Georgia's Updated, Adaptive Approach to Stormwater Management

SESWA's 10th Annual Regional Stormwater Conference

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Presenters

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Brief Background

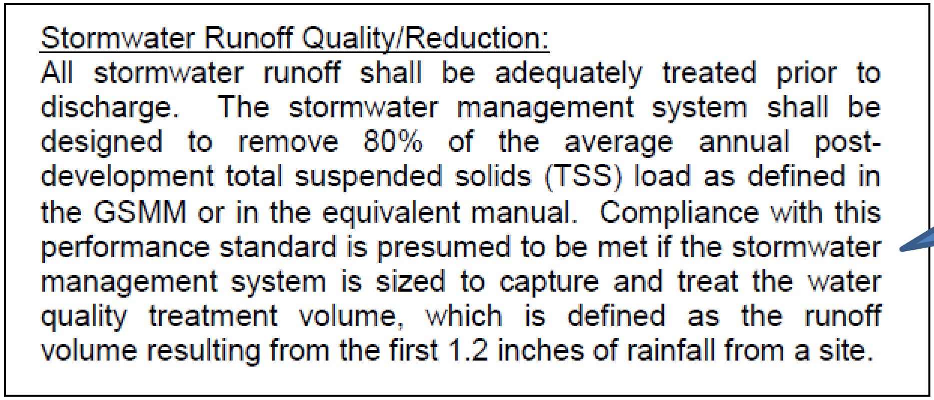
- Why update the “Blue Book”?
  - Original GSMM ~ 15yrs old
  - New and Better Information
  - Approaches have Changed
  - State Water Plan Update
  - Stakeholder Request

What are the Major Changes?

- New Water Quality Performance Standard
- Comprehensive Stormwater Management Approach
- Revised Better Site Design Credits
- New / Updated BMP Sections
- Digital Design Details
- Operations & Maintenance Guidance Document
- Planting & Soil Guidance
- Revised BMP Calculator Tool

Existing Water Quality (WQ) Performance Standard

- MS4 communities are required to adopt the performance standards listed in the permit, which most do not currently include runoff reduction
- All regulated communities are required to meet TSS requirements, except coastal communities. Coastal communities have a runoff reduction requirement.

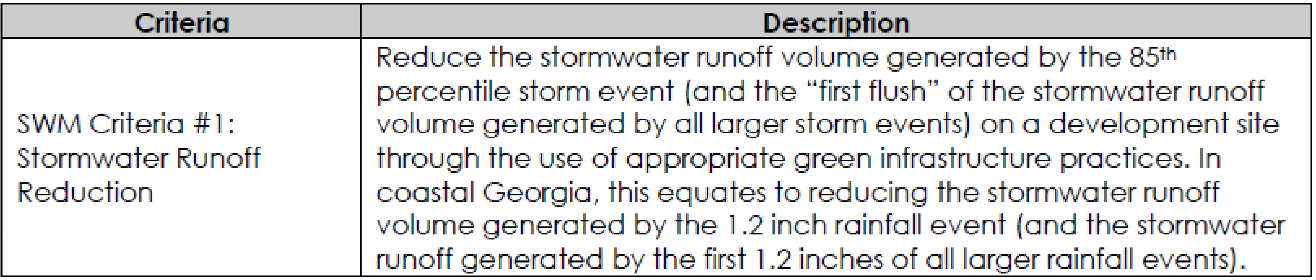


Stormwater Runoff Quality/Reduction:

All stormwater runoff shall be adequately treated prior to discharge. The stormwater management system shall be designed to remove 80% of the average annual post-development total suspended solids (TSS) load as defined in the GSMM or in the equivalent manual. Compliance with this performance standard is presumed to be met if the stormwater management system is sized to capture and treat the water quality treatment volume, which is defined as the runoff volume resulting from the first 1.2 inches of rainfall from a site.

Current GSMM & Most MS4 Permits Requirement - 80% TSS removal from the 1.2-inch rainfall event

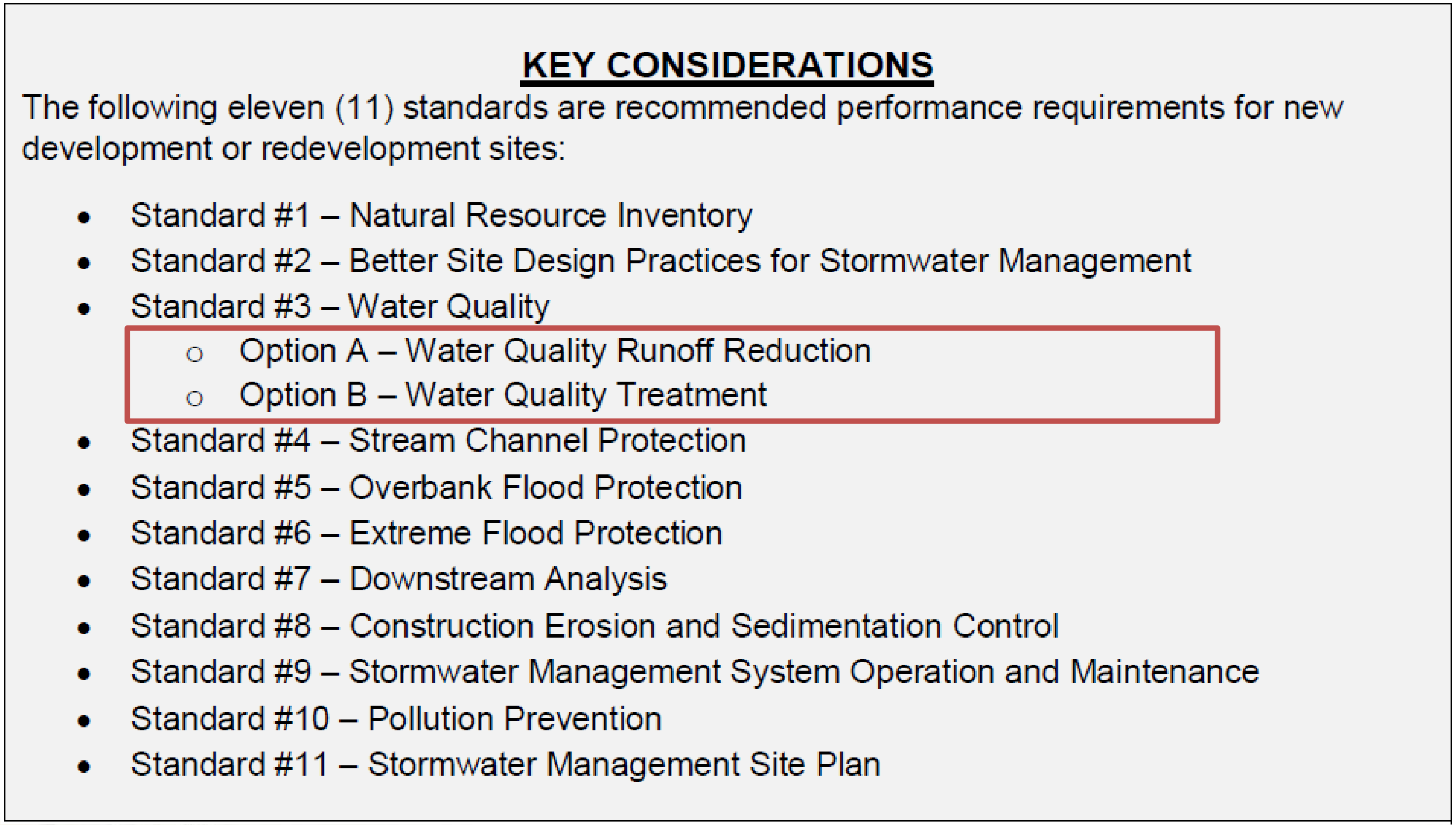
GSMM CSS – Runoff reduction of the 1.2-inch rainfall event



Criteria	Description
SWM Criteria #1: Stormwater Runoff Reduction	Reduce the stormwater runoff volume generated by the 85th percentile storm event (and the "first flush" of the stormwater runoff volume generated by all larger storm events) on a development site through the use of appropriate green infrastructure practices. In coastal Georgia, this equates to reducing the stormwater runoff volume generated by the 1.2 inch rainfall event (and the stormwater runoff generated by the first 1.2 inches of all larger rainfall events).

