Chapter 1. Introduction, Background, Purpose, and Administration

1.1 Introduction

Upon passage of the Southern Lowcountry Stormwater Post-Construction Ordinance (Ordinance) as amended and adopted by the Town of Bluffton within the Unified Development Ordinance (UDO), The Town of Bluffton will follow the design and permitting requirements of the *Southern Lowcountry Stormwater Design Manual* (~~Design~~ Manual). The UDO directs residents, land developers, redevelopment, and government permit applicants to submit details and plans that comply with this Manual. It is the intent of the Ordinance that all proposed development, redevelopment, and major substantial improvements shall provide post-developed condition stormwater quantity control and stormwater quality control for the stormwater retention volume (SWRv) for Watershed Protection Areas and/or Special Watershed Protection Areas. In the following chapters, Better Site Design (BSD) practices, green infrastructure/low-impact development practices (GI/LID), and stormwater best management practices (BMPs) are described in detail to support the stormwater retention requirements. Through in-line and off-line application of these practices, the cumulative impact is reduction of ~~the~~ stormwater runoff and the on-site retention ~~on-site~~ of design storms.

This Manual and the design criteria presented within represent good engineering practice and should be used in the preparation of stormwater management plans. The criteria are intended to establish requirements, minimum standards, and methods for a sound planning, design, and review process. It is intended to guide the stormwater design review of proposed work done by developers, private parties, and governmental agencies.

1.2 Background

The U.S. Environmental Protection Agency (EPA) recommends that the Phase II Small Municipal Separate Storm Sewer System (MS4) permit require the permittee to adopt a planning process that identifies the municipality's program goals (e.g., minimize water quality impacts resulting from post-construction runoff from new development and redevelopment), implementation strategies (e.g., adopt a combination of structural and/or non-structural BMPs), operation and maintenance policies and procedures, and enforcement procedures. In developing the program, EPA states that the permit should also require the permittee to assess existing ordinances, policies, programs and studies that address stormwater runoff quality. These policy assessments should include the following:

- Policies and ordinances that:
    - provide requirements and standards to direct growth to identified areas,
    - protect sensitive areas such as wetlands and riparian areas,
    - maintain and/or increase open space (including a dedicated funding source for open space acquisition),
    - provide buffers along sensitive water bodies,
    - minimize impervious surfaces, and
    - minimize disturbance of soils and vegetation;
- Policies or ordinances that encourage infill development in higher density urban areas and areas with existing infrastructure;

- Education programs for developers and the public about project designs that minimize water quality impacts; and
- Measures such as minimization of percent impervious area after development and minimization of directly connected impervious areas (81 Federal Register 237).

A complete summary of federal and state stormwater regulations can be found in Appendix N of this Manual.

1.3 Purpose

This Manual's purpose is to provide a framework for designing a stormwater management system to:

- Improve water quality through runoff reduction to the maximum extent practicable (MEP);
- Prevent downstream stream bank and channel erosion;
- Reduce downstream overbank flooding; and
- Safely pass or reduce the runoff from extreme storm events.

This Manual presents a unified approach for sizing stormwater best management practices (BMPs) in the Southern Lowcountry to meet pollutant removal goals, reduce peak discharges, and pass extreme floods. Additionally, it follows a watershed approach for their size and specification. Based on the site's watershed, stormwater design criteria specific to each must be met for development permit approval.

For a comprehensive list of terms and definitions utilized throughout this Manual, refer to Appendix L – Glossary.

1.4 Applicability and Exemptions

1.4.1 Applicability

Design criteria in this Manual are applicable to any new development or redevelopment activity that meets one or more of the following criteria, or is a major substantial improvement, unless exempt pursuant to Section 1.4.2 below:

1. Any development that involves ~~the creation of~~ 5,000 square feet or more of ~~impervious surface or that involves other~~ land disturbing activities ~~of one acre or more~~.
2. Any Redevelopment/Infill that will result in an additional~~involves the creation, addition, or replacement of 5~~2,000 square feet or more of impervious surface ~~or that involves other land disturbing activities of one acre or more~~.
3. ~~New development or redevelopment~~Any Land Disturbance, regardless of size, that is part of a larger common plan of development that meets criteria 1 or 2 above, even though multiple, separate, and distinct land disturbing activities may take place at different times and on different schedules.
4. A major substantial improvement of an existing property, which is defined as a renovation or addition to a structure that meets both of the following cost and size thresholds: a) construction costs for the building renovation/addition are greater than or equal to 50% of the pre-project assessed value of the structure as developed using current Building Valuation Data of the International Code Council, and b) project size where the combined footprint of structure(s)

exceeding the cost threshold and any land disturbance is greater than or equal to 5,000 square feet.

~~The design criteria are applicable for infill development of platted lots, whether they are new development or redevelopment sites if the work involves creation, addition or replacement of 5,000 square feet or more of impervious surface or that involves other land disturbing activities of acre or more.~~

1.4.2 Exemptions

The following activities are exempt from the permitting requirements of this Manual:

1. Any maintenance, alteration, renewal, or improvement as approved by the Town of Bluffton which does not alter existing drainage patterns, does not result in changes or adverse impacts on adjacent propertties~~y~~, or create adverse environmental or water quality impacts, and does not increase the temperature, rate, quality, volume, or location of stormwater runoff discharge.
2. Projects that are exclusively for agricultural or silvicultural activities within areas zoned for these agricultural and silvicultural uses;
3. Agricultural activity not involving relocation of drainage canals;
4. Projects within an LCP where the impervious surface was included as part of a larger approved stormwater management system, meeting current stormwater design standards, that addresses required retention for the specific lot.
5. Redevelopment that constitutes the replacement of the original square footage of impervious cover and original acreage of other land development activity when the original development is wholly or partially lost due to natural disaster or other acts of God occurring after ~~*<date of adoption>*~~September 14, 2021; and,
6. Work by agencies or property owners required to mitigate emergency flooding conditions. If possible, emergency work should be approved by the duly appointed officials in charge of emergency preparedness or emergency relief. Property owners performing emergency work will be responsible for any damage or injury to persons or property caused by their unauthorized actions. Property owners will stabilize the site of the emergency work within 60 days, or as soon as reasonable, following the end of the emergency period.
7. Town of Bluffton Capital Improvement Projects will consider the requirements of the ~~Design~~ Manual during project design implementation and incorporation into the project scope of work but are exempt.

1.5 Administration

1.5.1 Approval Requirements

Before the Town of Bluffton may issue a stormwater permit for any project requiring stormwater management, the Town of Bluffton must approve a Stormwater Management Plan (SWMP) meeting the requirements of the Southern Lowcountry Stormwater Ordinance and receive all fees required by the Town of Bluffton for site and building development plans.

A complete SWMP submittal includes a completed engineer's certification statement, a submittal checklist, plans and design that are signed and sealed by a registered professional engineer licensed in

South Carolina. Erosion and sediment control for sites below the thresholds set forth by South Carolina Department of ~~Health and~~ Environmental ~~Control~~Services (SC~~DHEC~~DES) National Pollutant Discharge Elimination System (NPDES) General Permit for Stormwater Discharges from Construction Activities (SCR100000) must obtain permit coverage under this stormwater permit. All construction stormwater permit applications above the SC~~DHEC~~DES thresholds are reviewed by the ~~DHEC~~DES Office of Coastal Resources Management (OCRM), or the reviews are delegated to the Town of Bluffton to determine compliance with the requirements of ~~SCDHEC's~~SCDES's NPDES General Permit for Stormwater Discharges from Construction Activities (SCR100000) ~~thresholds~~ and of the Construction Stormwater Pollution Prevention Plan (C-SWPPP). These permit applications must be approved, issued, and provided to Town of Bluffton prior to the issuance of the stormwater management plan approval.

1.5.2 Fees

An applicant is responsible for paying fees that provide for the cost of review, administration, and management of the stormwater permitting process and inspection of all projects subject to the requirements of the Town of Bluffton. These fees are posted by the Town of Bluffton as part of the Master Fee Schedule.

Chapter 2. Design, Review, & Permitting Process

2.1 Satisfying the Stormwater Management, Site Planning, & Design Criteria

2.1.1 Overview

This chapter presents a comprehensive set of site planning and design and post-construction criteria that must be applied to the Maximum Extent Practicable (MEP) to new development and redevelopment activities occurring within the Southern Lowcountry region. Satisfying these criteria promotes the systematic development of acceptable stormwater management plans, and a successful integration of natural resource protection and stormwater management through the site planning and design process (Example, Figure 2.1). Application of Better Site Design (BSD) principals within the jurisdictional limits of ~~t~~The Town of Bluffton shall be to the ~~Maximum Extent Practicable~~MEP. In the event of a conflict between requirements ~~between~~ among ~~Better Site Design~~BSD principals and the Unified Development Ordinance (UDO), the requirements of the ~~Unified Development Ordinance~~ UDO shall prevail and have precedence.

Through the consideration and implementation of ~~Better Site Design~~BSD principals to the MEP, as described in detail below, the integration of natural resource protection and stormwater management can be achieved by:

- Identifying and protecting valuable natural resources;
- Limiting land disturbance, new impervious cover, and disturbed pervious cover; and
- Reducing and managing post-construction stormwater runoff rates, volumes, and pollutant loads.

This approach involves the consideration and -use of two distinct, but complementary, groups of natural resource protection and stormwater management techniques:

- Green Infrastructure (GI) Practices: Natural resource protection and stormwater management practices and techniques (i.e., better site planning and design techniques, low impact development (LID) practices) that can be used to help prevent increases in post-construction stormwater runoff rates, volumes, and pollutant loads.
- Stormwater Management Practices: Stormwater management practices (e.g., wet ponds, swales) that can be used to manage post-construction stormwater runoff rates, volumes, and pollutant loads.

