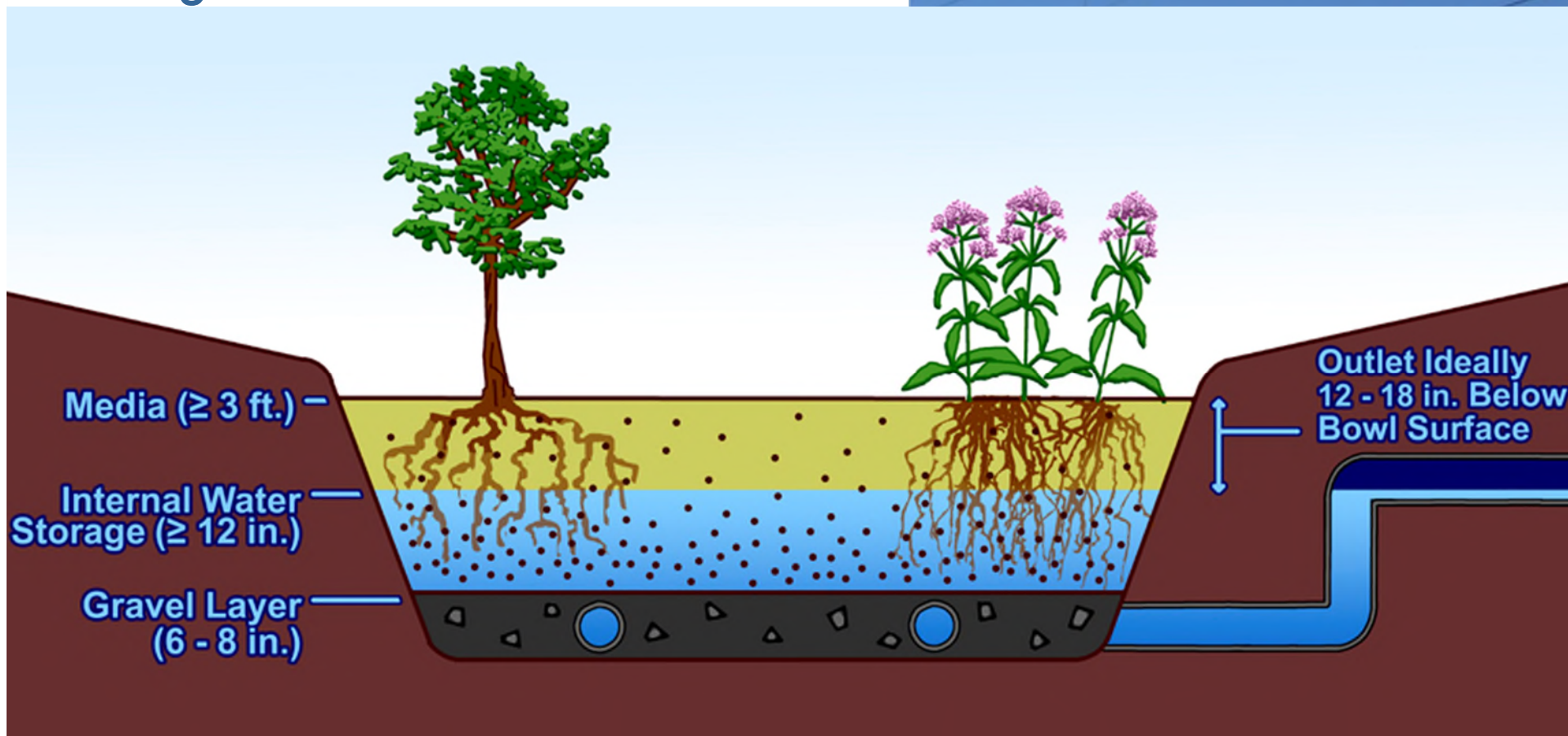
Adapted from Houdeshel et al. 2012



Photos courtesy Watershed Management Group

Green Infrastructure Practices – Bioretention

- Vegetation



Source: NCSU BAE

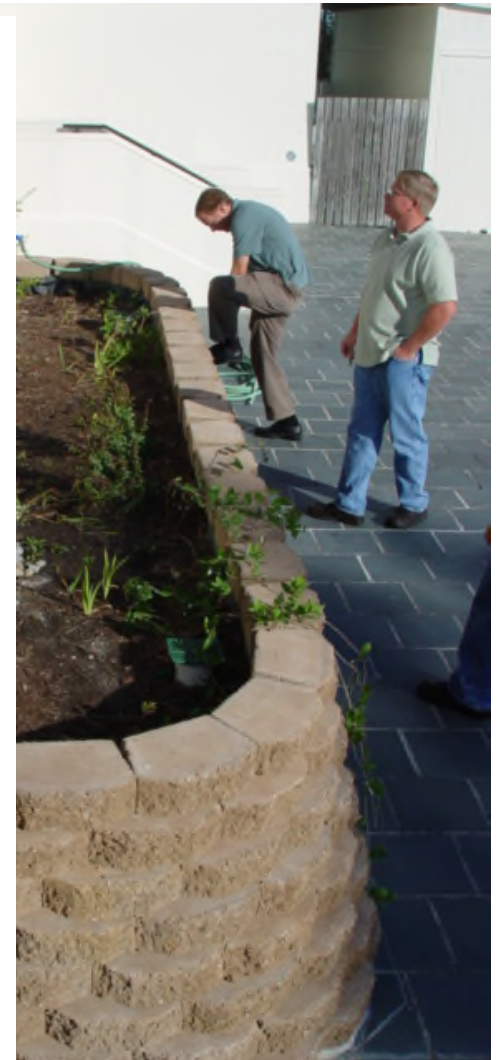
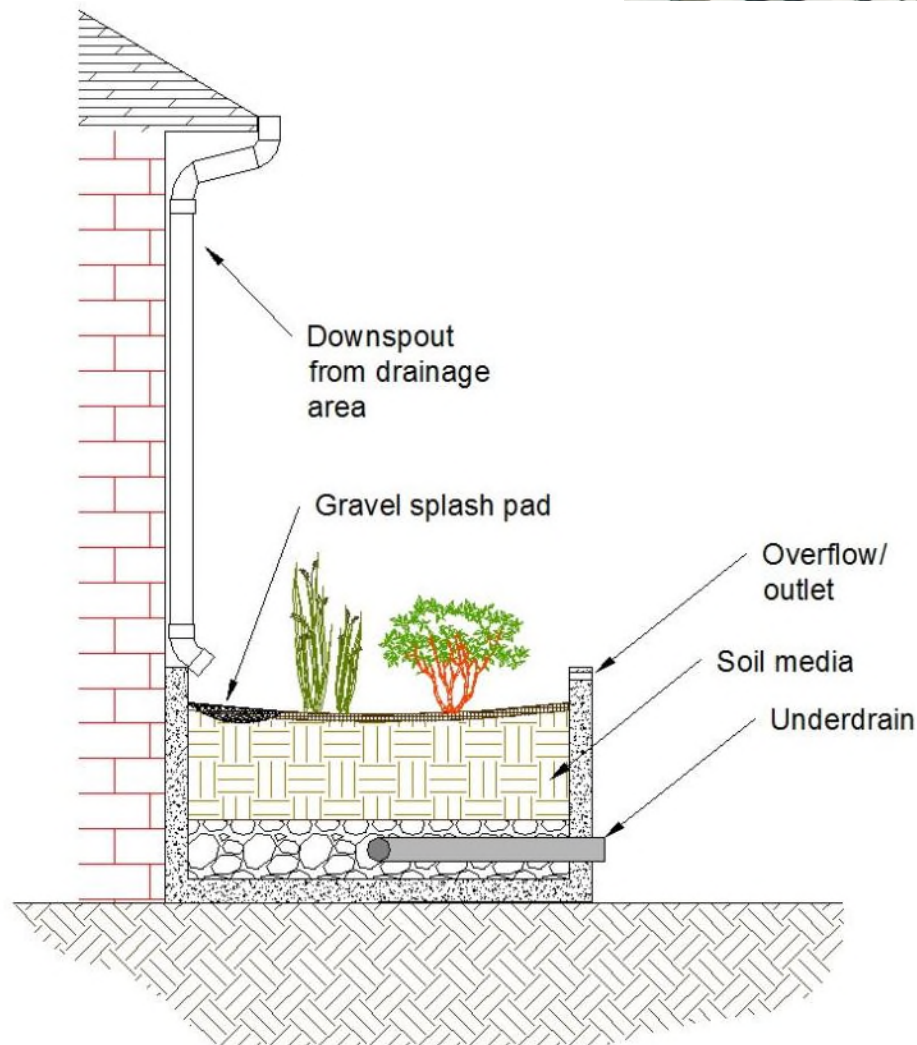
Green Infrastructure Practices – Bio / Bioretention Swales

- Bioswales / Bioretention Swales



Green Infrastructure Practices – Planter Boxes

■ Flow Through Planter Boxes



Green Infrastructure Practices – Permeable Pavement

- Allows for rainfall infiltration
- Ideal for low traffic surfaces (driveways, parking lots, walk ways)
- Provides peak flow mitigation, volume storage, and some water quality improvement