New WQ Performance Standard

- While communities do have to adopt the Blue Book, it provides recommended, not required, performance standards
- Includes a water quality runoff reduction option and a water quality treatment option

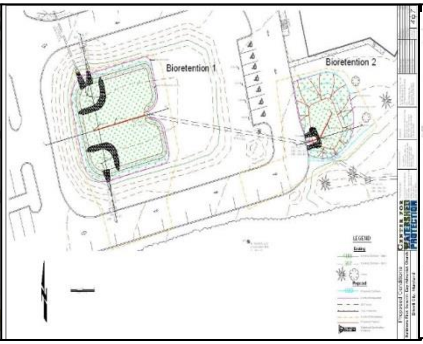


KEY CONSIDERATIONS

The following eleven (11) standards are recommended performance requirements for new development or redevelopment sites:

- Standard #1 – Natural Resource Inventory
- Standard #2 – Better Site Design Practices for Stormwater Management
- Standard #3 – Water Quality
    - Option A – Water Quality Runoff Reduction
    - Option B – Water Quality Treatment
- Standard #4 – Stream Channel Protection
- Standard #5 – Overbank Flood Protection
- Standard #6 – Extreme Flood Protection
- Standard #7 – Downstream Analysis
- Standard #8 – Construction Erosion and Sedimentation Control
- Standard #9 – Stormwater Management System Operation and Maintenance
- Standard #10 – Pollution Prevention
- Standard #11 – Stormwater Management Site Plan

New WQ Performance Standard



Standard #3 – Water Quality

Stormwater management systems should be designed to *retain or treat the runoff from 85% of the storms that occur in an average year, and reduce average annual post-development total suspended solids loadings by 80%.*

New WQ Performance Standard

Option A – Water Quality Runoff Reduction

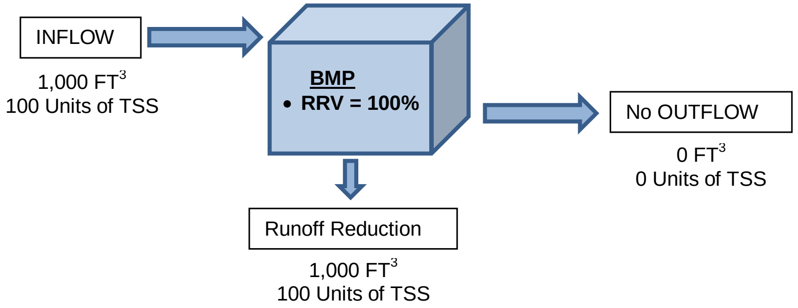
- Runoff reduction practices shall be sized and designed to retain the first 1.0 inch of rainfall on the site, or to the maximum extent practicable.
- Runoff reduction practices inherently reduce TSS and other pollutants to provide water quality treatment (i.e. 100% pollutant removal for stormwater retention, infiltration, evaporation, transpiration, or rainwater harvesting and reuse).
- If the entire 1.0-inch runoff reduction standard cannot be achieved, the remaining runoff from the 1.2-inch rainfall event must be treated by BMPs to remove at least 80% of the calculated average annual post-development TSS loading from the site.

Option B – Water Quality Treatment

- Stormwater runoff generated on the development site shall be retained and/or treated by BMPs to remove at least 80% of the calculated average annual post-development total suspended solids (TSS) loading from the site.
- This standard is quantified and expressed in terms of engineering design criteria through the specification of the water quality volume (WQ_v), which is equal to the runoff generated on a site from 1.2 inches of rainfall.
- This can be achieved through the use of BMPs that provide runoff reduction or BMPs that provide treatment.

New WQ Performance Standard

Runoff Reduction Approach



INFLOW

1,000 FT^3
100 Units of TSS

BMP
- **RRV = 100%**

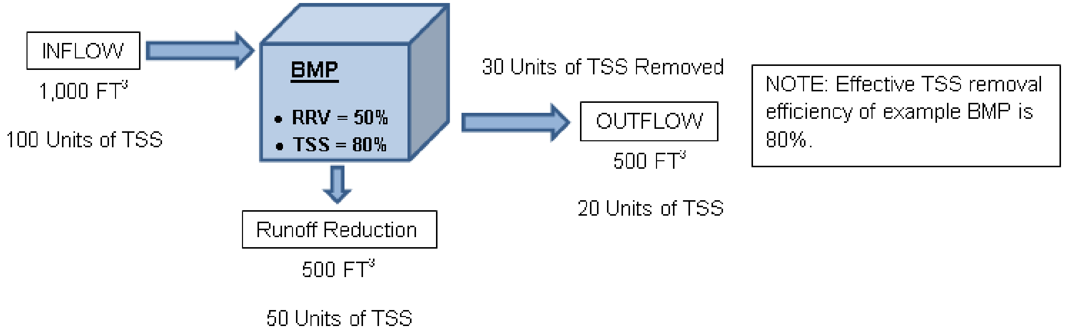
No OUTFLOW

0 FT^3
0 Units of TSS

Runoff Reduction

1,000 FT^3
100 Units of TSS

Partial Runoff Reduction Approach



INFLOW

1,000 FT^3

100 Units of TSS

BMP
- **RRV = 50%**
- **TSS = 80%**

30 Units of TSS Removed

OUTFLOW

500 FT^3

20 Units of TSS

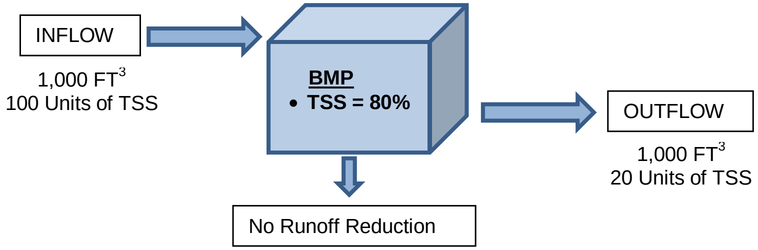
NOTE: Effective TSS removal efficiency of example BMP is 80%.

Runoff Reduction

500 FT^3

50 Units of TSS

Traditional TSS Removal Approach



INFLOW

1,000 FT^3
100 Units of TSS

BMP
- **TSS = 80%**

OUTFLOW

1,000 FT^3
20 Units of TSS

No Runoff Reduction

Comprehensive Stormwater Management Approach

Incentivized implementation of runoff reduction:

- Option A uses 1.0” vs. 1.2”
- 100% of 1.0” is equivalent to 80% of 1.2”

Runoff reduction:

- Reduces post-construction stormwater runoff rates, volumes, and pollutant loads
- Reduces risk of flooding
- Eliminates stormwater runoff (and the pollutants associated with it), rather than treating or detaining runoff
- Provides economic benefits (additional jobs, increased property values, etc)
- Maintains, mimics or replaces landscape hydrologic functions

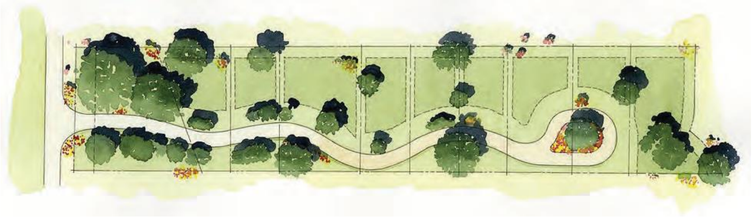
(Source: Center for Watershed Protection)

Comprehensive Stormwater Management Approach (cont'd)

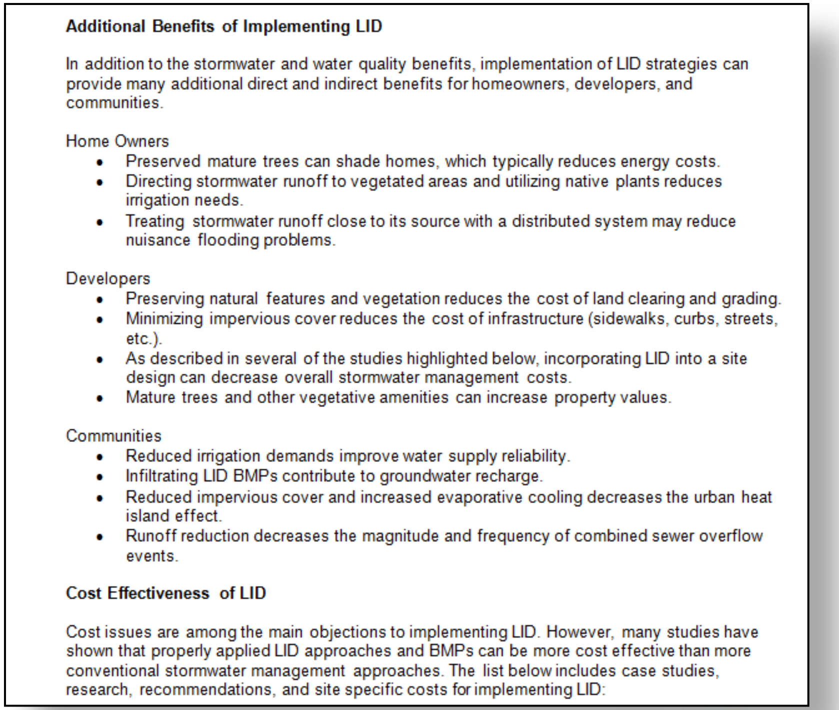
Communities are encouraged to:

- Use Green Infrastructure (GI), Low Impact Development (LID), and Better Site Design (BSD)

Case Study: Fox Hollow Development – James Island, SC Located on James Island, South Carolina, Fox Hollow is a 2.65 acre low impact development that protected the trees, wetlands, and topography of the site. Unlike conventional development, where mass grading is common, at Fox Hollow the land has been highly conserved – only enough land for the 9 houses and roadway were cleared. Narrow streets and driveways reduce impervious cover in the development. Rather than relying on pipes, a bioswale system conveys stormwater and bioretention cells replace stormwater ponds. The site has a density of 4.22 homes/acre with 0.52 acres of open space consisting of park, bioretention and wetlands. Named "Best New Community of 2013" by the Charleston Homebuilders Association, Fox Hollow was specifically recognized for its low impact development approach (Ellis et al. 2014).



