
Chapter 1. INTRODUCTION

1.1 Purpose of the Manual

The purpose of this Storm Water Management Design Manual is to provide engineers, developers, plan reviewers, inspectors, contractors, property owners, and interested citizens involved in land development within the unincorporated, non-South Carolina Department of Transportation (SCDOT) regulated areas of Greenville County and within the municipalities that chose to participate with Greenville County as co-permittees (Simpsonville, Mauldin, Travelers Rest and Fountain Inn are co-permittees) in its National Pollutant Discharge Elimination System (NPDES) Municipal Separate Storm Sewer System (MS4) Permit, with the following information:

- Storm water management requirements;
- Summarization of the permit application process;
- Submittal requirements and the plan review process;
- Technical guidance to meet storm water management design requirements; and,
- Guidelines for designing, implementing, and maintaining storm water best management practices (BMPs) used in Greenville County to improve water quality, and minimize storm water runoff impacts due to increased flow volumes and peak discharge rates from developed areas.

This Storm Water Management Design Manual has been prepared in fulfillment of the requirements of the Greenville County Storm Water Management Ordinance as imposed by NPDES Permit No. SC230001 and the South Carolina Storm Water Management and Sediment Reduction Act to accomplish the following objectives:

- Reduce storm water adverse impacts on water quality;
- Reduce storm water adverse impacts on water quantity;
- Protect downstream areas from adverse storm water quantity and quality impacts resulting from development;
- Identification of what is required for storm water plan submittal and plan reviews; and,
- Submittal of high quality storm water design plans from the design community.

1.2 Description and Use of the Manual

The Design Manual was developed under the assumption that the user possesses a basic understanding in storm water control design, construction, or land development depending on the users particular area of expertise. Users of this Manual who are not justly qualified by education or experience in the fields of storm water control design, construction, or land development should consult with a qualified professional in one or more of these areas prior to adhering to the requirements contained within the Manual.

This Manual is not intended to be a systematic design methodology that addresses every land development situation that may occur in Greenville County. The application of engineering principles and judgment combined with the information contained within this Manual are required to successfully complete the planning, design, and preparation of documents for storm water management plan submittal.

This Manual is not intended to restrain or inhibit engineering creativity, freedom of design, or the need for engineering judgment. When shown to be applicable, it is encouraged that new procedures, techniques, and innovative storm water BMPs be submitted with supporting documentation. The documentation submitted by design professionals should show that these procedures are equal to, or exceed the procedures and/or controls contained in this Design Manual.

1.3 Design Manual Organization

The Design Manual contains 12 chapters. A general Table of Contents is found at the beginning of the Manual. This Design Manual is organized to present technical and engineering procedures along with the criteria needed to comply with Greenville County's Storm Water Management regulations and standards. Each chapter of the Design Manual presents all the policies and procedures that must be met for approval. In general, references are included in Appendix L. However, Chapters 5 and 10 have their own list of references at the end of those chapters

1.4 Updates to the Design Manual

This Design Manual is intended to be a dynamic document. As design technology and criteria evolve, the Manual may and/or will require updates, modifications, and improvements. As updates are made, they will be available for download from Greenville County's website. It will be each users responsibility to maintain a current edition of the Design Manual. The website format will allow the user to easily obtain or update new Design Manual information.

1.5 The Need for Storm Water Management

Urbanization has the potential to alter the natural drainage system and flow of water in the environment. Typical patterns of urbanization change the physical chemical and biological conditions of natural waterways. When land is developed the natural hydrology of the watershed is disrupted and may become altered. Clearing removes vegetation that originally intercepted and slowed rainfall runoff. Grading removes beneficial topsoil, compacts the subsoil and fills in natural depressions that originally provided temporary storage. As a result of land development infiltration is decreased and rainfall that once seeped into the ground runs off the surface at an accelerated rate.