Green Infrastructure Practices – Permeable Pavement



Parking Lots

Green Infrastructure Practices – Permeable Pavement



Parking Lots

Green Infrastructure Practices – Permeable Pavement



Driveways and Alleys



Green Infrastructure Practices – Permeable Pavement



Source: Belgard Hardscapes

Green Infrastructure Practices - Water Harvesting

Court of Appeals
Albuquerque



TETRA TECH

Source: Leslie R. Kryder, Leslie Consulting, LLC

Green Infrastructure Practices - Water Harvesting



SSCAFCA
Rio Rancho, NM 87124



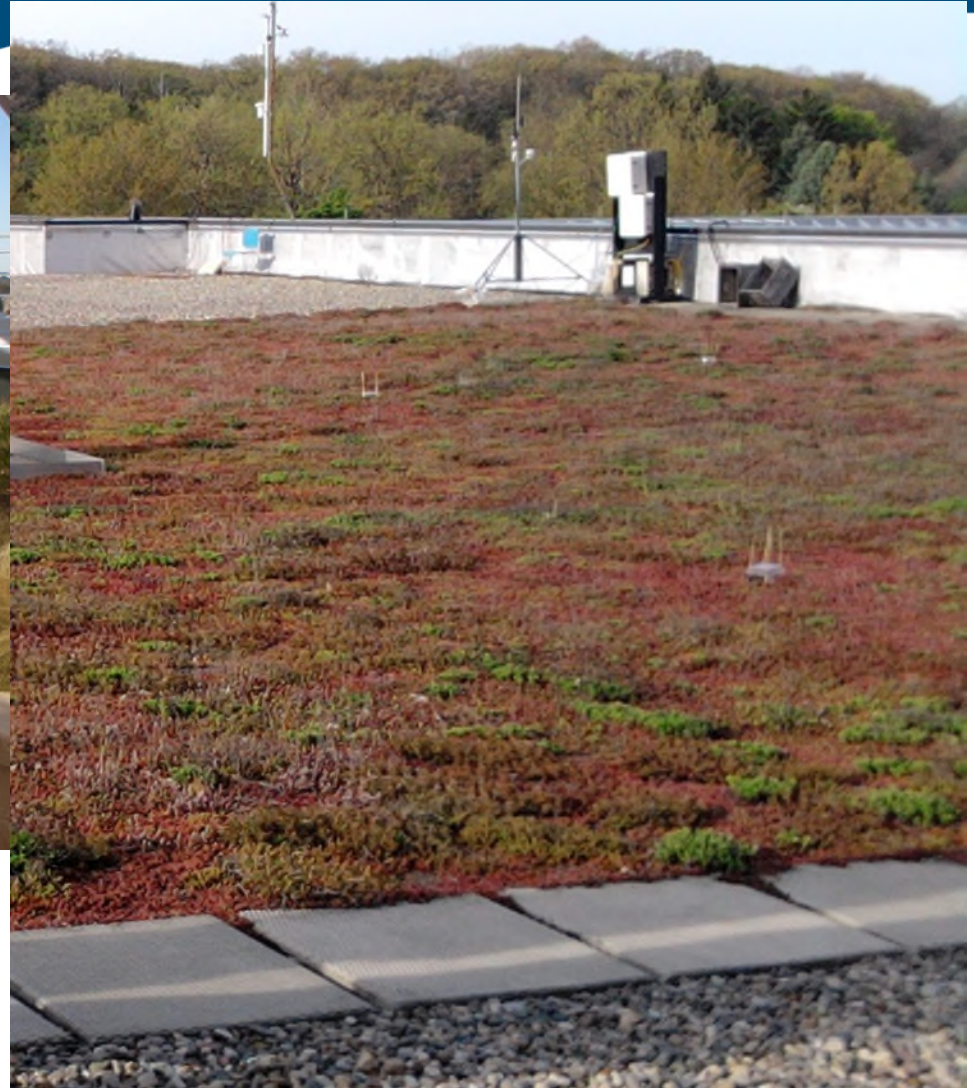
Green Infrastructure Practices - Water Harvesting



Green Infrastructure Practices – Living Roof



Intensive living roof



Extensive living roof

Green Infrastructure Practices - Summary

- Internal Water Storage
 - Holds water
- Permeable Pavement
 - Reduces localize flooding
 - Provide opportunities for storage
- Water Harvesting
 - Stores water for use
 - Maximizes the water use opportunitites

Using Green Infrastructure to Address Stormwater Regulations AND Build Resiliency



Developing Green Infrastructure
with Climate Change in Mind

Case Studies

Funding Options for Green
Infrastructure

Discussion

Sites Southwest Case Study

Imperial Building Site Design



Imperial Building Site Design



Imperial Building Site Design

- 120,000 square foot mixed use
 - Five story building
 - 100 car parking basement
 - 74 residential apartments
 - 23,000 square feet of ground floor retail space
 - Urban vegetable garden on the roof of the building