Site plan for Fox Hollow (Ellis et al, 2014)



Additional Benefits of Implementing LID

In addition to the stormwater and water quality benefits, implementation of LID strategies can provide many additional direct and indirect benefits for homeowners, developers, and communities.

Home Owners

- Preserved mature trees can shade homes, which typically reduces energy costs.
- Directing stormwater runoff to vegetated areas and utilizing native plants reduces irrigation needs.
- Treating stormwater runoff close to its source with a distributed system may reduce nuisance flooding problems.

Developers

- Preserving natural features and vegetation reduces the cost of land clearing and grading.
- Minimizing impervious cover reduces the cost of infrastructure (sidewalks, curbs, streets, etc.).
- As described in several of the studies highlighted below, incorporating LID into a site design can decrease overall stormwater management costs.
- Mature trees and other vegetative amenities can increase property values.

Communities

- Reduced irrigation demands improve water supply reliability.
- Infiltrating LID BMPs contribute to groundwater recharge.
- Reduced impervious cover and increased evaporative cooling decreases the urban heat island effect.
- Runoff reduction decreases the magnitude and frequency of combined sewer overflow events.

Cost Effectiveness of LID

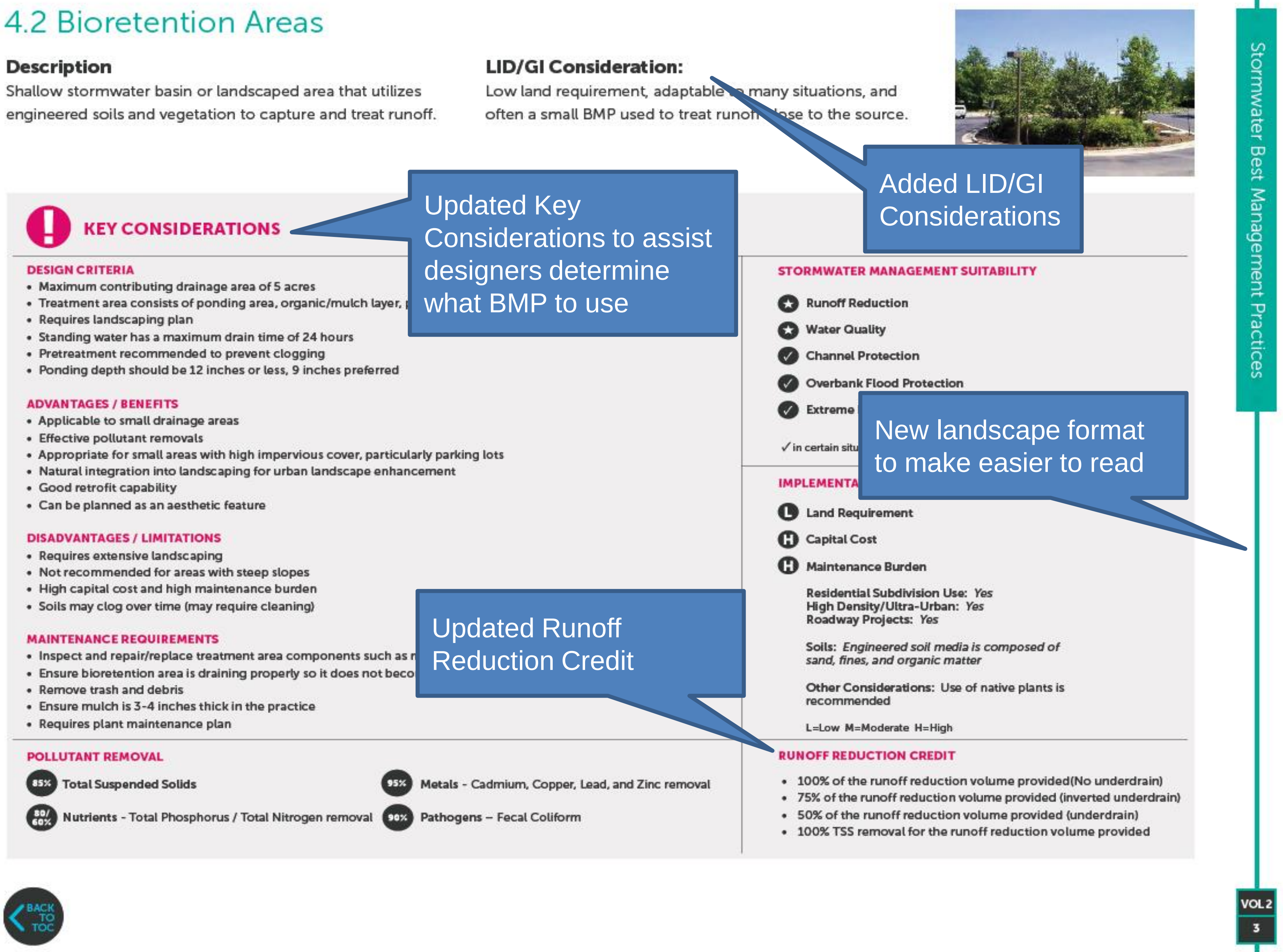
Cost issues are among the main objections to implementing LID. However, many studies have shown that properly applied LID approaches and BMPs can be more cost effective than more conventional stormwater management approaches. The list below includes case studies, research, recommendations, and site specific costs for implementing LID:

Better Site Design Credits

- Five existing credits intended to be a bonus, but they go above and beyond what math and science say
- More and better science available to calculate benefits of new BMPs and runoff reduction practices
- The following credits were removed
    - Stream Buffers
    - Grass Channel
    - Overland Flow Infiltration and Groundwater Recharge
    - Environmentally Sensitive Large Lot Subdivisions
- Only remaining credit
    - Natural Area Conservation Credit

BMP Changes/Updates

- Updated existing BMP sections to current industry standards
- New format for Manual
- Added new BMP sections
  - Bioslope
  - Dry Extended Detention Basin
  - Regenerative Stormwater Conveyance
  - Porous Asphalt
- Removed BMP sections
  - Alum Treatment Systems
  - Rain Garden (incorporated in bioretention)



4.2 Bioretention Areas

Description

Shallow stormwater basin or landscaped area that utilizes engineered soils and vegetation to capture and treat runoff.

LID/GI Consideration:

Low land requirement, adaptable to many situations, and often a small BMP used to treat runoff close to the source.

Added LID/GI Considerations

KEY CONSIDERATIONS

Updated Key Considerations to assist designers determine what BMP to use

DESIGN CRITERIA

- Maximum contributing drainage area of 5 acres
- Treatment area consists of ponding area, organic/mulch layer, p
- Requires landscaping plan
- Standing water has a maximum drain time of 24 hours
- Pretreatment recommended to prevent clogging
- Ponding depth should be 12 inches or less, 9 inches preferred

ADVANTAGES / BENEFITS

- Applicable to small drainage areas
- Effective pollutant removals
- Appropriate for small areas with high impervious cover, particularly parking lots
- Natural integration into landscaping for urban landscape enhancement
- Good retrofit capability
- Can be planned as an aesthetic feature

DISADVANTAGES / LIMITATIONS

- Requires extensive landscaping
- Not recommended for areas with steep slopes
- High capital cost and high maintenance burden
- Soils may clog over time (may require cleaning)

MAINTENANCE REQUIREMENTS

- Inspect and repair/replace treatment area components such as
- Ensure bioretention area is draining properly so it does not beco
- Remove trash and debris
- Ensure mulch is 3-4 inches thick in the practice
- Requires plant maintenance plan

STORMWATER MANAGEMENT SUITABILITY

★ Runoff Reduction
★ Water Quality
✓ Channel Protection
✓ Overbank Flood Protection
✓ Extreme

✓ in certain situ

New landscape format to make easier to read

IMPLEMENTA

L Land Requirement
H Capital Cost
H Maintenance Burden

Residential Subdivision Use: *Yes*
High Density/Ultra-Urban: *Yes*
Roadway Projects: *Yes*

Soils: *Engineered soil media is composed of sand, fines, and organic matter*

Other Considerations: Use of native plants is recommended

L=Low M=Moderate H=High

Updated Runoff Reduction Credit

POLLUTANT REMOVAL

85%	Total Suspended Solids	95%	Metals - Cadmium, Copper, Lead, and Zinc removal
80/60%	Nutrients - Total Phosphorus / Total Nitrogen removal	90%	Pathogens – Fecal Coliform

RUNOFF REDUCTION CREDIT

- 100% of the runoff reduction volume provided(No underdrain)
- 75% of the runoff reduction volume provided (inverted underdrain)
- 50% of the runoff reduction volume provided (underdrain)
- 100% TSS removal for the runoff reduction volume provided

4.2 Bioretention Areas

lot grades to divert the WQv into the facility; a splash/erosion prevention pad may be required. Bypass additional runoff to a downstream catch basin inlet. Requires temporary ponding in the parking lot (see Figure 4.2.3-4).