Effects of Urbanization on Watershed Hydrology

Development and urbanization have the following impacts on receiving waterbodies:

- Changes to Stream Flow:
 - Increased runoff volumes
 - Increased peak runoff discharges
 - Greater runoff velocities
 - Increased flooding frequency
 - Lower dry weather flows (baseflow)
- Changes to Stream Geometry:
 - Stream channel enlargement and erosion
 - Stream downcutting
 - Changes in channel bed due to sedimentation
 - Increase in floodplain elevation
- Degradation of Aquatic Habitat:
 - Degradation of habitat structure
 - Decline in stream biological functions
- Water Quality Impacts:
 - Reduced oxygen in streams
 - Microbial contamination
 - Hydrocarbons and toxic materials
 - Sedimentation
- Property damage and safety concerns
- Unsightly aesthetic stream channel conditions

1.5.1. Innovative Design Approach

When designing for maximum water quantity, erosion prevention, sediment control, and water quality benefits, the design professional should take the following considerations in mind:

- Storm water quantity and quality are best controlled at the source of the problem by reducing the potential maximum amount of runoff and pollutants; and
- Best site design techniques implement storm water management by using simple, nonstructural methods along with or in place of traditional storm water management structures when applicable.

Innovative approaches to site design are more of a source control for storm water runoff – the site design practices limit the amount of runoff generated as well as use certain BMPs within the design. Now many communities are focusing on runoff reduction measures and incorporating them into low impact design applications. These types of design concepts are described in detail in several sources including: Georgia Storm Water Manual, Volume 1: Policy Guidebook, First Edition, Atlanta Regional Commission, August 2001; and, Low-Impact Development Design Manual, Prince George’s County Maryland, Department of Environmental Resources, November 1997. Some general concepts from these sources are provided in the following Sections.

1.5.2. Best Site Design Practices and Site Planning Process

The first step in addressing storm water management begins in the site planning and design stage of the development project. By implementing Best Site Design Practices during the site planning process, the amount of runoff and pollutants generated from a site can be reduced by minimizing the amount of impervious area and utilizing natural on-site treatments. The minimizing of adverse storm water runoff impacts by the use of Best Site Design Practices and site planning should be a major consideration for a design professional.

The reduction of runoff volumes and storm water pollutants reduces the total number and size of storm water management controls that must be implemented under the guidelines set forth in this Design Manual. Best Site Design Practices reduce the amount of total post-development impervious areas and maintains natural characteristics of the pre-development site conditions. Therefore, the post-development curve number and time of concentrations are maintained more closely to those of the pre-development condition, thereby reducing the overall hydrologic and hydraulic impact of the development. Implementing Best Site Design Practices can reduce the Storm Water Utility Fee by decreasing the total impervious area of a development site.

Maintaining Site Resources and Natural Undisturbed Areas

Conservation of site resources and natural undisturbed areas helps to reduce the post development runoff volume and provide areas for natural storm water management. Some natural site resources that should be maintained include, but are not limited to:

- Natural drainage ways;
- Vegetated buffer areas along natural waterways;
- Floodplains;
- Areas of undisturbed vegetation;
- Low areas within the site terrain;
- Natural forested infiltration areas; and,
- Wetlands.

Land Disturbance Limits

- In steeply sloping areas with 15% or greater slopes, limit the amount of land disturbance to 5 acres at one time; non-active areas must be stabilized prior to disturbing additional areas; and,
- In areas with slopes less 15%, limit land disturbances to 17 acres or less at one time without applying stabilization practices.

Lower Impact Site Layout Techniques

Lower impact site layout techniques involve identifying and analyzing the location and configuration of structures on the site to be developed. Where applicable, the following options that create lower impacts layouts should be used:

- Fit the design layout to follow the natural contours of the site to minimize clearing and grading and preserve natural drainage ways;
- Limit the amount of clearing and grading by identifying the smallest possible area on the site that would require land disturbance;
- Place development areas on the least sensitive areas of the site; and,

-
- Utilize nontraditional lot designs for residential areas to reduce the overall imperviousness of the site by providing more undisturbed open space by minimizing clear-cutting.

