

IMPLEMENTING STORMWATER MANAGEMENT REQUIREMENTS FOR DEVELOPMENT

4.1 Overview



Description: Requirements and standards for controlling runoff from development are critical to addressing water quantity and quality impacts of post-construction urban stormwater. In addition, they are a required component of NPDES municipal stormwater programs.

The unified stormwater sizing criteria represent comprehensive rules for various storm events in Georgia.

KEY CONSIDERATIONS

The key concepts for addressing the effects of development on stormwater include:

- Natural Resources Inventory
- Stormwater Better Site Design
- Stormwater Credits for Natural Area Conservation
- Unified Stormwater Sizing Criteria
- Runoff Reduction Practices
- Guidance on Structural Stormwater Controls
- Downstream Assessments
- Stormwater Management Site Plans

Adoption of a comprehensive and integrated set of stormwater management requirements for new development and redevelopment projects is one of the key components of a comprehensive local stormwater management program. Performance requirements and standards for controlling runoff from development are critical to addressing both the water quantity and quality impacts of post-construction urban stormwater and are a required component of NPDES municipal stormwater programs.

Stormwater management standards must also be supported by a set of design and management tools and an integrated design approach for implementing both structural and nonstructural stormwater controls. The following elements of a local toolbox for addressing development activities are described in this chapter:

- Natural Resources Inventory - Prior to the start of any land disturbing activities (including any clearing and grading activities), acceptable site reconnaissance and surveying techniques should be used to complete a thorough assessment of the natural resources, both terrestrial and aquatic, found on a development site.
- Stormwater Better Site Design - The first step in addressing stormwater management begins with the site planning and design process. The goal of better site design is to reduce the amount of runoff and pollutants that are generated from a development site and provide for some nonstructural on-site treatment and control of runoff by implementing a combination of approaches collectively known as *stormwater better site design practices*. These include maximizing the protection of natural features and resources, developing a site design which minimizes impact, reducing overall site imperviousness, and utilizing natural systems for stormwater management.
- Stormwater Credits for Natural Area Conservation - One better site design practice, Conservation of Natural Areas, includes an additional stormwater credit. If a natural area is conserved (with a conservation easement or other similar mechanism), the runoff reduction volume and/or water quality volume will be reduced. This credit is intended to provide developers and site designers an incentive to conserve natural areas that can reduce the volume of stormwater runoff and minimize the pollutant loads from a site. The credit directly translates into cost savings to the developer by reducing the size of structural stormwater control and conveyance facilities.
- Unified Stormwater Sizing Criteria - An integrated set of design criteria for stormwater quality and quantity management which addresses the entire range of hydrologic events. These criteria allow the site engineer to calculate the stormwater control volumes required for water quality, downstream channel protection, and overbank and extreme flood protection.
- Runoff Reduction Practices - Runoff reduction practices are stormwater management practices that are used to disconnect impervious and disturbed pervious surfaces from the storm drain system and reduce post-construction stormwater runoff rates, volumes and pollutant loads. Since runoff reduction practices actually eliminate stormwater runoff (and the pollutants associated with it), rather than simply treating or detaining runoff, they can contribute to all of the Unified Stormwater Sizing Criteria, while providing many additional benefits as well.
- Guidance on Structural Stormwater Controls - When runoff reduction practices are insufficient, this Manual recommends a set of structural stormwater controls that can be used to meet stormwater management water quantity and quality goals.
- Downstream Assessments - Peak flow downstream assessments can be required to ensure that a proposed development is not adversely impacting downstream properties after the stormwater management requirements have been addressed. These assessments can also potentially be used to waive the need for detention for overbank and extreme flood control.
- Stormwater Management Site Plans - Communities should require the preparation of a *stormwater management site plan* for development activities. A stormwater site plan is a comprehensive report that contains the technical information and analysis to allow a local review authority to determine whether a proposed new development or redevelopment project meets the local stormwater

regulatory requirements.

Figure 4.1-1 illustrates how these design tools would be used in the development process to address the local stormwater management requirements.

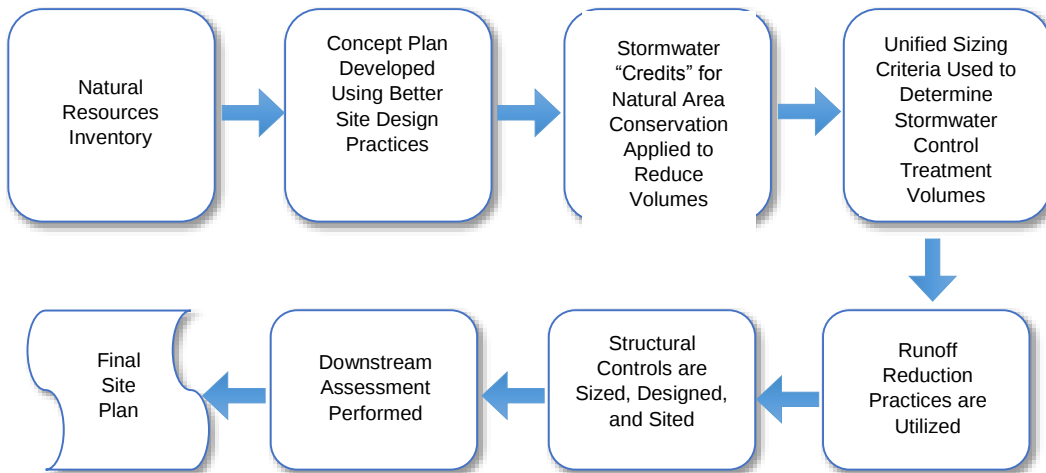


Figure 4.1-1 Typical Stormwater Management System Design Process

Better Site Design, Runoff Reduction, and the Unified Stormwater Sizing Criteria.

The Unified Stormwater Sizing Criteria, which are incorporated into the Standards for Development described in [Section 4.2](#) represent comprehensive rules for various storm events in Georgia. Rules regarding the quality of runoff are applied to small storm events (1.2"), while rules regarding the quantity and rate of runoff are applied to larger storm events (specifically, the 1-year, 25-year, and 100-year return intervals).

Some stormwater practices are best suited to address runoff quality, while others are best suited to address runoff quantity. However, better site design and runoff reduction practices address both simultaneously. As discussed in Chapter 3, by reducing the impervious cover associated with a development, better site design techniques reduce the amount of runoff being generated by a development in the first place. Runoff reduction practices, on the other hand eliminate some of the runoff after it is generated. Instead of treating the runoff like a typical water quality practice, or detaining it like a typical water quality practice, they remove it – removing the pollutants along with it. Runoff reduction practices remove the runoff through a variety of processes. Infiltration (sending runoff into the ground) may be the most common means, but it is not the only one. Runoff reduction can also be achieved through evaporation, transpiration, or rainwater harvesting and reuse. Through these processes, runoff reduction practices both improve water quality, and reduce the water quantity that must be managed for larger storm events.

Taken together, better site design and runoff reduction practices provide many other benefits as well:

- **Maintain Pre-Development Site Hydrology:** By reducing stormwater runoff volume and rates, post-development site hydrology is kept closer to pre-development site hydrology (the site operates much more like a natural system).
- **Reduced Combined Sewer Overflow Events:** Better site design and runoff reduction practices help reduce the magnitude and frequency of combined sewer overflow events.
- **Urban Heat Island Mitigation:** The trees, shrubs and other vegetation associated with better site design and runoff reduction practices create shade, reflect solar radiation and emit water vapor, all of which create cooler temperatures in urban environments and help mitigate the impacts of urban heat islands.
- **Reduced Energy Demand:** Trees, shrubs and other vegetation help lower ambient air temperatures and, when incorporated on and around buildings, help insulate buildings from temperature swings, decreasing the amount of energy used for heating and cooling.