- Figure 4.2.3- deflector wei designed to quality peak area.
- An in-system overflow consisting of an overflow catch basin inlet and/or a pea gravel curtain drain overflow.

Updated physical specifications

See Figure 4.2.3-5 for an overview of the various components of a bioretention area. For an example of a bioretention area without an underdrain see Figure 4.2.3-6

4.2.5.3 Physical Specifications/ Geometry

Recommended minimum dimensions of a bioretention area are 3-6% of the total drainage area though modeling is recommended to accurately size the area.

- The planting media should have a drain time of 24 hours and a coefficient of permeability (k) of 2-4 ft/day.
- The maximum recommended ponding depth of the bioretention areas is 12 inches.
- A grass channel can be used for pretreatment. The length of the grass channel depends on the drainage area, land use, and channel slope. Design guidance on grass channels for pretreatment can be found in subsection 4.9 (Grass Channel). A pea gravel diaphragm flow spreader can also be used.
- The mulch layer should consist of 3 to 4 inches of triple-shredded hardwood mulch. This provides additional benefits such as removing sediment and metals and retaining soil moisture.
- The planting media used within bioretention area planting beds should be an engineered soil mix that meets the following specifications:
  - Texture: Sandy loam or loamy sand.
  - Sand Content: Soils should contain 35%-60% clean, washed sand.
  - Topsoil Content: Soils should contain 20%-30% topsoil.
  - Organic Matter Content: Soils should contain 10%-25% organic matter.
  - Clay: 15%
  - Infiltration Rate: Soils infiltration rate of at le hour (in/hr), although between 1 and 2 in/h
  - Phosphorus Index (P-I P-Index of less than 30
  - Exchange Capacity (CEC): Soils should have a CEC that exceeds 10 milliequivalents (meq) per 100 grams of dry weight.
  - pH: Soils should have a pH of 6-8.
- Where needed, the underdrain collection system should be equipped with a 6-inch perforated PVC pipe (AASHTO M 252) in an 8-inch gravel layer. The pipe should have 3/8-inch perforations, spaced at 6-inch centers, with a minimum of 4 holes per row. The pipe is spaced at a maximum of 10 feet on center and a minimum grade of 0.5% must be maintained. A permeable geotextile is placed between the gravel layer and the planting media.
- To prevent damage to building foundations and contamination of groundwater aquifers, bioretention areas, unless equipped with a waterproof liner (e.g., 30 mil (0.030 inch) polyvinylchloride (PVC) or equivalent), should be located at least:
  - 10 feet from building foundations
  - 10 feet from property lines
  - 100 feet from private water supply wells
  - 1,200 feet from public water supply wells
  - 100 feet from septic systems
  - 100 feet from surface waters
  - 400 feet from public water supply surface waters

Updated specifications for the location of the BMP

4.2.5.4 Pretreatment/Inlets

dequate pretreatment and inlet protection or bioretention systems is provided when all f the following are provided: grass filter strip elow a level spreader (grass channel) or an rganic or mulch layer.

4.2.5.5 Outlet Structures

- Outlet structures should be included in the design of a bioretention configuration to ensure that larger storms can be bypassed without damaging the practice. Exceptions include small bioretention basins with flow bypass structures. Outlet configurations can include riser boxes and/or emergency spillway channels.

BACK TO TOC

4.2 Bioretention Areas

Updated design steps based on new research and incorporated runoff reduction calculations

Step 3. Calculate the Stormwater Runoff Reduction Volume.
Calculate the Runoff Reduction Volu e using the following formula:

RRV = (P) (RV) (A) / 12
Where:
RRV = Runoff Reduction Volume (acre-feet)
P = Target runoff reduction rainfall (inches)
RV = Volumetric runoff coefficient can be found by:
RV = 0.05+0.009(I)
Where:
I = new impervious area of the site (%)
A = Site area (acres)
12 = Unit conversion factor (in/ft)

Step 4. Determine the total runoff volume and bioretention footprint.
Calculate the Water Quality Volume (WQv), Channel Protection Volume (Cpv), Overbank Flood Protection Volume (Qp), and the Extreme Flood Volume (Qf).

Details on the Unified Stormwater Sizing Criteria are found in Section 2.1.

The peak rate of discharge for the water quality design storm is needed for sizing of off-line diversion structures (see subsection 2.1.7).

(a) Using WQv (or total volume to be captured), compute CN
(b) Compute time of concentration using TR-55 method
(c) Determine appropriate unit peak discharge from time of concentration
e Qwq from unit peak discharge,
ea, and WQv.

e the minimum surface area of the
n basin, use the following formula:

(d$_f$) / [(k) (hf + df) (tf)]

area of ponding area (ft^2)
WQ$_v$ = water quality volume (or total volume to be captured)
d$_f$ = media depth
k = coefficient of permeability of planting media (ft/day) (use 0.5 ft/day for silt-loam)
h$_f$ = average height of water above bioretention area bed (ft)
t$_f$ = design planting media drain time (days) (2 - 3 days is recommended maximum)

Step 5. Size flow diversion structure, if needed.
A flow regulator (or flow splitter diversion structure) should be supplied to divert the WQv to the bioretention area.

Size low flow orifice, weir, or other device to pass Q$_{wq}$.

Step 6. Determine the Pretreatment Volume.
Pretreat with a grass filter strip (on-line configuration) or grass channel (off-line), and stone diaphragm as needed. Pretreatment may also be desired to reduce flow velocities or assist in sediment removal and maintenance. Pretreatment can include forebay, weir, or check dam. Splash blocks or level spreaders should be considered to dissipate concentrated stormwater runoff at the inlet and prevent scour.

Step 7. Size underdrain system.
See subsection 4.2.5 (Physical Specifications/ Geometry)

Step 8. Design emergency overflow.
An overflow must be provided to bypass and/or convey larger flows to
system or stabilized w
locities need to be en

Step 9. Prepare Veget
A landscaping plan fo
be prepared to indica
with vegetation.

See section 4.2.5.7 (La scaping) and Appendix D for more details.