Reduction of Impervious Cover

The reduction of total impervious cover directly relates to a reduction in storm water runoff volume and the associated pollutants from a development site. The amount of impervious cover on a site can be reduced by the following techniques where applicable:

- Refer to and use the “High Intensity Residential Street Configuration Guidance”;
- Reduce building footprints by requiring some buildings to be multi-story;
- Reduce parking lot areas and/or the use of porous paver surfaces for desired overflow parking;
- Use clustering and provide more open space and green areas;
- Increase the amount of vegetated parking lot “islands” that can also be utilized for storm water management practices such as bioretention areas;
- Reduce the number of cul-de-sacs in residential areas and incorporate landscaped areas within them to reduce the amount of impervious cover; and,
- Use engineered soil mixtures to enhance infiltration from pervious covers.

Utilization of Natural Features for Storm Water Management

Traditional storm water drainage design does not utilize the natural drainage patterns of the pre-developed site. Structural storm water drainage controls are traditionally designed to quickly remove storm water runoff from the site without utilizing any of the natural storage areas. These natural drainage areas should be considered as potential storm water drainage systems. These natural areas can be utilized in the following ways where applicable:

- Vegetated buffers and undisturbed areas on the site are useful to control sheet flow (not concentrated flows) by providing infiltration, runoff velocity reduction, and pollutant removal;
- Various natural drainage ways should be maintained and not disturbed to provide a natural storm water drainage system to carry flows to their natural outlets. The use of these natural drainage ways allows for more storage of storm water runoff, lower peak flow rates, a reduction in erosive runoff velocities, and the capture and treatment of pollutants;
- Use of vegetated swales instead of curb and gutter applications where applicable. This application allows for more storage of storm water runoff, lower peak flow rates, a reduction in erosive runoff velocities, and the capture and treatment of pollutants which does not occur with curb and gutter systems;
- Where ditched roadways are not practicable, curb and gutter systems may be combined with vegetated swales at outfalls to provide added water quality benefits versus the traditional piped outfall designs;
- When applicable, direct rooftop runoff to pervious natural areas for water quality treatment and

infiltration instead of connecting rooftop drains to roadways and other structural storm water conveyance systems; and,

- Include the use of cisterns and rain gardens for individual residential units.

1.6 Storm Water Management Regulations and Policies

To address the adverse impacts of urbanization and land development, Federal, State and Local regulations have been adopted to protect the quantity and quality of the runoff received by the natural receiving waterbodies.

1.6.1 Federal and State Regulations

Clean Water Act

With the mandate of the Clean Water Act (CWA), the United States Environmental Protection Agency (USEPA) stated that it is illegal to discharge pollutants to the “Waters of the United States” without a NPDES Permit. The various types of NPDES storm water permits are described in this section. The CWA requires that a NPDES permit be obtained for every point source discharge of wastewater. The 1987 amendments to the CWA also required NPDES permits for industrial discharges, including storm water runoff associated with land disturbing activity (typically land development and construction) of five acres or greater. The threshold five-acre area was challenged and the federal NPDES regulations were amended in accordance with a court order for storm water discharges in December 1999. These amendments lower the acreage for when an NPDES permit is required for construction or land clearing to one acre while allowing a case-by-case determination for sites less than one acre.

The 1987 CWA Amendments also require NPDES permitting for storm water runoff from urbanized areas. A MS4 NPDES permit is required based on population. MS4s are divided into three categories: large (250,000 or greater); medium (less than 250,000 but equal to and greater than 100,000); and small (greater than 50,000). The implementation schedule for these MS4 permits has been repeatedly delayed, but large and medium permits are now in the process of being implemented.

For both the land disturbing and MS4 nonpoint source permits, preventing the pollution at the source through the use of BMPs is the preferred and most practical method. Additional BMPs can be used as needed to address capture, control and treatment of pollutants after they have been generated or released from a source area. Authority to administer the NPDES permit program was delegated to the South Carolina Department of Health and Environmental Control (SCDHEC) in accordance with the CWA by the USEPA.