U.S. Environmental Protection Agency (US EPA). 2008. "Environmental Benefits of Green Infrastructure." *Managing Wet Weather with Green Infrastructure*.
<http://cfpub.epa.gov/npdes/greeninfrastructure/information.cfm#enviroben>. Accessed: June 27, 2008.

4.2 Standards for Development



Description: A comprehensive set of performance standards for stormwater management for development and redevelopment activities should be incorporated into a community's development requirements.

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

4.2.1 Introduction

This section presents a comprehensive set of performance standards for stormwater management for development and redevelopment activities. These standards provide Georgia communities with an integrated approach to address both the water quality and quantity problems associated with stormwater runoff due to urban development. When adopted by Georgia communities, these standards will help maintain the quality and quantity of their community waters. They are designed to assist local governments in complying with regulatory and programmatic requirements for various state and Federal programs including the National Pollutant Discharge Elimination System (NPDES) Municipal Separate Storm Sewer System (MS4) permit program and the National Flood Insurance Program under FEMA.

These standards should be incorporated into a community's development requirements and supported by the plan review process, as well as inspection, tracking, and maintenance procedures. Where appropriate, they may be modified to meet local or watershed-specific stormwater management goals and objectives.

The goal of stormwater management requirements for areas of new development and redevelopment is to reduce the negative impacts of post-construction stormwater runoff on the watershed, i.e. deteriorating water quality, reduced base flows, stream entrenchment, stream bank instability and erosion, etc. This can be achieved by (1) maximizing the use of site design and nonstructural methods to reduce impervious cover and the generation of runoff and pollutants; (2) managing and treating stormwater runoff through the use of structural stormwater controls; and (3) implementing pollution prevention practices to limit potential stormwater contaminants. The stormwater management standards presented here incorporate these concepts and cover the entire cycle of development from site planning through long-term maintenance of stormwater management facilities.

4.2.2 Applicability

It is recommended that the stormwater management standards listed below be required for any new development and redevelopment site that meets one or more of the following criteria:

- (1) New development that includes the creation or addition of 5,000 square feet or greater of new impervious surface area, or that involves land disturbing activity of 1 acre of land or greater.
- (2) Redevelopment that includes the creation or addition of 5,000 square feet or greater of new impervious surface area, or that involves land disturbing activity of 1 acre or more.
- (3) Any commercial or industrial new development or redevelopment, regardless of size, with a Standard Industrial Classification (SIC) code that falls under the NPDES Industrial Stormwater Permit program, or a hotspot land use as defined below.

Since runoff from smaller developments can cause water quality and quantity impacts as well, an individual community may choose to adopt more stringent area criteria, especially if it determines that a significant amount of development in the community falls below these thresholds. In addition, a community may choose to apply the stormwater management standards on a case-by-case basis to smaller developments if it determines that due to the type or location of the development site or other circumstances, the quantity, quality, and/or rate of stormwater runoff coming from the site will cause significant impacts to the receiving waters.

Definitions

New development is defined as land disturbing activities, structural development (construction, installation or expansion of a building or other structure), and/or creation of impervious surfaces on a previously undeveloped site.

Redevelopment is defined as structural development (construction, installation or expansion of a building or other structure), creation or addition of impervious surfaces, replacement of impervious surface not part of routine maintenance, and land disturbing activities associated with structural or impervious

development on a previously developed site. Redevelopment does not include such activities as exterior remodeling.

A *hotspot* is defined as a land use or activity on a site that produces higher concentrations of trace metals, hydrocarbons or other priority pollutants than are normally found in urban stormwater runoff. Examples of hotspots include gas stations, vehicle service and maintenance areas, industrial facilities, such as salvage yards (both permitted under the Industrial General Permit and others), material storage sites, garbage transfer facilities, and commercial parking lots with high-intensity use.

Exemptions

The following development activities are suggested to be exempted from the stormwater management standards:

- (1) Individual single family residential lots. (Single family lots that are part of a subdivision or phased development project should not be exempt from the standards); and
- (2) Additions or modifications to existing single-family structures.
- (3) Duplex residential units that do not meet the criteria listed above.

As noted above, since runoff from smaller developments can cause water quality and quantity impacts as well, an individual community may choose not to exempt single family residential lots or structures from the stormwater management standards. The City of Atlanta, for example, currently requires that stormwater management measures be utilized for any new home or addition that is greater than 1,000 square feet of impervious surface. See the Case Study in Section 4.5.4.

Additional Requirements

New development or redevelopment in critical or sensitive areas, or as identified through a watershed study or plan, may be subject to additional performance and/or regulatory criteria. Furthermore, these sites may need to utilize or restrict certain structural controls in order to protect a special resource or address certain water quality or drainage problems identified for a drainage area.

4.2.3 Stormwater Management Standards

It is recommended that the following stormwater management performance standards be adopted for new development or redevelopment sites falling under the applicability criteria above. It is recommended that these eleven (11) standards be adopted in whole to create a comprehensive stormwater management approach, however, an individual community may choose to adopt some of the standards rather than the entire set, or modify individual standards, depending upon its regulatory requirements and specific local approach to stormwater management.

□ Standard #1 – Natural Resource Inventory

Prior to the start of any land disturbing activities (including any clearing and grading activities), acceptable site reconnaissance and surveying techniques shall be used to complete a thorough assessment of the natural resources, both terrestrial and aquatic, found on a development site.

The site's critical natural features and drainage patterns shall be identified early in the site planning process. The natural resources inventory shall be used to identify and map the natural resources on site, as they exist prior to the start of any land disturbing activities. The identification, and subsequent preservation and/or restoration of these natural resources, through the use of better site design practices, helps reduce the negative impacts of the land development process "by design."

Resources to be identified and mapped during the natural resources inventory, include, at a minimum, as applicable:

- Topography and Steep Slopes
- Natural Drainage Divides and Patterns
- Natural Drainage Features (e.g., Swales, Basins, Depressional Areas)
- Wetlands
- Water Bodies
- Floodplains
- Aquatic Buffers
- Shellfish Harvesting Areas
- Soils
- Erodible Soils
- Steep Slopes (i.e., Areas with Slopes Greater Than 15%)
- Groundwater Recharge Areas
- Wellhead Protection Areas
- Trees and Other Existing Vegetation
- High Quality Habitat Areas
- Protected River Corridors
- Protected Mountains
- Karst Areas

All relevant resources shall be shown on the Standard #11 Stormwater Site Plan.

□ **Standard #2 –Better Site Design Practices for Stormwater Management**

All site designs shall implement a combination of approaches collectively known as *stormwater better site design practices* to the maximum extent practicable. Through the use of these practices and techniques, the impacts of urbanization on the natural hydrology of the site and water quality can be significantly reduced. The goal is to reduce the amount of stormwater runoff and pollutants that are generated, provide for natural on-site control and treatment of runoff, and optimize the location of stormwater management facilities. Better site design concepts can be viewed as both water quantity and water quality management tools and can reduce the size and cost of required BMPs.