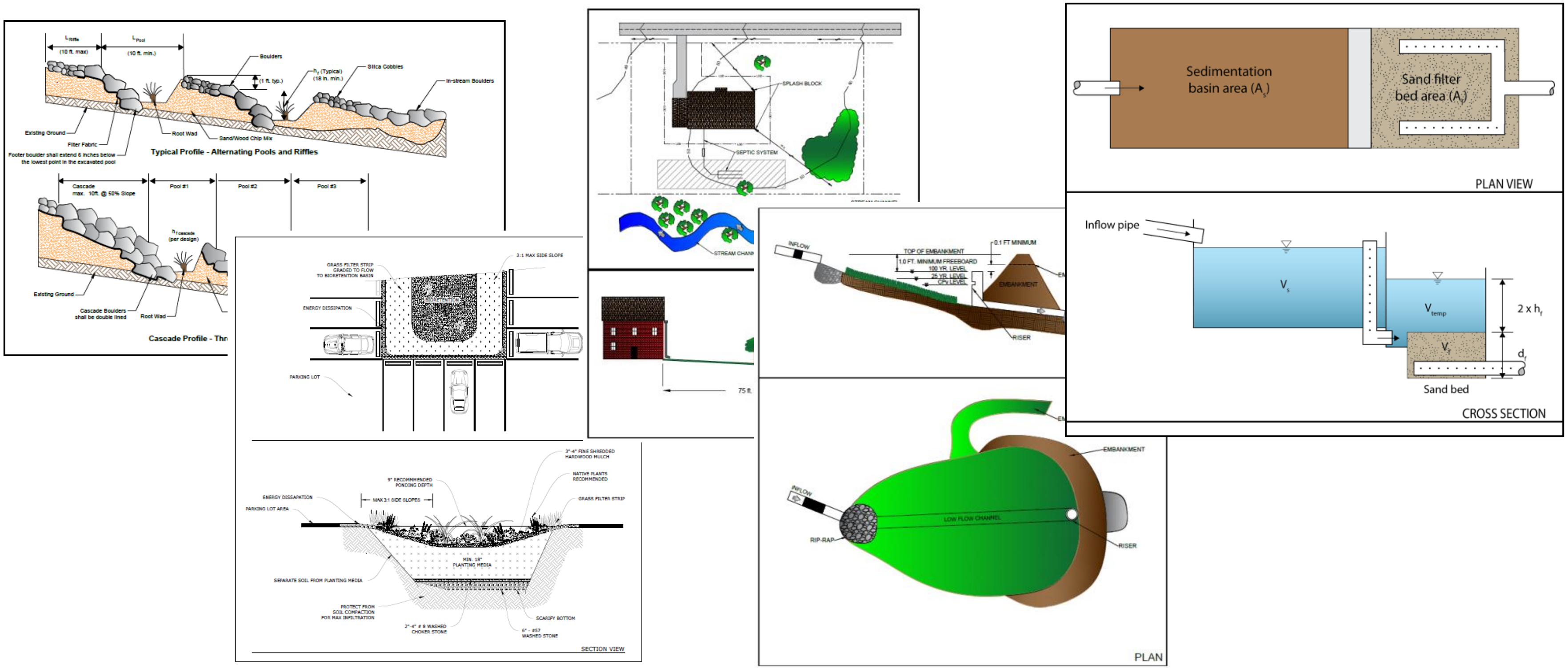
Added new photos of recently built BMPs

Online Biorentention Area

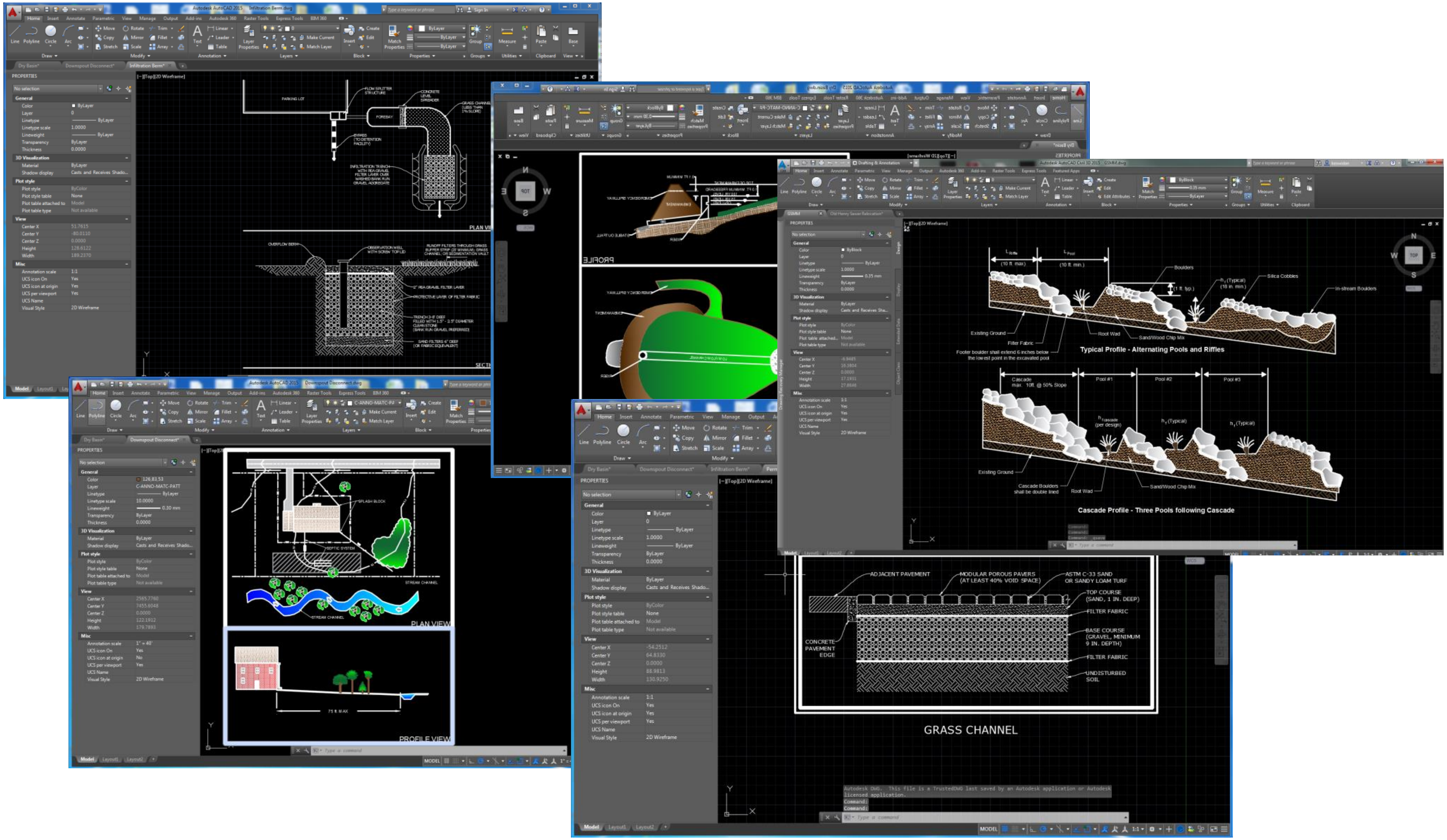
BACK TO TOC

Updated Graphics

Graphics were updated based on new research for BMPs



Digital Design Details



Updates to Appendices

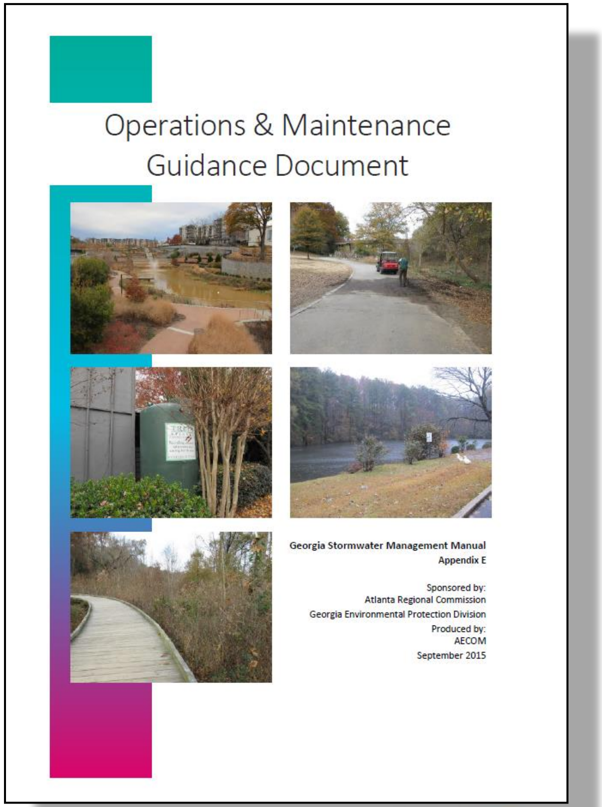
- Removed:
  - Computer Models
  - Georgia Safe Dams Act
  - Miscellaneous Specifications
- Added Reference to:
  - Rainfall Data for Georgia on NOAA Site
  - Soils Information for Georgia

Updates to Appendix D: Planting and Soil Guidance

- Additional information on trees and shrubs
- Updates on site characteristics and soil including soil tests, utilizing on-site soils, and utilizing a manufactured soil media.
- Information and characteristics on plant selection
- Included planting media characteristics
- Requirements for landscape plans
- Additional information on establishing vegetation and maintenance

New Operation and Maintenance Guidance Document

- Reference for inspectors and maintenance workers detailing the following:
  - Key Components of a BMP
  - Importance of Inspecting a BMP
  - Maintenance Agreements
  - General Maintenance
  - Vegetation Maintenance