Natural resource protection and stormwater management techniques help control and minimize the negative impacts of the land development process while retaining and, perhaps, even enhancing a developer's vision for a development site. When applied during the site planning and design process, they can be used to create more natural and aesthetically pleasing development projects and create more cost-effective post-construction stormwater management systems (ARC, 2001). The consideration and use of these techniques, particularly the ~~green infrastructure~~GI practices, can even reduce overall development costs while maintaining or increasing the resale value of a development project (MacMullan and Reich, 2007; US EPA, 2007; Winer-Skonovd et al., 2006).

2.1.2 Better Site Design in the Planning Process

Better Site Design (BSD) refers to planning land development using certain principles to minimize stormwater impacts. Integral to ~~low impact development~~LID design, proper consideration and application of BSD principles can allow for smaller required stormwater BMP storage and retention volumes, and can help provide significant reductions in post-construction peak flows and pollutant loads. These principles include reduction/restoration of impervious cover, conservation of natural cover areas, stream restoration, and integration of both structural and non-structural stormwater management within site design. The principles of ~~Better Site Design~~BSD are referenced in the sections below.

Fundamental to the consideration and -application of ~~Better Site Design~~BSD is the correlation between impervious surface area in a watershed and negative impacts on receiving water resources. On a national level, the Impervious Cover Model (ICM) estimates stream quality based on percentage of impervious cover (Schueler and Fraley-McNeal, 2009). This model demonstrates that streams follow a continuous gradient of degradation in response to increasing impervious cover in a watershed. Local studies have supported this paradigm, and report that changes in the rate and volume of stormwater runoff were primary causes of ecological impairment in headwater tidal creeks, such as those found in Beaufort and Jasper Counties. These studies have shown that physical and chemical characteristics such as altered hydrography, increased salinity variance, increased chemical contaminants, and increased fecal coliform loadings of tidal creeks were negatively impacted with as little as 10 to 20% impervious cover. When impervious cover exceeded 30% of the watershed, measurable impacts to living resources were observed, indicating the ecological processes in the creek ecosystems were impaired (Holland et al., 2004).

Such findings are of consequence to Beaufort and Jasper Counties. Increasing pressure for development in response to population growth, and land development practices of the Lowcountry result in significant tree removal and loss of vegetative cover from land grading and storm pond construction and increases in impervious surfaces. According to the NOAA C-CAP Land Cover Analysis (https://coast.noaa.gov/ccapatlas/), from 1996 to 2010, the percent net increase in impervious surface area was 60% for Beaufort County and 59% for Jasper County. Table 2. 1. Summary of land cover changes in Southern Lowcountry from 1996 to 2010. below summarizes the findings of this NOAA report. Although the percentage of total wetlands lost is relatively low for both counties, the actual wetland types have been converted from palustrine forested wetlands to palustrine scrub/shrub and palustrine emergent wetlands, which may alter ecosystem processes and hydrology in these areas.

Table 2.1. Summary of land cover changes in Southern Lowcountry from 1996 to 2010.

	Beaufort County[1]			**Jasper County[1]**		
Land Cover %	**1996**	**2010**	**% Change**	**1996**	**2010**	**% Change**
Development	3.87	6.16	+59.12	1.62	2.52	+55.15
Forested Area	25.28	21.5	-14.98	62.50	48.37	-22.60
Wetlands	33.85	33.20	-1.93	45.24	44.74	-1.11

[1] Percent of County under each land cover type.

Given the rapid growth the Southern Lowcountry experienced in the past 20 years, the goals of ~~Better Sign Design~~BSD should resonate with those charged with managing stormwater and its release into the area watersheds. Succinctly, the goals of ~~Better Sign Design~~BSD include the following:

- Preventing stormwater impacts rather than mitigating them;
- Managing stormwater (quantity and quality) as close to the point of origin as possible and minimizing collection and conveyance;
- Utilizing simple, nonstructural methods for stormwater management that are lower cost and lower maintenance than structural controls;
- Creating a multifunctional landscape; and
- Using hydrology as a framework for site design.

The Center for Watershed Protection's Better Site Design Handbook outlines 22 model development principles for site design that act to reduce impervious cover, conserve open space, prevent stormwater pollution, and reduce the overall cost of development (CWP, 2017). The principles can provide notable reductions in post-construction stormwater runoff rates, volumes and pollutant loads (ARC, 2001). ~~Better Sign Design~~BSD across the country is implemented through review of existing planning and development codes, ~~and~~as well as streets, parking and stormwater engineering criteria. Within the context of a stormwater management document and this Southern Lowcountry Stormwater Design Manual ~~-~~(Manual), the ~~Better Sign Design~~BSD techniques of greatest application include protection of existing natural areas, incorporation of open space into new development, effective sediment and erosion control practices, and stormwater management that mimics natural systems. The following sections identify ~~Better Sign Design~~BSD techniques to be considered and applied to the MEP to the Southern Lowcountry Watershed Protection Areas and Special Watershed Protection Areas to help mitigate the effects of development to the watersheds. Therefore, the conservation principles below are part of an overall watershed approach to stormwater management and will complement the Watershed Protection Area approach in this Manual. Their application is subject to Town of Bluffton requirements and/or standards.

2.1.3 Natural Resources Inventory

The first step to conserve natural resources is properly documenting existing assets. An up-to-date natural resources inventory map can provide geospatial information for water resources, soils, sensitive natural resource areas, critical habitats, and other unique resources (Ellis et al., 2014).

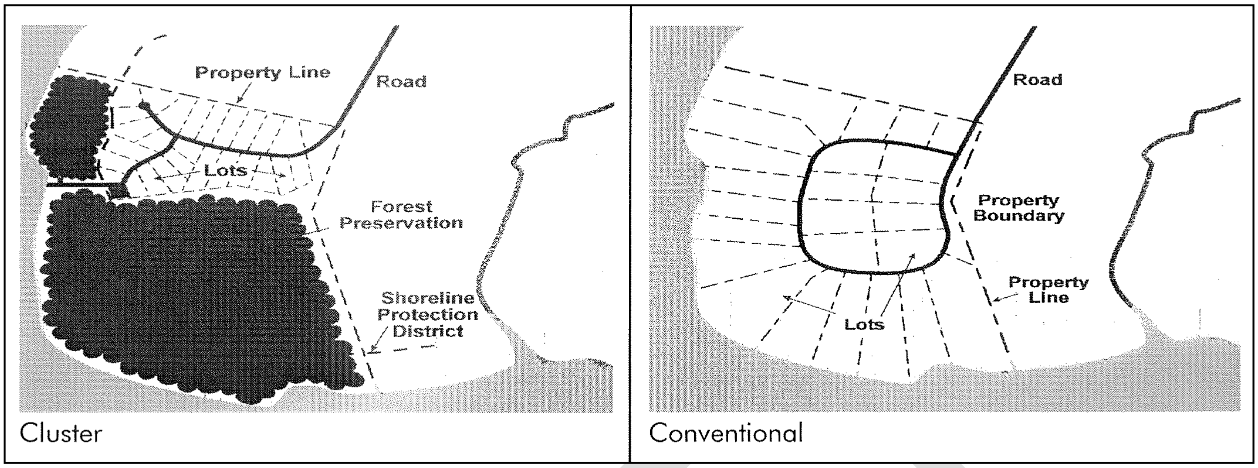
An application for new development requires a natural resources inventory prior to the start of any land disturbing activities. A natural resources inventory prepared by a qualified person shall be used to identify and map the most critical natural resources identified on the property that would be best to preserve, such as those listed in Table 2.2, as they exist predevelopment. Qualified persons include individuals with a working knowledge of hydrology, wetlands, plant taxonomy, and field survey methods. Qualified individuals include but are not limited to licensed foresters, professional wetland scientists, and geographic information professionals. A thorough assessment and narrative of the natural resources, both terrestrial and aquatic, found on a development site shall be submitted in the preliminary development application package and should represent and describe the efforts taken to preserve the most critical natural resources identified on the property and the most critical natural resources directly impacted by the proposed development.

Table 2.2. Resources to be identified and mapped during the Natural Resources Inventory.

Resource Group	Resource Type
General Resources	• Topography • Natural Drainage Divides • Natural Drainage Patterns • Natural Drainage Features (e.g., Swales, Basins, Depressional Areas) • Soils • Erodible Soils • Steep Slopes (e.g., Areas with Slopes Greater Than 15%) • Trees and Other Existing Vegetation
Freshwater Resources	• Rivers • Perennial and Intermittent Streams • Freshwater Wetlands
Estuarine Resources	• Tidal Rivers and Streams • Tidal Creeks • Coastal Marshlands • Tidal Flats • Scrub-Shrub Wetlands
Marine Resources	• Near Coastal Waters • Beaches
Groundwater Resources	• Groundwater Recharge Areas • Wellhead Protection Areas
Terrestrial Resources	• Dunes • Maritime Forests • Marsh Hammocks • Evergreen Hammocks • Canebrakes • Bottomland Hardwood Forests • Beech-Magnolia Forests • Pine Flatwoods • Longleaf Pine-Wiregrass Savannas • Longleaf Pine-Scrub Oak Woodlands
Other Resources	• Shellfish Harvesting Areas • Floodplains • Aquatic Buffers • Other High Priority Habitat Areas as described by South Carolina Department of Natural Resources

2.1.4 Conservation Development

Conservation development, also known as open space development or cluster development, is a site planning and design technique used to concentrate structures and impervious surfaces in a small portion of a development site, leaving room for larger conservation areas and managed open spaces elsewhere on the site (Example, Figure 2.1). Alternative lot designs are typically used to "cluster" structures and other impervious surfaces within these conservation developments.



