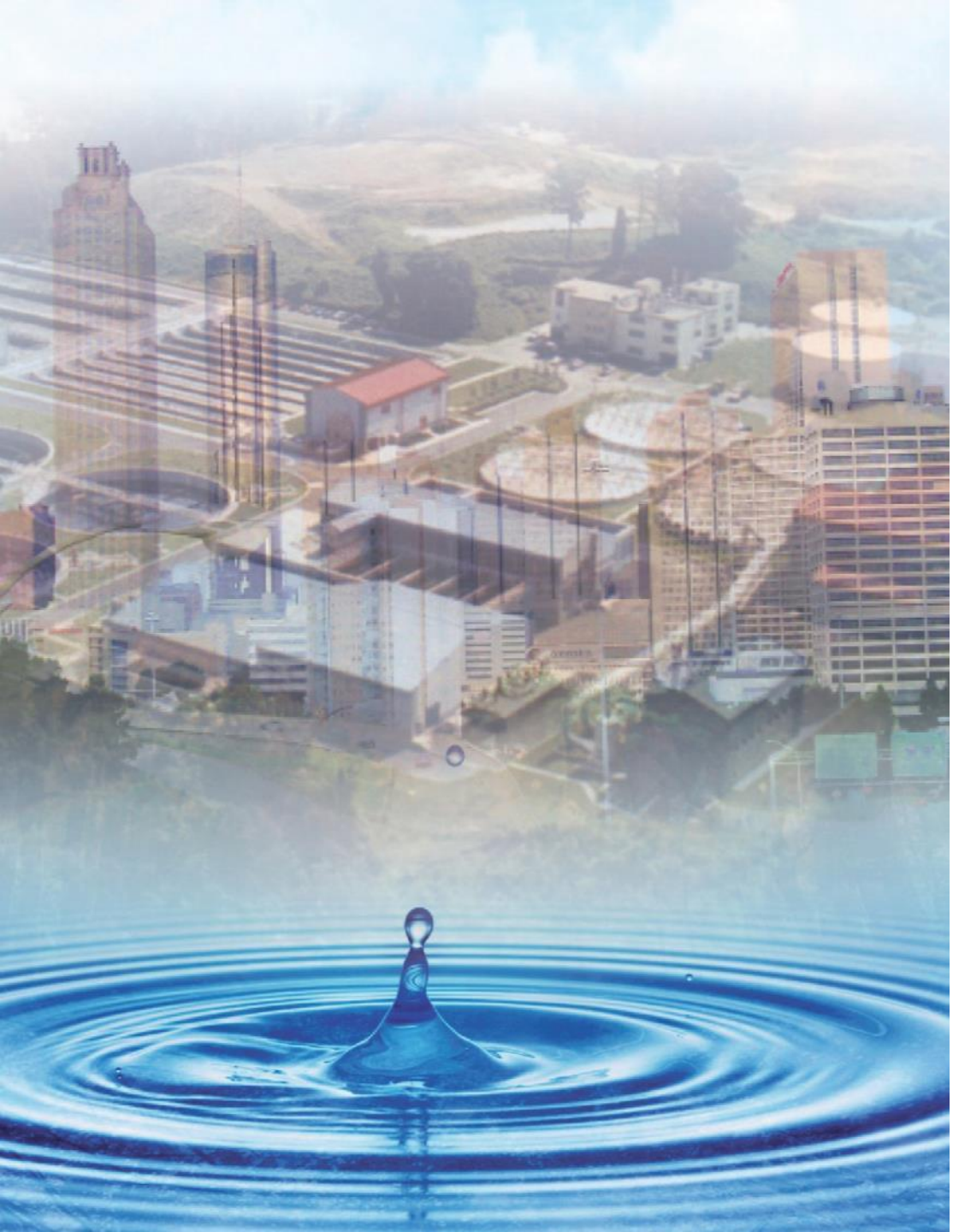


City of Atlanta

Mayor Kasim Reed

Department of Watershed Management

Building Green: An Update on Atlanta's Green Infrastructure Approach

Cory Rayburn, CPESC, CFM

Environmental Program Manager

SESWA Spring Seminar

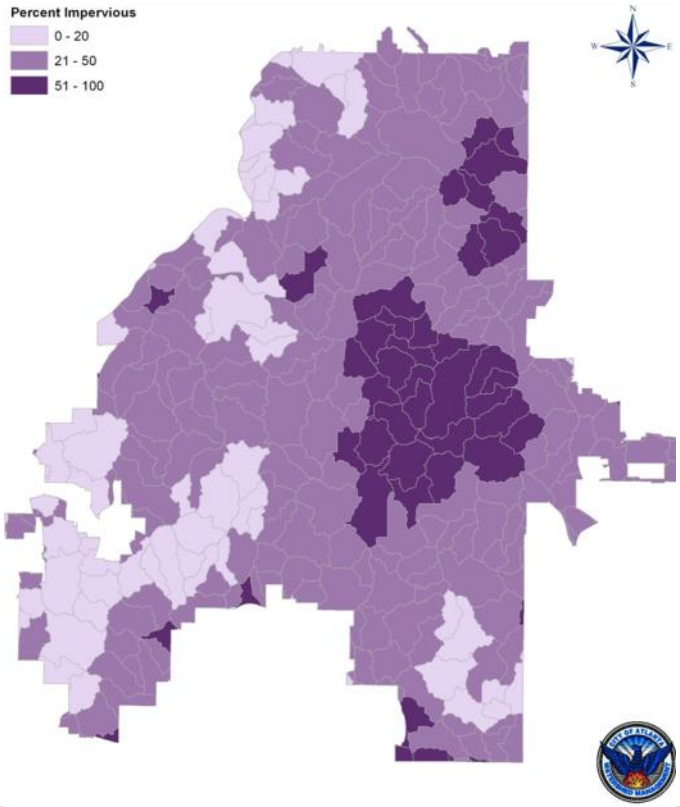
April 17, 2015

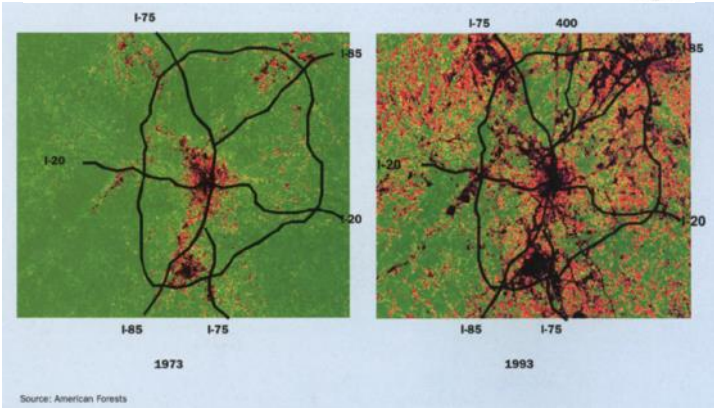
Presentation Outline

- Overview of Atlanta's program and how it's unique
- First two years of Implementation
  - *Single Family and Small Commercial design manuals*
  - *Challenges and Solutions*
  - *Common green infrastructure practices used*
- Recent public green infrastructure projects
  - *Southeast Atlanta Green Infrastructure Initiative – combined sewer capacity relief*
  - *Historic 4th Ward – economic development*

Why use green infrastructure in Atlanta?

- Environmental Protection
  - *Improves water quality*
  - *Supports Mayor Reed's sustainability initiatives*
- Compliance
  - *Complies with NPDES permit – Removing Barriers*
  - *Prepares the City for potential changes in federal stormwater rules*
- Community
  - *Addresses drainage issues in redeveloping historic neighborhoods*
  - *Maximizes infrastructure investments by further reducing combined sewer overflows and flooding*





Back School of Atlanta
Map
Traffic
Northside Dr NW
Spring Valle

Amended Stormwater Ordinance

- Added Green Infrastructure requirement for new and redevelopment projects
- Process for success
  - *Technical Advisory Committee*
  - *Robust stakeholder involvement*
  - *'Give and take' approach*
  - *Outreach, education, and technical guidance documents*
- Unanimous Council approval in Feb 2013

What's makes Atlanta unique?

- Requires green infrastructure on single family infill and commercial development/redevelopment
  - *1.0" Runoff Reduction Volume (RR_v)*
  - *Mandatory versus voluntary**
  - *No direct financial incentive*
  - *Low threshold for compliance*

* Allows for fallback to 1.2" Water Quality (80% TSS reduction) upon showing 1.0" RR_v is not possible on the given site – written rationale and separate approval required

Who has to do what?

- Single family development (RR_v only)
  - *New or infill home construction*
  - *Large additions (> 1,000 ft^2)*
- Small commercial category (RR_v only)
  - *500 - 5,000 ft^2 added or replaced impervious surface*
- Commercial adding > 5,000 ft^2
  - *Full blown stormwater management plan and hydro study*
  - *Rate Reduction up to 25-year storm*
  - *100-yr – no increase in peak discharge rate*
- All Commercial projects
  - *Infiltration testing*
  - *Pre-submittal consultation*
  - *Site-specific Operation and Maintenance Plan*

The Pioneer Projects

Green Roof - Atlanta City Hall

Cistern & Green Roof - Southface

Bioretention - Adair Park

Bioretention - 14th St DWM office

Bioswale - Fernbank Museum

Porous Concrete - Felder St

Pervious Pavers - English Park

Wet pond, wetlands bench, sewer capacity relief, urban reforestation - Historic Fourth Ward

Bioswale - Klaus Building - GT campus

Recent Installs

Bioretention - Kelly St

Porous Concrete - Delia's Chicken Sausage Stand

Bioswale - Edgewood Townhomes

Bioretention - Whitehall Terrace ROW

Cistern SFR - Leslie St

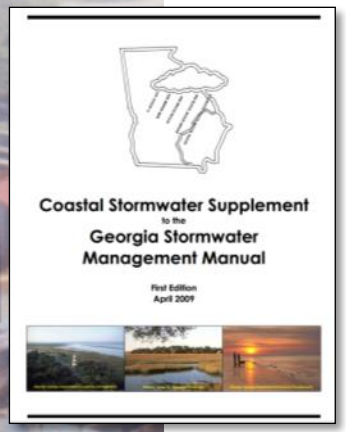
Permeable Pavers - Urban Market on Howell Mill

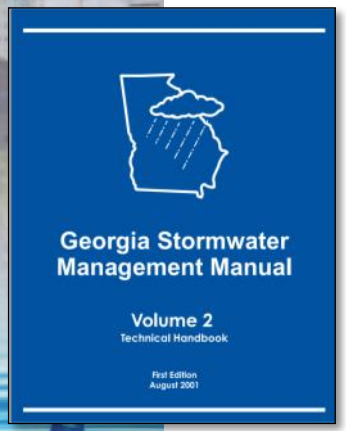
Permeable Pavers - 6th and Juniper

Bioretention - Regions Bank

Permeable Pavers - Lakemoore Townhomes

Adopted the Coastal Stormwater Supplement





PROS

- Provides design criteria and 'credit' system for green infrastructure
- Dependant on soil type