Site designs shall preserve the natural drainage and treatment systems and reduce the generation of additional stormwater runoff and pollutants to the maximum extent practicable. More information on Better Site Design is provided in [Chapter 3](#).

The use of certain better site design practices that provide water quality benefits allows for a reduction (known as a “credit”) of the water quality volume. The applicable design practices and stormwater site design credits are covered in [Volume 2, Section 2.2.4](#).

□ **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%. Averaged from rainfall events across the state of Georgia, this equates to treating storm events of 1.2 inches or less, as well as the first 1.2 inches of runoff for all larger storm events. This water quality standard can be met using one of two options. A community's desire or need to require the use of runoff reduction best management practices (BMPs) will determine which option is most appropriate.

Only one of the two options should be adopted by an individual community. Option A requires the use of runoff reduction practices to the maximum extent practicable to meet the water quality standard. Option B allows the use of runoff reduction practices to help achieve the water quality standard, but does not require their use. While runoff reduction practices provide important water

quality benefits, as described in Chapter 2, certain conditions, such as karst topography, soils with very low infiltration rates, high groundwater, or shallow bedrock, may lead a community to choose the more flexible Option B instead of Option A. These conditions can also be addressed on a site-specific basis if Option A is selected.

Case Study: City of Atlanta's Runoff Reduction Requirement

In February 2013, the City of Atlanta amended its Post-Development Stormwater Management Ordinance to require green infrastructure on new and redevelopment projects in the City. One of the most significant revisions to the ordinance was a volume-based runoff reduction requirement. Commercial and single family residential developments must capture the first 1.0" of runoff and reduce this volume onsite using infiltration, evapotranspiration, or harvesting the rainwater and reusing it in irrigation or indoor plumbing systems. This new standard replaces the previous water quality requirement of capturing and removing 80% of the total suspended solids from the first 1.2" of runoff on commercial sites.

In order to implement the Runoff Reduction standard, the City adopted the Coastal Stormwater Supplement (CSS) of the Georgia Stormwater Management Manual (Blue Book). The CSS (2009) includes these runoff reduction practices BMPs and provides design parameters and a specified credit system for implementation. Because these practices both clean and reduce the volume of runoff, quantifiable credit is given to satisfy both runoff reduction and attenuation requirements, reducing the size of detention ponds or underground vaults.

Source: Rayburn, Rutherford, *Implementing Green Infrastructure: Atlanta's Post-Development Stormwater Ordinance*, City of Atlanta Department of Watershed Management, 2013.

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 are stormwater BMPs used to disconnect impervious and disturbed pervious surfaces from the storm drain system and reduce post-construction stormwater runoff rates, volumes, and pollutant loads. Since runoff reduction practices actually eliminate stormwater runoff (and the pollutants associated with it), rather than simply treating or detaining runoff, they can contribute to several of the other performance standards, while providing many additional benefits as well.

Runoff reduction percentages are assigned to applicable BMPs that reduce the amount of stormwater required for treatment, and subsequently reduce the other stormwater management volumes, incentivizing their use. 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). This standard is quantified and expressed in terms of engineering design criteria through the specification of the runoff reduction volume (RR_v), which is equal to the runoff generated on a site from 1.0 inches of rainfall. Individual runoff reductions specific to each practice are described in detail in [Volume 2, Section 4.1](#).

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. 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. The WQ_v must be treated to the 80% TSS removal performance goal.

This standard assumes that BMPs will be designed, constructed and maintained according to the criteria in this Manual. Stormwater discharges from land uses or activities with higher or special potential pollutant loadings may require the use of specific structural practices and pollution prevention practices. A detailed overview of BMPs is provided in [Volume 2, Section 4.1](#).

OR

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 can be achieved through the use of BMPs that provide runoff reduction or BMPs that provide treatment

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. The WQ_v must be treated to the 80% TSS removal performance goal.

This standard assumes that BMPs will be designed, constructed and maintained according to the criteria in this Manual. Stormwater discharges from land uses or activities with higher or special potential pollutant loadings may require the use of specific structural practices and pollution prevention practices. A detailed overview of BMPs is provided in [Volume 2, Section 4.1](#).

□ Standard #4 – Stream Channel Protection

Stream channel protection shall be provided by using all of the following three approaches: (1) 24-hour extended detention storage of the 1-year, 24-hour return frequency storm event; (2) erosion prevention measures such as energy dissipation and velocity control; and (3) preservation of the applicable stream buffer. Stream channel protection requirements are further described in [Section 4.3](#) and [Volume 2, Section 2.2.4](#).

The first method of providing stream bank protection is the extended detention of the 1-year, 24-hour storm for a period of 24 hours using BMPs. It is known that the increase in runoff due to development can dramatically increase stream channel erosion. This standard is intended to reduce the frequency, magnitude and duration of post-development bankfull flow conditions. The volume to be detained is also known as the channel protection volume (Cp_v). The use of nonstructural site design practices and runoff reduction BMPs that reduce the total amount of runoff may also reduce Cp_v by a proportional amount.

This requirement may be waived by a local jurisdiction for sites that discharge directly or through piped stormwater drainage systems into larger streams, rivers, wetlands, lakes, estuaries, tidal waters, or other situations where the reduction in the smaller flows will not have an impact on stream bank or channel integrity.

The second stream bank protection method is to implement velocity control, energy dissipation, stream bank stabilization, and erosion prevention practices and structures as necessary in the stormwater management system to prevent downstream erosion and stream bank damage. Energy dissipation and velocity control methods are discussed in [Volume 2, Section 5.5](#).

The third method of providing for stream channel protection is through the establishment of riparian stream buffers on the development site. Stream buffers not only provide channel protection but also water quality benefits and protection of streamside properties from flooding. It is recommended that 100-foot buffers be established where feasible. Additional stream buffer guidelines are presented in [Volume 2, Section 2.3](#).

□ Standard #5 – Overbank Flood Protection

Overbank flood protection shall be provided by controlling the post-development peak discharge rate

to the predevelopment rate for the 25-year, 24-hour return frequency storm event. If control of the 1-year, 24-hour storm (Standard #4) is exempted, then overbank flood protection shall be provided by controlling the post-development peak discharge rate to the predevelopment rate for the 2-year through the 25-year return frequency storm events. Overbank flood protection requirements are further described in [Section 4.3 and Volume 2, Section 2.2.4](#).

The use of nonstructural site design practices and runoff reduction BMPs that reduce the total amount of runoff will also reduce Q_{p25} by a proportional amount.

Smaller storm events (e.g., 2-year and 10-year) are effectively controlled through the combination of the extended detention for the 1-year, 24-hour event (channel protection criterion) and the control of the 25-year peak rate for overbank flood protection. These design standards, therefore, are intended to be used in unison.

This standard may be adjusted by a local jurisdiction for areas where all downstream conveyances and receiving waters have the natural capacity to handle the full build-out 25-year storm through a combination of channel capacity and overbank flood storage without causing flood damage.

□ **Standard #6 – Extreme Flood Protection**

Extreme flood protection shall be provided by controlling and/or safely conveying the 100-year, 24-hour storm event (denoted Q_T). This is accomplished either by (1) controlling Q_T through BMPs to maintain the existing 100-year floodplain, or (2) by sizing the on-site conveyance system to safely pass Q_T and allowing it to discharge into a receiving water whose protected floodplain is sufficiently sized to account for extreme flow increases without causing damage. In this case, the extreme flood protection criterion may be waived by a local jurisdiction in lieu of provision of safe and effective conveyance to receiving waters that have the capacity to handle flow increases at the 100-year level.

