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Simplified LID for Residential and Small Commercial Sites

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Amec Foster Wheeler

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Green is popping up everywhere

- Permit compliance
- TMDL mandates
- Park and recreation planning
- CSO consent decrees
- Livable cities
- Water supply protection
- Federal facilities
- Groundwater replenishment
- “Sustainable” popularity
- LEED or other ratings

It's now
EASY being
green!



Program Drivers: The Big Three

Primary Program Driver

1. CSO Abatement
Reduce Overflows
2. Permit Compliance
Reduce Pollution
3. Community
Development
Attractive and Effective

Key Design Consideration

1. Instantaneous CSS
Volume Removal
2. Adequate Volume
Treatment to Reduce
Pollutants
3. Balanced TBL Benefits
and Adequate
Hydrologic Mimicry



A Comparison of Two Different Land Plans

PROJECTED RESULTS FROM TOTAL DEVELOPMENT

Total Site	Conventional Plan	Revised Green Plan
Lot Yield	358	375
Linear Feet - Street	21,770	21,125
Linear Feet - Collector Street	7,360	0
Linear Feet - Drainage Pipe	10,098	6,733
Drainage Sections (Inlets, Boxes, Headwalls)	103	79
Estimated Total Cost	\$4.6 million	\$3.9 million

ACTUAL RESULTS FROM PHASE ONE

Total Site (engineer's estimate)	Conventional Plan	Green Plan
Lot Yield	63	72
Total Cost	\$1,028,544	828,523
Cost Per Lot	\$16,326	\$11,507

ECONOMIC AND OTHER BENEFITS FROM LOW-IMPACT DEVELOPMENT

Higher Lot Yield	17 additional lots
Higher Lot Value	\$3,000 more per lot than competition
Lower Cost per Lot	\$4,800 less per lot
Enhanced Marketability	80 percent of lots sold in the first year
Added Amenities	23.5 acres of green space/parks
Recognition	National, state, and professional groups

TOTAL ECONOMIC BENEFIT More than \$2.2 million in savings.

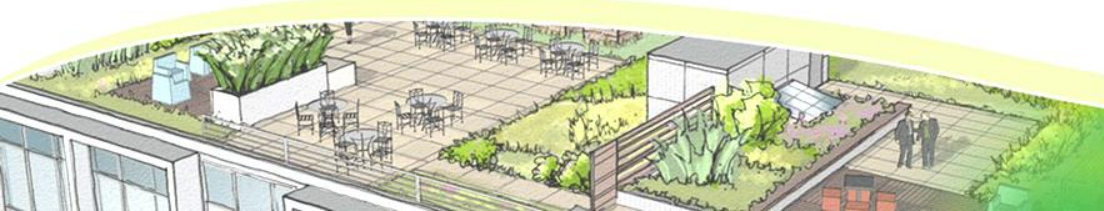
**Source: National
Home Builders
Association**

**No, I'm not
kidding !**

**No guarantees, but
these approaches
can save money
while protecting
the environment.**

Atlanta: Why use GI on SFR lots?

- **Existing drainage problems in neighborhoods**
- **Redevelopment often maximizes building footprints**
- **No stormwater management required previously**
- **Compounded effects on downstream property owners**
 - Increased flooding
 - Increased Erosion & Sedimentation
 - Incised streams




Single Family Residential Lots

- **Construction of a new home, tear down & rebuild, & large additions (>1,000 square feet) of impervious surface**
- **Required to capture and treat first 1.0" of runoff ONLY (no detention requirements)**
- **Does not apply to:**
 - Second story additions
 - Renovations
 - Replacing driveways





SO... I ASKED MY HERO TOM SCHUELER...

A man with grey hair, wearing a light green button-down shirt and blue jeans, is crouching on a rocky stream bed. He is holding a dark, irregularly shaped object in his hands and looking towards the camera. The background shows a shallow stream with rocks and some green foliage. A blue speech bubble is overlaid on the upper right portion of the image.

Complicated
spreadsheets...
No kidding.