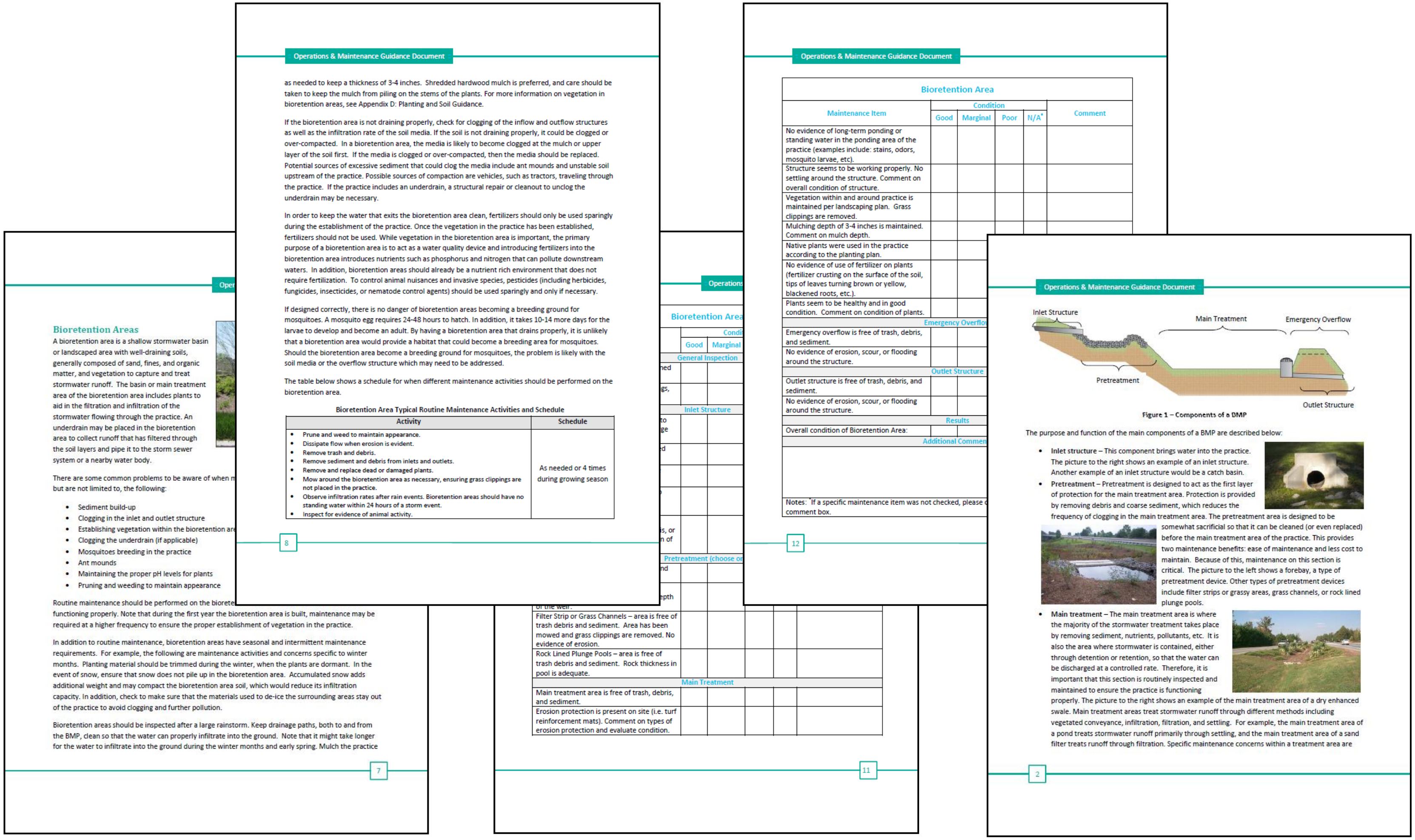


Operations & Maintenance
Guidance Document

Georgia Stormwater Management Manual
Appendix E

Sponsored by:
Atlanta Regional Commission
Georgia Environmental Protection Division
Produced by:
AECOM
September 2015

New Operation and Maintenance Guidance Document



Bioretention Areas

A bioretention area is a shallow stormwater basin or landscaped area with well-draining soils, generally composed of sand, fines, and organic matter, and vegetation to capture and treat stormwater runoff. The basin or main treatment area of the bioretention area includes plants to aid in the filtration and infiltration of the stormwater flowing through the practice. An underdrain may be placed in the bioretention area to collect runoff that has filtered through the soil layers and pipe it to the storm sewer system or a nearby water body.

There are some common problems to be aware of when m
but are not limited to, the following:

- Sediment build-up
- Clogging in the inlet and outlet structure
- Establishing vegetation within the bioretention ar
- Clogging the underdrain (if applicable)
- Mosquitoes breeding in the practice
- Ant mounds
- Maintaining the proper pH levels for plants
- Pruning and weeding to maintain appearance

Routine maintenance should be performed on the biorete
functioning properly. Note that during the first year the bioretention area is built, maintenance may be required at a higher frequency to ensure the proper establishment of vegetation in the practice.

In addition to routine maintenance, bioretention areas have seasonal and intermittent maintenance requirements. For example, the following are maintenance activities and concerns specific to winter months. Planting material should be trimmed during the winter, when the plants are dormant. In the event of snow, ensure that snow does not pile up in the bioretention area. Accumulated snow adds additional weight and may compact the bioretention area soil, which would reduce its infiltration capacity. In addition, check to make sure that the materials used to de-ice the surrounding areas stay out of the practice to avoid clogging and further pollution.

Bioretention areas should be inspected after a large rainstorm. Keep drainage paths, both to and from the BMP, clean so that the water can properly infiltrate into the ground. Note that it might take longer for the water to infiltrate into the ground during the winter months and early spring. Mulch the practice

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as needed to keep a thickness of 3-4 inches. Shredded hardwood mulch is preferred, and care should be taken to keep the mulch from piling on the stems of the plants. For more information on vegetation in bioretention areas, see Appendix D: Planting and Soil Guidance.

If the bioretention area is not draining properly, check for clogging of the inflow and outflow structures as well as the infiltration rate of the soil media. If the soil is not draining properly, it could be clogged or over-compacted. In a bioretention area, the media is likely to become clogged at the mulch or upper layer of the soil first. If the media is clogged or over-compacted, then the media should be replaced. Potential sources of excessive sediment that could clog the media include ant mounds and unstable soil upstream of the practice. Possible sources of compaction are vehicles, such as tractors, traveling through the practice. If the practice includes an underdrain, a structural repair or cleanout to unclog the underdrain may be necessary.

In order to keep the water that exits the bioretention area clean, fertilizers should only be used sparingly during the establishment of the practice. Once the vegetation in the practice has been established, fertilizers should not be used. While vegetation in the bioretention area is important, the primary purpose of a bioretention area is to act as a water quality device and introducing fertilizers into the bioretention area introduces nutrients such as phosphorus and nitrogen that can pollute downstream waters. In addition, bioretention areas should already be a nutrient rich environment that does not require fertilization. To control animal nuisances and invasive species, pesticides (including herbicides, fungicides, insecticides, or nematode control agents) should be used sparingly and only if necessary.

If designed correctly, there is no danger of bioretention areas becoming a breeding ground for mosquitoes. A mosquito egg requires 24-48 hours to hatch. In addition, it takes 10-14 more days for the larvae to develop and become an adult. By having a bioretention area that drains properly, it is unlikely that a bioretention area would provide a habitat that could become a breeding area for mosquitoes. Should the bioretention area become a breeding ground for mosquitoes, the problem is likely with the soil media or the overflow structure which may need to be addressed.

The table below shows a schedule for when different maintenance activities should be performed on the bioretention area.

Bioretention Area Typical Routine Maintenance Activities and Schedule

Activity	Schedule
• Prune and weed to maintain appearance. • Dissipate flow when erosion is evident. • Remove trash and debris. • Remove sediment and debris from inlets and outlets. • Remove and replace dead or damaged plants. • Mow around the bioretention area as necessary, ensuring grass clippings are not placed in the practice. • Observe infiltration rates after rain events. Bioretention areas should have no standing water within 24 hours of a storm event. • Inspect for evidence of animal activity.	As needed or 4 times during growing season

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Bioretention Area

	Condi				
	Good	Marginal			
General Inspection					
ned					
gs,					
Inlet Structure					
to ge					
ed					
is, or n of					
Pretreatment (choose on					
nd					
epth					
Filter Strip or Grass Channels – area is free of trash debris and sediment. Area has been mowed and grass clippings are removed. No evidence of erosion.					
Rock Lined Plunge Pools – area is free of trash debris and sediment. Rock thickness in pool is adequate.					
Main Treatment					
Main treatment area is free of trash, debris, and sediment.					
Erosion protection is present on site (i.e. turf reinforcement mats). Comment on types of erosion protection and evaluate condition.					

Bioretention Area

Maintenance Item	Condition				Comment
	Good	Marginal	Poor	N/A*	
No evidence of long-term ponding or standing water in the ponding area of the practice (examples include: stains, odors, mosquito larvae, etc).					
Structure seems to be working properly. No settling around the structure. Comment on overall condition of structure.					
Vegetation within and around practice is maintained per landscaping plan. Grass clippings are removed.					
Mulching depth of 3-4 inches is maintained. Comment on mulch depth.					
Native plants were used in the practice according to the planting plan.					
No evidence of use of fertilizer on plants (fertilizer crusting on the surface of the soil, tips of leaves turning brown or yellow, blackened roots, etc.).					
Plants seem to be healthy and in good condition. Comment on condition of plants.					
Emergency Overflo					
Emergency overflow is free of trash, debris, and sediment.					
No evidence of erosion, scour, or flooding around the structure.					
Outlet Structure					
Outlet structure is free of trash, debris, and sediment.					
No evidence of erosion, scour, or flooding around the structure.					
Results					
Overall condition of Bioretention Area:					
Additional Commen					
Notes: *If a specific maintenance item was not checked, please c comment box.					