The use of nonstructural site design practices and runoff reduction BMPs that reduce the total amount of runoff will also reduce Q_T by a proportional amount.

Existing and future floodplain areas shall be preserved as possible. Extreme flood protection requirements are further described in [Section 4.3 and Volume 2, Section 2.2.4](#).

□ **Standard #7 – Downstream Analysis**

Due to peak flow timing and runoff volume effects, some structural practices fail to reduce discharge peaks to predevelopment levels downstream from the development site. A downstream peak flow analysis shall be provided to the point in the watershed downstream of the site or the stormwater management system where the area of the site comprises 10% of the total drainage area. This is to help ensure that there are minimal downstream impacts from the developed site. The downstream analysis may result in the need to resize BMPs, or may allow the waiving of some unnecessary peak flow controls altogether. The use of a downstream analysis and the “ten-percent” rule are discussed in [Volume 2, Section 3.1](#).

□ **Standard #8 – Construction Erosion and Sedimentation Control**

Erosion and sedimentation control practices shall be utilized during the construction phase or during any land disturbing activities.

All new development and redevelopment sites must meet the regulatory requirements for land disturbance activities under the Georgia Erosion and Sedimentation Control Act and/or the NPDES General Permit for Construction Activities. This involves the preparation and implementation of an approved erosion and sedimentation control plan, including appropriate best management practices, during the construction phase of development. Further guidance on practices for construction site erosion and sedimentation control can be found in the latest version of the *Manual for Erosion and Sediment Control in Georgia*.

Better site design practices and techniques that can reduce the total amount of area that needs to be cleared and graded should be implemented wherever possible. It is essential that erosion and sedimentation control be considered and implemented in stormwater concept plans and throughout the construction phase to prevent damage to natural stormwater drainage systems and previously constructed best management practices and conveyance facilities.

❑ **Standard #9 – Stormwater Management System Operation and Maintenance**

The stormwater management system, including all best management practices and conveyances, shall have an operation and maintenance plan to ensure that it continues to function as designed. See [Volume 1, Section 5.2](#) for more information on stormwater operation and maintenance.

If new development and redevelopment sites are to prepare a comprehensive operation and maintenance plan for the on-site stormwater management system. This is to include all of the stormwater management system components, including drainage facilities, BMPs, and conveyance systems. To ensure that stormwater management systems function as they were designed and constructed, the operation and maintenance plan must provide: (1) a clear assignment of stormwater inspection and maintenance responsibilities; (2) the routine and non-routine maintenance tasks to be undertaken; (3) a schedule for inspection and maintenance; and (4) any necessary legally binding maintenance agreements.

❑ **Standard #10 – Pollution Prevention**

To the maximum extent practicable, the development project shall implement pollutant prevention practices and have a stormwater pollution prevention plan.

All new development and redevelopment sites are to consider pollution prevention in the design and operation of the site, and prepare a formal stormwater pollution prevention plan. Specific land use types and hotspots may need to implement more rigorous pollution prevention practices. The preparation of pollution prevention plans and the full set of pollution prevention practices are covered in Volume 3 of this Manual.

❑ **Standard #11 – Stormwater Management Site Plan**

The development project shall prepare a stormwater management site plan for local government review that addresses Standards #1 through 10.

All new development and redevelopment sites will require the preparation of a *stormwater management site plan* for development activities. A stormwater site plan is a comprehensive report that contains the technical information and analysis to allow a local review authority to determine whether a proposed new development or redevelopment project meets the local stormwater regulatory requirements. See [Section 4.3](#) and other local stormwater regulatory requirements for specific guidance.

4.3 Stormwater Management Site Plans



Description: A stormwater management site plan is a comprehensive plan used to show compliance for all applicable stormwater management requirements. The stormwater management site plan is the key document in the site plan review process and used to ensure that a development has been designed and will be constructed as required. It also provides important details and certifications for the long-term ownership, operation, and maintenance of stormwater BMPS on a site.

KEY CONSIDERATIONS

- The stormwater management site plan should be signed and sealed by a qualified design professional.
- A typical stormwater management site plan should include the following components:
 1. Natural Resources Inventory
 2. Existing Conditions Hydrologic Analysis
 3. Post-Development Hydrologic Analysis
 4. Stormwater Management System
 5. Downstream Analysis
 6. Erosion and Sediment Control Plan
 7. Landscaping Plan
 8. Operations and Maintenance Plan
 9. Evidence of Acquisition of Applicable Permits
 10. Waiver Requests (if applicable)
- The site plan review should be performed by a qualified local government staff person or consultant. The review may consist of the following steps:
 1. Pre-consultation Meeting and Joint Site Visit
 2. Review Stormwater Concept Plan
 3. Review Preliminary Stormwater Site Plan
 4. Review Final Stormwater Site Plan
 5. Pre-construction Meeting
 6. Construction Inspections
 7. Ongoing Maintenance Inspections

4.3.1 Introduction

To encourage and ensure that local stormwater guidelines and requirements are implemented, communities should implement a formal site plan preparation, submittal, and review procedure that facilitates open communication and understanding between the involved parties.

A stormwater management site plan is a comprehensive report that contains the technical information and analysis to allow a community to determine whether a proposed new development or redevelopment project meets the local stormwater regulatory requirements. This section discusses the typical contents of a stormwater management site plan and the recommended review and consultation checkpoints between the local government staff and the site developer.

The procedures and guidelines for the preparation of a site stormwater plan should be explicitly stated in a local ordinance. The ordinance, in turn, may refer to a design guidance document for additional detail. Ideally, site stormwater plans are developed with open lines of communication between the developer (and developer's engineer) and the plan reviewer. Stormwater plans are more than just the preparation of a document and maps. Instead, stormwater plans should be thought of as a process that occurs over the planning and development cycle and then continues after buildout via regular inspection and maintenance of the stormwater management system.

4.3.2 Contents of a Stormwater Management Site Plan

The following elements are recommended components for local stormwater management site plan requirements. It is often required that a stormwater management site plan be sealed and signed by a licensed professional engineer or landscape architect.

Based on a community's prerogative, small-scale projects could be allowed to prepare a site plan that includes a defined subset of the elements outlined below.