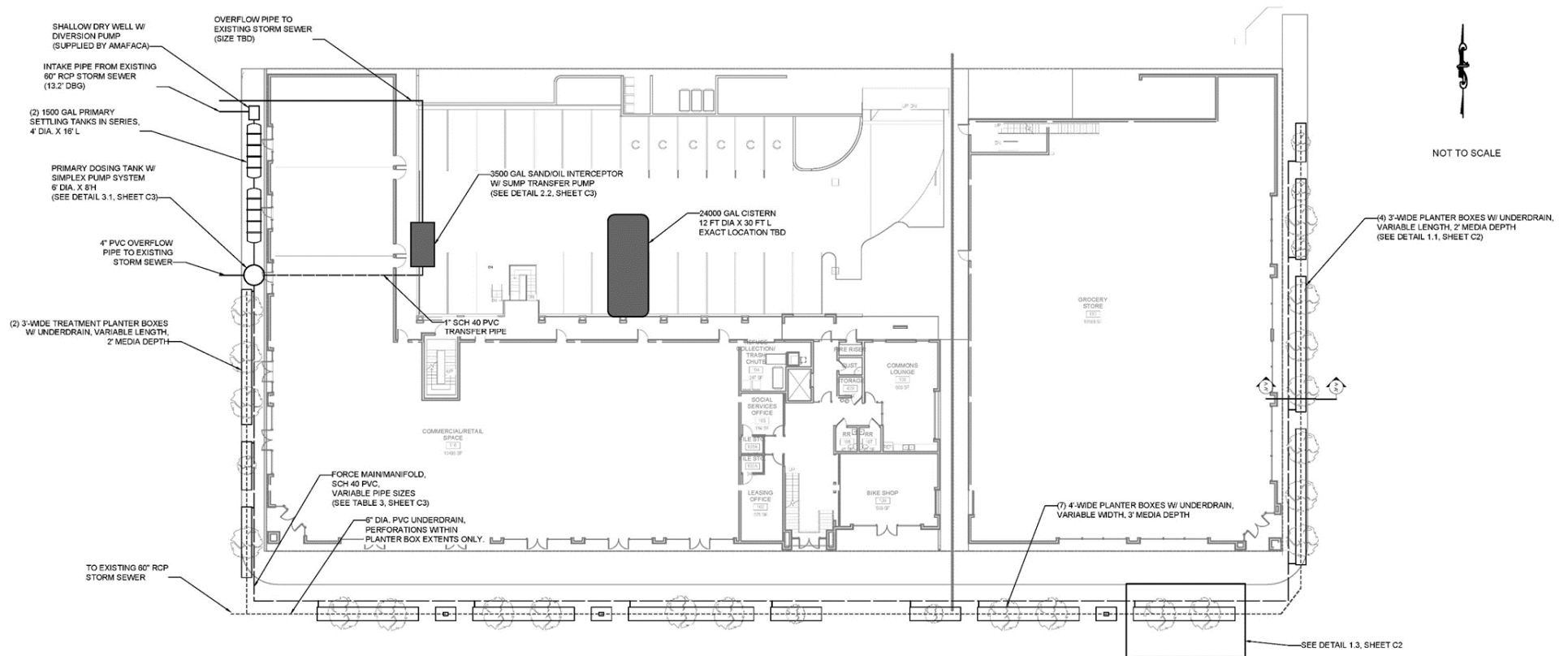
Imperial Building Site Design



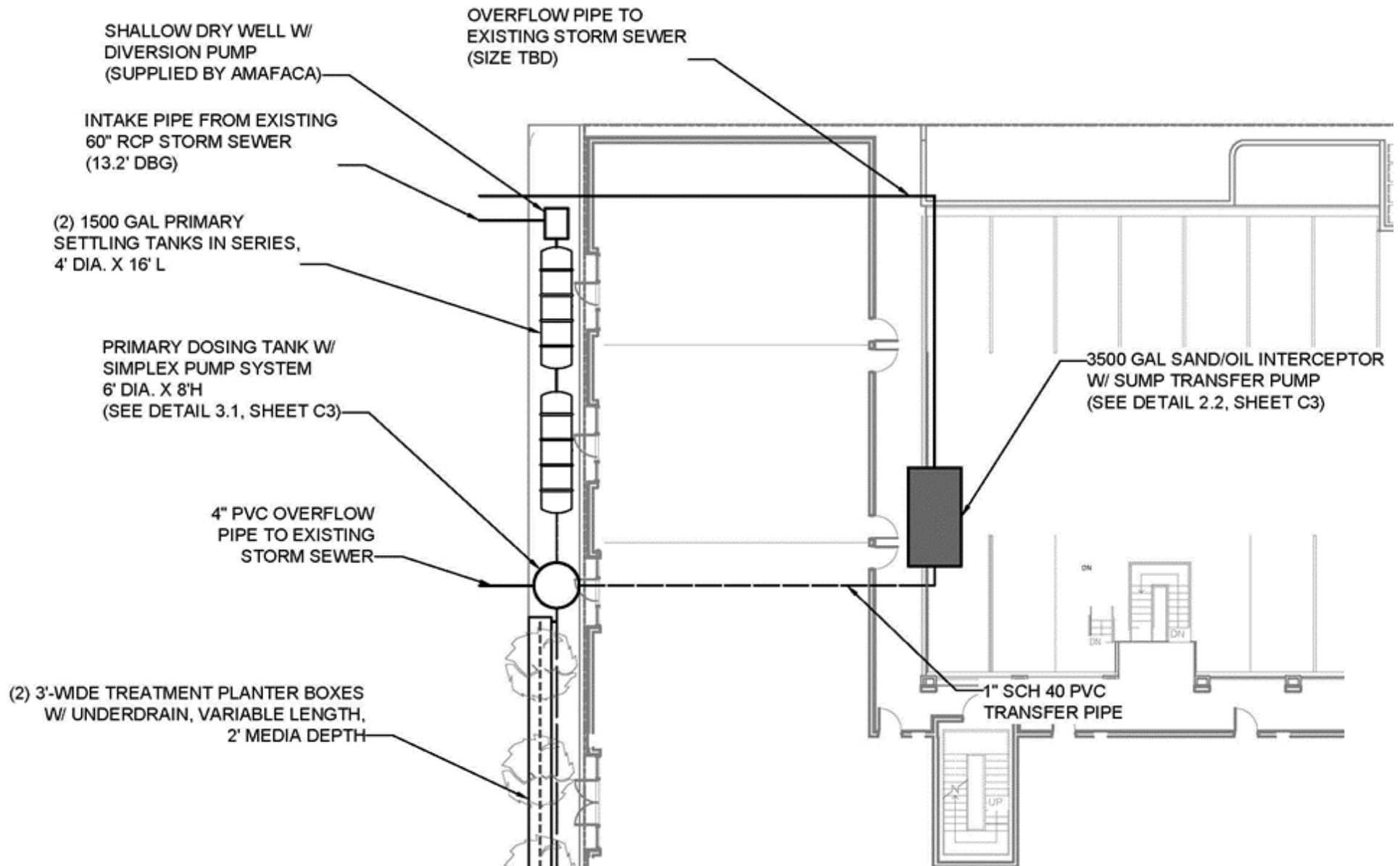
Imperial Building Site Design



Imperial Building Site Design



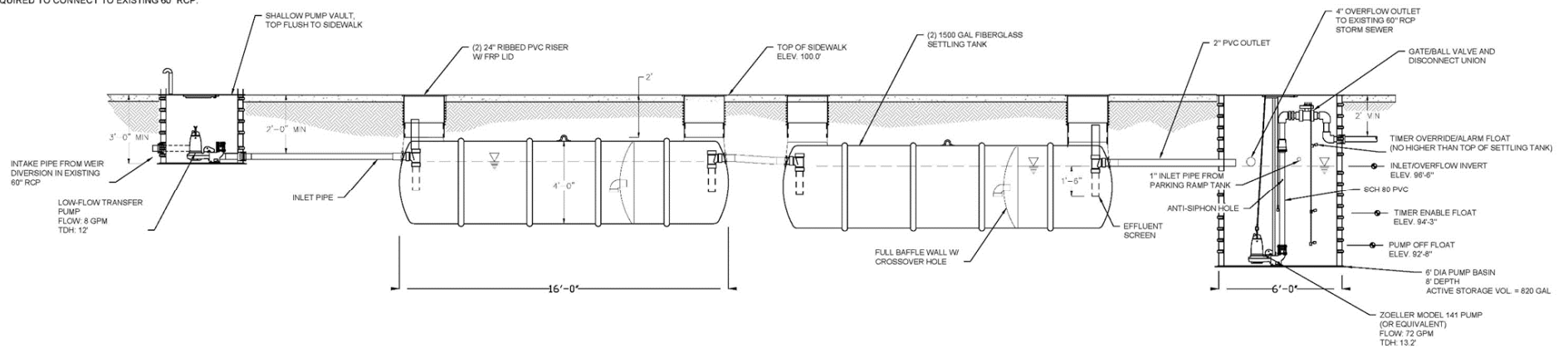
Imperial Building Site Design



Imperial Building Site Design

NOTES:

1. ELEVATIONS ARE RELATIVE, BASED ON BUILDING ELEVATIONS PROVIDED BY DEKKER/PERICH/SABATINI.