Figure 1 – Components of a BMP

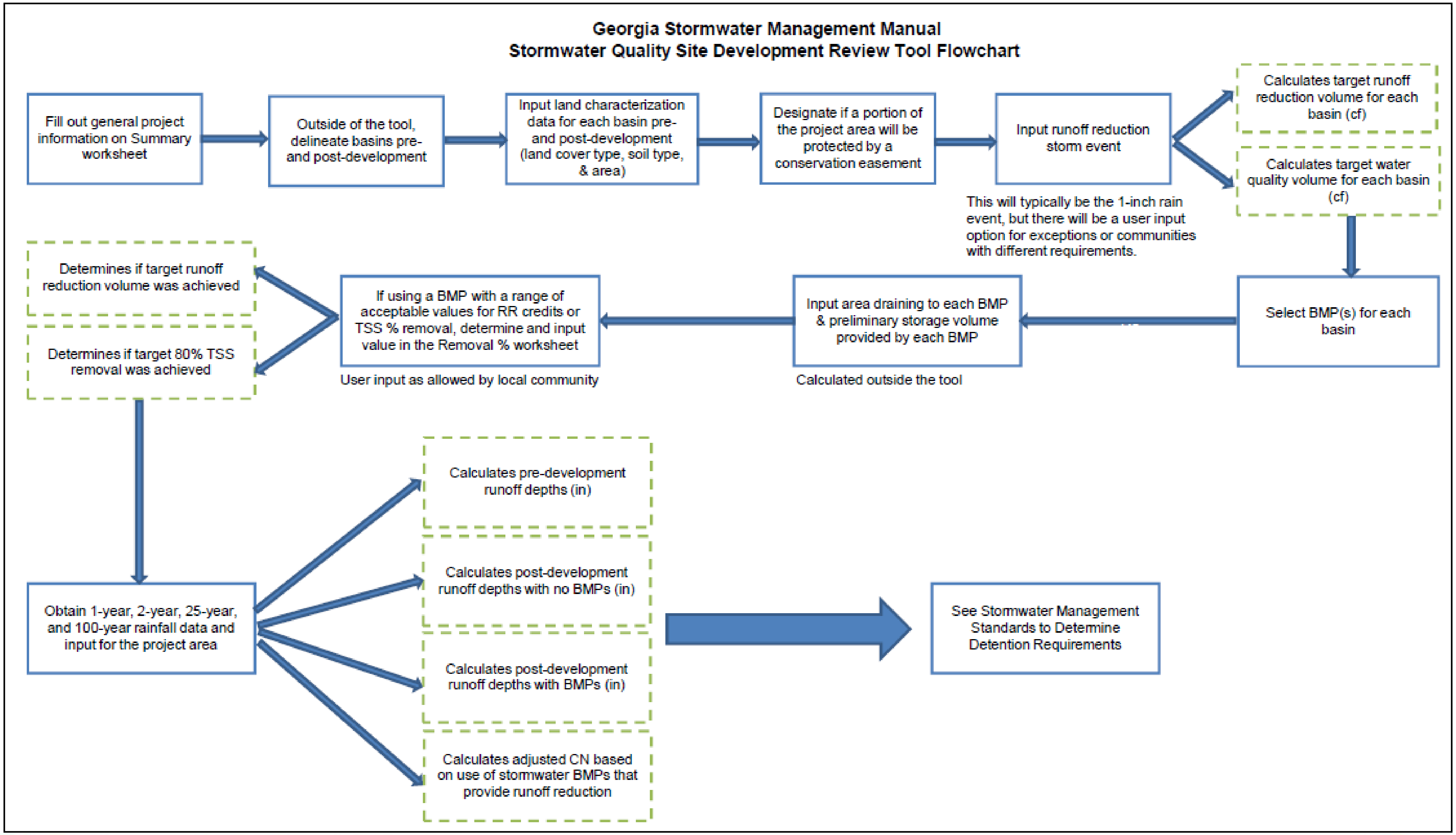
The purpose and function of the main components of a BMP are described below:

- **Inlet structure** – This component brings water into the practice. The picture to the right shows an example of an inlet structure. Another example of an inlet structure would be a catch basin.
- **Pretreatment** – Pretreatment is designed to act as the first layer of protection for the main treatment area. Protection is provided by removing debris and coarse sediment, which reduces the frequency of clogging in the main treatment area. The pretreatment area is designed to be somewhat sacrificial so that it can be cleaned (or even replaced) before the main treatment area of the practice. This provides two maintenance benefits: ease of maintenance and less cost to maintain. Because of this, maintenance on this section is critical. The picture to the left shows a forebay, a type of pretreatment device. Other types of pretreatment devices include filter strips or grassy areas, grass channels, or rock lined plunge pools.
- **Main treatment** – The main treatment area is where the majority of the stormwater treatment takes place by removing sediment, nutrients, pollutants, etc. It is also the area where stormwater is contained, either through detention or retention, so that the water can be discharged at a controlled rate. Therefore, it is important that this section is routinely inspected and maintained to ensure the practice is functioning properly. The picture to the right shows an example of the main treatment area of a dry enhanced swale. Main treatment areas treat stormwater runoff through different methods including vegetated conveyance, infiltration, filtration, and settling. For example, the main treatment area of a pond treats stormwater runoff primarily through settling, and the main treatment area of a sand filter treats runoff through filtration. Specific maintenance concerns within a treatment area are

BMP Maintenance and Inspection Checklists

- Each BMP includes:
  - A description of how the BMP functions
  - A typical photo
  - Common maintenance issues
  - Key maintenance items
  - Typical routine maintenance activities and schedule
  - Inspection checklists

Updated BMP Calculator Tool



Georgia Stormwater Management Manual
Stormwater Quality Site Development Review Tool Flowchart

Fill out general project information on Summary worksheet

Outside of the tool, delineate basins pre- and post-development

Input land characterization data for each basin pre- and post-development (land cover type, soil type, & area)

Designate if a portion of the project area will be protected by a conservation easement

Input runoff reduction storm event

This will typically be the 1-inch rain event, but there will be a user input option for exceptions or communities with different requirements.

Calculates target runoff reduction volume for each basin (cf)

Calculates target water quality volume for each basin (cf)

Select BMP(s) for each basin

Input area draining to each BMP & preliminary storage volume provided by each BMP

Calculated outside the tool

If using a BMP with a range of acceptable values for RR credits or TSS % removal, determine and input value in the Removal % worksheet

User input as allowed by local community

Determines if target runoff reduction volume was achieved

Determines if target 80% TSS removal was achieved

Obtain 1-year, 2-year, 25-year, and 100-year rainfall data and input for the project area

Calculates pre-development runoff depths (in)

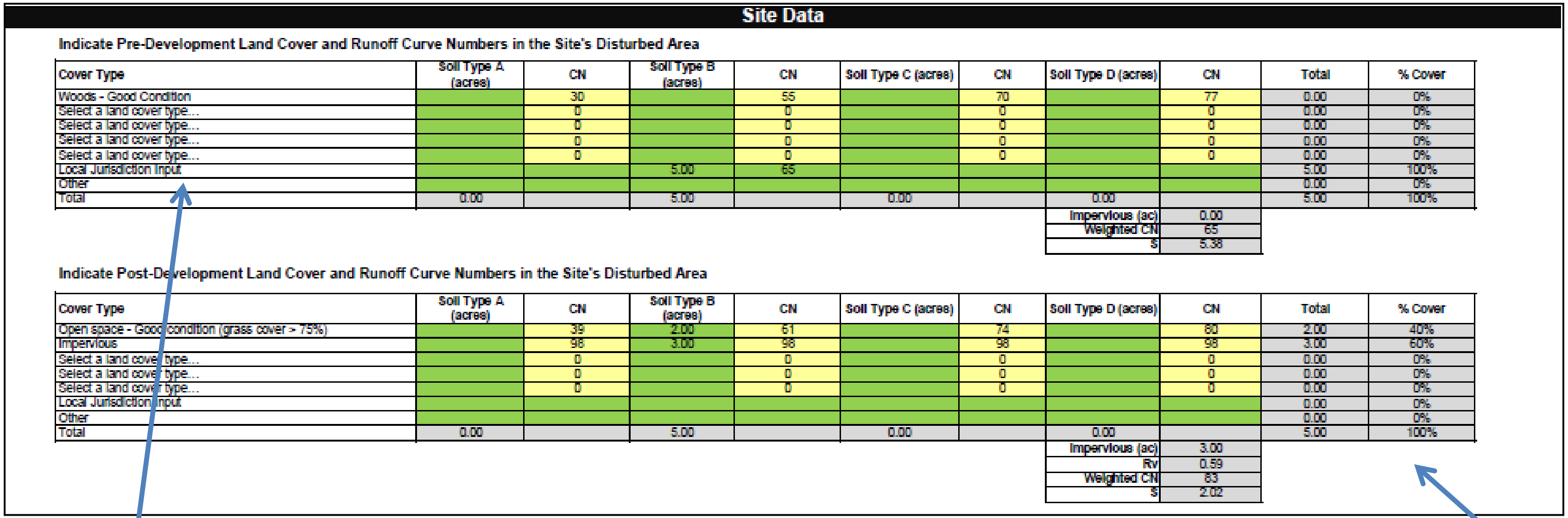
Calculates post-development runoff depths with no BMPs (in)

Calculates post-development runoff depths with BMPs (in)

Calculates adjusted CN based on use of stormwater BMPs that provide runoff reduction

See Stormwater Management Standards to Determine Detention Requirements

Updated BMP Calculator Tool



Site Data

Indicate Pre-Development Land Cover and Runoff Curve Numbers in the Site's Disturbed Area