1) Natural Resources Inventory

- Natural Drainage Divides
- Natural Drainage Features (e.g., Swales, Basins, Depressional Areas)
- Wetlands
- Water Bodies
- Floodplains
- Aquatic Buffers
- Shellfish Harvesting Areas
- Soils
- Erodible Soils
- Steep Slopes (i.e., Areas with Slopes Greater Than 15%)
- Groundwater Recharge Areas
- Wellhead Protection Areas
- Trees and Other Existing Vegetation
- High Quality Habitat Areas

2) Existing Conditions Hydrologic Analysis

- A topographic map of existing site conditions (minimum 2-foot contour interval recommended) with the basin boundaries indicated
- Acreage, soil types and land cover of areas for each subbasin affected by the project
- All perennial and intermittent streams and other surface water features
- All existing stormwater conveyances and structural control facilities
- Direction of flow and exits from the site
- Analysis of runoff provided by off-site areas upstream of the project site

- Infiltration rates of existing soils
- Methodologies, assumptions, site parameters and supporting design calculations used in analyzing the existing conditions site hydrology

3) Post-Development Hydrologic Analysis

- A topographic map of developed site conditions (minimum 2-foot contour interval recommended) with the post-development basin boundaries indicated
- Total area of post-development impervious surfaces and other land cover areas for each subbasin affected by the project
- Unified stormwater sizing criteria runoff calculations for water quality, channel protection, overbank flooding protection and extreme flood protection for each subbasin
- Location and boundaries of proposed natural feature protection areas
- Documentation and calculations for any applicable site design credits that are being utilized
- Methodologies, assumptions, site parameters and supporting design calculations used in analyzing the existing conditions site hydrology

4) Stormwater Management System

- Drawing or sketch of the stormwater management system including the location of non-structural site design features and the placement of existing and proposed structural stormwater controls. This drawing should show design water surface elevations, storage volumes available from zero to maximum head, location of inlet and outlets, location of bypass and discharge systems, and all orifice/restrictor sizes.
- Narrative describing that appropriate and effective structural stormwater controls have been selected
- Cross-section and profile drawings and design details for each of the structural stormwater controls in the system. This should include supporting calculations to show that the facility is designed according to the applicable design criteria.
- Hydrologic and hydraulic analysis of the stormwater management system for all applicable design storms (should include stage-storage or outlet rating curves, and inflow and outflow hydrographs)
- Documentation and supporting calculations to show that the stormwater management system adequately meets the unified stormwater sizing criteria
- Drawings, design calculations and elevations for all existing and proposed stormwater conveyance elements including stormwater drains, pipes, culverts, catch basins, channels, swales and areas of overland flow

5) Downstream Analysis

- Supporting calculations for a downstream peak flow analysis using the ten-percent rule necessary to show safe passage of post-development design flows downstream

6) Erosion and Sedimentation Control Plan

- Must contain all the elements specified in the Georgia Erosion and Sediment Control Act and local ordinances and regulations
- Sequence/phasing of construction and temporary stabilization measures
- Temporary structures that will be converted into permanent stormwater controls

7) Landscaping Plan

- Arrangement of planted areas, natural areas and other landscaped features on the site plan
- Information necessary to construct the landscaping elements shown on the plan drawings
- Descriptions and standards for the methods, materials and vegetation that are to be used in the construction

8) Operations and Maintenance Plan

- Description of maintenance tasks, responsible parties for maintenance, funding, access and safety issues

9) Evidence of Acquisition of Applicable Permits

10) Waiver Requests (if applicable)

4.3.3 Procedure for Reviewing Stormwater Site Plans

Section 1.3 of Volume 2 describes the general procedure in the preparation of a stormwater site plan. The following steps are intended to provide a community with a review process and checkpoints that complements the procedure from the site developer's perspective:

- (1) Pre-consultation Meeting and Joint Site Visit**
- (2) Review Stormwater Concept Plan**
- (3) Review Preliminary Stormwater Site Plan**
- (4) Review Final Stormwater Site Plan**

Additional steps to ensure compliance with the stormwater management site plan include:

- (5) Pre-construction Meeting**
- (6) Construction Inspections**
- (7) Ongoing Maintenance Inspections**

Step 1. Pre-consultation Meeting and Joint Site Visit

The most important action that can take place at the beginning of the development project is a pre-consultation meeting between the local review authority and the developer and his team to outline the stormwater management requirements and other regulations, and to assist developers in assessing constraints, opportunities, and potential for stormwater design concepts.

This recommended step helps to establish a constructive partnership through the development process. A joint site visit, if possible, can yield a conceptual outline of the stormwater management plan and strategies. By walking the site, the two parties can identify and anticipate problems, define general expectations and establish general boundaries of natural feature protection and conservation areas. A major incentive for pre-consultation is that permitting and plan approval requirements will become clear at an early stage, increasing the likelihood that the approval process will proceed faster and more smoothly.

The site developer should be made familiar with the local stormwater management and development requirements and design criteria that apply to the site. These may include:

- Design and performance standards for stormwater management
- Design storm frequencies
- Conveyance design criteria
- Floodplain criteria
- Buffer/setback criteria
- Wetland provisions
- Watershed-based criteria
- Erosion and sedimentation control requirements
- Maintenance requirements
- Need for physical site evaluations (infiltration tests, geotechnical evaluations, etc.)

This guidance could be provided at the pre-consultation meeting and should be detailed in various local ordinances (e.g., subdivision codes, stormwater and drainage codes, etc). This information could be contained in a set of checklists which would be provided to the developer. Appendix B contains example checklists outlining the necessary steps to prepare preliminary and final stormwater management site plans.

Current land use plans, comprehensive plans, zoning ordinances, road and utility plans, watershed or overlay districts, and public facility plans should all be consulted to determine the need for compliance with other local and state regulatory requirements. Opportunities for special types of development (e.g., clustering) or special land use opportunities (e.g., conservation easements or tax incentives) should be investigated. There may also be an ability to partner with the site developer in the development of greenways or open space parks.

Case Study: City of Atlanta Stormwater Concept and Consultation Meeting

For certain types of developments, the City of Atlanta requires that a stormwater concept plan and consultation meeting be held early in the design process. At this meeting, the project's engineer and City of Atlanta staff discuss the post-development stormwater management measures necessary for the proposed project and assess constraints, opportunities and ideas for better site design, low impact development, and runoff reduction techniques early in the design process. This consultation meeting must be held prior to submittal of an application for a building permit (BB) or land disturbance permit (LD).

Per the City of Atlanta's Post Development Stormwater Management Ordinance, the project's engineer must present a Stormwater Concept Plan to City of Atlanta staff for the following activities:

- New commercial development (Greenfield) that involves the creation of any impervious cover;
- Commercial redevelopment that includes the creation, addition, or replacement of 500 square feet of impervious cover or more;
- Commercial development or redevelopment that disturbs one acre of land or more; and,
- Commercial demolition projects that leave in place more than 500 square feet of impervious cover

The City's Stormwater Concept Plan and Consultation Meeting Record is available here:
<https://www.atlantawatershed.org/greeninfrastructure/stormwater-concept-plan-requirements-and-meeting-record/>

Step 2. Review Stormwater Concept Plan

During the concept plan stage the site designer will perform most of the layout of the site including the preliminary stormwater management system design and layout. The stormwater concept plan allows the design engineer to propose a potential site layout and gives the developer and local review authority a "first look" at the stormwater management system for the proposed development. The stormwater concept plan should be submitted to and approved by the local plan reviewer before detailed preliminary site plans are developed.

It is extremely important at this stage that stormwater design is integrated into the overall site design concept in order to best reduce the impacts of the development as well as provide for the most cost-effective and environmentally sensitive approach.

Step 3. Review Preliminary Stormwater Site Plan

The preliminary plan ensures that local requirements and criteria are being complied with and that opportunities are being taken to minimize adverse impacts from the development.

The preliminary stormwater management site plan should consist of maps, narrative, and supporting design calculations (hydrologic and hydraulic) for the proposed stormwater management system, and

should include the following elements from [Section 4.8.2](#):

- **Existing Conditions Hydrologic Analysis**
- **Post-Development Hydrologic Analysis**
- **Stormwater Management System**
- **Downstream Analysis**

It should be demonstrated that appropriate and effective stormwater controls have been selected and adequately designed. The preliminary plan should also include, among other things, street and site layout, delineation of natural feature protection and conservation areas, soils data, existing and proposed topography, relation of site to upstream drainage, limits of clearing and grading, and proposed methods to manage and maintain conservation areas (e.g., easements, maintenance agreements/responsibilities, etc.)