Tom Schueler Chesapeake Bay, Center for Watershed
Protection and Washington DC Stormwater program

How we think LID gets built



How LID actually gets built



foster
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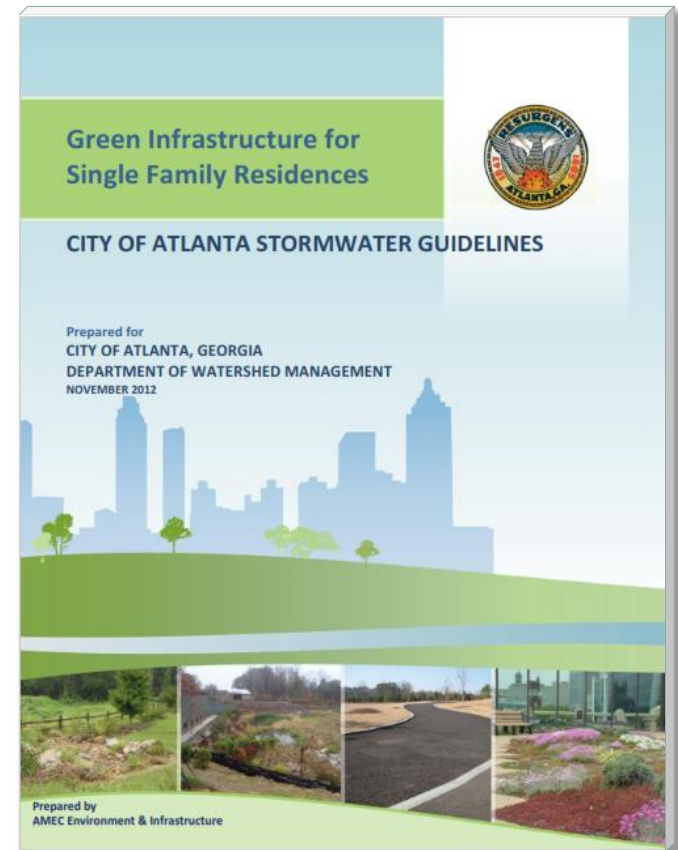
So we set some goals:

1. My brother in law using a backhoe can get it right most of the time
2. Almost no mathematics involved
3. No new plans or specs needed
4. Use GI builders are used to building
5. Must work in clay
6. Use things homeowners would maintain anyway
7. Inspect twice if you want it done right once