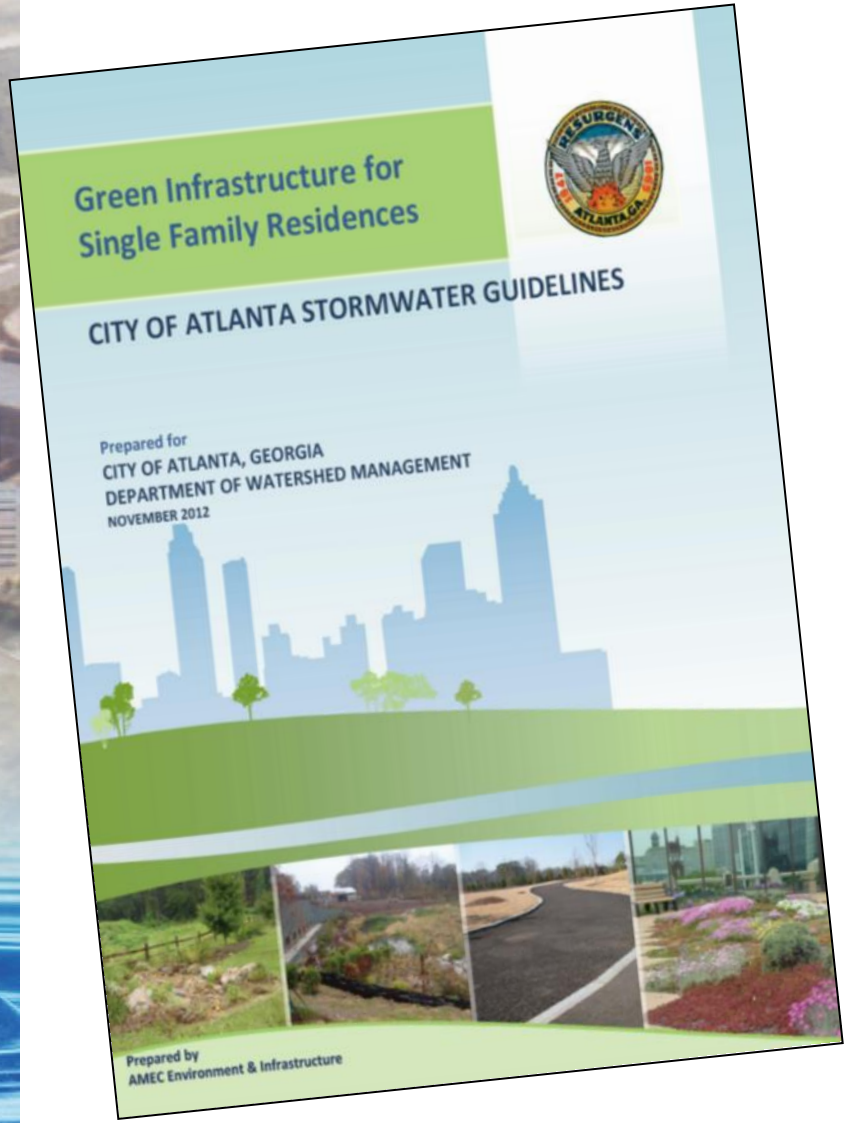
CONS

- Does not address SFR or Small Commercial

- Created SFR and Small Commercial design manuals
- Atlanta Regional Commission (ARC) in process of updating Blue Book

Simplified Design Approach

SFR Manual



- Provides a list of acceptable practices
- Reduces the need for complicated calculations
- Provides tear-off details and construction specification for each practice
- Simplifies the review and approval process

General Info & Tear-off Details

RAIN GARDENS

SINGLE FAMILY RESIDENTIAL GUIDE
CITY OF ATLANTA, GEORGIA
DEPARTMENT OF WATERSHED MANAGEMENT

Rain gardens are small landscaped depressions that are filled with a mix of native soil and compost, and are planted with trees, shrubs and other garden-like vegetation. They are designed to temporarily store stormwater runoff from rooftops, driveways, patios and other areas around your home while reducing runoff rates and pollutant loads in your local watershed. A rain garden can be a beautiful and functional addition to your landscape.

Location

- Rain gardens s
  surfaces, and w
- Swales, berms,
- Locate at least
  over septic fiel
  your property.
- Rain gardens o

Design

- The size of the
  the amended s
  determine the
- A maximum po
  allowed within
  rain gardens d
  not create a m
- Design rain gar
  intercept inflow
  stones, dense h
  means.
- If sides are to b
  should be desi
  (H:V) or flatter.
- For best results
  your local Cour
- Soils for rain ga

DRY WELL

SINGLE FAMILY RESIDENTIAL GUIDE
CITY OF ATLANTA, GEORGIA
DEPARTMENT OF WATERSHED MANAGEMENT

Dry wells are comprised of seepage tanks set in the ground and, in Atlanta's tight soils, surrounded with stone that are designed to intercept and temporarily store stormwater runoff until it infiltrates into the soil. Alternately the pit can be filled with stone with water entering via a perforated pipe with a perforated standpipe in place of the tank.

Source: www.earthcontactproducts.com/

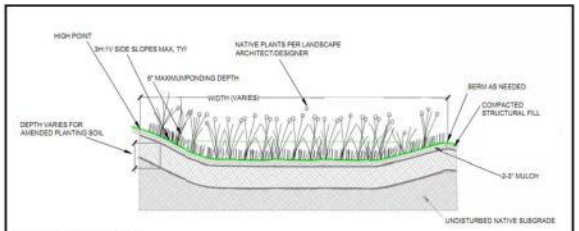
Dry wells are particularly well suited to receive rooftop runoff entering the tank via an inlet grate (shown right) or direct downspout connection (below right). When properly sized and laid out dry wells can provide significant reductions in stormwater runoff and pollutant loads.

Location

- Dry wells must be located at least 10 feet from building foundations and 10 feet from property lines.
- To reduce the chance of clogging, dry wells should drain only impervious areas, and runoff should be pretreated with at least one of the leaf removal options to remove debris and larger particles.
- The height of the tank should not exceed 45 inches unless infiltration testing has been done to insure a drain time of 72 hours or less.
- Dry wells should be located in a lawn or other pervious (unpaved) area and should be designed so that the top of the dry well is located as close to the surface as possible.
- Dry wells should not be located: (1) beneath an impervious (paved) surface; (2) above an area with a water table or bedrock less than two feet below the trench bottom; (3) over other utility lines; or, (4) above a septic field. Always call 811 to locate utility lines before you dig.

Construction

- Consider the drainage area size and the soil infiltration rate when determining the size of the dry well, (see table on next page).
- The sides of the excavation should be trimmed of all large roots that will hamper the installation of the permeable drainage fabric used to line the sides and top of the dry well.
- The dry well hole should be excavated 1 foot deeper and two feet larger in diameter than the well to allow for a 12 inch stone fill jacket.



CONSTRUCTION STEPS:

1. Locate rain garden(s) where downspouts or driveway runoff can enter garden flowing away from the home. Locate at least 10 feet from foundations, not within the public right of way, away from utility lines, not over septic fields, and not near a steep bluff edge.
2. Measure the area draining to the planned garden and determine required rain garden surface area from the table on the next page and your planned excavation depth.
3. Optionally, perform infiltration test according to Appendix A. If the rate is less than 0.25 in/hr an underdrain will be necessary. If the rate is more than 0.50 in/hr the size of the garden may be decreased 10% for every 0.50 in/hr infiltration rate increase above 0.50 in/hr.
4. Measure elevations and stake out the garden to the required dimensions insuring positive flow into garden, the overflow elevation allo
   higher than the overflow point. If th
   be constructed on the downhill sid
   care for erosion control at the gard
5. Remove turf or other vegetation in
   compact soils in the bottom of the
   infiltration area.
6. Mix compost, topsoil, and some of t
   soil mix should be 1/3 compost, 2/
7. Fill rain garden with the amended s
   surrounding surface. Eight inches al
   rain garden should be as close to le
8. Build a berm at the downhill edge
   of the berm needs to be level, and
9. Plant the rain garden using a selec
10. Mulch the surface of the rain garde
    best choice is finely shredded hard
11. Water all plants thoroughly. As in
    needed to establish plants during th
12. During construction build the inlet t
    lined swale with a gentle slope. Use
    near the house is recommended to
    water from the source to the garde
13. Create an overflow at least 10 feet

CITY OF ATLANTA DEPARTMENT OF WATERSHED MANAGEMENT	NAME/

SKETCH LAYOUT

PROVIDE PLAN VIEWS OF RAIN GARDEN AND HOUSE SHOWING DRAINAGE AREA DIRECTED TO RAIN GARDEN AND KEY DIMENSIONS AND OVERFLOW AREA RELATIVE TO PROPERTY LINE.

SIZING CALCULATION:

Contributing Drainage Area (square feet)	Depth of Amended Soil (inches)			
	18	24	30	36
	Area of Rain Garden (square feet)			
100	6.6	5.7	5.1	4.6
500	35	30	25	23
1000	65	60	50	45
2000	135	115	100	90
3000	200	170	150	140
4000	260	230	200	185
5000	330	290	255	230

MEASURE CONTRIBUTING DRAINAGE AREA AND READ AREA FOR GIVEN MEDIA DEPTH.

CONTRIBUTING DRAINAGE AREA= _____ SQ FT
DEPTH OF SOIL MEDIA= _____ INCHES
AREA OF RAIN GARDEN= _____ SQ FT

MAINTENANCE:

1. IRRIGATE VEGETATION AS NEEDED IN FIRST SEASON
2. REMOVE WEEDS
3. REPLACE UNSUCCESSFUL PLANTINGS
4. REPLENISH MULCH
5. REPAIR ERODED AREAS
6. RAKE CLOGGED SURFACE TO RESTORE INFILTRATION
7. MONITOR RAIN GARDEN FOR APPROPRIATE DRAINAGE TIMES IF GARDEN DOES NOT DRAIN AN UNDERDRAIN MAY BE NECESSARY

CITY OF ATLANTA DEPARTMENT OF WATERSHED MANAGEMENT	ATTACH THIS TWO-PAGE SPECIFICATION TO HOUSE PLAN SUBMITTAL	RAIN GARDEN SPECIFICATIONS PAGE 2 OF 2

Easy-to-Use Sizing Tables

Impervious Area Treated

Design Options

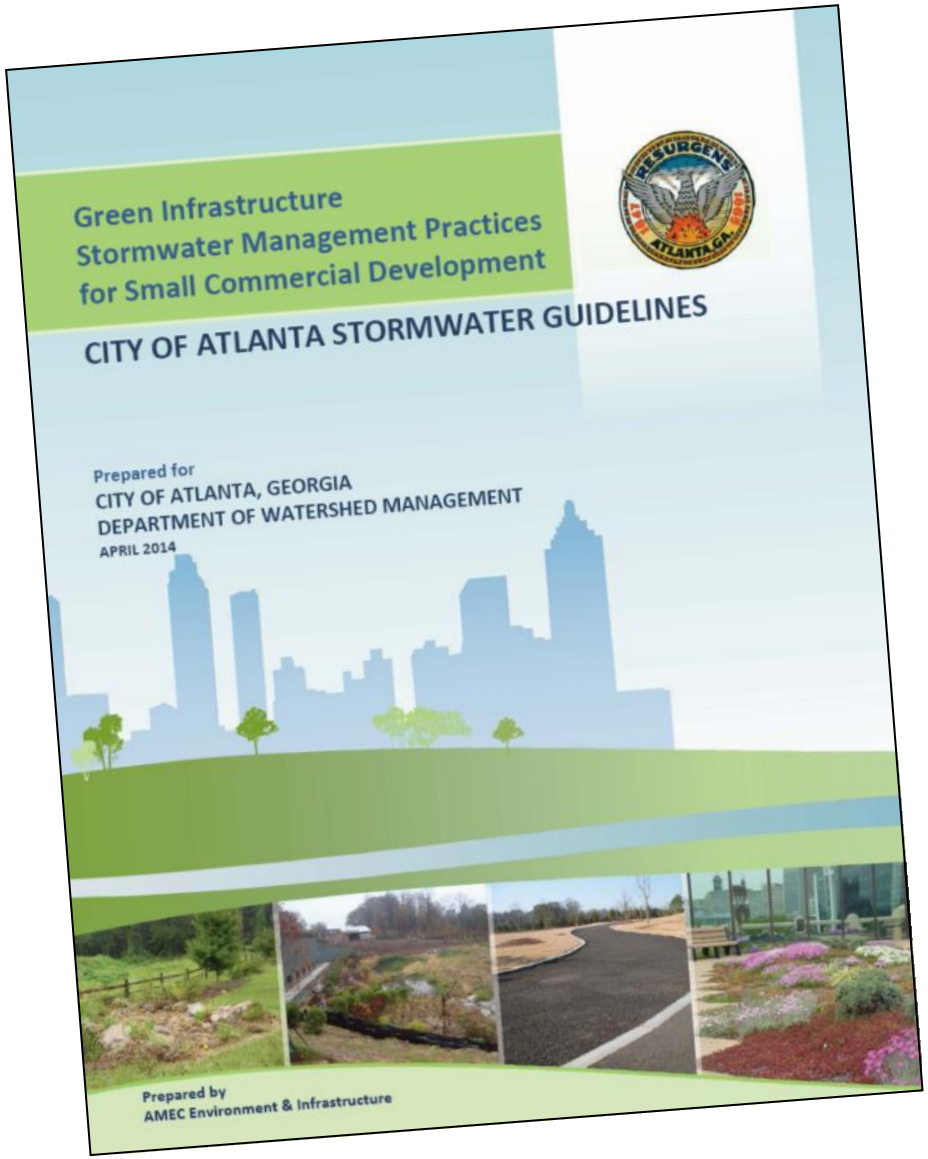
Rooftop Area (square feet)	Depth of Gravel From Top of Pipe (inches)			
	18	24	30	36
	Required Linear Feet of MFD			
100	6	5	4	3
500	30	25	20	15
1000	60	45	40	35
2000	120	95	75	65
3000	185	140	115	100
4000	245	190	155	130
5000	305	235	195	165