2. DESIGN DOES NOT INCLUDE STORM SEWER INFRASTRUCTURE REQUIRED TO CONNECT TO EXISTING 60" RCP.



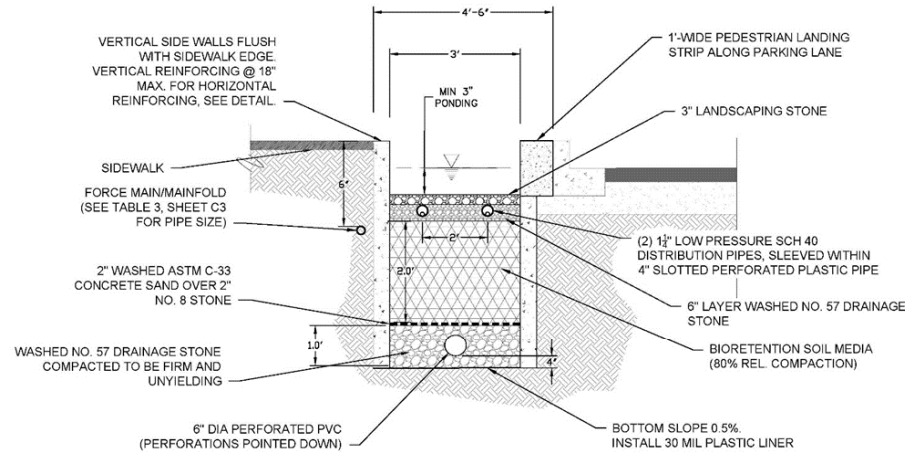
DETAIL 2.1 - NUISANCE FLOW PRE-TREATMENT
AND PUMP TANKS

BIORETENTION MEDIA SPECIFICATION

BSM Composition	Sand	Sandy Loam		Compost
	Sand	Silt	Clay	
Volume	65%	20%	15%	
Weight	75-80%	10% max	3% max	9% max

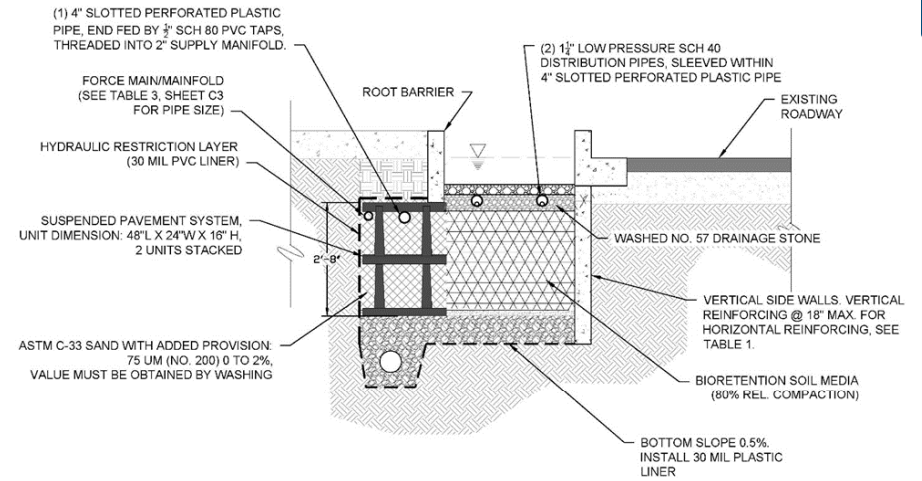
* compost by weight results in approximately 5% organic matter by weight.