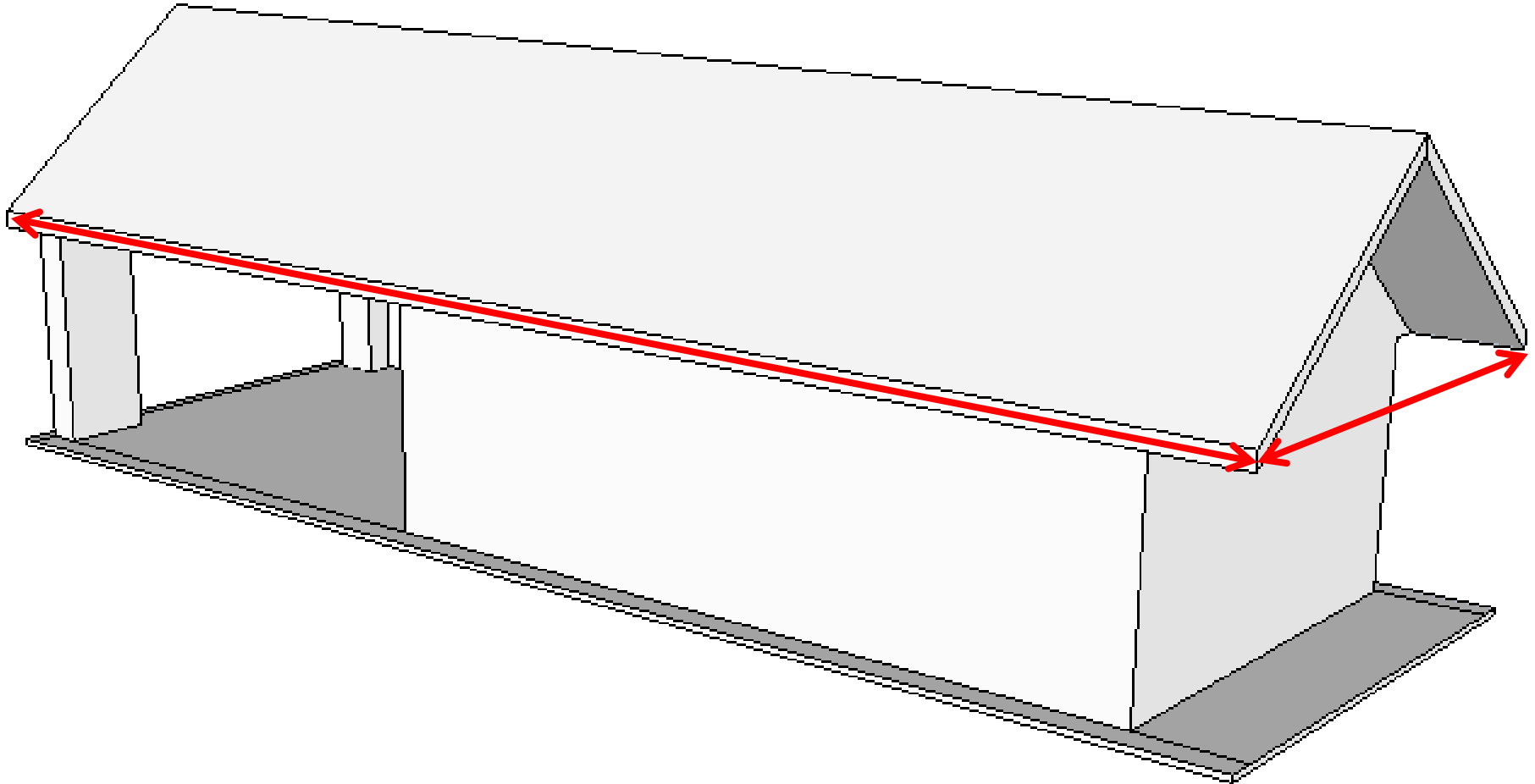


Key characteristics: Residential

- Basic guidance on key action steps
- GI application list
 - Tables for sizing
 - Slightly conservative
 - Stand alone
- Tear-off specification and sizing sheet



Measuring Area



Measure looking down from heaven
Ignore the roof slant

Simple “Hardware Store” Guidance

- **Gravel**
- **Perforated Pipe**
- **Filter Fabric**
- **Leaf and Trash Screen Options**
- **Infiltration Testing**



General 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

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

Modified French Drain
Example

Types of Practices

- Cisterns
- Dry Well
- Vegetated Filter Strips
- Modified French Drain
- Permeable Pavers
- Rain Garden

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 should be located to receive the maximum amount of stormwater runoff from impervious surfaces, and where downspouts or driveway runoff can enter garden flowing away from the home.
- Swales, berms.
- Locate at least 10 feet from septic lines, not over septic field.
- Rain gardens in your property.

Description

- The size of the rain garden will vary depending on the impervious surface draining to it and the depth of the amended soils. Use the table to determine the required surface area.
- A maximum ponding depth of 6 inches is allowed within rain gardens. On average, rain gardens drain within a day which will not create a mosquito problem.
- Design rain garden entrance to immediately intercept runoff and reduce its velocity with stones, dense hardy vegetation or by other means.
- If sides are to be mowed rain gardens should be designed with side slopes of 3:1 (4:1) or flatter.
- For best results, it is suggested to test your soil characteristics as you would for a garden, or contact your local County Extension Service for help www.ces.uga.edu/extension/atlanta.
- Soils for rain gardens should be amended native soils containing: 2/3 native soils and 1/3 compost.