South Carolina Pollution Control Act

The South Carolina Pollution Control Act (SCPCA) was originally enacted in 1950 and last amended in 1970 during the initial stages of the environmental movement. It was written very broadly and because of that is applicable to essentially any activity.

An important provision of the statute is Section 48-1-90, which states that it is “unlawful for any person, directly or indirectly, to throw, drain, run, allow to seep or otherwise discharge into the environment ...[any] wastes, except as in compliance with a permit” issued by SCDHEC.

South Carolina Storm Water Management and Sediment Reduction Act

The South Carolina Storm Water Management and Sediment Reduction Act of 1991 (SMSRA), S.C. Code Ann. §§ 48-14-10 et seq., was enacted to address the increase in storm water runoff rate and quantity, the decrease of rainwater infiltration, and the increase in erosion associated with the extensive urban development that has been occurring throughout the state. Greenville County has the right to implement the requirements of this Act and its associated regulations.

NPDES Permit for Storm Water Discharges Associated with Industrial Activity

All storm water runoff from “industrial activities” is considered an illegal discharge without an NPDES Storm Water Permit (SCR100000). These permits require certain industries to develop and implement a Storm Water Pollution Prevention Plan (SWPPP), which must include appropriate BMPs to minimize pollution to the receiving waterbodies. There are two general types of industrial activity permits: “construction related” and “other”. A NPDES storm water permit for storm water discharges from construction sites is required for all construction sites that disturb one or more acres of land. The requirements for obtaining and complying with this type of permit are covered in this Design Manual.

NPDES Municipal Separate Storm Sewer System Water (MS4) Permit

Greenville County is required to obtain a NPDES MS4 Permit from the SCDHEC for storm water discharges. The permit requires the County to develop and implement a Storm Water Management Program (SWMP) to control the discharge of pollutants from its MS4 to the maximum extent practicable (MEP).

Greenville County has been granted the authority by the State of South Carolina and the South Carolina General Assembly for the following responsibilities:

- Comply with all Federal and State regulatory requirements imposed by the NPDES Permit in accordance with the CWA to manage storm water discharges from the Greenville County MS4;
- Conduct all activities necessary to carry out the storm water management programs and other requirements included in the Greenville County NPDES Permit, the SWMP and the Storm Water Management Ordinance, and pursue the necessary means and resources required to properly fulfill this responsibility;
- Enter contractual agreement with other governmental entities or private persons or entities to provide or procure services to conduct and carry out storm water management activities;
- Maintain the storm water system consistent with provisions of the Greenville County NPDES Permit, the SWMP and the Storm Water Management Ordinance, and pursue the necessary means and resources required to properly fulfill this responsibility;
- Direct and oversee the continuous implementation of the Greenville County SWMP and the Storm Water Management Ordinance and to direct and ensure compliance with the Greenville County NPDES permit;
- Direct, review, and recommend for approval by County Council, the Storm Water Management Program Operating Budget; and,
- Direct, review, and recommend for approval by County Council, the necessary changes to the existing Storm Water Management Funding.

1.6.2 Local Ordinances

There are three Greenville County Ordinances that affect storm water management within Greenville County. These are:

-  The Storm Water Management Ordinance;
-  Tree Ordinance #4173; and
-  The Flood Control Ordinance.

A description of each ordinance is provided below.

Storm Water Management Ordinance of Greenville County, South Carolina

The purpose of this ordinance is to protect, maintain, and enhance the environment of Greenville County and the short- and long-term public health, safety, and general welfare of the citizens of Greenville County by establishing requirements and procedures to control the adverse effects of increased storm water runoff associated with both future development and existing developed land. It is further the purpose of this ordinance to comply with the Federal and corresponding State storm water discharge (NPDES) regulations.

The ordinance gives Greenville County the legal authority at a minimum to:

-  Control the contribution of pollutants to receiving waters by storm water discharges associated with residential, commercial, industrial, and related facility activity;
-  Prohibit illicit discharges to receiving waters;
-  Control discharge to receiving waters of spills, dumping or disposal of materials other than storm water;
-  Control through intergovernmental agreements, contribution of pollutants from one MS4 to another;
-  Require compliance conditions in ordinances, permits, contracts or orders; and,
-  Carry out all inspections, surveillance and monitoring procedures necessary to determine compliance and noncompliance with permit conditions including the prohibition of illicit discharges to the Greenville County MS4 and receiving waters.