Practice Size

Modified French Drain Example

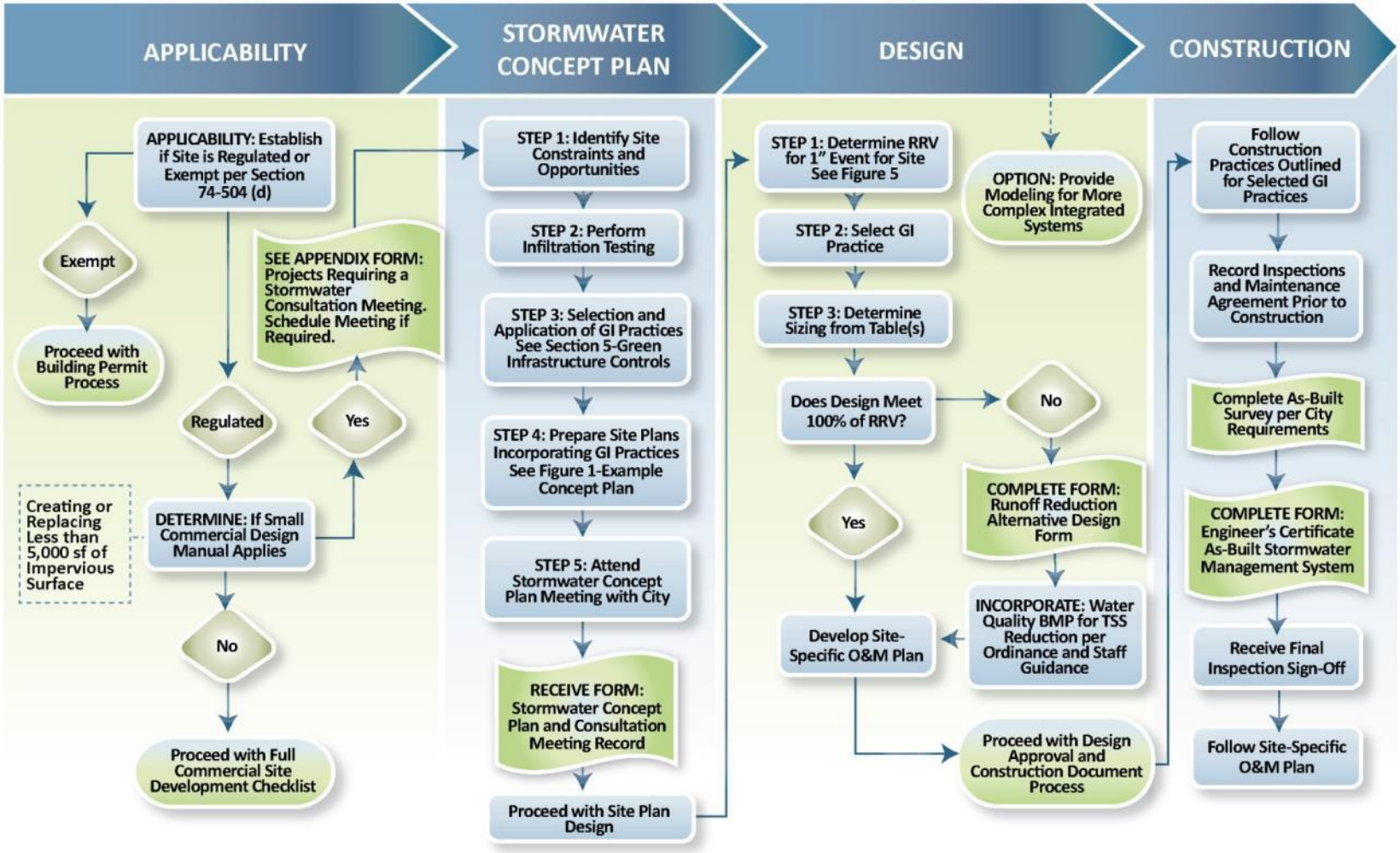
- Options within practical range
- Accommodate actual rainfall and runoff data
- Allows for median infiltration duration
- Assumes 0.25-0.50 in/hr infiltration rate

Small Commercial Manual



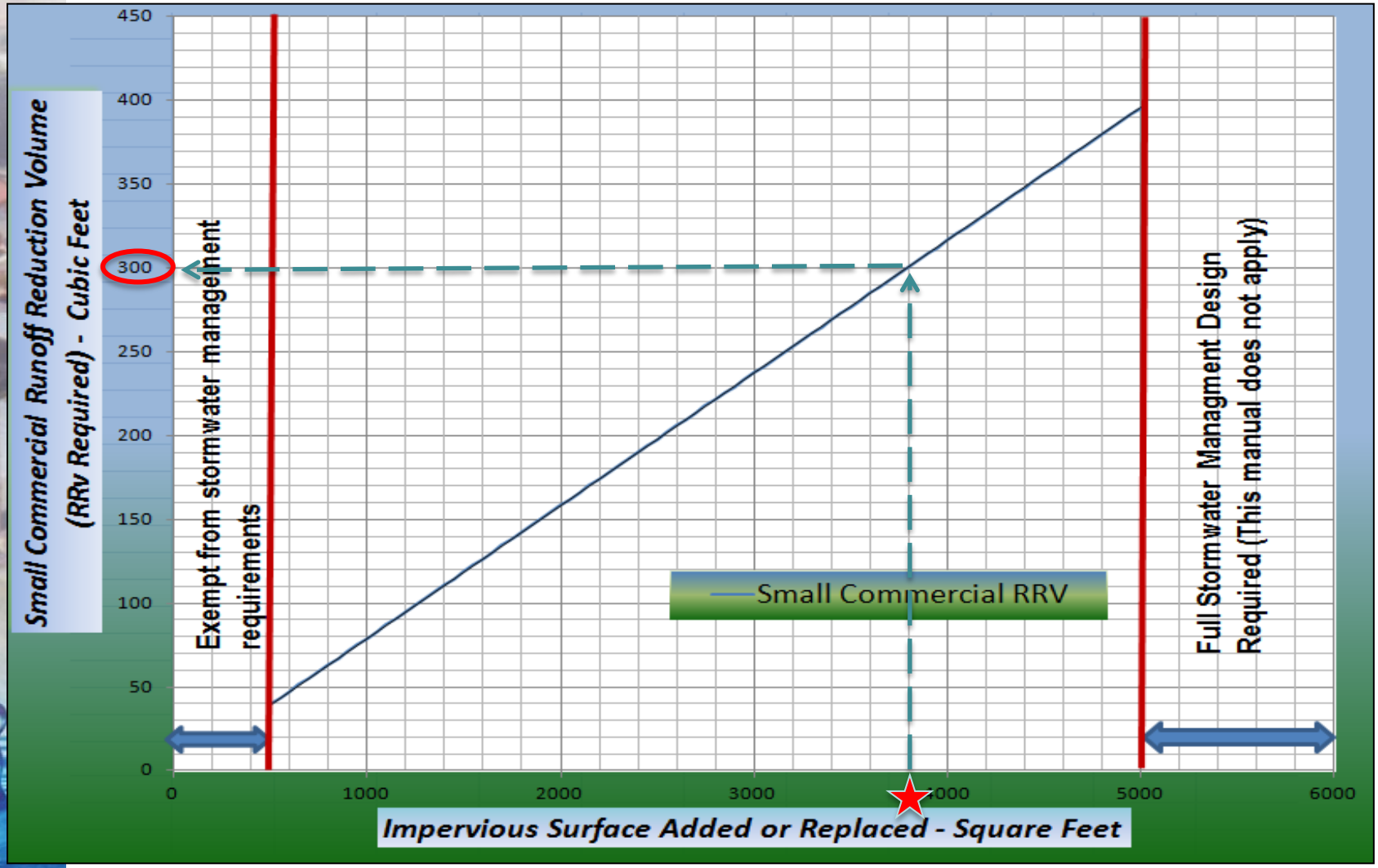
- For projects that add/replace between 500 and 5,000 ft^2 of impervious surface
- Catered to small urban redevelopment and addition projects
- Supplement to CSS and Blue Book
- Provides clarification to specific issues

Step-by-step Processes



NOTE: For small commercial redevelopment sites involving less than 5,000 sf of impervious surface (new or replaced), stream channel protection, overbank flood, and extreme flood protection will be waived if runoff reduction requirements are met.

Simplified RRv Calculation



Example:
3,800 ft²
addition

Sizing Charts for each Practice

BIORETENTION TABLE A
Bioretention Surface Storage Volumes (cubic feet)

Bioretention Typical Dimensions (feet)	5x10	5x15	5x20	5x30	10x10	10x15	10x20	10x30	10x40	10x50	10x60	10x70	10x80	20x20	20x30	20x40	30x30
surface area (square feet)	50	75	100	150	100	150	200	300	400	500	600	700	800	400	600	800	900
Surface Storage at 6" Depth (cubic feet)	25	38	50	75	50	75	100	150	200	250	300	350	400	200	300	400	450
Surface Storage at 9" Depth (cubic feet)	38	56	75	113	75	113	150	225	300	375	450	525	600	300	450	600	675
Surface Storage at 12" Depth (cubic feet)	50	75	100	150	100	150	200	300	400	500	600	700	800	400	600	800	900

GI Practice 1

BIORETENTION TABLE B
Bioretention Soil Storage Volumes for all Infiltration Rates (cubic feet)
100% RRv Credit by Volume

Bioretention Typical Dimensions (feet)	5x10	5x15	5x20	5x30	10x10	10x15	10x20	10x30	10x40	10x50	10x60	10x70	10x80	20x20	20x30	20x40	30x30
surface area (square feet)	50	75	100	150	100	150	200	300	400	500	600	700	800	400	600	800	900
Soil Storage at 18" Depth (cubic feet)	24	36	48	72	48	72	96	144	192	240	288	336	384	192	288	384	432
Soil Storage at 24" Depth (cubic feet)	32	48	64	96	64	96	128	192	256	320	384	448	512	256	384	512	576
Soil Storage at 36" Depth (cubic feet)	48	72	96	144	96	144	192	288	384	480	576	672	768	384	576	768	864

GI Practice 1

note: table assumes a void ratio of 0.32

Example Design

Example Site Information

Size = ½ acre
Existing Impervious Surface= 100%
Tested Soil Conditions = Infiltration rate 0.15 inch/hour (Type C)
Proposed building addition = 1,000 square feet
Pre-development pavement area impacted = 7,500 square feet
Proposed net impacted impervious change (see Table A-1 and Figure A-2) = 4,700 square feet

Table A-1. Example Site Impervious Surface

	Site element	Area (square feet)
A	Building addition	1000
B1	Demolished pavement for island	- (500)
B2	Demolished pavement for island	- (900)
B3	Demolished pavement for green buffer	-(1800)
B4	Demolished pavement for green buffer	- (600)
C	Replaced Pavement	3,700
	Impacted Impervious Surface	**4,700**

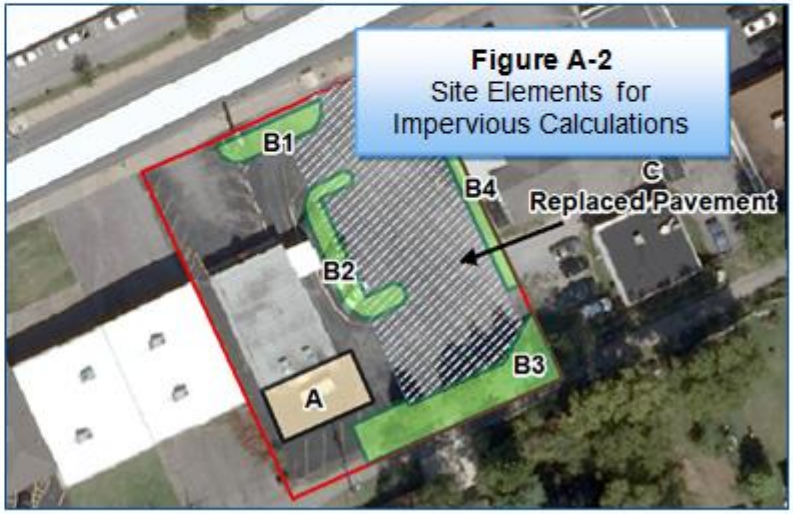
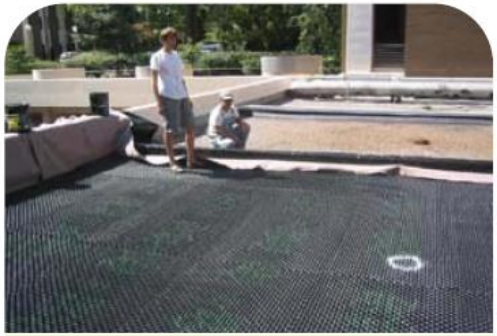


Figure A-2
Site Elements for Impervious Calculations

(Note: This manual applies because the net impacted impervious area is less than 5,000 square feet.)