Contributing Drainage Area (square feet)	Depth of Amended Soil (inches)			
	18	24	30	36
100	6.6	5.7	5.1	4.6
500	25	20	18	15
1000	45	40	35	30
2000	115	110	100	90
3000	230	210	180	160
4000	290	270	230	200
5000	350	330	280	250

Tear-Off Spec Sheets

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 allow for six inches of ponding, and the perimeter of the garden is higher than the overflow point. If the garden is on a gentle slope a berm at least two feet wide can be constructed on the downhill side and/or the garden can be dug into the hillside taking greater care for erosion control at the garden inlet(s).
5. Remove turf or other vegetation in the area of the rain garden. Excavate garden being careful not to compact soils in the bottom of the garden. Level bottom of garden as much as possible to maximize infiltration area.
6. Mix compost, topsoil, and some of the soil mix should be 1/3 compost, 2/3 native soil.
7. Fill rain garden with the amended soil to the required depth.
8. Build a berm at the downhill edge of the rain garden should be as close to the edge of the garden as possible.
9. Plant the rain garden using a selection of native plants. The best choice is finely shredded hardwood mulch.
10. Water all plants thoroughly. As in a garden, it is important to establish plants during the first year.
11. During construction build the inlet lined swale with a gentle slope. Use near the house is recommended to keep water from soaking in at that point. Test the drainage of water from the source to the garden prior to finishing.
12. Create an overflow at least 10 feet from your property edge and insure it is protected from erosion.

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

Contributing Drainage Area (square feet)	Depth of Amended Soil (inches)			
	18	24	30	36
100	6.6	5.7	5.1	4.6
500	25	20	18	15
1000	45	40	35	30
2000	115	110	100	90
3000	230	210	180	160
4000	290	270	230	200
5000	350	330	280	250

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

**CITY OF ATLANTA
DEPARTMENT OF WATERSHED
MANAGEMENT**

NAME/ADDRESS:

**RAIN GARDEN SPECIFICATIONS
PAGE 1 OF 2**

1. IRRIGATE VEGETATION AS NEEDED IN FIRST SEASON
2. REMOVE WEEDS
3. REPLACE UNSUCCESSFUL PLANTINGS
4. REFRESH 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

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

**CITY OF ATLANTA
DEPARTMENT OF WATERSHED
MANAGEMENT**

ATTACH THIS TWO-PAGE SPECIFICATION TO HOUSE PLAN SUBMITTAL

**RAIN GARDEN SPECIFICATIONS
PAGE 2 OF 2**



Example: Cisterns



- Its all about catching and using water
- 0.6 gallons per square foot
- \approx 55 gallon barrel per 100 sq ft of roof
- 10 location pointers
- Pump or gravity outflow
- Can get fancy analysis

Example: Cisterns

CISTERN

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



Cisterns are low impact development practices that store rainwater for later use. Rain is collected from a downspout system, screened to remove trash and leaves and conveyed to a storage container for subsequent use. Unless an advanced filtration system is used, water stored in the cistern is for non-potable water use only. If properly sized, they can provide significant reductions in stormwater runoff rates, volumes and pollutant loads from residential sites. Rain barrels may be part of an overall stormwater management system; however, by themselves they may not be sufficient to meet the requirements of this ordinance.



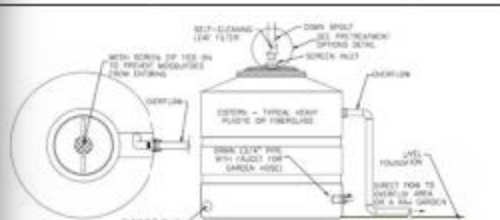
1,500 Gallon Cistern
Source: AED Urban Design Tools

Location

- Consider the size of the contributing drainage areas, and projected water needs, to determine how large a storage tank is needed. Cisterns should drain only impervious areas – preferably rooftops.
- Pick a location keeping in mind: (1) ease in connecting roof drains, (2) overflow to downslope areas, (3) level area, (4) location relative to intended water uses, (5) other utility conflicts, (6) electrical connections if applicable, (7) residential emergency ingress/egress, (8) leaf screen option, (9) location of hoses or other water distribution components, and (10) aesthetic considerations.