Example, Figure 2.1. Conservation (i.e., cluster) development versus conventional development.

Conservation development projects provide a host of environmental benefits that are typically more difficult to achieve with conventional site design techniques. They provide for better natural resource protection on development sites and inherently limit increases in site imperviousness, sometimes by as much as 40 to 60 percent (CWP, 1998). Reduced site imperviousness results in reduced post-construction stormwater runoff rates, volumes and pollutant loads, which helps better protect both on-site and downstream aquatic resources from the negative impacts of the land development process. Reduced stormwater runoff rates, volumes and pollutant loads also help reduce the size of and need for storm drain systems and stormwater management practices on development sites.

As a number of recent studies have shown (MacMullan and Reich, 2007; US EPA, 2007; Winer-Skonovd et al., 2006), conservation development projects can also be significantly less expensive to build than more conventional development projects. Most of the cost savings can be attributed to the reduced amount of infrastructure (e.g., roads, sidewalks, post-construction stormwater management practices) needed on these development projects. And while these projects are frequently less expensive to build, developers often find that the lots located within conservation developments command higher prices and sell more quickly than those located within more conventional developments (ARC, 2001).

Table 2.3 provides suggestions for ~~Better Site Design~~BSD techniques that will help protect valuable resources such as buffers, trees, wetlands, and open space.

Table 2.3. Better Site Design principles for conservation.

Principle	Description
Vegetated Buffer System	Create a variable width, naturally vegetated buffer system along all streams that also encompasses critical environmental features such as the 100-year floodplain, steep slopes, and freshwater wetlands. *Recommended buffer widths are included in Table 3.2-4 in Ellis et al., 2014*
Buffer Maintenance	The riparian buffer should be preserved or restored with native vegetation that can be maintained through delineation, plan review, construction, and occupancy stages of development.
Clearing and Grading	Clearing and grading of forests and native vegetation should be limited to the minimum amount needed for lot construction, allow access, and provide fire protection. A fixed portion of any community open space should be managed as protected green space in a consolidated manner.
Tree Conservation	Conserve trees and other vegetation at each site by planting additional vegetation, clustering tree areas, and promoting the use of native plants. Wherever practical, manage community open space, street rights-of-way, parking lot islands, and other landscaped areas to promote natural vegetation.
Land Conservation	Open space development should be encouraged to promote conservation of stream buffers, forests, meadows, and other areas of environmental value. In addition, off-site mitigation consistent with locally-adopted watershed plans should be encouraged.
Stormwater Outfalls	New stormwater outfalls should not discharge unmanaged into jurisdictional wetlands, sole-source aquifers, or sensitive areas.

2.1.5 Residential Streets & Parking Lots

Up to 65% of the total impervious cover in a watershed can be ~~the~~ attributed to streets, parking lots, and driveways (CWP, 1998). Table 2.4 describes ~~Better Site Design~~BSD principles related to techniques to be considered to reduce the impervious surfaces associated with these hardscapes.

Table 2.4. Better Site Design principles for streets and parking to meet Town of Bluffton requirements.

Principle	Description
Street Width	Design residential streets for the minimum required pavement width needed to support travel lanes; on-street parking; and emergency, maintenance, and service vehicles.
Street Length	Reduce the total length of residential streets by examining alternative street layouts to determine the best option for increasing the number of homes per unit length.
Right-of-Way Width	Wherever possible, residential street right-of-way widths should reflect the minimum required to accommodate the travel-way, the sidewalk, and vegetated open channels. Utilities and storm drains should be located within the pavement section of the right-of-way wherever feasible.

Cul-de-sacs	Minimize the number of residential cul-de-sacs and incorporate landscaped areas to reduce their impervious cover. The radius of cul-de-sacs should be the minimum required to accommodate emergency and maintenance vehicles. Alternative turnarounds should be considered.
Vegetated Open Channels	Where density, topography, soils, and slope permit, vegetated open channels should be used in the street right-of-way to convey and treat stormwater runoff.
Parking Ratios	The required parking ratio governing a particular land use or activity should be enforced as both a maximum and a minimum in order to curb excess parking space construction. Existing parking ratios should be reviewed for conformance, taking into account local and national experience to see if lower ratio is warranted and feasible.
Parking Lots	Reduce the overall imperviousness associated with parking lots by providing compact car spaces, minimizing stall dimensions, incorporating efficient parking lanes, and using pervious materials in spillover parking areas.
Structured Parking	Utilize structured (e.g., parking garage) and shared parking to reduce impervious surface area.
Parking Lot Runoff	Wherever possible, provide stormwater treatment for parking lot runoff using bioretention areas, filter strips, and/or other practices that can be integrated into required landscaping areas and traffic islands.

2.1.6 Lot Development Principles to Meet Requirements

Development of lots follows similar guidelines for reducing impervious cover and protecting natural areas, such as open space. Table 2. 5 summarizes ~~Better Site Design~~BSD principles to be considered for lot development. Preserving open space is critical to maintaining water quality at the regional level. Compared to traditional development, open space development can reduce the annual runoff volume from a site by 40%–60%, nitrogen loads by 42%–81%, and phosphorus loads by 42%–69% (CWP, 1998). Large, continuous areas of open space reduce and slow runoff, absorb sediments, serve as flood control, and help maintain aquatic communities. Open space can be provided by minimizing lot sizes, setbacks, and frontage distances.

Table 2.5. Better Site Design principles for lot development.

Principle	Description
Open Space Development	Utilize open space development that incorporates smaller lot sizes to minimize total impervious area, reduce total construction costs, conserve natural areas, provide community recreational space, and promote watershed protection.
Setbacks and Frontages	Consider minimum setbacks allowed by Town of Bluffton. Relax side yard setbacks and allow narrower frontages to reduce total road length in the community and overall site imperviousness. Relax front setback requirements to minimize driveway lengths and reduce overall lot imperviousness.
Sidewalks	Where practical, consider locating sidewalks on only one side of the street and providing common walkways linking pedestrian areas.

Driveways	Reduce overall lot imperviousness by promoting alternative driveway surfaces and shared driveways that connect two or more homes together.
Rooftop Runoff	Direct rooftop runoff to pervious areas such as yards, open channels, or vegetated areas and avoid routing rooftop runoff to the roadway and the stormwater conveyance system.
Open Space Management	Clearly specify how community open space will be managed and designate a sustainable legal entity responsible for managing both natural and recreational open space.

For more detailed descriptions of these techniques, please reference *Better Site Design: A Handbook for Changing Development Rules in Your Community* (CWP, 1998) and Chapter 3 of *Low Impact Development in Coastal South Carolina: A Planning and Design Guide* (Ellis et al., 2014).

2.1.7 Site Planning & Design Process

Figure 2.2 depicts the site planning and design process that is ~~captured in *Low Impact Development in Coastal South Carolina: A Planning and Design Guide* (Ellis et al., 2014)~~ applicable to the Town of Bluffton. The site planning and design checklist of the ~~Southern Lowcountry Design~~ Manual does not make each of the phases of the process a submittal requirement. The checklist, however, gives the Town of Bluffton the opportunity to determine whether each of these steps have been adequately considered. The actual document submittal begins with the ~~Stormwater Concept Plan,~~ Preliminary Development Plan application and submittal package when considered in context of the planning process below:

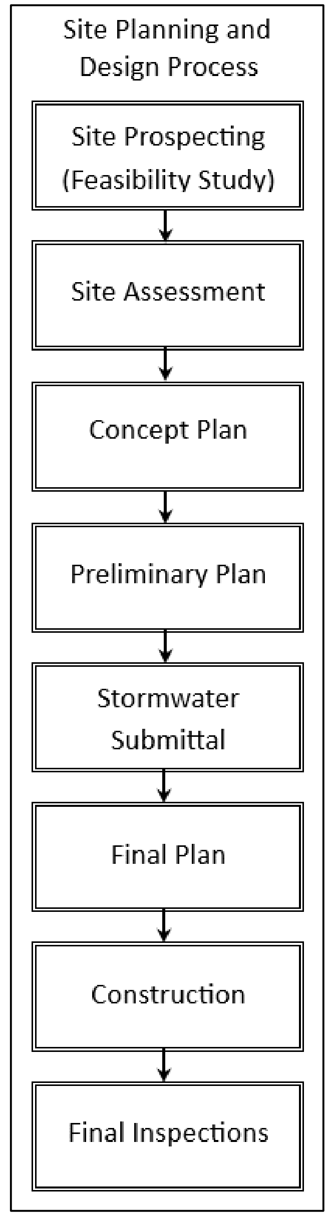


Figure 2.2. Site planning & design process (source: Center for Watershed Protection, Inc.)

- Site Prospecting: During the site prospecting phase, some basic information is used to evaluate the feasibility of completing a development or redevelopment project. A *feasibility study* is typically used to evaluate the many factors that influence a developer's decision about whether or not to move forward with a potential development project. Factors that are typically evaluated during a *feasibility study* include information about site characteristics and constraints, applicable local, state and federal stormwater management and site planning and design requirements, adjacent land uses and access to local infrastructure (e.g., water, sanitary sewer).

- Site Assessment: Once a potential development or redevelopment project has been deemed feasible, a more thorough assessment of the development site is completed. The site assessment, which is typically completed using acceptable site reconnaissance and surveying techniques, provides additional information about a development site's characteristics, its natural resource inventory and constraints. Once the assessment is complete, a developer can identify and analyze the natural, man-made, economic and social aspects of a potential development project, define the actual buildable area available on the development site and begin making some preliminary decisions about the layout of the proposed development project.