Construction Sequence

Flood Test



Drainage Layer

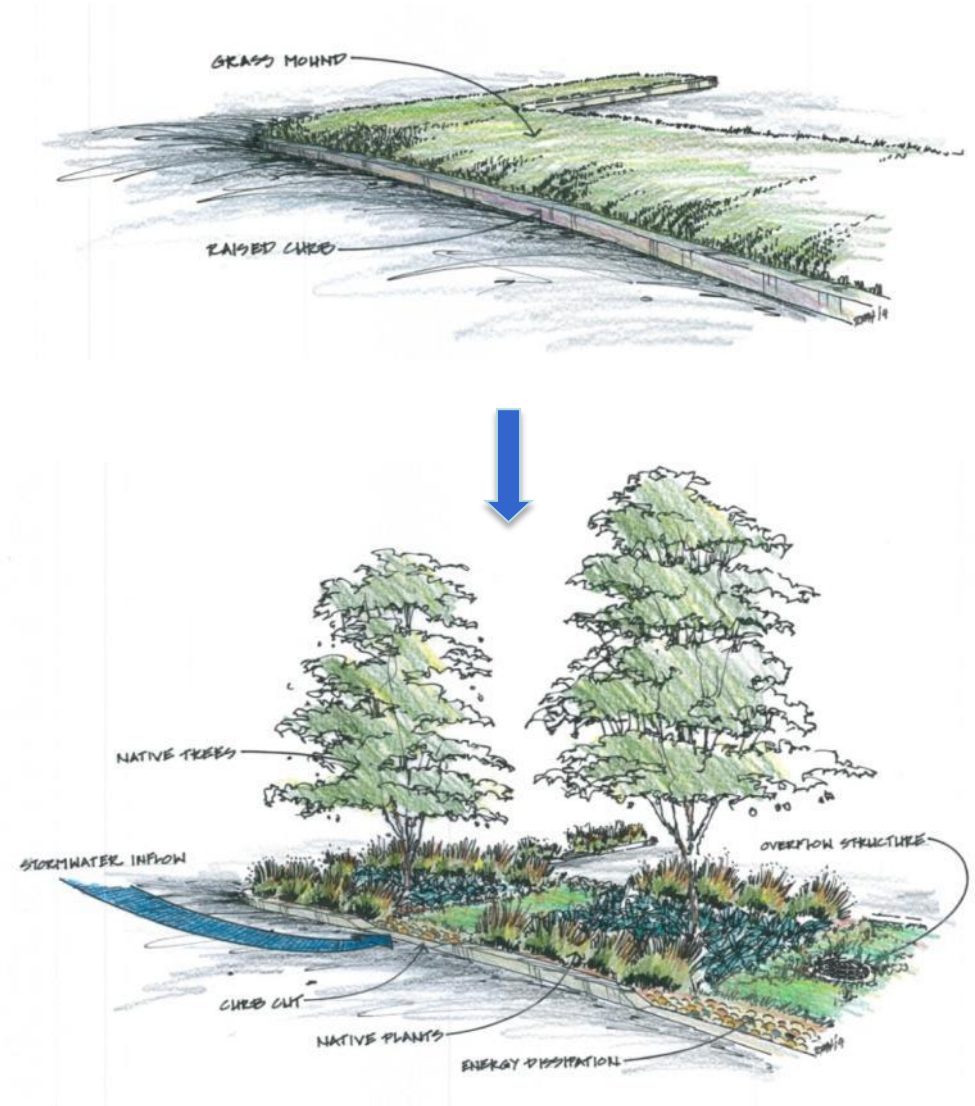
Filter Fabric

Engineered Soil Mix

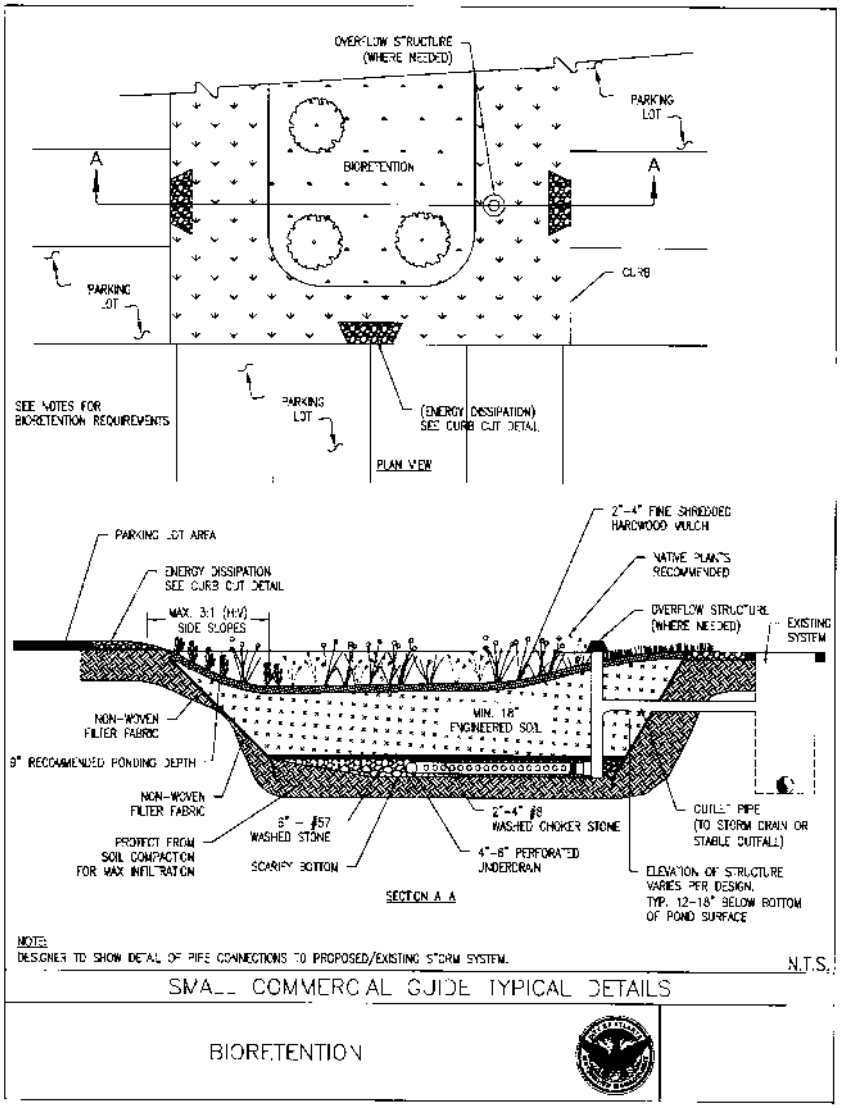
Plant Material

- Extensive green roof installation

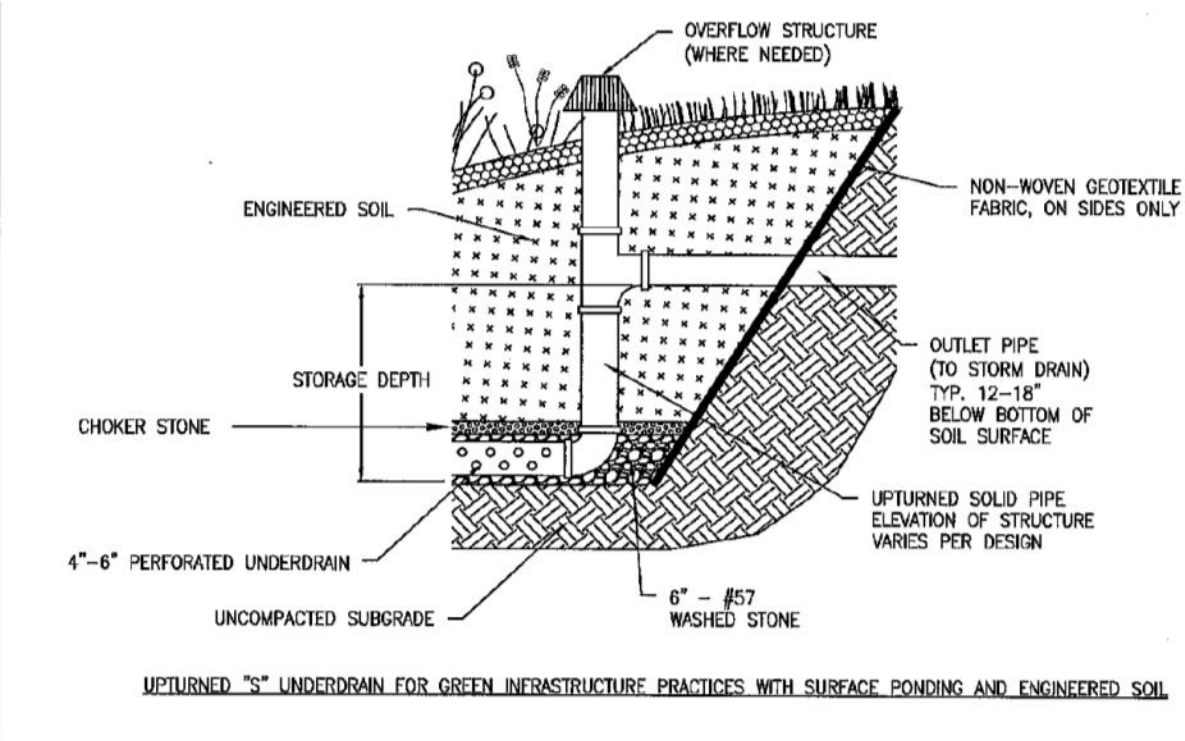
Retrofit examples - Landscape Islands



Typical Details



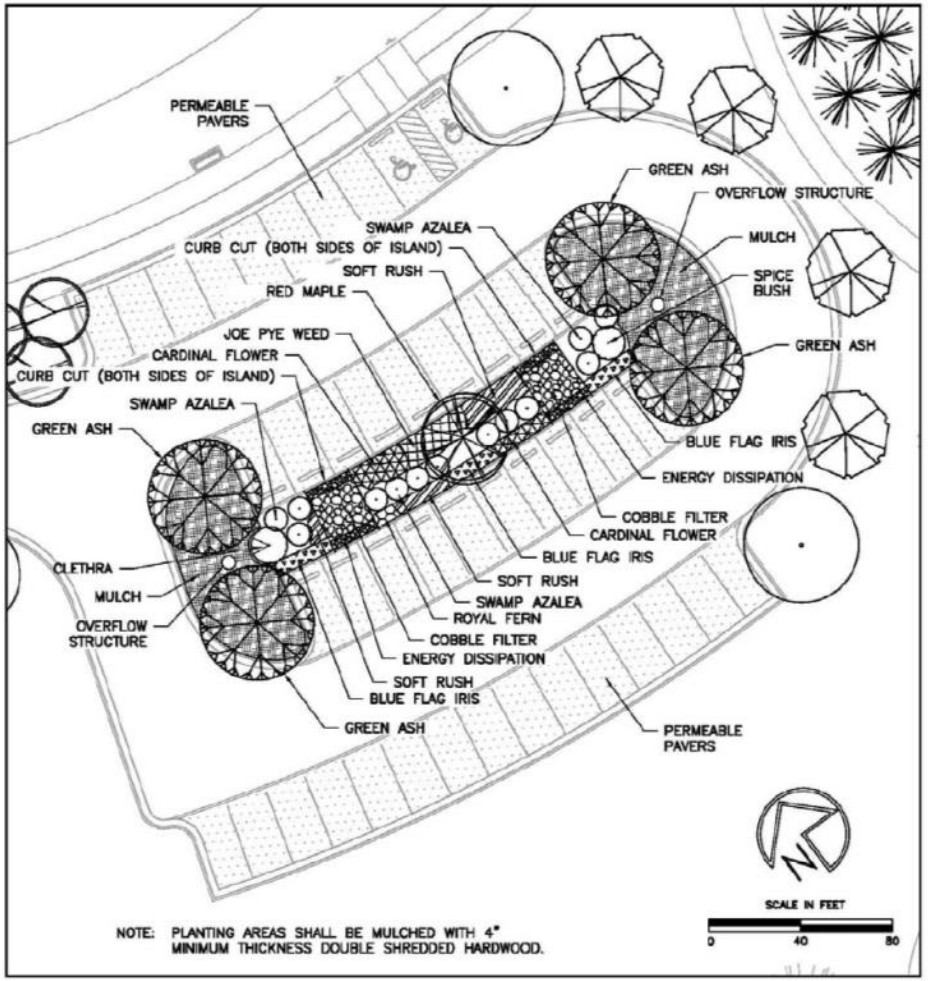
Innovative designs included



UPTURNED "S" UNDERDRAIN FOR GREEN INFRASTRUCTURE PRACTICES WITH SURFACE PONDING AND ENGINEERED SOIL

- Upturned "S" Underdrain
  - *Creates saturated zone*
  - *Aids in denitrification*
  - *Additional infiltration in poor draining soils*