Design

- To fully meet the Atlanta standard, cistern capacity must be designed for a 1 inch storm. A good rule of thumb is that when sizing a cistern for the one inch rain standard, each square foot of rooftop will contribute 0.6 gallons of runoff. A one-hundred square foot roof surface will fill a 55-gallon barrel.
- Cisterns come in sizes from a 55-gallon rain barrel to a 1,500-gallon cistern. If the cistern cannot hold the full inch one alternative is to divert overflow to another low impact development structure such as a filter strip or rain garden.
- Measure contributing roof area width from the drip line of the overhang to the roof peak ignoring the slant, and the length. The width times the length in feet is the drainage area. Multiply that by 0.6 gallons and that is the size of the cistern you will need to fully meet the one-inch rainfall standard.
- All holding tanks should be opaque to prevent algae growth.



TYPICAL COMPONENTS (ATTACH MANUFACTURER'S SPECIFICATIONS)

CONSTRUCTION STEPS:

1. Locate cistern for: (1) ease in connecting roof drains, (2) overflow to downslope area, (3) level area, (4) location relative to intended water uses, (5) other utility conflicts, (6) electrical connections if applicable, (7) emergency ingress/egress, (8) leaf screen option, (9) location of hoses or other water distribution components, and (10) aesthetic considerations.
2. Depending on use review and follow applicable plumbing code.
3. Provide level foundation of compacted earth, blocks, gravel or other hard long-lasting surface.
4. Place cistern tank and review all connections for layout and sizing.
5. Cut and route downspouts or other rainwater delivery components, leaf screen option(s) chosen (circle selected options in Pretreatment Options Detail figure), and mosquito screen as applicable. Strap and support as needed.
6. Install water outlet connections including pumps as applicable. Follow manufacturer's specification for all connections and fittings including inlet, overflow, and clean out.
7. Extend overflow to adequate non-erosion discharge point no less than 10 feet from any common property line.
8. Test cistern by filling with water and testing all components in turn – including spraying water on the roof and observing flow.
9. Consider appearance and final landscaping and screening. Complete construction, landscaping, etc.



PRETREATMENT OPTIONS DETAIL

SKETCH LAYOUT

ELEVATION VIEWS OF CISTERN AND HOUSE SHOWING ROOF AREA DIRECTED TO CISTERN AND CONNECTIONS AND OVERFLOW RELATIVE TO PROPERTY LINE.

MANUFACTURER'S SPECIFICATIONS AND OTHER DETAILS

ROOF AREA DIRECTED TO CISTERN:

TO CISTERN = _____ SQ. FT.
CISTERN SIZE = _____ GAL.

MANUFACTURER:

MAINTENANCE

1. TO MAINTAIN THE STORAGE CAPACITY OF THE CISTERN RAINWATER SHOULD BE USED REGULARLY.
2. ROUTINE CHECKS OF THE INTAKE AND LEAF SCREENING COMPONENTS SHOULD BE DONE ONCE IN THE SPRING AND PERIODICALLY DURING THE FALL IF LEAVES FALL ON THE CONTRIBUTING ROOF AREA.
3. INSPECT AND IF NECESSARY CLEAN OUT TANK ANNUALLY BY SCRUBBING AND LETTING WATER DRAIN THROUGH LOW FLOW PLUG. CHECK CONNECTIONS FOR LEAKS, AND INSPECT OVERFLOW FOR EROSION.