- Concept Plan: The results of the site assessment are typically used to create a concept plan (also known as a *sketch plan*) for the proposed development project and ~~it~~ is provided during the~~a~~ pre-application meeting. A concept plan is used to illustrate the basic layout of the proposed development project, including lots and roadways, and post-construction stormwater management system layout. ~~Geotechnical investigations have been performed to obtain necessary information to determine certain feasibilities of the proposed development.~~ This concept is usually reviewed with the local development review authority on a very surface level before additional resources are used to create a more detailed plan of development. During this phase, several alternative concept plans can be created and compared with one another to craft a plan of development that best “fits” the character of the development site (~~Example~~ Example, Figure 2.3, ~~Example~~ Example, Figure 2.4, and ~~Example~~ Example, Figure 2.5). ~~It is at this point in the planning and design process that a Maximum Extent Practicable (MEP) demonstration described in Section 3.9 is intended and recommended to be provided for development projects seeking MEP considerations.~~

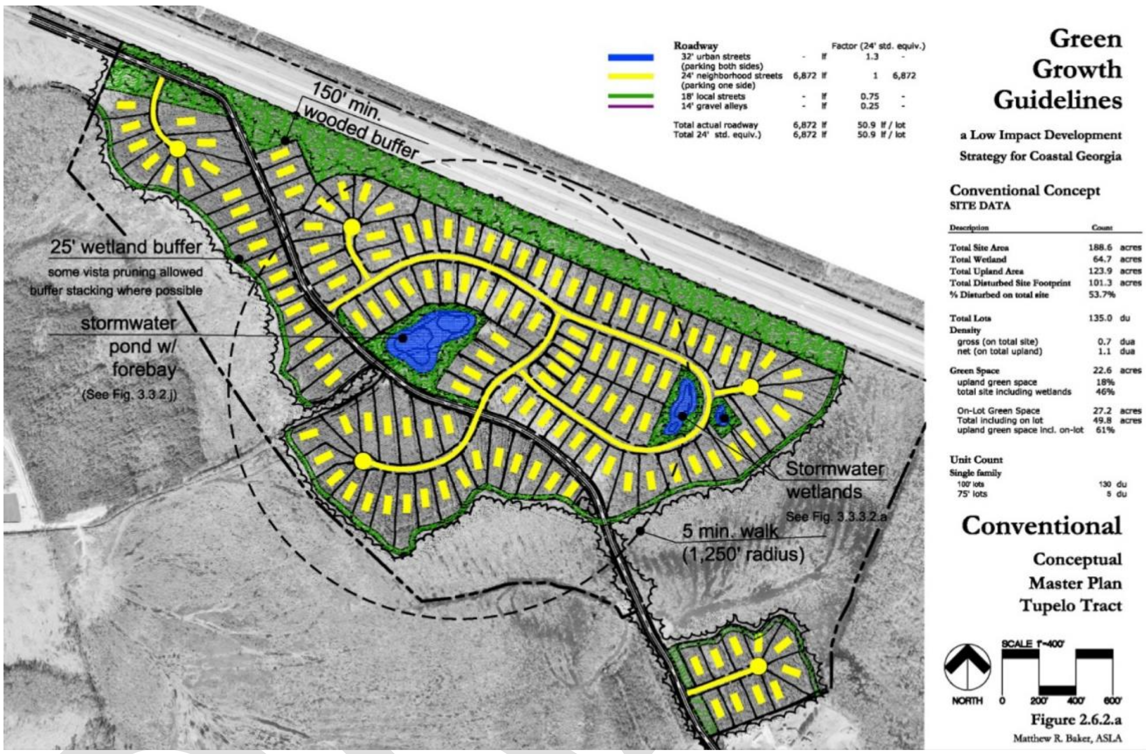
- Preliminary Plan: A preliminary plan presents a more detailed layout of a proposed development project. It typically includes information about lots, buildings, roadways, parking areas, sidewalks, conservation areas, utilities and other infrastructure, including the post-construction stormwater management system. Soil information has been obtained through sources such as USDA Natural Resources Conservation Service (NRCS) or another source acceptable to the Town of Bluffton to estimate certain feasibilities. After the preliminary plan has been reviewed and approved by the local development review authority, a final plan may be prepared. There may be several iterations of the preliminary plan between the time that it is submitted and the time that it is approved by the local development review authority.

- Stormwater Submittal: Geotechnical investigations have been performed to obtain necessary information to determine certain feasibilities of the proposed development. It is at this point in the planning and design process that an MEP demonstration described in Section 3.11 is intended and recommended to be provided for development projects seeking MEP considerations. There may be several iterations of the stormwater submittal between the time that it is submitted and the time that it is approved by the local development review authority. Once the stormwater submittal has been reviewed and conditionally approved, Town staff issue the MS4 Approval to SCDES.

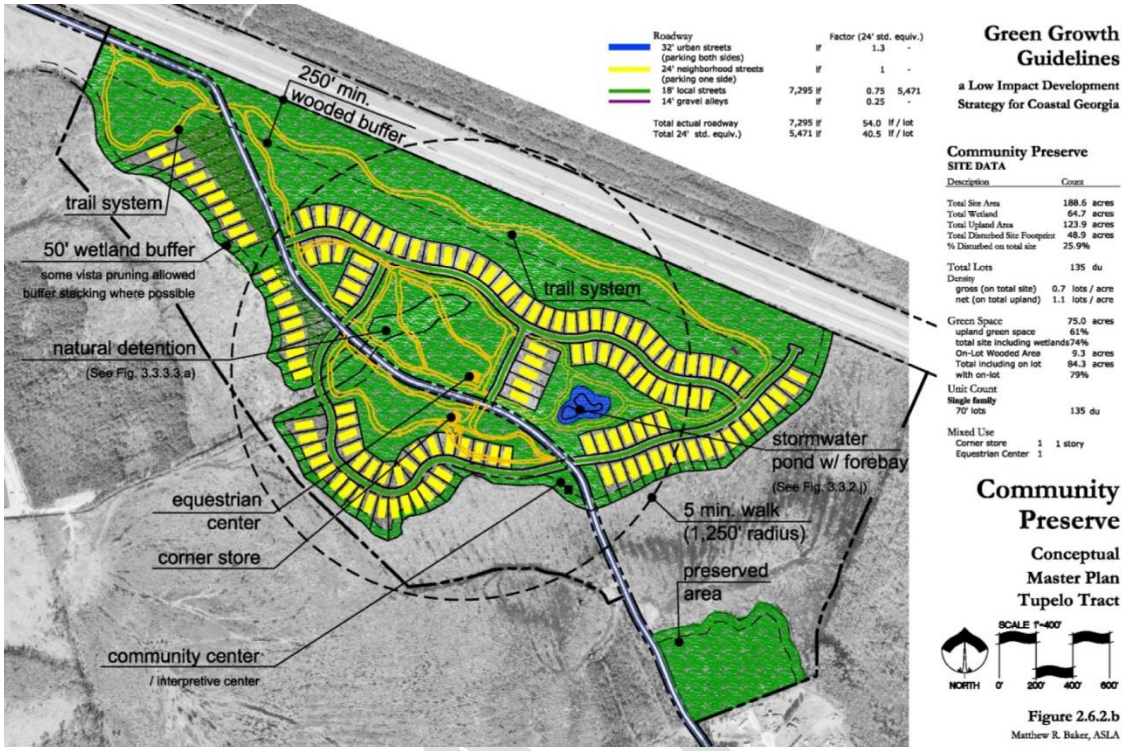
- Final Plan: The final plan adds further detail to the preliminary plan and stormwater submittal and reflects any changes to the plan of development that were requested or required by the local development review authority. The final plan typically includes all of the information that was included in the preliminary plan, as well as information about landscaping, pollution prevention, erosion and sediment control and long-term operation and maintenance of the site’s post-construction stormwater management system. There may be several iterations of the final plan between the time that it is submitted and the time that it is approved by the local development review authority.

- Construction: Once the final plan has been reviewed and approved, performance bonds are set and placed, contractors are retained, and construction begins. During the construction phase, a development project may be inspected on a regular basis by the local development review authority to ensure that all roadways, parking areas, buildings, utilities and other infrastructure, including the post-construction stormwater management system, are being built in accordance with the approved final plan and that all primary and secondary conservation areas have been protected from any land disturbing activities.