Step 4. Review Final Stormwater Site Plan

The final stormwater management site plan adds further detail to the preliminary plan and reflects changes that are requested or required by the local review authority. The final stormwater site plan should include all of the revised elements from the preliminary plan as well as the following items:

- **Erosion and Sedimentation Control Plan**
- **Landscaping Plan**
- **Operations and Maintenance Plan and Agreement** ([see section 5.2 and Appendix D](#))
- **Evidence of Acquisition of Applicable Local and Non-local Permits**
- **Waiver Requests**

This process may be iterative. The reviewer should ensure that all submittal requirements have been satisfactorily addressed and permits, easements, and pertinent legal agreements (e.g., maintenance agreements, performance bond, etc.) have been obtained and/or executed.

The completed final stormwater site plan should be submitted to the local review authority for final approval prior to any construction activities on the development site. Approval of the final plan is the last major milestone in the stormwater planning process. The remaining steps are to ensure that the plan is installed, implemented, and maintained properly.

Step 5. Pre-construction Meeting

This step ensures that the contractor, engineer, inspector, and plan reviewer can be sure that each party understands how the plan will be implemented on the site. A pre-construction meeting should occur before any clearing or grading is initiated on the site. This is the appropriate time to ensure that natural feature protection areas and limits of disturbance have been adequately staked and adequate erosion and sediment control measures are in place.

Step 6. Construction Inspections

Project sites should periodically be inspected during construction by local agencies to ensure that conservation areas have been adequately protected and that stormwater control and conveyance facilities are being constructed as designed. Inspection frequency may vary with regard to site size and location; however, monthly inspections are a good target. In addition it is recommended that some inspections occur after larger storm events (e.g., 0.5 inches and greater). The inspection process can prevent later problems that result in penalties and added cost to developers. Example construction inspection forms are included in Appendix C.

An added benefit of a formalized and regular inspection process is that it should help to motivate contractors to internalize regular maintenance of sediment controls as part of the daily construction operations. If necessary, a community can consider implementing a penalty system, whereby fines can be assessed or even stop work orders issued.

A final inspection is needed to ensure that the construction conforms to the intent of the approved design. Prior to issuing an occupancy permit and releasing any applicable bonds, the review authority should ensure that: (1) temporary erosion control measures have been removed; (2) stormwater controls are unobstructed and in good working order; (3) permanent vegetation cover has been established in exposed areas; (4) any damage to natural feature protection and conservation areas has been restored; (5) conservation areas and buffers have been adequately marked or signed; and (6) any other applicable conditions.

Record drawings of the structural stormwater controls and drainage facilities should also be acquired by the community, as they are important in the long-term maintenance of the facilities. The review authority should keep copies of the drawings and associated documents and develop a local stormwater control inventory and data storage system. With geographic information systems (GIS) becoming more widely used, much of these data can be stored electronically.

Step 7. Ongoing Maintenance Inspections

Ongoing inspection and maintenance of a project site's stormwater management system is often the weakest component of stormwater plans. It needs to be clearly detailed in the stormwater site plan which entity has responsibility for operation and maintenance of all structural stormwater controls and drainage facilities. Often, the responsibility for maintenance is transferred from the developer and contractor to the owner. Communication about this important responsibility is usually inadequate; therefore communities may need to consider ways to notify property owners of their responsibilities. For example, notification can be made through a legal disclosure upon sale or transfer of property or public outreach programs may be instituted to describe the purpose and value of maintenance.

Ideally, preparation of maintenance plans should be a requirement of the stormwater site plan preparation and review process. A maintenance plan should outline the scope of activities, schedule, and responsible parties. Vegetation, sediment management, access, and safety issues should also be addressed. It is important that the maintenance plan contains the necessary provisions to ensure that vegetation establishment occurs in the first few years after construction. In addition, the plan should address testing and disposal of sediments that will likely be necessary.

Annual inspections of stormwater management facilities should be conducted by an appropriate local agency. Where chronic or severe problems exist, the local government should have the authority to remedy the situation and charge the responsible party for the cost of the work. This authority should be well established in an ordinance.

4.4 Different Development Types



Description: Comprehensive plan used to show compliance for all applicable stormwater management requirements. The stormwater management site plan is the key document in the site plan review process and used to ensure that a development has been designed and will be constructed as required. It also provides important details and certifications for the long-term ownership, operation, and maintenance of stormwater BMPs on a site.

KEY CONSIDERATIONS

Development types discussed in this section that may require special consideration include:

- Subdivisions
- Linear Development
- Redevelopment
- Single Family Homes
- Planned Unit Developments (PUDs)

There are many different types of development that impact natural site features and runoff patterns. By revising local codes, communities may be able to help conserve these site features and reduce the amount of impact a development has on the existing hydrology and topography. The Atlanta Regional Commission's (ARC) Community Choices Toolkit (<http://atlantaregional.com/local-government/implementation-assistance/best-practices>) educates local officials on the choices available to them to create and sustain quality communities and takes many of the types of development discussed in this section into account.

In addition to having tailored ordinance language, communities should be prepared to address the different stormwater challenges that may be unique to each particular development type. The following offers a basic overview of the typical development categories and some of the more common challenges to implementing effective stormwater strategies.

4.5.1. Subdivision

A subdivision is a large parcel of residential, commercial, or industrial zoned land divided into smaller parcels, or lots, for the purpose of developing and selling the individual lots. In the Georgia Construction General Permit Program, this is referred to as a Common (Plan of) Development which is a contiguous area where multiple, separate, and distinct construction activities will be taking place at different times on different schedules under one plan of development.

Residential Subdivisions

For some single-family detached residential subdivisions, the original owner or developer also serves as the home builder and will construct the primary infrastructure, i.e., roads, utilities, and other common improvements, including the stormwater management strategy in concert with the home construction, allowing for gradual and sequential construction, stabilization, and occupancy. However, the more common approach is for the original owner/developer to commit to constructing the primary infrastructure, i.e., roads, utilities, and other common improvements, and sell the lots to be developed individually by others. This latter approach will not typically follow a sequential construction pattern and is often more difficult to manage in terms of ESC and SWM implementation and oversight.

In all cases, the erosion and sediment control plan and the post-construction stormwater management plan for residential subdivisions should be developed for the entire plan of development. The Natural Resources Inventory (NRI) and the Stormwater Concept Plan (SCP) should be reviewed carefully with a focus on any proposed phasing of construction or stormwater practice implementation.

Industrial/Commercial Subdivisions

The development of an industrial or commercial subdivision may be very different. The primary access road and utility infrastructure is built and the lots are left untouched, or only minimally disturbed as may be needed for ancillary improvements. This allows the individual purchasers or tenants to develop a site plan customized for the intended use. However, the NRI should identify all the relevant features for the entire plan of development. The NRI should be utilized to configure the individual lot lines so as to minimize potential future impacts and for the alignment of the primary access road. Likewise, the SCP should establish the strategy for managing the stormwater runoff from the roadway, and if applicable, conceptually identify the potential strategies for the future development of the individual lots.