November 2012

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NAME/ADDRESS:

CISTERN
SPECIFICATIONS
PAGE 1 OF 2

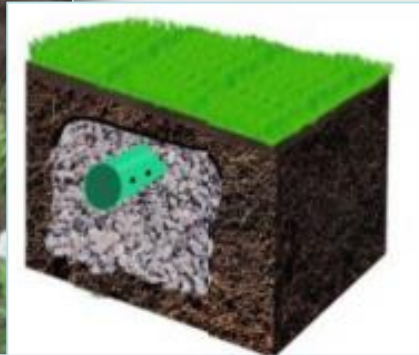
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WATERSHED MANAGEMENT

ATTACH THIS TWO-PAGE
SPECIFICATION TO HOUSE PLAN
SUBMITTAL

CISTERN
SPECIFICATIONS
PAGE 2 OF 2

November 2012

Modified French Drain



- Its all about holding water in rock until it soaks away
 - Keep it from clogging: filter and fabric
 - Right size for 1" rain: porosity + infiltration
 - Assume 24" width
 - Pipe near top not bottom
 - Safe overflow: daylight downstream

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	180	155	130
5000	305	235	195	165

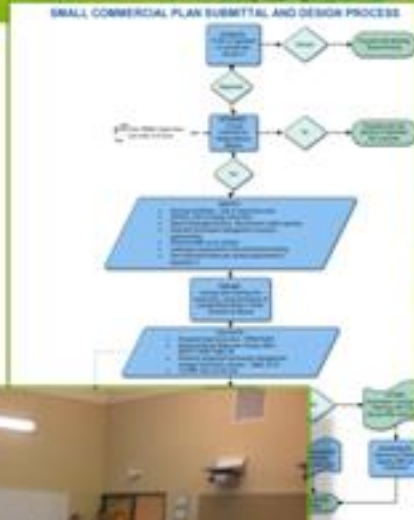
SMALL COMMERCIAL GUIDE
CITY OF ATLANTA, GEORGIA
DEPARTMENT OF WATERWASH MANAGEMENT

BIORETENTION




Location

- 1. Areas that have been paved or sealed in the past 10 years.
- 2. Areas that have been paved or sealed in the past 10 years.
- 3. Areas that have been paved or sealed in the past 10 years.
- 4. Areas that have been paved or sealed in the past 10 years.
- 5. Areas that have been paved or sealed in the past 10 years.
- 6. Areas that have been paved or sealed in the past 10 years.
- 7. Areas that have been paved or sealed in the past 10 years.
- 8. Areas that have been paved or sealed in the past 10 years.
- 9. Areas that have been paved or sealed in the past 10 years.
- 10. Areas that have been paved or sealed in the past 10 years.

Green Infrastructure for Single Family Residences
CITY OF ATLANTA STORMWATER GUIDELINES

Prepared for
CITY OF ATLANTA, GEORGIA
DEPARTMENT OF WATERWASH MANAGEMENT



PERMEABLE PAVERS
SINGLE FAMILY RESIDENTIAL GUIDE
CITY OF ATLANTA, GEORGIA
DEPARTMENT OF WATERWASH MANAGEMENT



Location

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- 9. Areas that have been paved or sealed in the past 10 years.
- 10. Areas that have been paved or sealed in the past 10 years.

Location Table

Location	Permeable Paver Requirement
Driveway	100%
Parking Lot	100%
Walkway	100%
Roof	100%
Other	100%

City of Atlanta GI Program Support
Development of ordinance, design criteria manuals, training, reviewer checklist, first in state



Results after 8 months?

- 550 sites with 1,300 separate structures
- 6 inspectors – 3x each site incl. erosion
- Very few problems



Then we did it again for very small commercial:

- **Differences:**
 - Slightly “smarter” people going it
 - Lots of utility conflicts
 - High impervious area applications
 - Must fit within mandatory green space