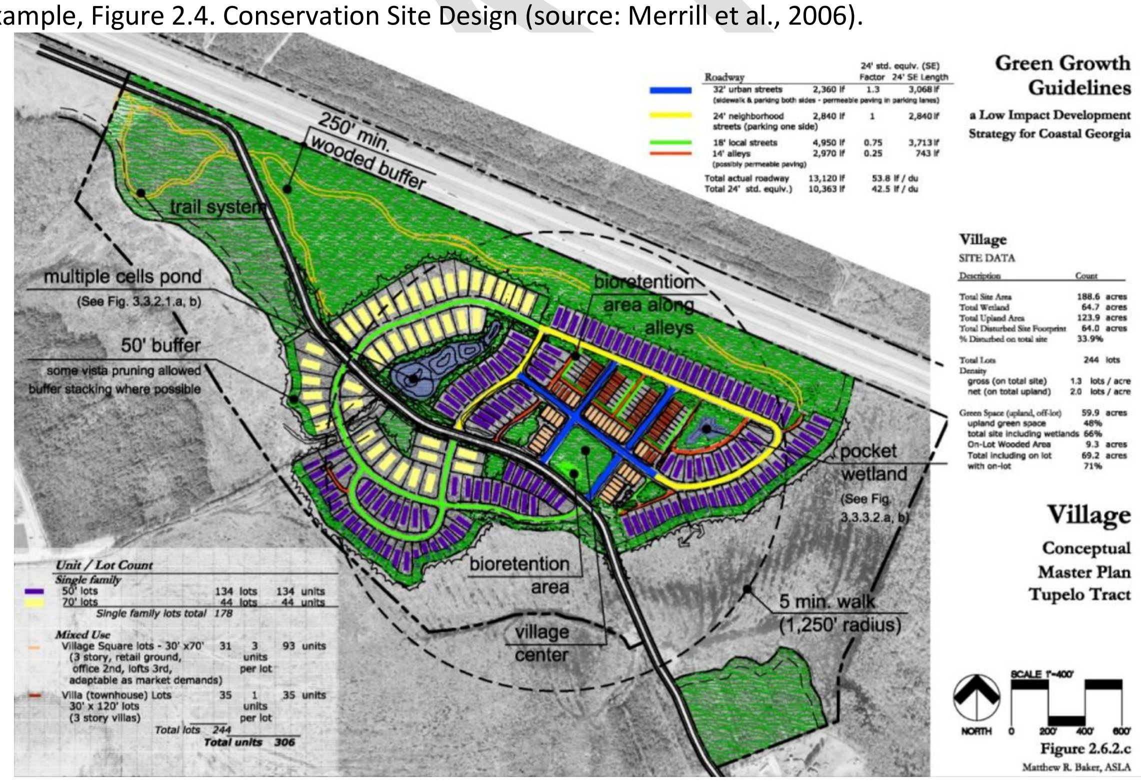
- Final Inspections: Once construction is complete, final inspections take place to ensure that all roadways, parking areas, buildings, utilities and other infrastructure, including the post-construction stormwater management system, were built according to the approved final plan. As-built plans are also typically prepared and executed during this phase. If a development project passes all final inspections, an occupancy permit may be issued for the project.



Example, Figure 2.3. Conventional Site Design (source: Merrill et al., 2006).



Example, Figure 2.4. Conservation Site Design (source: Merrill et al., 2006).



Example, Figure 2.5. New Urbanist Site Design (source: Merrill et al., 2006).

2.1.8 Integrating Natural Resource Protection & Stormwater Management with the Site Planning & Design Process Town of Bluffton Development Plan Review and Stormwater Approval Process

In order to successfully consider and *integrate* to the MEP natural resource protection and stormwater management with the site planning and design process, site planning and design teams are encouraged to consider following questions at the beginning of the process:

- What valuable natural resources, both terrestrial and aquatic, can be found on the development site?
- How can better site planning techniques be used to protect these valuable natural resources from the direct impacts of the land development process?
- How can better site design techniques be used to minimize land disturbance and the creation of new impervious and disturbed pervious cover?
- What ~~low impact development~~LID practices can be used to help preserve pre-development site hydrology and *reduce* post-construction stormwater runoff rates, volumes and pollutant loads?
- What stormwater management practices can be used to *manage* post-construction stormwater runoff rates, volumes and pollutant loads?
- Are there any site characteristics or constraints that prevent the use of any particular ~~low impact development~~LID or stormwater management practices on the development site?

Although answering these questions is no easy task, they can be readily obtained within the context of the six-step *stormwater management planning and design process* outlined in Figure 2.6, and the steps are described in more detail below.

- **Step 1: Pre-Application Meeting**

It is recommended that a pre-application meeting between the applicant's site planning and design team and the Town of Bluffton development review authority occur at the very beginning of the stormwater management planning and design process. This meeting, which should occur during the site prospecting phase of the overall site planning and design process (Figure 2.6), helps establish a relationship between the site planning and design team and the Town of Bluffton development review authority. The pre-application meeting also provides an opportunity to discuss the local site planning and stormwater management design criteria that will apply to the proposed development project, which increases the likelihood that the remainder of the site planning and design process will proceed both quickly and smoothly.

- **Step 2: Review of Local, State, and Federal Stormwater Management, Site Planning, & Design Requirements**

Once a pre-application meeting has been completed, it is recommended that the site planning and design team review the local, state and federal requirements that will apply to the proposed development project. This review should occur during the site prospecting phase of the overall site planning and design process (Figure 2.6), while the feasibility study is still being completed.

During their review of stormwater management and site planning and design requirements, the applicant's site planning and design teams should also investigate opportunities and incentives for land conservation, and opportunities and incentives for conservation development as illustrated earlier in Example, Figure 2.1.

- **Step 3: Natural Resources Inventory**

Once the potential development or redevelopment project has been deemed feasible, acceptable site reconnaissance and surveying techniques must be used to complete a thorough assessment of the natural resources, both terrestrial and aquatic, found on the development site. The identification and subsequent preservation and/or restoration of these natural resources helps reduce the negative impacts of the land development process “by design.” The natural resources inventory should be completed during the site assessment phase of the overall site planning and design process. A map that is created to illustrate the results of the natural resources inventory, known as a site fingerprint, should be used to prepare a stormwater management concept plan for the proposed development project.

Once the natural resources inventory has been completed and a site fingerprint has been created, the site planning and design team should have a better understanding of a development site’s characteristics and constraints. This information can be used to identify primary and secondary conservation areas (~~Example~~ Example, Figure 2.7. Buildable Area and Primary/Secondary Conservation Areas (source: Merrill et al., 2006).) and define the actual buildable area available on the development site. Along with information about adjacent land uses and available infrastructure (e.g., roads, utilities), the site fingerprint can also be used to make some preliminary decisions about the layout of the proposed development project and to guide the creation of the stormwater management concept plan.

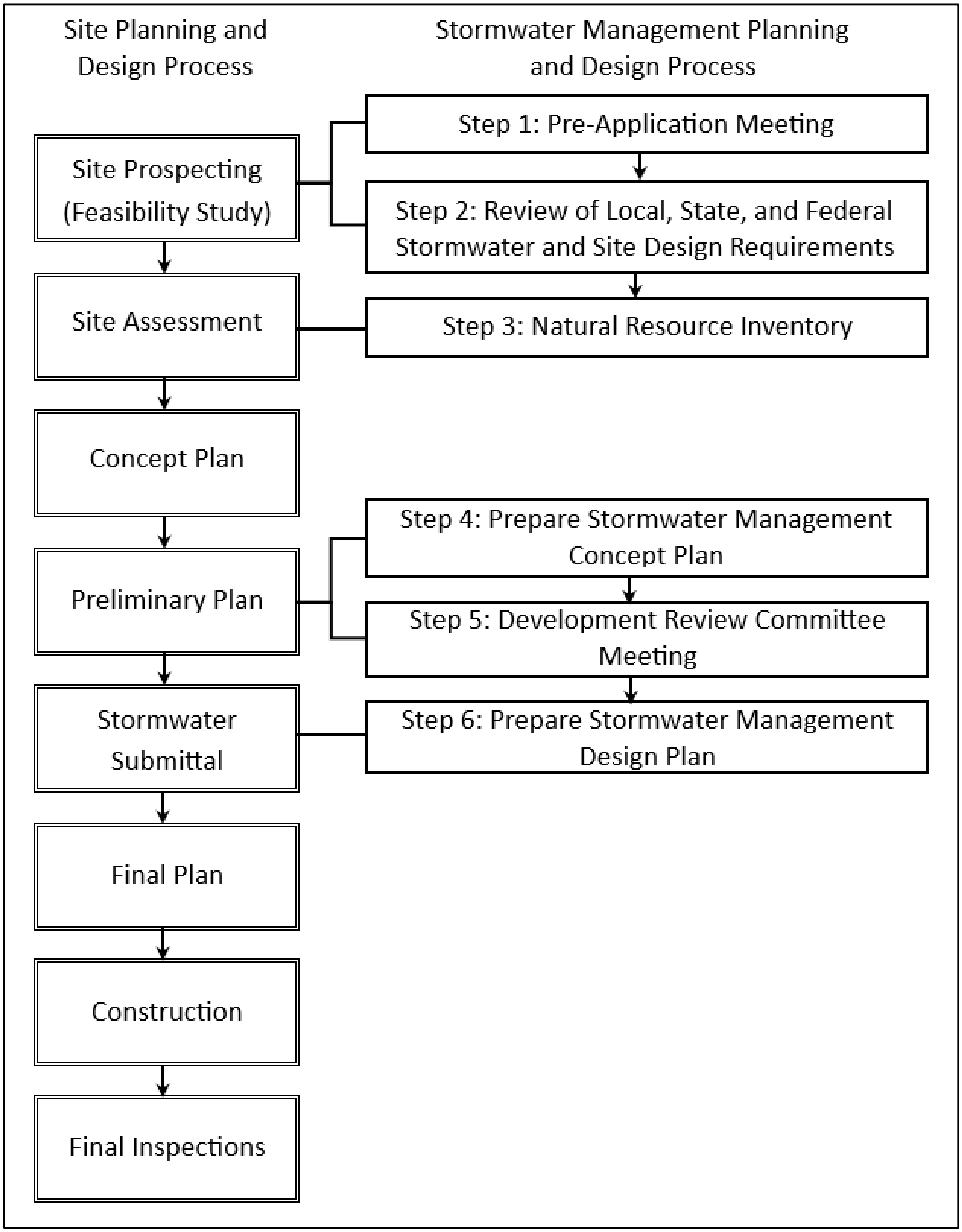
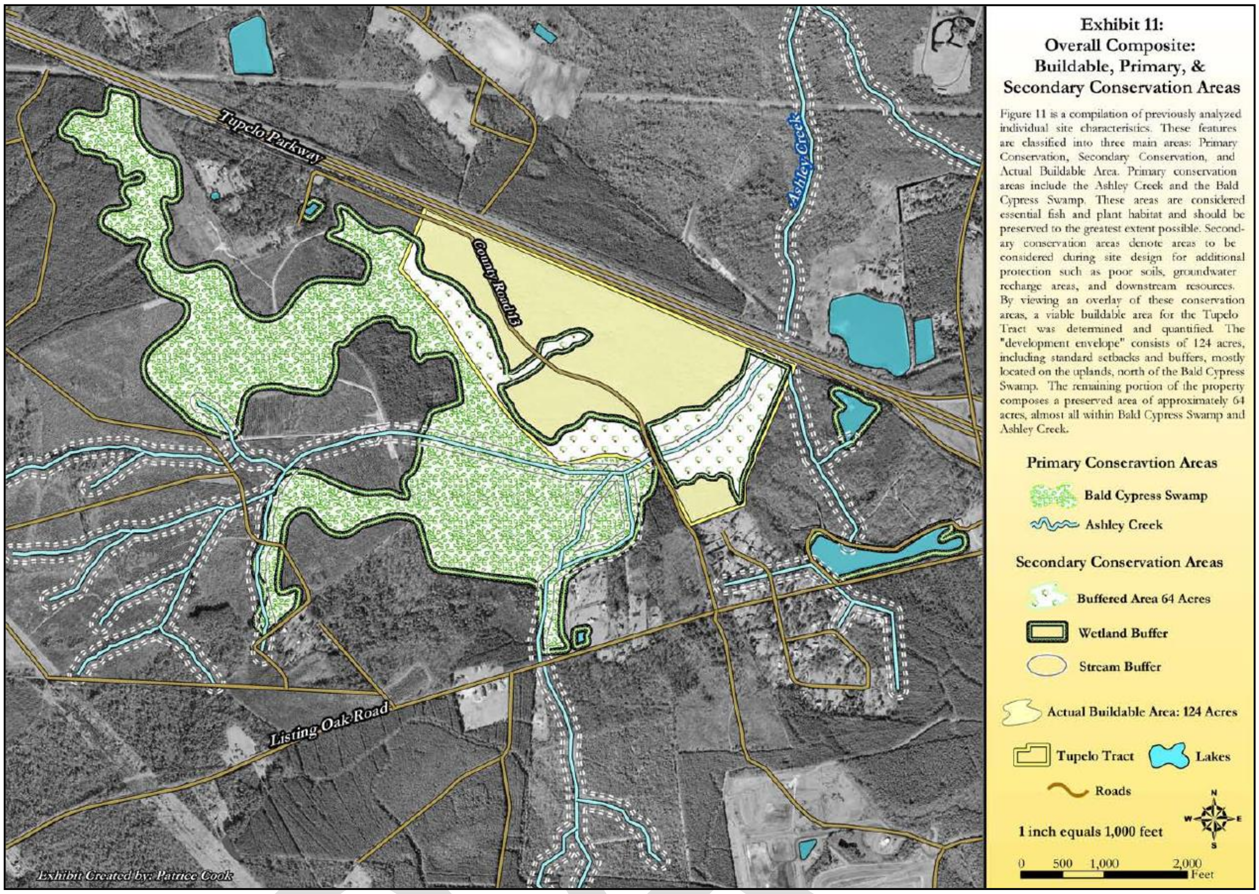