In some cases, the owner/developer of a commercial or industrial subdivision will benefit from an economy of scale and construct a stormwater management plan for entire build-out of the subdivision. This will allow for a more efficient plan review and initial construction inspection, however, the subsequent ESC plan review for individual parcel construction

should be cognizant of the potential disturbed acreage in the contributing drainage area to the stormwater controls.

Stormwater Strategies for Residential Subdivisions

Applying and enforcing the application of distributed stormwater BMPs in a subdivision development can be challenging. Since traditional residential subdivisions have many different owners and potentially on-going construction, it can be difficult to be sure adequate stormwater measures are being implemented appropriately. Ideally a subdivision layout would maintain natural site features as amenities and identify the most advantageous topography and soils for locating stormwater practices. Figure 4.4-1 represents a combined NRI and a SCP for a large mixed use development. Based on the NRI, the SCP identifies the locations of high, medium, and low density development zones. The SCP also identifies the ideal locations for the primary 'subdivision-scale' stormwater controls. Figure 4.4-2 represents the conceptual layout.

Generally, the NRI offers an opportunity to maximize the cost-effectiveness of the stormwater strategy and the development as a whole by informing the overall layout of the development. The next step is to develop a SCP for each development zone in order to identify the degree to which the development achieves the goals of Standard #2: Better Site Design Practices for Stormwater Management, and Standard #3: Water Quality. The SCP for each development zone should include preliminary sizing computations to ensure that the stormwater practice locations are adequate for the development.

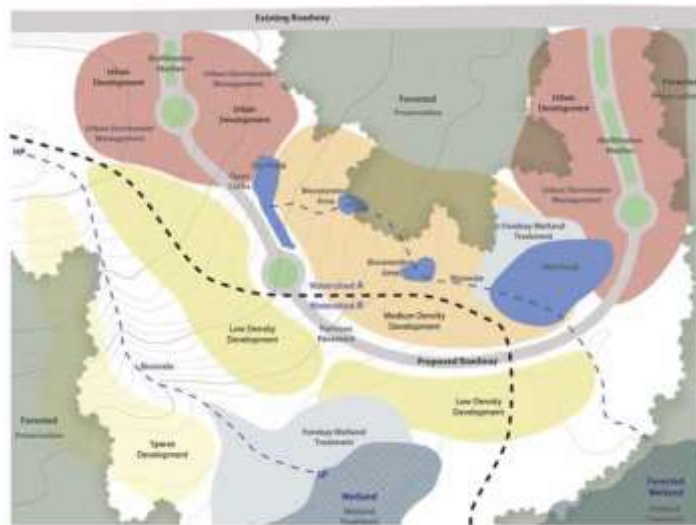


Figure 4.4-1. Schematic of a Water Quality Treatment Plan
(Source: Central, LA Municode)



Figure 4.4-2. Final Water Quality Treatment Plan
(Source: Central, LA Municode)

In order to review the SCP, communities should establish basic standards for acceptable better site design and water quality practices within residential subdivisions. Not all better site design strategies are consistent with local ordinances, i.e., cluster development, reduced front yard setbacks, reduced road widths, etc (See [Section 3.2](#) for more information about aligning local ordinances with Better Site Design Principles). Likewise, not all water quality practices are compatible with residential subdivisions. For example, maintenance-intensive or underground practices, can be difficult to manage on residential sites. Communities should establish provisions to guide the selection of subdivision scale and micro-scale stormwater practices based on lot size (i.e., 1/2-acre lots versus 1/8-acre lot subdivisions), the presence of a Home Owners Association for establishing a single entity responsible for ongoing inspection and maintenance, and neighborhood-wide covenants related to the protection of stream buffers and proper pollution prevention and management of open space, etc. These documents are critical to the long-term maintenance of the stormwater infrastructure. Proper review of these documents and acceptance by the developer and future owners should be established early in the review process.



Figure 4.4-3. Bioretention Area in a Subdivision
(Source: US EPA)

4.5.2. Linear Projects

Linear development projects can include roads and highways, railroad tracks, and utility corridors such as gas and electric transmission lines. Linear development projects are different enough that the Georgia Department of Natural Resources developed a sector specific NPDES construction general permit: Infrastructure Construction General Permit. These projects can represent numerous design challenges for both ESC and SWM:

- The right-of-way for these infrastructure corridors is highly constrained. Public acquisition processes limit the purchase or taking of right-of-way to only that which is necessary for the primary transportation goal (meaning acquiring additional right-of-way for ancillary features such as stormwater management practices can be difficult and expensive).
- The alignment of these corridors is not flexible. Either specific topographic or public safety considerations can force the selection of the least unfavorable alignment, rather than the one that meets all the design goals;
- Alignments can form a 'levy' or diversion system intercepting off-site areas of sheet flow and creating concentrated flow from the combined on-site and off-site drainage where it discharges from the right-of-way. Defining the specific stormwater requirements can become complicated.
- Alignments can cross several watersheds and sub-watersheds creating very complex conveyance and treatment design strategies.

Early coordination through the environmental permitting processes will typically direct these linear alignments towards minimizing impacts, i.e., impacts to regulated waters of the US, private property, etc. However, this process will likely establish design performance goals

rather than the design itself, especially on new location highway projects. Primary and limited access collector widening projects and urban infrastructure upgrades are much more common and more difficult to address due to severely limited space.

Designers and plan reviewers should utilize the [pre-consultation SCP process to identify and assess these challenges early in the design process](#) to identify the efficacy of linear LID to the extent practicable. The Georgia Department of Transportation (GDOT) Manual on Drainage Design for Highways (<http://www.dot.ga.gov/PS/DesignManuals>) provides design guidance for linear applications of filter strips, grass channels, enhanced swales, infiltration trenches, bioslopes, sand filters, bioretention basins, and open-graded friction course. Where these practices cannot achieve full compliance, designers should [consider supplemental off-site mitigation options as a viable compliance option. \(Section 5.7\).](#)



Figure 4.4-4. Linear Bio-swale (Source MDSHA)

4.5.3. Redevelopment

Many jurisdictions actively encourage redevelopment with tax breaks, reduced impact fees, and other monetary incentives to revitalize abandoned or underutilized urban lands. Redevelopment of existing urban lands is preferred over the 'greenfield' development that expands the urban area footprint into rural areas. The desire to retrofit these redeveloping sites with stormwater controls requires a delicate balance to avoid creating a disincentive to redevelopment.

Designers and plan reviewers should utilize the pre-consultation and SCP process to identify and assess the treatment options. In some cases, reductions in impervious cover can help satisfy stormwater management requirements. Designers may also evaluate the most readily managed portion of the site for treatment in order to reduce costs to the maximum extent practicable, rather than treating the specific area of new impervious cover. Designers should also consider off-site mitigation as a [viable compliance option](#).

Ultimately, the financial or other incentives to encourage redevelopment should take precedence over exemptions or variances to environmental protection ordinances. Other avenues to encourage redevelopment include:

- Establish a formal infill development/redevelopment program to ensure that developers and property owners are aware of the incentives:
 - Financial incentives and prioritized capital funding or financing for infrastructure improvements (water, sewer, road, sidewalk, etc. upgrades) in identified growth areas;
 - Housing density bonuses and accelerated permitting process for infill and redevelopment projects.
 - Reduced impact fees for infill development based on less demand for new infrastructure.
 - Establishment of Tax Incremental Financing districts to encourage redevelopment.
 - More restrictive zoning, utility access, stormwater requirements, and other provisions outside of growth boundary or at the edge of a city to restrict development and to preserve rural character (Nevue, 2009).
- Review and revise local codes to eliminate unnecessary site infrastructure upgrades to the extent practicable;
- Utilize and promote financial incentives provided by State and Federal programs to encourage redevelopment and revitalization.