Example Landscape Plans



EXAMPLE #1: PARKING ISLAND BIORETENTION PLANTING

Maintenance Checklists

Sample Bioretention Inspection and Maintenance Checklist

Inspector:	
Date:	*Time:*
Weather: *Rainfall over previous 2-3 days?*	
Bioretention Location:	

Mark items in the table below using the following key:

- X Needs immediate attention
- – Not Applicable
- ✓ Okay
- ? Clarification Required

Bioretention Components:

Items Inspected	Checked		Maintenance Needed		Inspecti Frequen
DEBRIS CLEANOUT	Y	N	Y	N	
Bioretention and contributing areas clean of debris.					Monthly
No dumping of yard wastes into bioretention.					Monthly
Litter (trash, debris, etc.) have been removed.					Monthly
VEGETATION					
No evidence of erosion.					Monthly
Is plant composition still according to approved plans?					Monthly
No placement/growth of inappropriate plants.					Monthly
DEWATERING AND SEDIMENTATION					
Bioretention dewaters between storms.					After Maj Storms
No evidence of standing water.					
No evidence of surface clogging.					
OUTLETS/OVERFLOW SPILLWAY					
Good condition, no need for repair.					Annually a After Maj Storms
No evidence of erosion.					
No evidence of any blockages.					
INTEGRITY OF BIORETENTION					
Bioretention has not been blocked or filled inappropriately.					Annually
Mulch layer is still in place (depth of at least 2").					Annually
Noxious plants or weeds removed.					Annually

City of Atlanta, Georgia
Green Infrastructure Practices for Small Commercial Development

COMMENTS:

OVERALL CONDITION OF FACILITY:

In accordance with approved design plans? Y / N *In accordance with As Built plans?* Y / N

Dimension on as built:

Field Verified Dimension:

Maintenance required as detailed above? Y / N Compliance with any other required conditions? Y / N

Comments: _____

Dates by which maintenance must be completed: _____ /_____ /_____

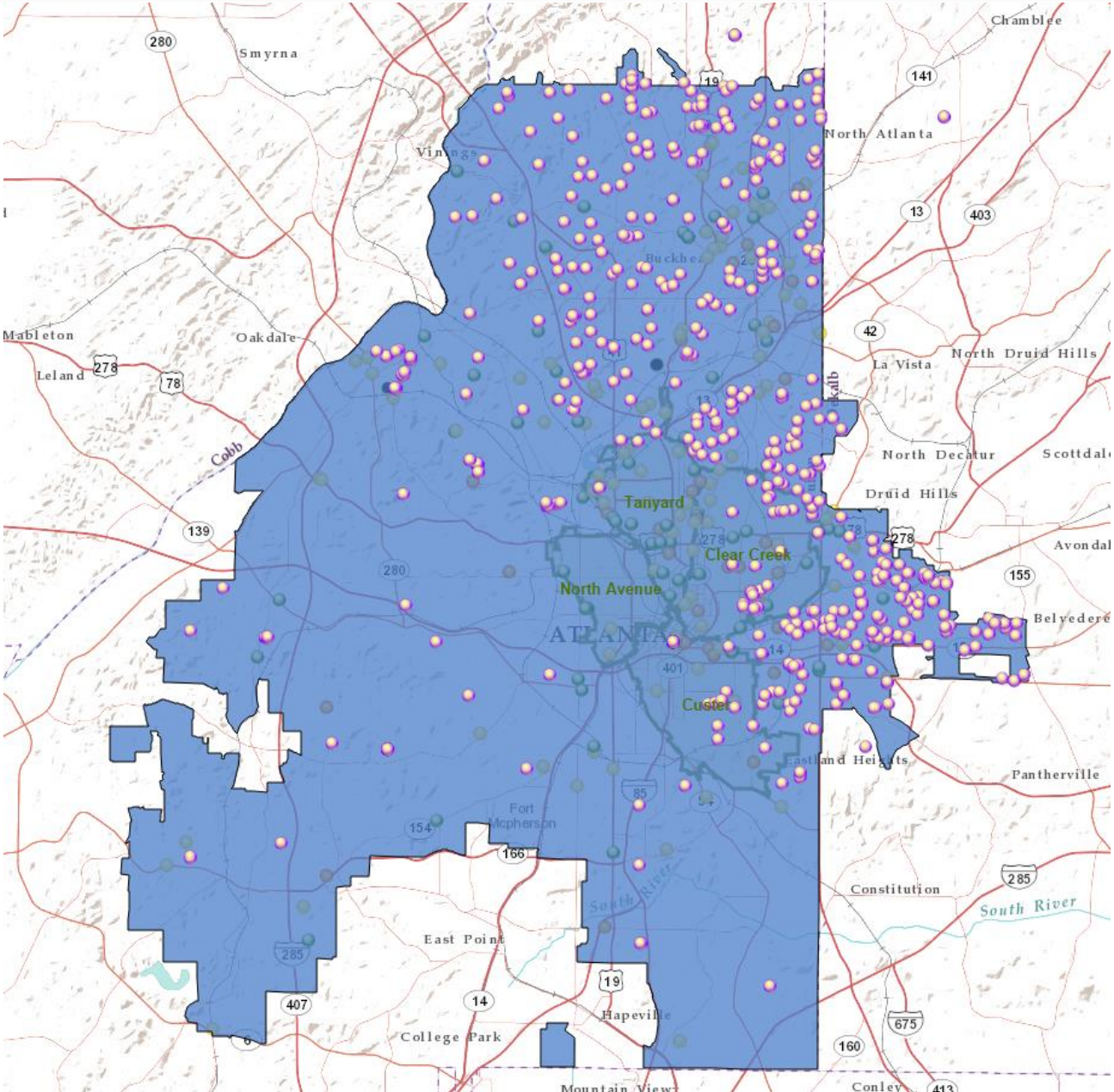
Dates by which outstanding information is required: _____ /_____ /_____

Inspector's signature: _____

Engineer/Agent's signature: _____

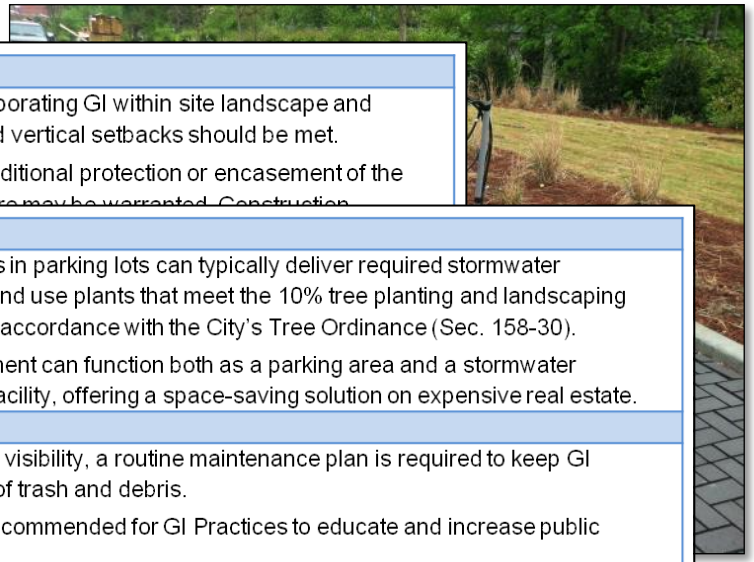
Engineer/Agent's name printed: _____

Tracking green infrastructure with GIS



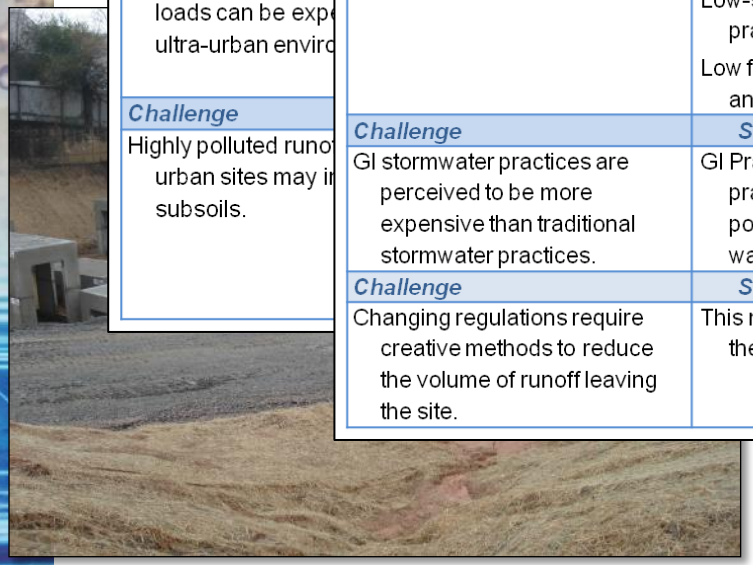
- 270+ Commercial
- 1,100+ Single Family Residential
- GIS attributes contain:
  - Owner
  - Date of completion
  - Copy of I&M agreement
  - Inspections information
  - Green infrastructure BMPs
  - Detention BMPs
  - Runoff Reduction Volumes

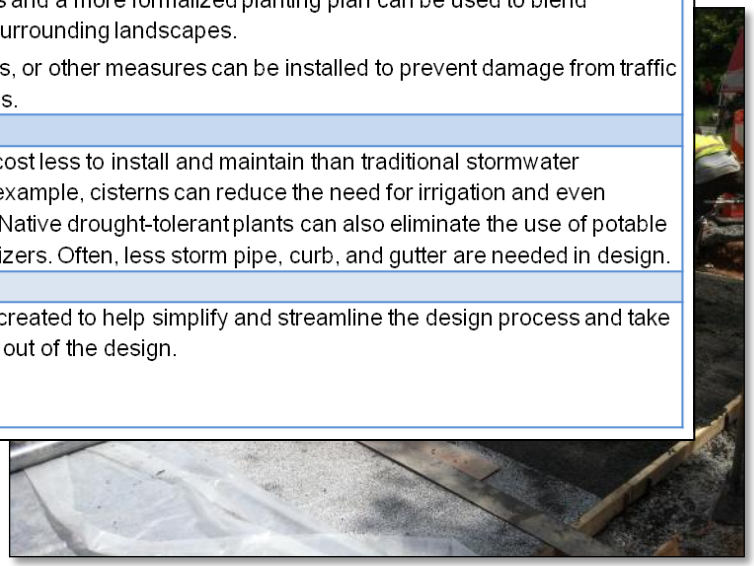
Challenges & Solutions



Challenge	Solution
GI can compete for space with a variety of existing utilities and infrastructure.	Be creative with the site layout by incorporating GI within site landscape and parking. Utility-specific horizontal and vertical setbacks should be met. When encroachment is unavoidable, additional protection or encasement of the utility or protection of the infrastructure may be warranted. Construction
Challenge	
Urban soils are often compacted and n deficient, and limi of plants and infilt stormwater.	
Challenge	
Concentrated runoff potentially high se loads can be expe ultra-urban enviro	
Challenge	
Highly polluted runo urban sites may i subsoils.	