NOT TO SCALE

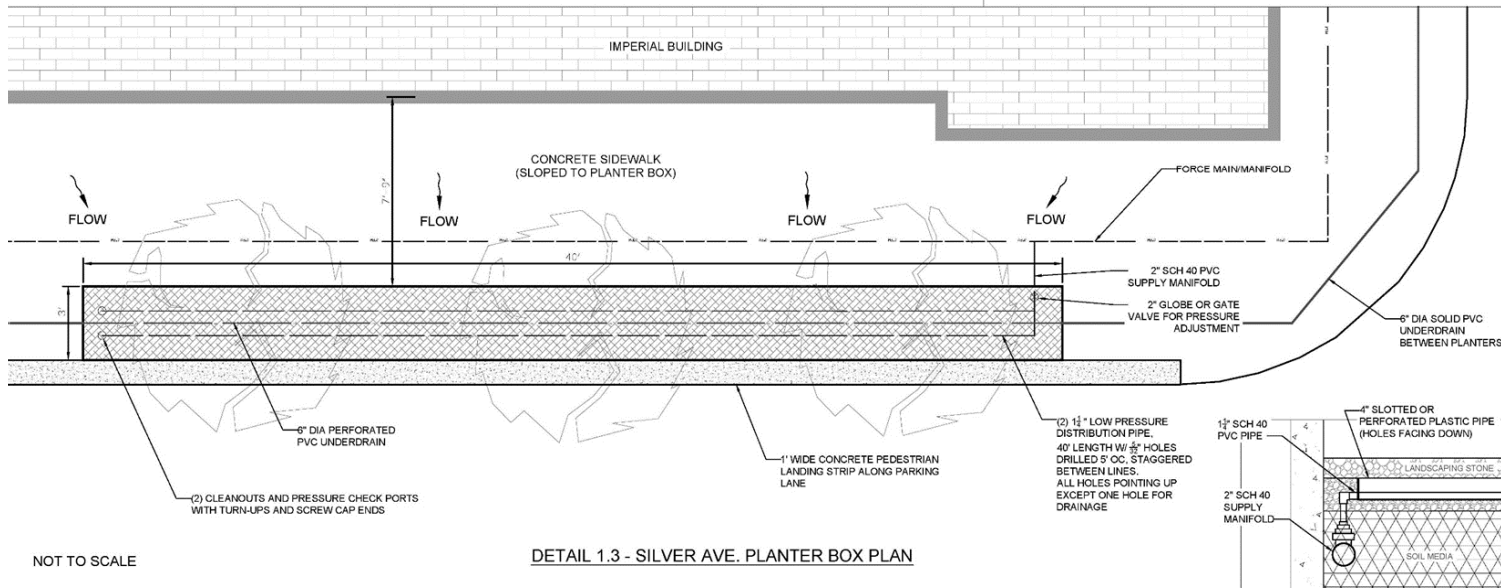


DETAIL 1.1 - (SECTION A-A) PLANTER BOX SECTION

NOT TO SCALE



DETAIL 1.2 - SCENARIO 3 PLANTER BOX SECTION
W/ SUSPENDED PAVING TREATMENT



NOT TO SCALE

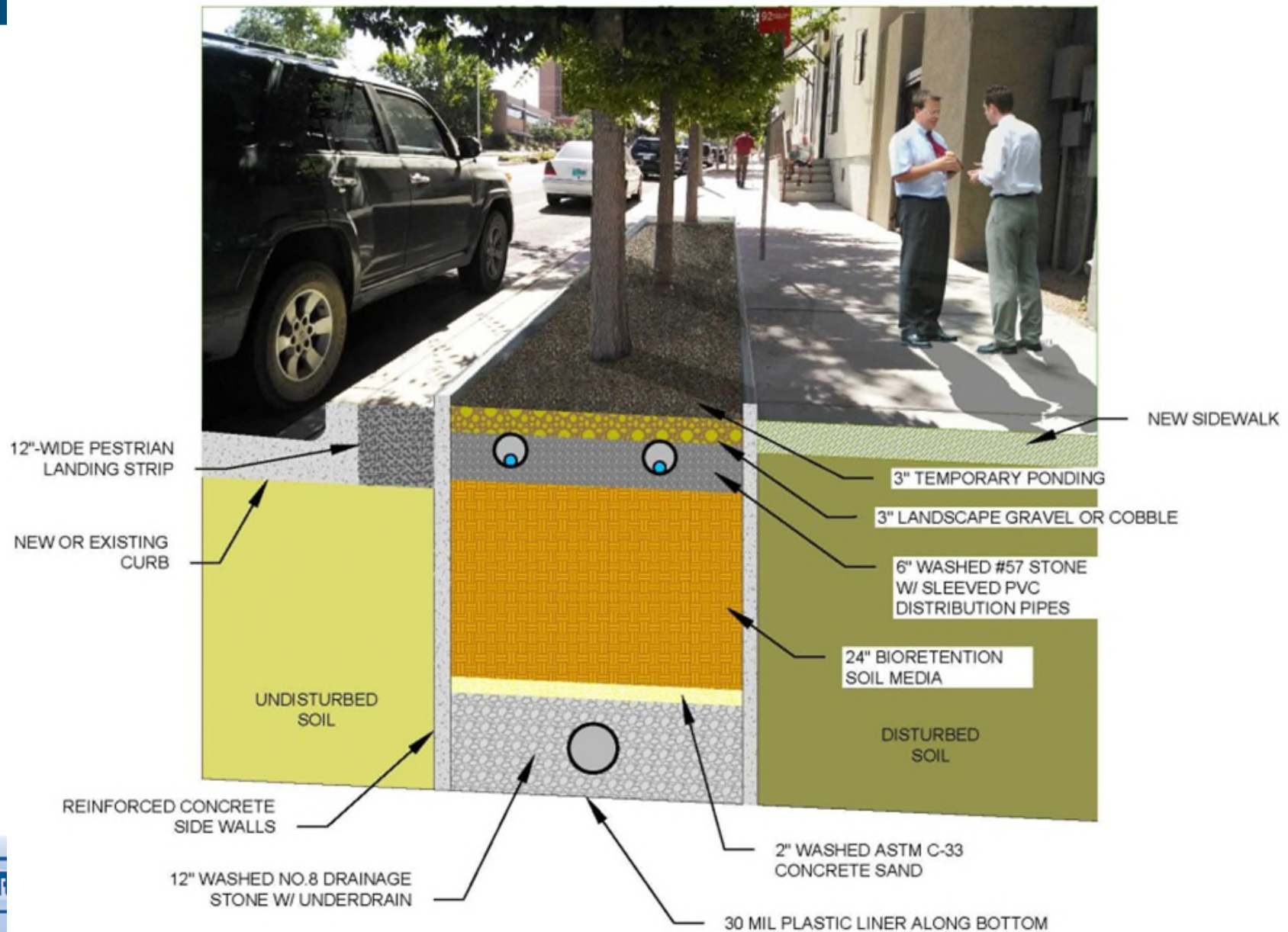
DETAIL 1.3 - SILVER AVE. PLANTER BOX PLAN