Figure 2.6. Integrating Natural Resource Protection & Stormwater Management with the Site Planning & Design Process (source: Center for Watershed Protection, Inc.).



Example, Figure 2.7. Buildable Area and Primary/Secondary Conservation Areas (source: Merrill et al., 2006).

- **<u>Step 4: Prepare Stormwater Management Concept Plan</u>**

After the natural resources inventory has been completed, it is recommended that the site fingerprint be used to develop a stormwater management concept plan for the proposed development project. The stormwater management concept plan should illustrate the layout of the proposed development project and should show, in general, how post-construction stormwater runoff will be managed on the development site. Geotechnical investigations have been performed to obtain necessary information to determine certain feasibilities of the proposed development and stormwater concept plan.

The creation of a stormwater management concept plan allows the applicant's site planning and design team to make some preliminary decisions about the layout of the proposed development project in meeting the requirements of the Manual. Once the stormwater management concept plan is completed it can also be used to solicit early discussions and feedback with the Town of Bluffton review authority on the stormwater management practices that will be used to manage post-construction stormwater runoff on the development site. Submittal, review and discussions with the Town of Bluffton review authority of the stormwater management concept plan are required prior to proceeding with submittal to Town of Bluffton as part of the ~~Development~~ <u>Preliminary Development</u> Plan approval process and is particularly relevant in cases where MEP considerations may be sought by the Owner/applicant and in meeting the requirements of 3.9.

During the creation of the stormwater management concept plan, most of the site layout, including the layout of lots, buildings, roadways, parking areas, sidewalks and ~~green infrastructure~~GI and stormwater management practices, will be completed. Therefore, it is very important that natural resource protection and stormwater management be considered throughout this part of the stormwater management planning and design process.

The Stormwater Concept Plan shall consider and include, but not be limited to, the following:

- A current Natural Resources Inventory identifying natural resources within the site at time of application. A thorough assessment and narrative of the natural resources, both terrestrial and aquatic, found on the development site.
- Better Site Design (BSD) principals have been evaluated, considered, and incorporated to the maximum extent practicable.
- Post development stormwater management facilities/systems to address stormwater runoff volume, rate, quality, off-site discharge points, evaluation of downstream conveyance from off-site discharge points for safe/adequate conveyance capacity and downstream study point for Extreme Flood, 10% Rule analysis. Preliminary calculations to determine feasibility of plan submitted.

- **Step 5: ~~Development Preliminary Plan Submittal, Review, Approval~~Development Review Committee Meeting**

Once a stormwater management concept plan has been created, the applicant's site planning and design team shall submit a Preliminary Development Plan Application and submit requisite documentation to the Town of Bluffton ~~development review authority~~Development Review Committee. This application and submission, which should occur after completion of the stormwater management concept plan, provides an opportunity to discuss the proposed development project and the approach that was used to satisfy the stormwater management and site planning and design criteria that apply to the development site. Geotechnical investigations have been performed to obtain necessary information to determine certain feasibilities of the proposed development. It may be advantageous for a consultation meeting to take place on the development site after the application and plan submittal, but prior to approval. This meeting can be used to verify site conditions and feasibility of the proposed stormwater management concept plan and development. Comments, if any, pertaining to the Preliminary Development Plan submittal are heard at the Development Review Committee Meeting. The Stormwater Concept Plan components of the Preliminary Development ~~Preliminary~~ Plan Application shall include, but not be limited to, the following:

- A current Natural Resources Inventory identifying natural resources within the site at time of application. A thorough assessment and narrative of the natural resources, both terrestrial and aquatic, found on the development site. Represent and describe the efforts taken to preserve the most critical natural resources identified on the property and the most critical natural resources directly impacted and to be removed by the proposed development.
- Better Site Design (BSD) principals have been evaluated, considered, and incorporated to the maximum extent practicable. A thorough assessment and narrative of the ~~Better Site Design~~BSD Principals considered and employed within the proposed Preliminary

Development ~~Preliminary~~ Plan submittal package and ~~Better Site Design~~BSD Principals considered and found to be not feasible and reasons why.

  - Post-development stormwater management facilities/systems to address stormwater runoff volume, rate, quality, off-site discharge points, evaluation of downstream conveyance from off-site discharge points for safe/adequate conveyance capacity and downstream study point for Extreme Flood, 10% Rule analysis. Preliminary calculations to determine feasibility of plan submitted.

It is at this point in the planning and design process that a Maximum Extent Practicable (MEP) demonstration described in Section 3.~~9~~11 is intended for the proposed development project. In cases where MEP considerations are being sought by the applicant, the applicant shall review and understand the requirements of 3.~~9~~11 and shall provide and present required information to determine if MEP applies to the proposed development site, and if so, to what to degree for Town of Bluffton consideration, review and approval. The Preliminary Development Plan Application and Stormwater Management Concept Plan must be Approved or Approved with Conditions prior to proceeding with the Town of Bluffton Development Plan approval process.

- **Step 6: Prepare Stormwater Management Design Plan**

Subsequent to review and approval of the Preliminary Development Plan and Stormwater Management Concept Plan, the site planning and design team should prepare a stormwater management design plan. The stormwater management design plan should detail how post-construction stormwater runoff will be managed on the development site and should include maps, narrative descriptions and design calculations (e.g., hydrologic and hydraulic calculations) that show how the stormwater management and site planning and design criteria that apply to the development project have been met. The stormwater management design plan should be submitted to the Town of Bluffton development review authority by way of the Stormwater Management Plan Application, with requisite documentation, for review and approval.

Stormwater Management Design Plan conditional approval is required prior to Applicant proceeding to Town of Bluffton's Development Final Plan approval process. Final Stormwater approval and Permit ~~is issued~~issuance occurs once all administrative requirements, County/ State/Federal permits (as required) have been obtained and submitted, and ~~other~~ requirements of the UDO and ~~Design~~ Manual have been ~~meet~~met, but prior to ~~Development~~ Final Development Plan approval.

2.2 Submittal & Review Process of Stormwater Management Plans

The Stormwater Management Plan (SWMP) consists of the entire submittal package and includes the following components:

- Project description and narrative;
- Description of selected stormwater management systems;
- Erosion and sediment control plans;
- Sufficient information to evaluate the environmental characteristics of the affected areas, the potential impacts of the proposed development on water resources, the effectiveness and acceptability of stormwater best management practices (BMPs), and land covers (Appendix R) for managing stormwater runoff;
- Supporting computations and drawings; and

- Construction, inspection, and maintenance schedules.