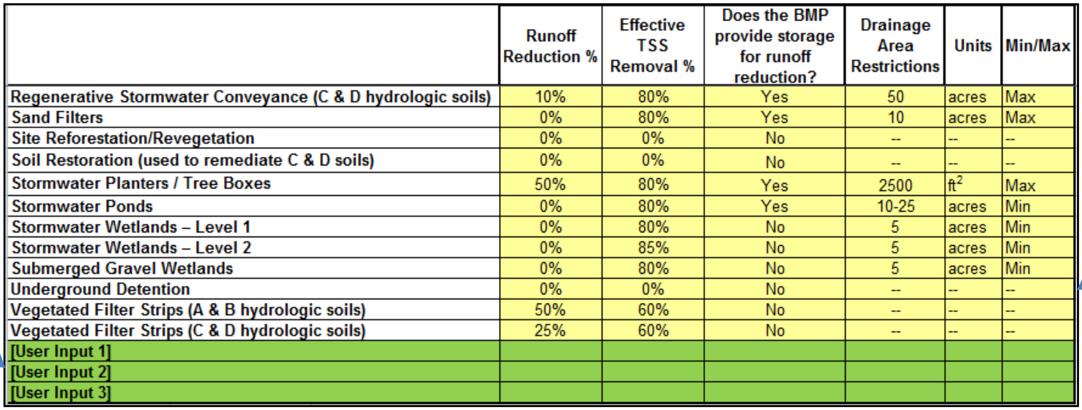
Cover Type	Soil Type A (acres)	CN	Soil Type B (acres)	CN	Soil Type C (acres)	CN	Soil Type D (acres)	CN	Total	% Cover
Woods - Good Condition		30		55		70		77	0.00	0%
Select a land cover type...		0		0		0		0	0.00	0%
Select a land cover type...		0		0		0		0	0.00	0%
Select a land cover type...		0		0		0		0	0.00	0%
Select a land cover type...		0		0		0		0	0.00	0%
Local Jurisdiction Input			5.00	65					5.00	100%
Other									0.00	0%
Total	0.00		5.00		0.00		0.00		5.00	100%

Impervious (ac)	0.00
Weighted CN	65
S	5.38

Indicate Post-Development Land Cover and Runoff Curve Numbers in the Site's Disturbed Area

Cover Type	Soil Type A (acres)	CN	Soil Type B (acres)	CN	Soil Type C (acres)	CN	Soil Type D (acres)	CN	Total	% Cover
Open space - Good condition (grass cover > 75%)		39	2.00	61		74		80	2.00	40%
Impervious		98	3.00	98		98		98	3.00	60%
Select a land cover type...		0		0		0		0	0.00	0%
Select a land cover type...		0		0		0		0	0.00	0%
Select a land cover type...		0		0		0		0	0.00	0%
Local Jurisdiction Input									0.00	0%
Other									0.00	0%
Total	0.00		5.00		0.00		0.00		5.00	100%

Impervious (ac)	3.00
Rv	0.59
Weighted CN	83
S	2.02

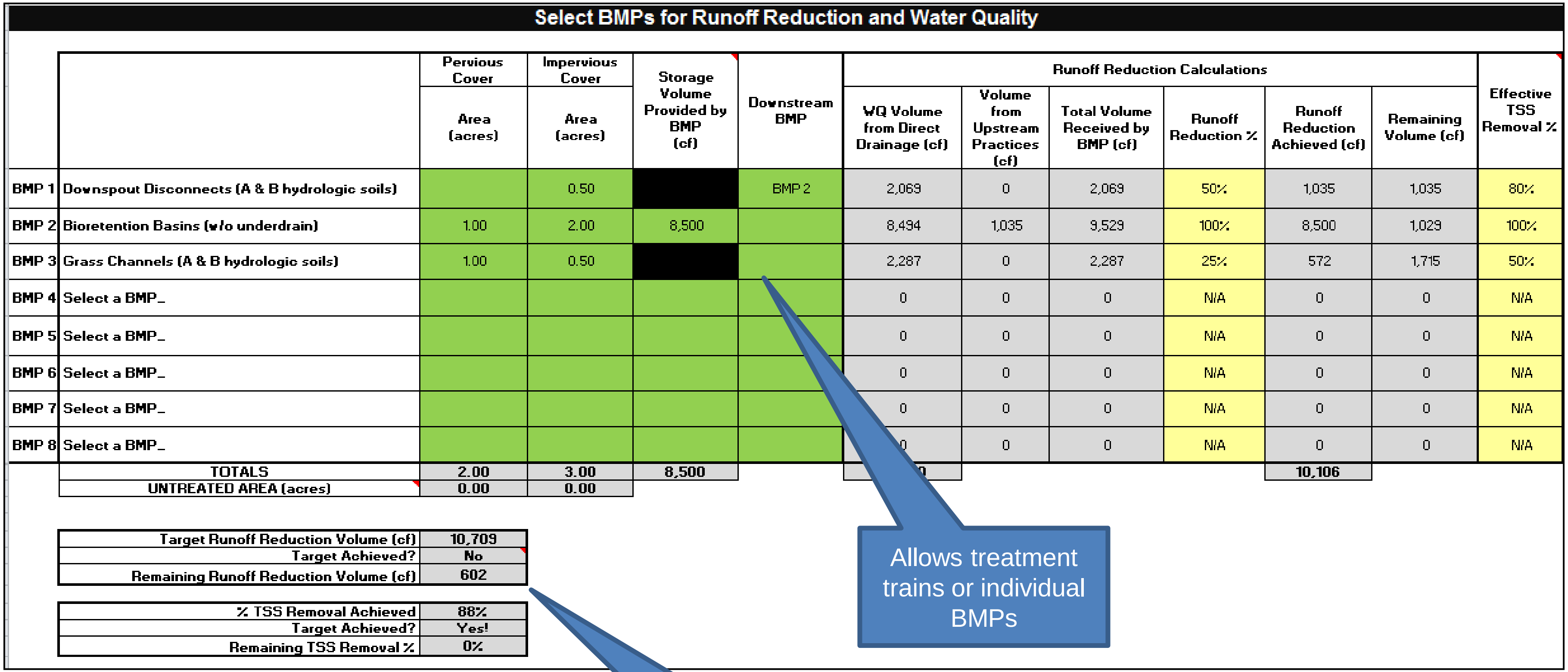


	Runoff Reduction %	Effective TSS Removal %	Does the BMP provide storage for runoff reduction?	Drainage Area Restrictions	Units	Min/Max
Regenerative Stormwater Conveyance (C & D hydrologic soils)	10%	80%	Yes	50	acres	Max
Sand Filters	0%	80%	Yes	10	acres	Max
Site Reforestation/Revegetation	0%	0%	No	--	--	--
Soil Restoration (used to remediate C & D soils)	0%	0%	No	--	--	--
Stormwater Planters / Tree Boxes	50%	80%	Yes	2500	ft^2	Max
Stormwater Ponds	0%	80%	Yes	10-25	acres	Min
Stormwater Wetlands – Level 1	0%	80%	No	5	acres	Min
Stormwater Wetlands – Level 2	0%	85%	No	5	acres	Min
Submerged Gravel Wetlands	0%	80%	No	5	acres	Min
Underground Detention	0%	0%	No	--	--	--
Vegetated Filter Strips (A & B hydrologic soils)	50%	60%	No	--	--	--
Vegetated Filter Strips (C & D hydrologic soils)	25%	60%	No	--	--	--
[User Input 1]						
[User Input 2]						
[User Input 3]						

Allows flexibility for local requirements

New look and feel

Updated BMP Calculator Tool



Select BMPs for Runoff Reduction and Water Quality

		Pervious Cover	Impervious Cover	Storage Volume Provided by BMP (cf)	Downstream BMP	Runoff Reduction Calculations						Effective TSS Removal %
		Area (acres)	Area (acres)			WQ Volume from Direct Drainage (cf)	Volume from Upstream Practices (cf)	Total Volume Received by BMP (cf)	Runoff Reduction %	Runoff Reduction Achieved (cf)	Remaining Volume (cf)	
BMP 1	Downspout Disconnects (A & B hydrologic soils)		0.50		BMP 2	2,069	0	2,069	50%	1,035	1,035	80%
BMP 2	Bioretention Basins (w/o underdrain)	1.00	2.00	8,500		8,494	1,035	9,529	100%	8,500	1,029	100%
BMP 3	Grass Channels (A & B hydrologic soils)	1.00	0.50			2,287	0	2,287	25%	572	1,715	50%
BMP 4	Select a BMP_					0	0	0	N/A	0	0	N/A
BMP 5	Select a BMP_					0	0	0	N/A	0	0	N/A
BMP 6	Select a BMP_					0	0	0	N/A	0	0	N/A
BMP 7	Select a BMP_					0	0	0	N/A	0	0	N/A
BMP 8	Select a BMP_					0	0	0	N/A	0	0	N/A
	TOTALS	2.00	3.00	8,500		0				10,106		
	UNTREATED AREA (acres)	0.00	0.00									

Target Runoff Reduction Volume (cf)	10,709
Target Achieved?	No
Remaining Runoff Reduction Volume (cf)	602

% TSS Removal Achieved	88%
Target Achieved?	Yes!
Remaining TSS Removal %	0%

Allows treatment trains or individual BMPs

Automatically calculates runoff reduction and TSS removal achieved

QUESTIONS?

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