HORIZONTAL REINFORCING NOTES:

1. CONCRETE SHALL BE 560-C-3250 UNLESS OTHERWISE NOTED.
2. REINFORCING STEEL SHALL COMPLY WITH THIS DRAWING UNLESS OTHERWISE SPECIFIED.
3. REINFORCING STEEL SHALL BE INTERMEDIATE GRADE DEFORMED BARS CONFORMING TO LATEST ASTM SPECIFICATIONS.
4. BENDS SHALL BE IN ACCORDANCE WITH LATEST ACI CODE.
5. MINIMUM SPLICE LENGTH FOR REINFORCING SHALL BE 30 DIAMETERS.
6. FLOOR SHALL HAVE A WOOD TROWEL FINISH AND, EXCEPT WHERE USED AS JUNCTION BOXES, SHALL HAVE A MINIMUM SLOPE OF 1:12 TOWARD THE OUTLET.
7. DEPTH V IS MEASURED FROM THE TOP OF THE STRUCTURE TO THE FLOWLINE OF THE BOX.
8. WALL THICKNESS AND REINFORCING STEEL REQUIRED MAY BE DECREASED IN ACCORDANCE WITH TABLE 1.
9. WALL THICKNESS SHALL BE STEPPED ON THE OUTSIDE OF THE BOX.
10. WHEN THE STRUCTURE DEPTH V EXCEEDS 4', STEPS SHALL BE CAST INTO THE WALL AT 15' INTERVALS FROM 15' ABOVE FLOOR TO WITHIN 12" OF TOP OF STRUCTURE. PLACE STEPS IN WALL WITHOUT PIPE OPENING, OTHERWISE OVER OPENING OF SMALLEST DIAMETER.
11. ALTERNATE STEP MAY BE AN APPROVED STEEL REINFORCED POLYPROPYLENE STEP.
12. UPON APPROVAL OF THE ENGINEER, AS DEFINED BY SECTION 6703 OF THE BUSINESS AND PROFESSIONS CODE, THE USE OF PRECAST STORM STRUCTURES IS ACCEPTABLE AS AN ALTERNATE TO ASTM STANDARDS AND BE MANUFACTURED IN A PERMANENT FACILITY DESIGNED FOR THAT PURPOSED.

TABLE 1. BOX SECTION REINFORCEMENT			
MAXIMUM SPAN X OR Y	DEPTH V	THICKNESS T	HOR. & FLR. REIN.
3'-0" TO 4'-0"	4'-0"	6"	#4 18"
4'-1" TO 7'-0"		6"	#4 12"
7'-1" TO 8'-0"		6"	#4 8"
3'-0" TO 4'-0"	4'-1" TO 8'-0"	6"	#4 18"
4'-1" TO 5'-0"		6"	#4 12"
5'-1" TO 6'-0"		6"	#4 8"
6'-1" TO 8'-0"		6"	#4 6"

Imperial Building Site Design





Lunch Break!

Using Green Infrastructure to Address Stormwater Regulations AND Build Resiliency, cont.



Developing Green Infrastructure
with Climate Change in Mind

Case Studies

**Funding Options for Green
Infrastructure**

Discussion

Funding Local Stormwater Programs

- Most Common
 - General Government Tax Receipts/Ad Valorem Property Taxes
 - Stormwater Management Fees/Bonds
 - In-Lieu of Charges to Developers
 - Stormwater Management District Tax/ Stormwater Bonds

Local Fees

- Most Common Stormwater Related Fees
 - Stormwater Utility Fee
 - Impact Fees
 - Inspection Fees
 - Development Review Fee

Fee Credit Trading Program Example Washington D.C.