The Director of Greenville County's Storm Water Management Program shall coordinate the County's activities with other Federal, State, and Local agencies that manage and perform functions relating to the protection of receiving water bodies.

Greenville County may open agreements with other governmental and private entities to carry out the purposes of the Storm Water Management Ordinance. These agreements may include but are not limited to:

-  Enforcement;
-  Resolution of disputes;
-  Cooperative monitoring;
-  Cooperative management of storm water systems; and
-  Cooperative implementation of storm water management programs.

Nothing in the Storm Water Management Ordinance limits or appeals any Ordinance of local governments or the powers granted to these local governments by the South Carolina Constitution or South Carolina statues, including the power to require additional or more stringent storm water management requirements within their jurisdictional boundaries.

Greenville Tree Ordinance # 4173

A Tree Ordinance is effective in Greenville County. This ordinance applies to all new development which disturbs one acre or more. The purpose of this ordinance is to mitigate the adverse effects of the loss of trees in Greenville County as a result of residential, commercial, institutional and industrial development practices. It is intended to protect and require re-establishment of the tree cover in Greenville County to reduce pollution of air, water and noise in the community. In general, the Tree Ordinance has the following requirements:

- Tree Protection Plans (TRP) may be required:
- Stream buffers are established by the Tree Ordinance:
- Tree population densities are required:
- Project development types are considered in the requirements; and
- Compliance required for development activities.

While the Land Development Department (LDD) does not review for compliance with this ordinance, compliance is required prior to issuance of a grading and storm water approvals or permits.

Greenville County Flood Control Ordinance #4113

The purpose of this ordinance is to promote the public health, safety and general welfare and to minimize public and private losses due to flood conditions in specific areas by provisions designed to:

- Restrict or prohibit uses that are dangerous to health, safety and property due to water or erosion in flood heights or velocities;
- Require that uses vulnerable to floods, including facilities that serve such uses be protected against flood damage at the time of initial construction;
- Control the alteration of natural floodplains, stream channels and natural protective barriers that are involved in the accommodation of flood waters;
- Control filling, grading, dredging and other development that may increase erosion or flood damage; and,
- Prevent or regulate the construction of flood barriers that will unnaturally divert flood waters or that may increase flood hazards to other lands.

The objectives of this ordinance are to:

- Protect human life and health;
- Minimize expenditure of public money for costly flood projects;

-
- Minimize the need for rescue and relief efforts associated with flooding and generally undertaken at the expense of the general public;
 - Minimize prolonged business interruptions;
 - Minimize damage to public facilities and utilities such as water and gas mains, electric, telephone and sewer lines and streets and bridges located in floodplains;
 - Help maintain a stable tax base by providing the sound use and development of flood prone areas in such a manner as to minimize future flood height areas; and,
 - Ensure that potential homebuyers are notified that property is in a flood area.

A copy of the Greenville County Flood Control Ordinance can be found on the Greenville County website.

Co-Permittee Ordinances

Greenville County's NPDES MS4 permit co-permittees also have municipal ordinances that affect storm water management within their jurisdictions. These are:

- Town of Simpsonville Code of Ordinances, Chapter 18, Environment, Article III Water; and, Chapter 22, Floods;
- Town of Mauldin Code of Ordinances, Chapter 32, Soil Erosion and Sedimentation Control; and, Chapter 40, Utilities, Article III, Storm Water Management;
- Town of Travelers Rest Municipal Codes, Title 5 Planning and Development, Chapter 5-20, Storm Water Management and Water Quality Controls, Chapter 5-24, Storm Water Management and Sediment Reduction, and Chapter 5-28, Floods;
- Town of Fountain Inn Code of Ordinances, Chapter 21 Floods; and, Land Development Regulations, Article II, Drainage System Design Standards.