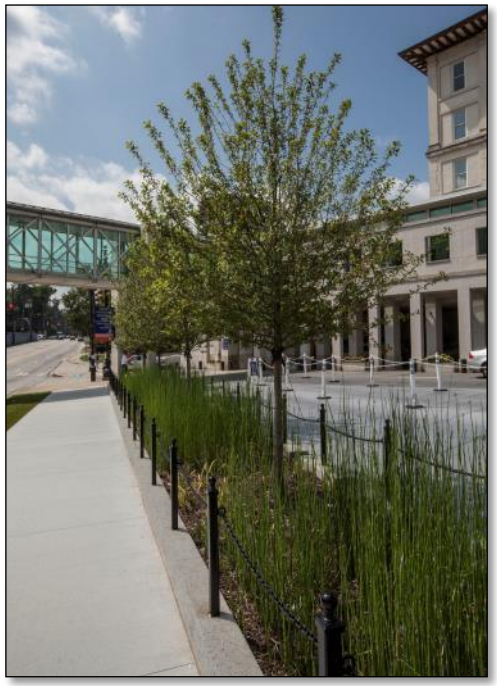
Challenge	Solution
Small commercial sites will be limited in space to meet multiple zoning, landscape, parking, and stormwater requirements.	Bioretention areas in parking lots can typically deliver required stormwater management and use plants that meet the 10% tree planting and landscaping requirement in accordance with the City's Tree Ordinance (Sec. 158-30). Permeable pavement can function both as a parking area and a stormwater management facility, offering a space-saving solution on expensive real estate.
Challenge	**Solution**
Urban GI is often subject to higher public visibility, greater trash loads, pedestrian use, vandalism, and vehicular loads.	To address public visibility, a routine maintenance plan is required to keep GI Practices free of trash and debris. Signage is also recommended for GI Practices to educate and increase public awareness. Low-stature plants and a more formalized planting plan can be used to blend practices into surrounding landscapes. Low fences, grates, or other measures can be installed to prevent damage from traffic and pedestrians.
Challenge	**Solution**
GI stormwater practices are perceived to be more expensive than traditional stormwater practices.	GI Practices can cost less to install and maintain than traditional stormwater practices. For example, cisterns can reduce the need for irrigation and even potable water. Native drought-tolerant plants can also eliminate the use of potable water and fertilizers. Often, less storm pipe, curb, and gutter are needed in design.
Challenge	**Solution**
Changing regulations require creative methods to reduce the volume of runoff leaving the site.	This manual was created to help simplify and streamline the design process and take the uncertainty out of the design.





Green infrastructure can compete for space

- Creativity with site layout
  - *Upfront coordination between Civil, LA, and Architect*
- Dual purpose practices:
  - *permeable pavement*
  - *landscape islands → bioretention*
  - *green roof*
  - *underground detention/infiltration systems*
- Able to meet tree planting and runoff reduction requirements with one practice



Appropriate site layout?

Infiltration Practices in Atlanta

- Soils analysis required for all commercial sites
  - *Infiltration rates, high water table, bedrock, contaminated soils*
- Clay soils and compaction
  - *Loosening compacted soils on redevelopment sites*
  - *Prevent compaction during construction*
  - *Innovative designs (upturned underdrain) to encourage surface drainage and promote infiltration in clay soils*
- Erosion control
  - *Phasing installation to prevent sedimentation issues*
  - *Installation of appropriate BMPs*

Erosion control and phasing

Erosion control and phasing

Common Practices on Commercial Sites

- Bioretention/Bioswales/Stormwater Planters
- Infiltration below an underground detention system
- Permeable Pavement
- Infiltration Trenches/Dry Wells
- Rainwater Harvesting/Cisterns
- Green Roof (only 2)

< 20% of sites fell back on old Water Quality standards for part or all of the volume requirement

WQ Fallback

- Requires written rationale and separate approval
- Extreme economic hardship or physical impossibility
- Must consider infiltration-alternative BMPs (lined stormwater planters, rainwater harvesting & green roofs)
  - *Rainwater harvesting reuse potential depends on type of project*
  - *Irrigation, evaporative cooling, toilet flushing*

Return on Investment

- Grand Hyatt in Buckhead retrofit
  - *Rainwater Harvesting: 50,000 ft^2 rooftop*
  - *Evaporative cooling towers and toilet flushing*
  - *Cost of project: $100,000.00*
  - *Annual savings: $42,000.00*
- ROI = **2.4 years**

Green Roof Costs and Benefits

- $10-$24/ft^2
- Extends life of roof
- Cooler air intake and insulation benefits = energy savings
- Amenity potential

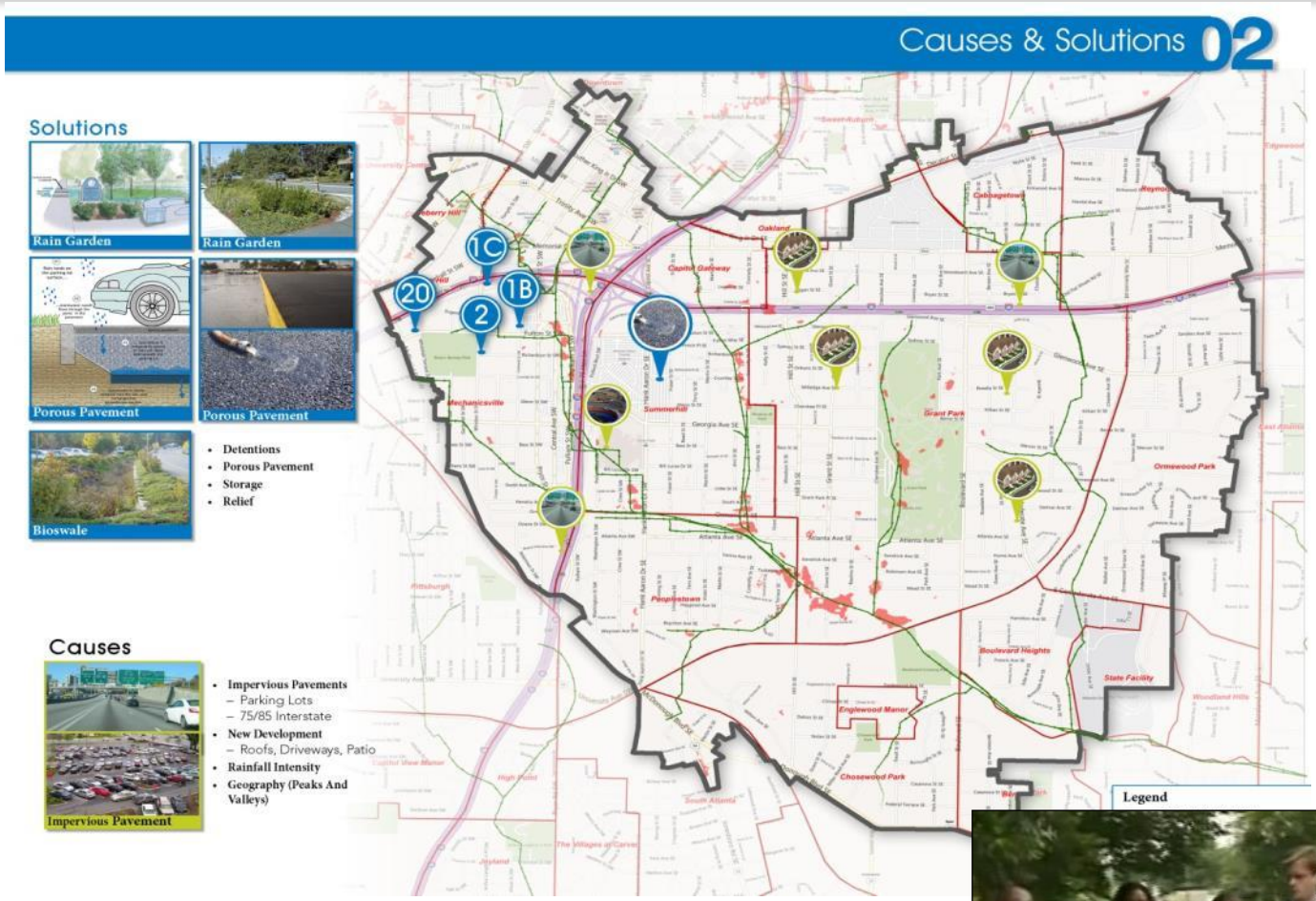
Underground Infiltration Systems

- Saves space compared to traditional dry/wet ponds
- Appropriate pretreatment required
- Surface drainage area to infiltration area ratio
- May require additional aggregate under system for structural support (without compacting subsoils)
- Geotextile underliner vs. choker stone
- Erosion control during installation!

Common Practices on SFR

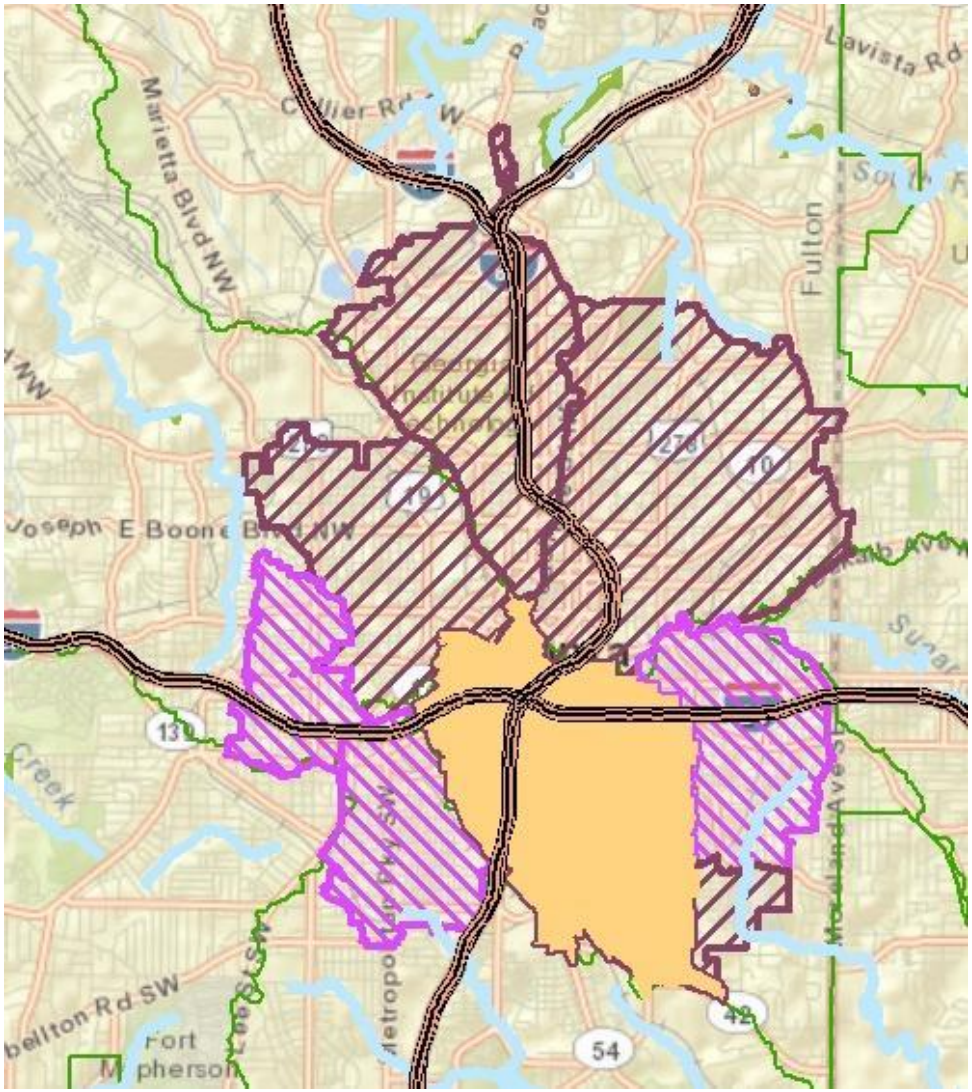
- *55% Dry Wells*
- *21% Rain Gardens*
- *10% Modified French Drains*
- *6% Permeable Pavement*
- *5% Cisterns (not rain barrels)*
- *3% Vegetated Filter Strips*