- Washington D.C. Stormwater Retention Trading Program
 - Increases retention of stormwater at all regulated development
 - Dense downtown areas allowed to purchase credits
 - Less dense regulated and unregulated areas can install BMPs that generate retention credits
 - Provides more flexibility and cost-effectiveness

Partnership: Rebates and Installation Financing Cost-Share Program Example City of Raleigh

- Up to 50-50 cost-share for private development
 - For BMPs on new construction, must go beyond regulatory requirements

Bioretention Area



Residential Cistern Project - Installation



Partnership: Development Agreements

- Contract between local jurisdiction and property owner
- Details the standards that will govern development of the property
- Benefit to applicant
 - Provides certainty regarding regulations for a project (adhere to conditions of contract)
- Benefit to local jurisdiction
 - May include conditions and mitigation requirements that go beyond the local code, including infrastructure

Partnership: Federal Grants and Loans for Public-Private Projects

- Community Development Block Grants
 - For affordable housing, can incorporate green infrastructure
- Sustainable Communities Regional Planning Grants
 - Support metro and multi-jurisdictional planning efforts to address sustainability challenges
- Section 108 Loan Guarantees
 - Allows future CDBG allocations to be used to guarantee loans for neighborhood revitalization projects including infrastructure

Incentives for Retrofitting LID in Existing Development

- Most Common
 - Free consultations/workshops
 - Rebates/installation cost sharing
 - Stormwater fee discounts
 - Awards/recognitions
- Less Common
 - Grants
 - Installation financing/loan program
 - Tax credits

Free Workshops and Consultations



Cost-Share Program

City of Raleigh

- Up to 50-50 cost-share for private development
 - BMP retrofits for existing development
 - BMPs on new construction
 - Must go beyond regulatory requirements

Bioretention Area



Residential Cistern Project - Installation



Rebates and Installation Financing

- Rain Catchers
 - Reverse auction
 - Projects installed for free
 - Residents receive a one-time incentive payment
 - City maintains for 3years
 - After 3 years, property owners maintain



Rebates and Installation Financing

- Neighborhood Street Redesign and Reconstruction
 - City constructs raingardens in ROW property
 - Manages drainage from roofs, yards, driveways
 - Residents plant plants provided and maintain gardens
 - Free technical assistance provided



Fee Credit/Discount Incentive

- Add a credit to the annual stormwater fee
- Must be high enough to induce incentive
- City of Philadelphia
 - Green City, Clean Water
 - Committed to greening over 10,000 acres
 - Significantly raised fee to induce retrofits
- Prince George's County, MD
 - Significantly raising fee to create financing mechanism
 - Privatizing retrofits

Incentives for New Development

- Most Common
 - Volume/retention performance standard
 - Reduction in code requirements
 - Increased allowable development
 - Awards/recognition
- Less Common
 - Fee waivers/credit
 - Tax Incentives

Reduction in Stormwater Requirements

- City of Atlanta deemed that retention of runoff from first 1st inch of rainfall meets all *water quality* requirements.
- Developers may be granted a *stormwater credit* when impervious areas are disconnected from the stormwater control system via overland flow and infiltration zones.



Development Code Incentives

- Floor Area Ratio (FAR) bonus
- Density bonus
- Increase in building height allowance
- Decreased parking requirements
- Flexibility in site design



Development Code Incentives

“Planter boxes, green infrastructure planters, green rainwater harvesting systems, a green wall or other green infrastructure BMPs may be used as a substitute for the required [landscaping][open space]. Such substitute shall be subject to the approval of [local official] or in accordance with the standards of the stormwater management design manual.”

Development Code Incentives

“Minimum parking may be reduced by one parking space for each tree 12” in diameter or larger that is preserved. A maximum of 2 parking spaces or 10 percent of the total required may be reduce, whichever is greater.”

Development Code Incentives

“In order to accommodate green infrastructure BMPs, required setbacks, sideyards, and rear yards may be reduced up to 25 percent. The reductions may not compromise public safety such as the site distance triangles defined in the zoning ordinance.”

Development Code Incentives

“Where a portion of a project or public improvement has been designed specifically as a green infrastructure stormwater management feature, the [City][County] Manager or designee shall have the authority to waive the [dimensional][material] requirements of this section to enable the installation of green infrastructure stormwater management measures.”

Local Code Incentives

- Green Roof/Green Infrastructure Tax Credit
 - Commercial building owners may receive credit for green roof covers at least 50% of rooftop
 - May also claim tax credit for 25% of all costs associated with construction
 - Tax credit can not exceed \$100,000
 - Applied against applicant's total business privilege tax liability for year approved.



Fee Waivers and Expedited Review

- Green Permit Program (City of Chicago)
 - Projects approved for Green Building Program can receive permits in less than 30 business days (instead of 60-90 days)
 - High level of green infrastructure implementation results in fees waived for consultant code review

Federal and State Tax Incentives

- DOE Energy Efficient Tax Incentives
 - Can fund green roofs and stormwater facilities for energy efficient related businesses
- Dept. of Treasury New Markets Tax Credit Program
 - For private investment in distressed areas

Awards and Recognition Programs



Using Green Infrastructure to Address Stormwater Regulations AND Build Resiliency

Group Discussion

- Given current regulations, how could green infrastructure be used to meet multiple objectives in Albuquerque?
- What do you see as key water rights constraints? How can we work through these issues?