All SWMPs must include the Stormwater submittal checklist (Appendix D) and calculations summary. The ~~plans~~SWMP must include the calculated stormwater retention volume (SWRv) for each BMP and for the overall project, ~~the~~a pre- and post-development peak flow comparison, extreme flood requirements, 10% rule analysis, and any off-site retention or detention volume obligation.

The SWMP and accompanying documentation shall be submitted electronically according to the Town of Bluffton process, carrying the stamp of a registered professional engineer licensed in the State of South Carolina with all supporting documentation to Town of Bluffton.

Upon acceptance of a complete application (which includes payment of filing fees), the Town of Bluffton will review the SWMP and make a determination to approve~~,~~ or disapprove the SWMP. Relatively large and/or complicated projects tend to require a longer review time than smaller and less complicated projects. A written response of approval or disapproval will be provided to the applicant. If it is determined that more information is needed or that a significant number of changes must be made before the SWMP can be approved, the applicant must resubmit the applications with the required revisions ~~required and~~that have been certified by ~~the~~a registered professional engineer according to the plan resubmittal process of the Town of Bluffton. A final SWMP a~~A~~pproval results in the issuance of a Stormwater P~~p~~ermit associated with the Development. ~~and a~~A Stormwater ~~p~~Permit approval is required prior to proceeding ~~to~~ with the Town of Bluffton ~~development review authority~~Final Development Plan a~~A~~pproval process.

When a SWMP approval is granted, a final submission package is required, including the following:

- One PDF copy of the SWMP, certified by a registered professional engineer licensed in the State of South Carolina,
- A fully executed declaration of covenants for each BMP and Conservation Area/Tree credit area identified on the SWMP that has been approved for legal sufficiency by the Town of Bluffton, and
- All supporting documents specified within this Manual or as requested during the review process according to the Town of Bluffton requirements.

2.2.1 Components of a Stormwater Management Plan

As itemized in the SWMP Design ~~c~~Checklist in Appendix D~~ Design Checklists~~, a SWMP includes the following:

Site Plan

The following information must be formatted to print as a standard drawing size of 24 by 36 inches. The site drawing will provide details of existing and proposed conditions:

- ~~A cover page that contains a blank space measuring 7 inches wide by 9.5 inches high. The blank space must be located 1 inch below the top edge and 1 inch from the left edge of the page;~~
- A plan showing all property boundaries and the complete address of the property;
- Lot number or property identification number designation (if applicable);
- North arrow, scale, and date;
- Property lines (include ~~longitude and latitude~~distance and bearings);

- Location of easements (if applicable);
- Existing and proposed structures, utilities, roads, and other paved areas;
- Existing and proposed topographic contours;
- Soil information for design purposes;
- Limits ~~Area(s)~~ of soil disturbance (LOD) shown on all plan sheets;
- Drainage area(s) within the ~~limits of disturbance (~~LOD~~)~~ and contributing to the LOD;
- Contributing drainage area (CDA) to each BMP;
- Location(s) of BMPs, marked with the BMP ID Numbers to agree with ~~the~~a BMP design summary list;
- Cross sections for each BMP;
- Necessary design details for each BMP, material descriptions, including inlets, outlets, and overflow structures;
- Delineation of existing and proposed land covers (Appendix R) including natural cover, compacted cover, and impervious surfaces. Consult Appendix G – Compliance Calculator Instructions for details;
- A landscaping plan, including specific planting plans for each proposed BMP;
- Natural resources inventory with site fingerprint map;
- All plans and profiles must be drawn at a scale of 1 in. = 10 ft, 1 in. = 20 ft, 1 in. = 30 ft, 1 in. = 40 ft, 1 in. = 50 ft, or 1 in. = 100 ft. Although, 1 in. = 10 ft, 1 in = 20 ft, and 1 in. = 30 ft, are the most commonly used scales. Vertical scale for profiles must be 1 in. = 2 ft, 1 in. = 4 ft, 1 in. = 5 ft, or 1 in. = 10 ft;
- Drafting media that yield first- or second-generation, reproducible drawings with a minimum letter size of No. 4 (1/8 inch);
- Location and size of existing utility lines including gas lines, sanitary lines, telephone lines or poles, electric utilities and water mains;
- A legend identifying all symbols used on the plan;
- Applicable flood boundaries and FEMA map identification number for sites lying wholly or partially within the 100-year floodplain;
- Site development plan and stormwater management narrative;
- Assess potential application of ~~green infrastructure~~GI practices in the form of better site planning and design techniques. ~~Low impact development~~LID practices should be used to the ~~maximum extent practicable~~MEP during the creation of a stormwater management concept plan. A demonstration of better site planning is required. The following site information and practices shall be considered:
    - Soil type(s) (from Soil Study);
    - Depth(s) of ground water on site;
    - Whether the type of development proposed is a hotspot as defined by the ~~Ordinance~~UDO and ~~Design~~ Manual and address how this influences the concept proposal;
    - Protection of primary and secondary conservation areas;
    - Reduced clearing and grading limits;
    - Reduced roadway lengths and widths;
    - Reduced parking lot and building footprints to minimize impervious surface;
    - Soil restoration;
    - Site reforestation/revegetation;
    - Impervious area disconnection;
    - Green roof (for redevelopment, infill and major substantial improvement projects); and

    - Permeable pavements.
- Stormwater Pollution Prevention Plan (SWPPP) or Erosion and Sediment Control narrative (for projects disturbing over an acre);
- Information regarding the mitigation of any off-site impacts anticipated as a result of the proposed development;
- Construction specifications;
- Design ~~and As-Built~~ Certification, including the following:
    i Design Certification by a registered professional engineer licensed in the State of South Carolina seal that engineering features of all stormwater best management practices (BMPs), stormwater infrastructure, and land covers (collectively the "Facility") have been designed/examined by me and found to be in conformity with the standard of care applicable to the treatment and disposal of stormwater pollutants. The Facility has been designed in accordance with the specifications required under the ~~Unified Development Ordinance~~UDO of the Town of Bluffton. ~~Note these changes were made to be consistent with language of 2.2.3~~

    ~~ii As-Built Certification and submission shall include one set of the As-Built drawings sealed by a registered professional engineer licensed in the State of South Carolina within 21 days after completion of construction of the site, all BMPs, land covers, and stormwater conveyances. The Engineer shall certify as-built SWMPs and state that "all activities including clearing, grading, site stabilization, the preservation or creation of pervious land cover, the construction of drainage conveyance systems, the construction of BMPs, and all other stormwater-related components of the project were accomplished in strict accordance with the approved SWMP and specifications and function as designed. Furthermore, to the best of my knowledge and belief this As-Built truly represents existing field conditions including but not limited to sizes, diameters, dimensions, depth, horizontal location, line and grade, and elevation" (this comes from right before 2.3).~~

    ~~iii For a project consisting entirely of work in the public right-of-way (PROW), the submission of a Record Drawing certified by an officer of the project contracting company is acceptable if it details the as-built construction of the BMP and related stormwater infrastructure.~~
- Maintenance sheet for stormwater BMPs, including the following:
    i A maintenance plan that identifies routine and long-term maintenance needs and a maintenance schedule;

    ii A ~~m~~Maintenance ~~a~~Agreement (Appendix O) and schedule for all post-construction best management practices in a form and manner that meets the Town of Bluffton requirements.

    iii For applicants using Rainwater Harvesting, submission of third-party testing of end-use water quality may be required at equipment commissioning as determined by the requirements in Appendix J – Rainwater Harvesting Treatment and Management Requirements. Additional regular water quality reports certifying compliance for the life of the BMP may also be required in Appendix J – Rainwater Harvesting Treatment and Management Requirements. Irrigation re-use systems must have a submitted and approved Operations and User's Manual describing: 1) design assumptions of system including daily, weekly, monthly, annual, output requirements, 2) system layout in schematic drawing showing control panel, irrigation zones, irrigation line(s) and head(s) locations, 3) narrative of operation set-up and troubleshooting, and 4) system component maintenance requirements and frequency as monthly, quarterly and annual.

Stormwater Retention Volume Computations

The following summary calculations must be included on the plan set. Supporting documentation and the South Carolina ~~DHEC~~DES C-SWPPP are not in the plan set but provided separately.

- Calculation(s) of the required SWRv for the entire site within the LOD and each site drainage area (SDA) and contributing drainage area (CDA) within the LOD, as determined using the SWRv Compliance Calculator;
- Calculation(s) for each proposed BMP demonstrating storage volume provided and retention value achieved towards SWRv in accordance with Chapters 2 and 4;
- For Rainwater Harvesting BMP, calculations demonstrating the annual water balance between collection, storage, and demand, as determined using the Rainwater Harvesting Retention Calculator (Appendix K);
- For proprietary and non-proprietary BMPs follow the guidance in Chapter 4.~~13~~15 to identify/receive approval or denial to use these practice(s); and
- Off-site stormwater volume requirement.

Pre-/Post-Development Hydrologic Computations

Include in the plan set a summary of the pre-/post-runoff analysis with the following information at a minimum:

- A summary of soil conditions and field data;
- Pre- and post-project curve number summary table;
- Pre- and post-construction peak flow summary table for the 2-, 10-, 25- ,50- and 100-year, 24-hour storm events for each SDA within the project's LOD; and
- Flow control structure elevations.