Southeast Atlanta Green Infrastructure Initiatives



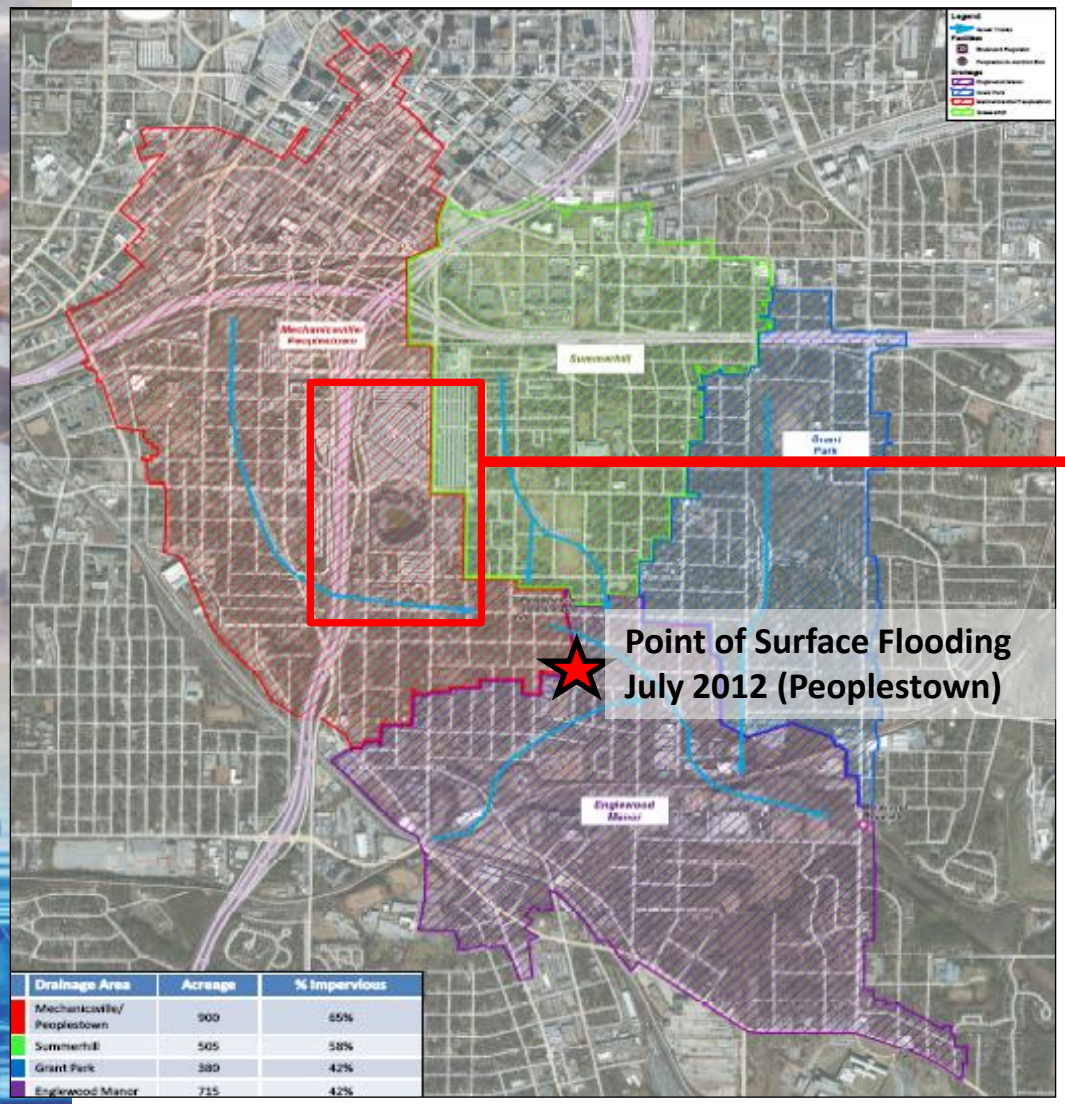
Combined Sewer Capacity Relief

Custer CSO Basin Location



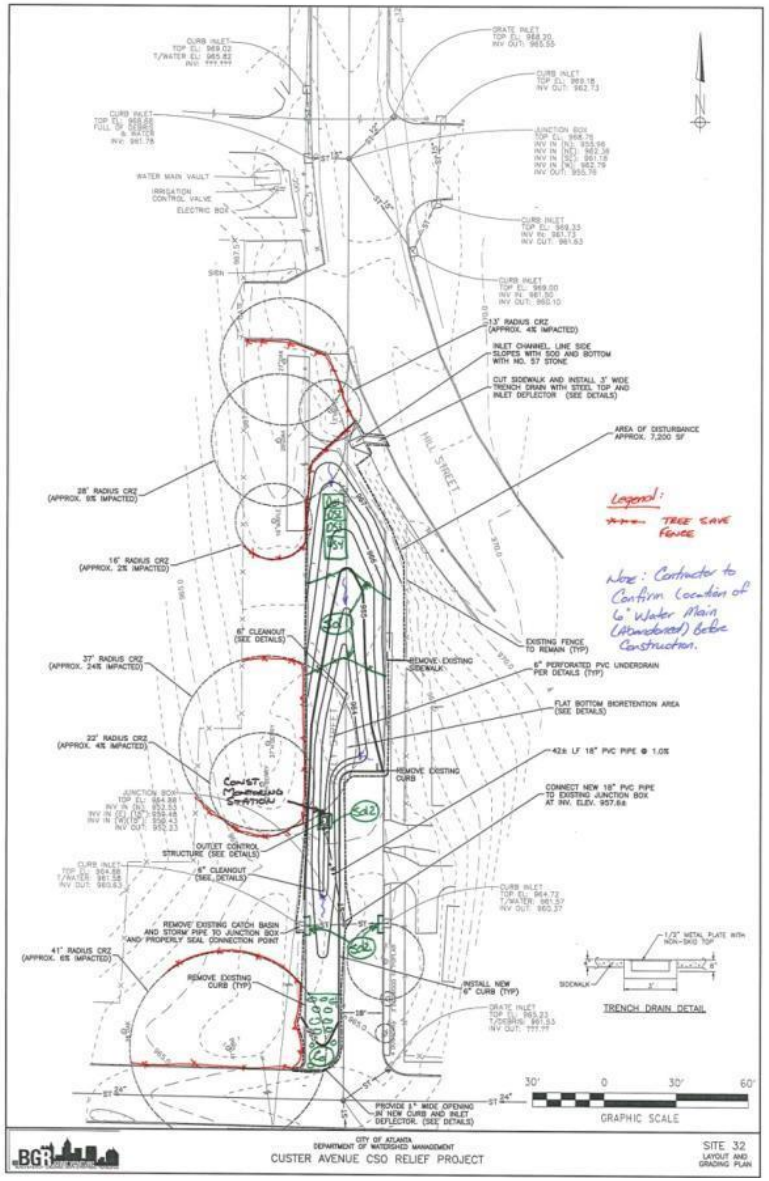
- Heart of Atlanta
- Highly impervious
- Piped Streams
- Repeated Flooding

Contributing Conditions



Short-term Projects

- First 6 months



Curb Extension

- Whitehall Terrace - converted parking spaces into bioretention area

Bioretention and Cistern

- Rosa Burney Park - converted area with poor soil conditions into bioretention

Bioretention

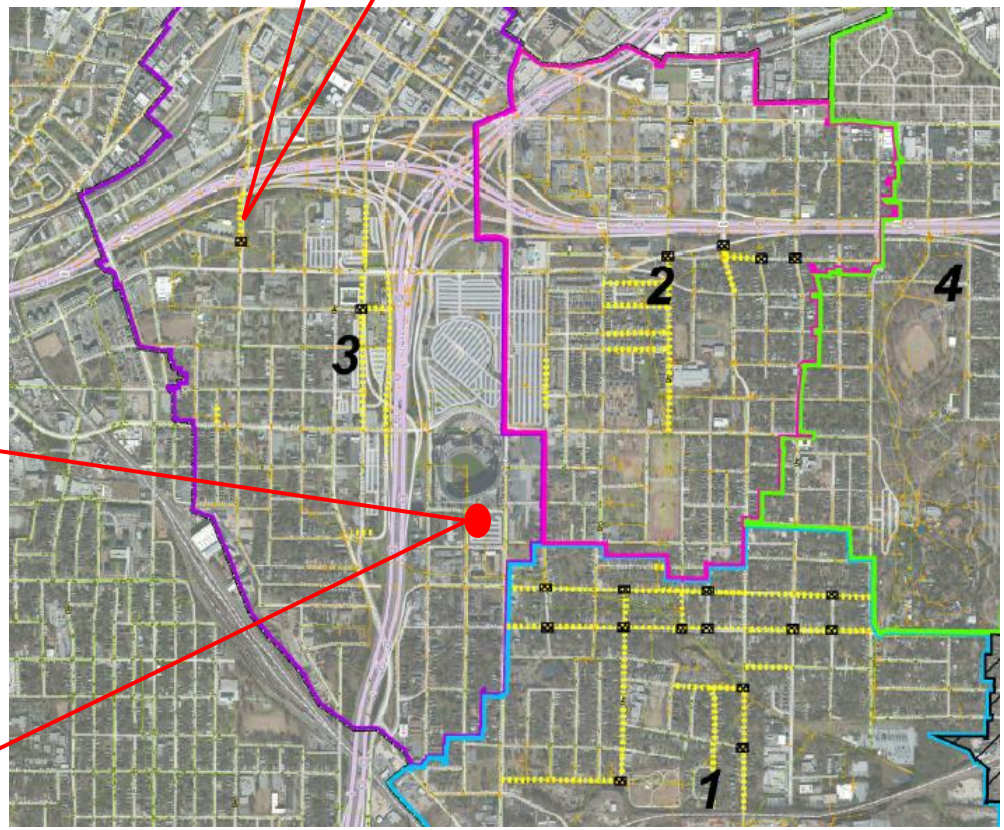
- Windsor Street - redirected runoff from street into new bioretention area

Bioretention

- Kelly Street - converted paved street into bioretention area

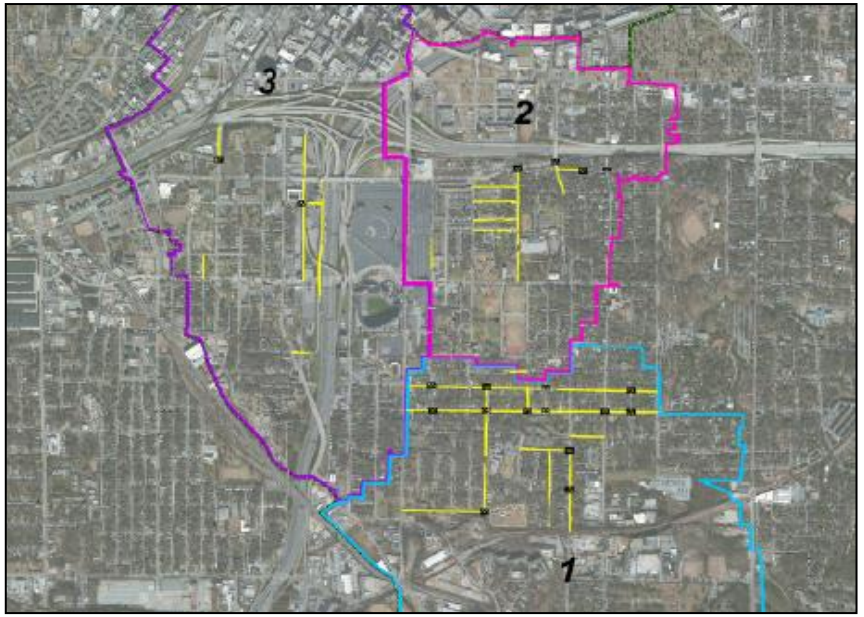
Intermediate Projects

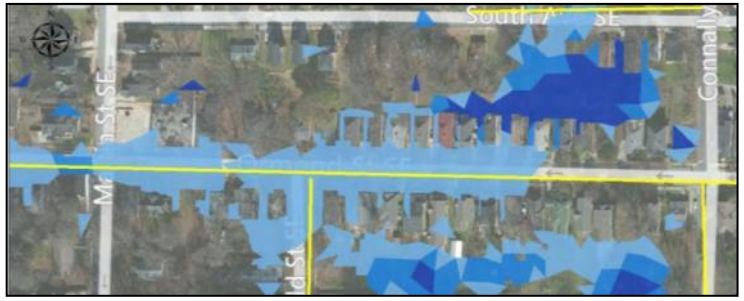
- Media lot vault
  - *Completed Feb 28, 2014*
- Permeable Pavers
  - *Design-build contractor selected*
  - *Construction began 3/31/2015*
  - *Estimated completion date – Spring of 2016*

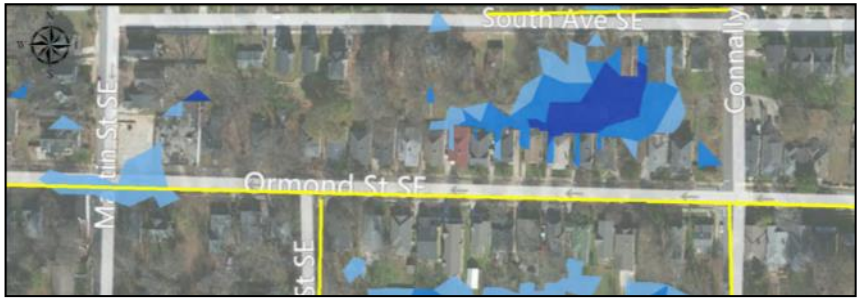


Permeable Pavers

- **~6 miles** of permeable pavers:
  - *Mechanicsville*
  - *Peoplestown*
  - *Summerhill*