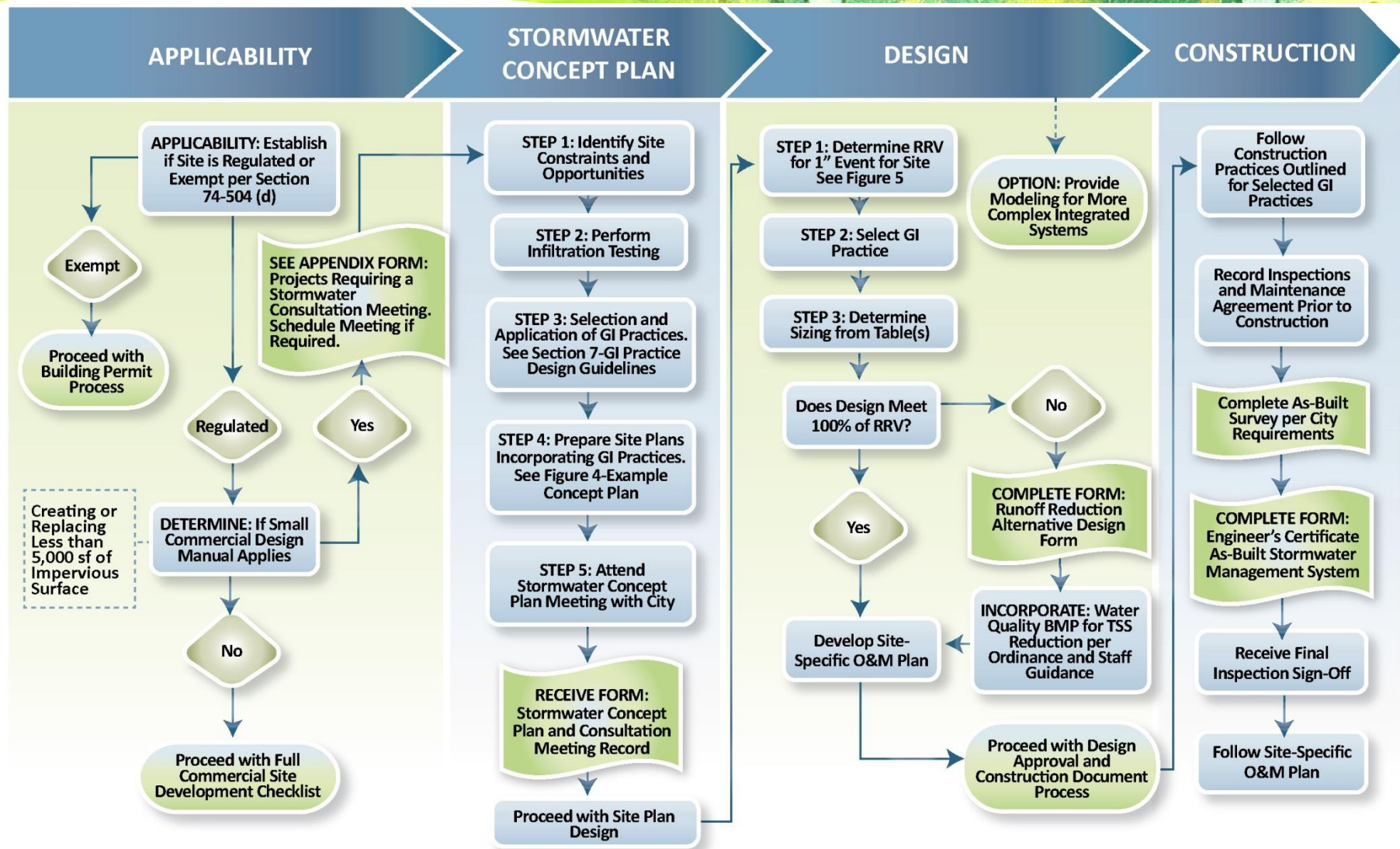


Then we did it again for very small commercial:



- **So... we added**
 - “Belt and suspenders” approach
 - Under IA or IA modified practices
 - A better site planning process
 - More design calculations and options

Design steps using the manual



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.

Green Infrastructure for Single Family Residences



CITY OF ATLANTA STORMWATER GUIDELINES

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NOVEMBER 2012

Green Infrastructure Stormwater Management Practices for Small Commercial Development



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Prepared for
CITY OF ATLANTA, GEORGIA
DEPARTMENT OF WATERSHED MANAGEMENT
APRIL 2014

<http://www.atlantawatershed.org/greeninfrastructure/>



Questions ?

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