More information on the advantages, opportunities, and strategies for local adoption of infill and redevelopment and planning policies is provided in [Chapter 3](#) of this manual.

4.5.4. Single Family Homes

Single family home construction that is not part of a common plan of development is usually exempt from stormwater management requirements. However, the cumulative effect of many new homes and/or large additions can result in changes to the hydrologic conditions of a developing area. Some guiding principles can be applied to individual building permits to help property owners and general contractors minimize impacts as well as the potential for ongoing drainage problems:

- Provide educational materials with building permits to clearly illustrate proper implementation of pollution prevention and ESC measures;
- Ensure adequate grading and drainage around the house foundation and other improvements without creating concentrated flow. This can include the use of level spreaders or impervious disconnection at downspouts; and
- Review soil conditions and make property owners aware of permeable soils for directing downspout and sheet flow, or the implementation of rain gardens, dry wells, permeable pavers for driveways and patios; etc.;



Figure 4.4-5. Residential Rain Barrel
(Source: www.energyearth.com)

Case Study: City of Atlanta Single-Family Development Requirements

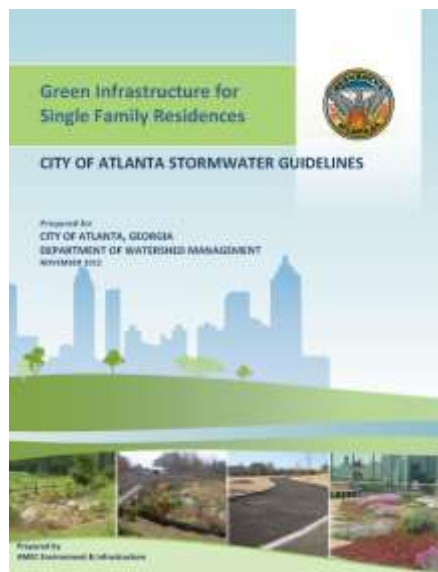
In February 2013, the City of Atlanta amended its Post-Development Stormwater Management Ordinance to require green infrastructure on new and redevelopment projects in the City. Atlanta's ordinance is unique in terms of its applicability to single-family development.

The City's previous requirements allowed 99% of homes to be constructed in existing neighborhoods without any form of stormwater management. The City now requires new homes and large additions (>1,000 ft² of impervious surface) to manage the first 1.0" of runoff on their site using green infrastructure.

With the help of a consultant, the City developed a guidance document, *Green Infrastructure for Single Family Residences*, which specifies the types of stormwater practices that can be utilized on an individual lot, allows the user to size the practice using easy to read sizing charts, and provides tear-off detail sheets that show a step-by-step construction sequence for the given practice. The practices include routing the runoff from the roof to a simplified rain garden, dry well, modified French drain, cistern, or natural buffer.

The guidance document is available here:

<https://www.atlantawatershed.org/greeninfrastructure/atlanta-residential-gi-nov-20122013/?showMeta=2&ext=.pdf>



Source: Rayburn, Rutherford, *Implementing Green Infrastructure: Atlanta's Post-Development Stormwater Ordinance*, City of Atlanta Department of Watershed Management, 2013.

4.5.5. Planned Unit Development

According to the American Planning Association, a planned unit development (PUD) is a large, integrated development adhering to a comprehensive plan and located on a single tract of land or on two or more tracts of land that may be separated only by a street or other right-of-way. Establishing PUD districts can enable the building of innovative new developments while preserving natural features or open spaces.

PUDs offer a comprehensive approach to the design of large scale developments, as opposed to the conventional lot-by-lot approach typically allowed in community zoning codes and regulations. Unlike conventional development, a PUD allows developers to bypass standard zoning and development regulations in exchange for site-specific design and development innovations, such as clustered lots, mixed land uses, conservation of open spaces, and natural resource preservation. (Ellis, 2014)

These considerations offer a potentially unlimited list of options to creatively and holistically manage stormwater. Specific strategies can be applied to different areas or phases of the development. Regional or subdivision-scale practices can be supplemented with micro-scale practices distributed throughout the development on outparcels or on individual lots.

The zoning approval process for PUDs typically involves many rounds of negotiation. Any commitments regarding stormwater management made during these negotiations, including any restrictive covenants or shared responsibilities for the stormwater infrastructure. These should be clearly documented and passed forward to the stormwater program plan review staff. The pre-consultation and SCP process should incorporate these provisions into the final construction drawings, accompanied by detailed HOA and common area restrictive covenants and maintenance agreements.

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Case Study: Planned Unit Development Case Study: Palmetto Bluff, SC (Ellis et al, 2014)

Palmetto Bluff, SC is a sea island with expansive frontage on the May, Cooper and New Rivers. For most of the last century, Palmetto Bluff has been managed and enjoyed as a private wildlife and forest preserve. The property has been carefully master-planned to grow into a complete, balanced, controlled community within a coastal setting. Its size makes possible the creation of a series of inter-related, yet distinctive settlements and natural preserves. The combination of its location and varied natural features makes this a unique community.

Palmetto Bluff has been designed to preserve the land's beauty, vastness, and rich landscape while taking advantage of the views and island setting to create a strong sense of place. Owners, along with their Architect and Landscape Architect are encouraged to work together from the initial phases of design to ensure all aspects of the design are consistent with specific design objectives, such as implementing sustainable building systems, site development, materials and construction techniques in all development. Reducing consumption of materials and energy, reducing waste and making intelligent choices about how a building is used benefits both Palmetto Bluff as a community and the sensitive sea island landscape as a whole. Palmetto Bluff is committed to the implementation of Sustainable and Low Impact Design concepts such as reducing the house's "footprint" on the land, energy and water conservation measures, reuse and recycling of building materials, and the preservation of the existing forest and river marsh frontage.

The text for the Palmetto Bluff Planned Unit Development is based on the Beaufort County Zoning and Development Standards Ordinance 90/3 with the following amendments:

- *River Protection Overlay District*
 - The buffer width was changed from fifty (50) feet to an average of one hundred (100) feet, with a minimum of eighty (80) feet.
 - Development setbacks changed from fifty (50) feet to an average of one hundred (100) feet, with a minimum of eighty (80) feet. Additionally, streets and roads to access land within the PUD can penetrate the buffer provided stormwater runoff is treated.
- *Site Design and Development Standards*
 - Minimum Off-Street Parking in the planned resort, residential and commercial developments the parking spaces were changed for the following uses. The assumption underlying the change was that a substantial number of visitors would arrive by public transportation, thus requiring fewer spaces than the current requirements.
 - Auditorium and Theaters: 0.2 spaces for each spectator seat.
 - Automobile Service Station: One (1) space for each vehicle stored or parked, plus one (1) space for each employee.
 - Bank: One (1) space for each two-hundred square feet (200 sf) of gross floor space, plus one (1) space for each two (2) employees.
 - Church: One (1) space for each six (6) seats in the main assembly room.

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Nevue Ngan Associates, Eisen|Letunic, Van Meter Williams Pollack LLP, ICF International. May 2009. *Stormwater Management Handbook: Implementing Green Infrastructure in Northern Kentucky Communities*.

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