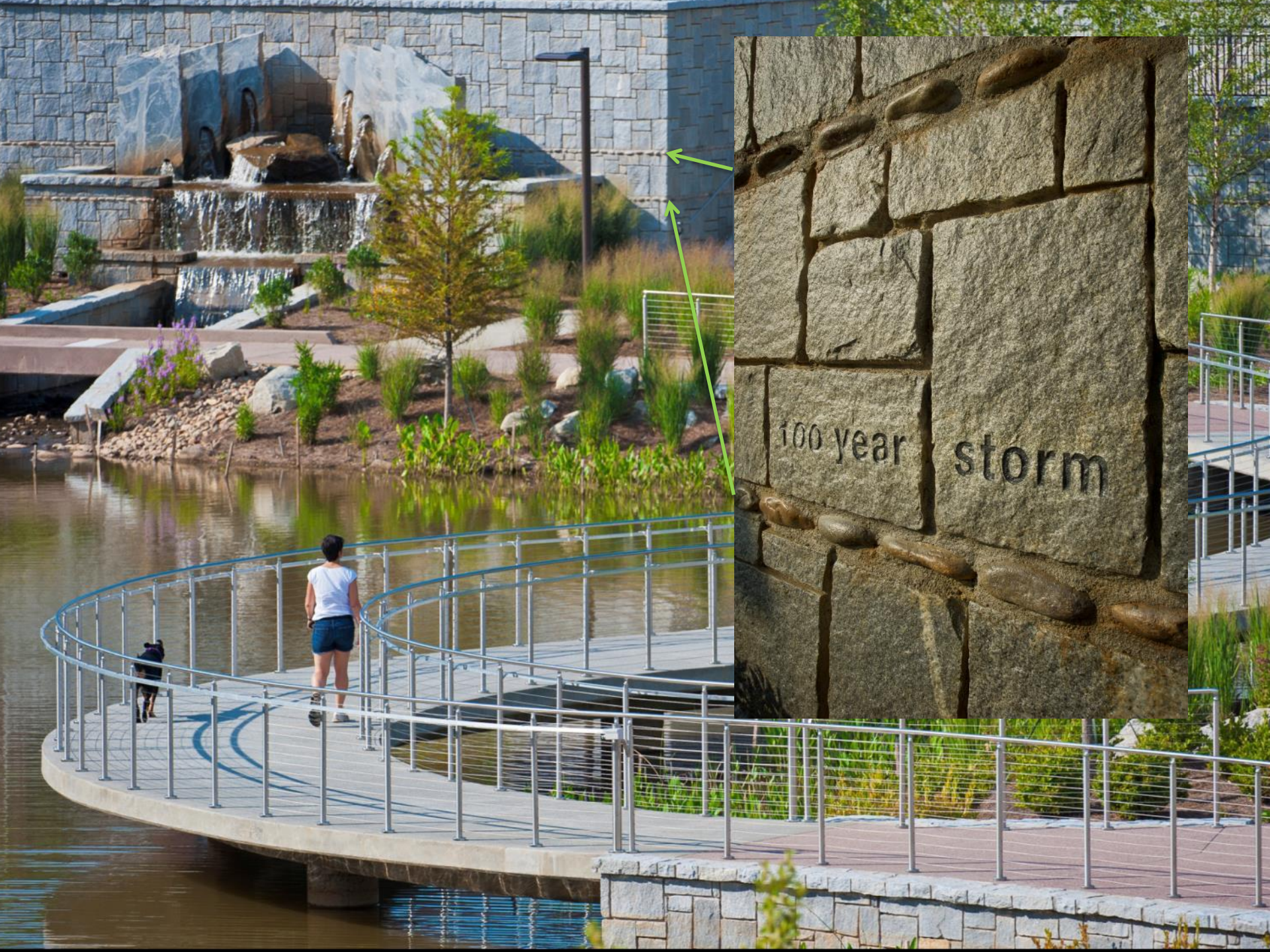






Historic Fourth Ward Park

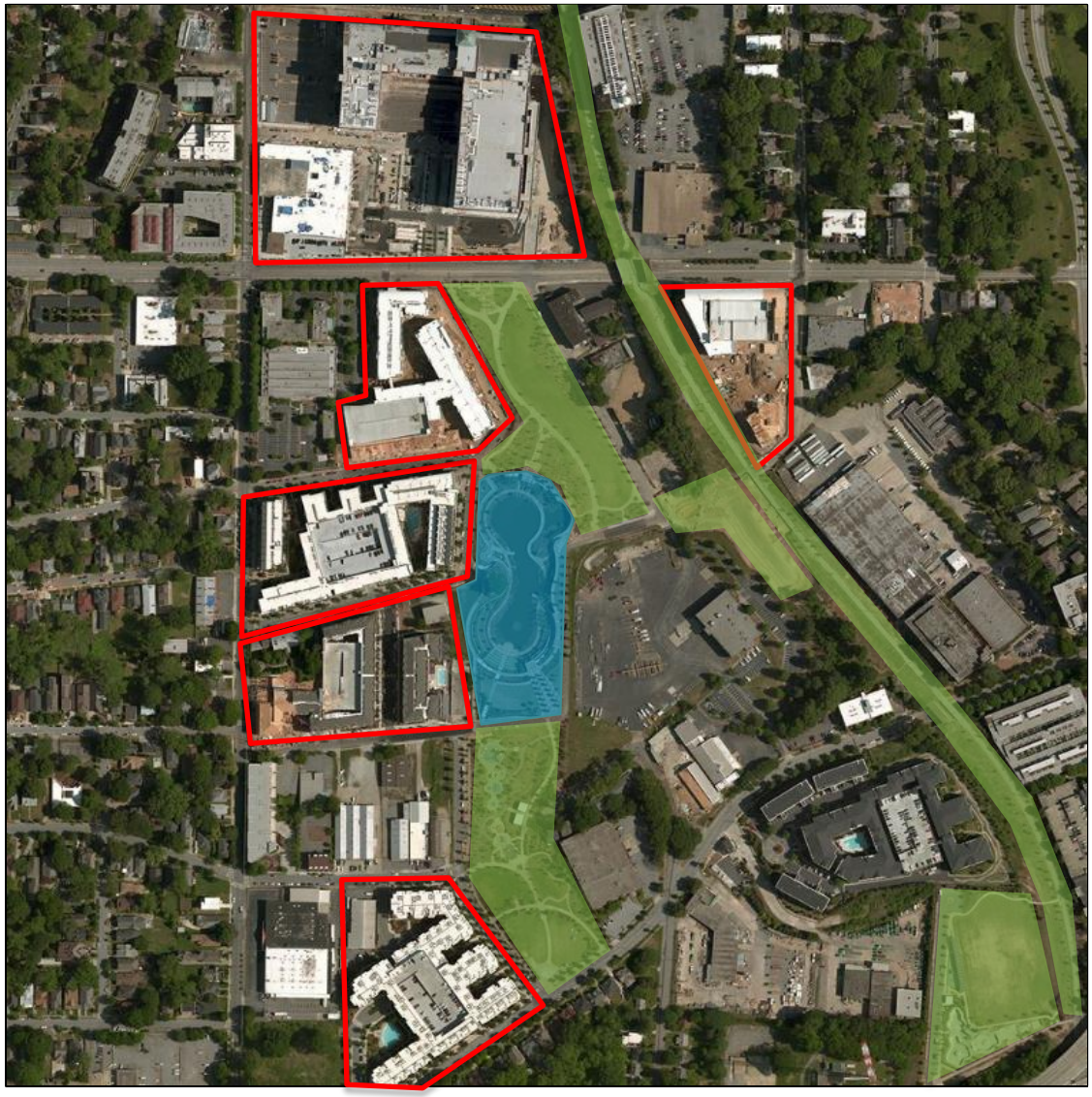
- Opened 2011. Combined Sewer Capacity relief


100 year
storm

Public-Private Partnership

Which would you prefer?

Spurring Redevelopment



2006

2008

2009

Land for pond finalized, adjacent condo construction begins

2010

Construction on pond begins

2011

Pond complete

Adjacent park and Beltline underway

~$500 Million in redevelopment

2012-2013

Apartments, condos, & Ponce City Market underway

Beltline complete

2014

Apartments, condos, Ponce City Market nearing completion

Masquerade redevelopment underway

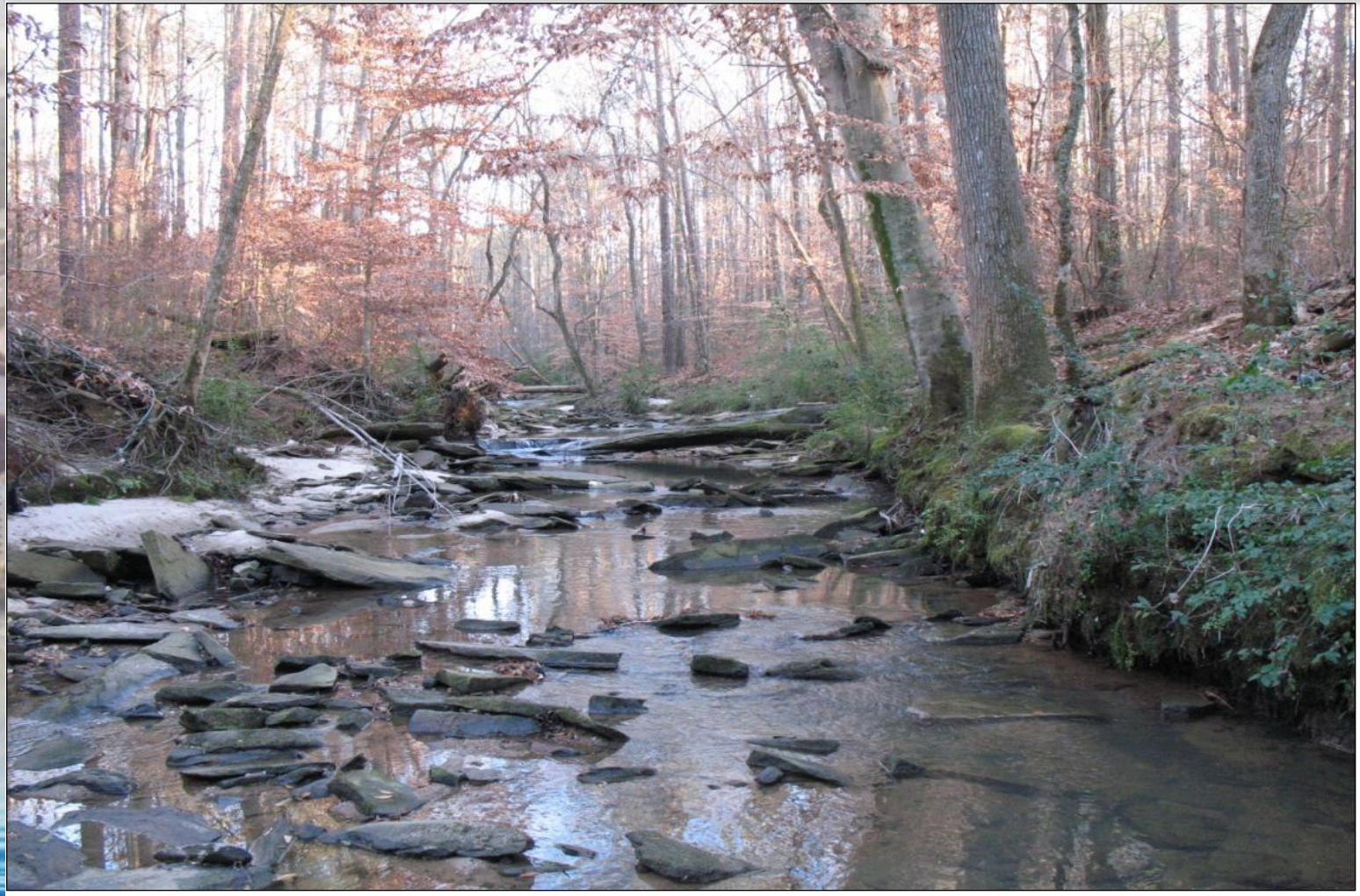
Mayor's Commitment

"It is my goal for Atlanta to become one of the top tier sustainable cities in the nation"

-Mayor Kasim Reed

Questions?

www.AtlantaWatershed.org/GreenInfrastructure



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