Hydraulic Computations

Hydraulic computations for the final design of water quality and quantity control structures may be accomplished by hand or through the use of software using equations/formulae as noted in Chapters 3 and 4. The summary of collection or management systems will include the following:

- Existing and proposed SDA and CDA must be delineated on separate plans with the flow paths used for calculation of the times of concentration;
- Hydraulic capacity and flow velocity for drainage conveyances, including ditches, swales, pipes, inlets, and gutters designed for the 25-year, 24-hour design storm. Plan profiles for all open conveyances and pipelines, with energy and hydraulic gradients for the 25-year and 100-year, 24-hour storms;
- The proposed development layout including the following:
    - Location and design of BMP(s) on site, marked with the BMP ID Numbers;
    - Stormwater lines and inlets;
    - A list of design assumptions (e.g., design basis, 2- through 50-year return periods);
    - The boundary of the CDA to the BMP;
    - Schedule of structures (a listing of the structures, details, or elevations including inverts); and
    - Manhole to manhole profile, listing of pipe size, pipe type, slope, (i.e., a storm drain pipe schedule) computed velocity, and computed flow rate, hydraulic grade line (HGL), assumed Tailwater elevations, seasonally high groundwater table/channel water surface elevation (WSEL) of receiving channel, and King Tide WSEL as applicable, indicated at proposed outfall structures.

Supporting Documentation

Provide a written report with the following supporting documentation:

- Pre- and post-project curve number selection;
- Time of concentration calculation;
- Travel time calculation;
- Hydrologic computations supporting peak discharges assumed for each SDA within the project's LOD for the 2-, 10-, 25-, 50- and 100-year, 24-hour storm events;
- SC~~DHEC's~~DES's Construction Stormwater Pollution Prevention Plan (C-SWPPP).

A professional engineer registered in the State of South Carolina must also submit the following:

1. Elevation and topographic data illustrating changes in topography and drainage;
2. Impacts upon local flood flows (25- and 100-yr storm events).
3. Identify areas where stormwater flows are discharged off-site or off-property;
4. For proposed off-site/property discharge points, perform analysis of receiving off-site conveyance systems to confirm safe conveyance from the proposed developed property, no negative impact to adjacent properties, and adequacy of the receiving, existing conveyance system for 25-yr storm flows. Such analysis shall be taken to point where the 25-yr storm conveyance is determined to be adequate in the public stormwater conveyance/infrastructure system; and
5. Documentation supporting safe passage of the 100-yr post development flow according to the 10% Rule (see Section 3.~~8~~10);

2.2.2 Resubmission of Stormwater Management Plans

If major changes occur in the design or construction of an accepted SWMP, the applicant may be required to ~~re~~submit the amended SWMP for approval. Examples of major changes during design and construction that will require SWMP resubmission for review include the following:

1. Revision to the property boundary, property size, or LOD boundaries that may require redesigning BMPs;
2. Any change to SWRv through land cover (Appendix R) designation change;
3. Change in compaction or infiltration rates due to construction activities;
4. Encountering contaminated soil or other underground sources of contamination;
5. Changes to floodplain designation or requirements;
6. Changes in any component of the BMP that may adversely affect the intended capacity of the approved BMP, such as the following:
    a. Modification to approved BMP selection, dimensions, or location
    b. Modification to approved material specification
    c. Changes to the size, invert, elevation, and slopes of pipes and conveyances
    d. Installation of new drains and conveyance structures
    e. Need for a new storm sewer outlet connection to the sanitary/storm sewer main
    f. Changes to the amount of off-site requirements
    g. Changes to the CDA to a BMP
7. Revision to the approved grading and drainage divides and that may require redesigning BMPs;
8. Relocation of an on-site storm sewer or conveyance; or
9. Abandonment, removal, or demolition of a BMP.

If the applicant must ~~re~~submits an~~d~~ amended~~ an~~ SWMP~~ after making changes~~, the resubmission must contain a list of the major changes made and may be in the form of a response to comments. The resubmittal plans and calculations must include the stamp of the registered professional engineer licensed in the state of South Carolina.

However, if any of the following minor changes are made to the SWMP, resubmission is not required. These minor changes may be made anytime during inspection or at the time of as-built submittal to the Town of Bluffton.

1. Changes to SWMP components that do not adversely affect BMP capacity while in consultation with the Town of Bluffton. The inspector should review the appropriate manufacturer's documentation to his/her satisfaction before approving such a change and should ensure that such changes are recorded as red line changes or deviations in the as-built plans. These changes include the following:
    a. Changes to parts type of similar function (e.g. dewatering valve)
    b. Change in project address, ownership, permit status, or zoning

2.2.3 Design Certifications

The engineer shall certify that the~~is~~ ~~Plan~~SWMP satisfies all requirements of the ~~Town of Bluffton Unified Development Ordinance~~UDO and ~~Stormwater Design~~ Manual. The following statement with engineer's seal, signature and date is required in the ~~Plan~~SWMP submittal.

> The engineering features of all stormwater best management practices (BMPs), stormwater infrastructure, and land covers (collectively the "Facility") have been designed/examined by me and found to be in conformity with the standard of care applicable to the treatment and disposal of stormwater pollutants. The Facility has been designed for safe passage of the 100-year post-development flow. The Facility has been designed in accordance with the specifications required under Town of Bluffton Unified Development Ordinance.

2.2.4 Performance Bonds

Bonding for the cost of stormwater facilities approved for the proposed development shall be provided in accordance with Article 3 of the ~~Town of Bluffton Unified Development Ordinance~~UDO~~, Article 3~~. The stormwater bond shall not be fully released without a final inspection of the completed work by the Town of Bluffton, a recorded inspection and maintenance agreement (Appendix O) and plan, and submission of "as-built" plans containing minimum as-built information/documentation as specified in Section 2.5 and certifications provided by the applicant and engineer, including the following:

1. Certification that facilities were constructed in accordance with the submitted and approved design and will function as designed.
2. As-built certification to be on as-built drawing submitted by ~~E~~engineer after construction and prior to Certificate of Project Completion ~~and~~ confirming line, size, elevation and grade of constructed stormwater BMPs and drainage/conveyance systems.

Stormwater bonds may be reduced, utilizing procedures outlined in Article 3 of the UDO. ~~A~~ Bond reductions~~procedure~~ may be used to release parts of the bond held by the Town of Bluffton after various stages of construction have been completed and accepted by the Town of Bluffton. ~~Partial Bond release will be determined for the portion of work being accepted and construction work has been approved by the Town of Bluffton.~~ All requirements pertaining to this portion of work have been satisfied to include, but not be limited to, as-built~~s~~ plans, all certifications and approvals for that portion of work related to the ~~partial bond release~~bond reduction have been provided by applicant's engineer and approved by

Town of Bluffton. ~~The procedures used for partially releasing performance bonds must be specified by the Town of Bluffton in writing prior to the approval of a stormwater management design plan.~~

2.3 Construction Inspection Requirements

2.3.1 Inspection Schedule & Reports

Prior to the approval of a SWMP, the applicant will submit a proposed construction inspection schedule detailing inspections to be performed by the applicant's professional engineer responsible for certifying the as-built SWMP to ensure required information is obtained by applicant's ~~E~~engineer for As-Built drawing documentation submittal and certification requirements. The Town of Bluffton will review the schedule to determine if changes are required. The construction schedule should reflect the construction sequences defined ~~in~~for each stormwater Best Management Practice (BMP) ~~BMP section Stormwater~~ in Chapter 4 ~~Best Management Practices (BMPs)~~ of this Manual. The construction and inspection schedule for each BMP must be included in the SWMP. The Town of Bluffton may also conduct inspections and file reports of inspections during construction of BMPs and site stormwater conveyance systems to ensure compliance with the approved plans.

Note: No stormwater management work may proceed past the stage of construction that the Town of Bluffton has identified as requiring an inspection unless:

- the professional engineer responsible for certifying the as-built SWMP has issued an "approved" or "passed" report;
- the professional engineer responsible for certifying the as-built SWMP has approved a plan modification that eliminates the inspection requirement; or
- the Town of Bluffton has eliminated or modified the inspection requirement in writing.

The Town of Bluffton may require~~s~~ that the professional engineer responsible for certifying the as-built SWMP be present during inspections. For a project entirely in the PROW, the officer of the contracting company responsible for certifying the Record Drawing shall be present during inspections.

If the professional engineer responsible for certifying the as-built SWMP conducts an inspection and finds work that is not in compliance with the SWMP, he must so inform the Owner/applicant and the applicant must take prompt corrective action. If such inspection is performed by The Town of Bluffton, The Town of Bluffton will issue a written notice to the applicant. The written notice shall provide details on the nature of corrections required and the time frame within which corrections must be made.

2.3.2 Inspection Requirements Before & During Construction

The Town of Bluffton construction stormwater inspection form is provided in Appendix E Construction Inspection Form.

Pre-~~c~~Construction Meetings. These meetings are required prior to the commencement of any land-disturbing activities and prior to the installation of and/or construction of any BMPs. The applicant is required to contact the Town of Bluffton to schedule and hold a pre-construction meeting~~s three days (3)~~ prior to ~~beginning any construction activity subject to the requirements the Town of Bluffton~~installation of any tree protection and erosion and sediment control measures, as shown on the approved Final Development Plan.

Pre-Clearing Inspection. Prior to beginning any construction activity subject to the requirements of the Town of Bluffton, the applicant is required to contact the Town of Bluffton to schedule a pre-clearing inspection to ensure proper installation of any tree protection and erosion and sediment control measures, as shown on the approved Final Development Plan.

Inspections During Construction. The applicant is required to contact the Town of Bluffton and the professional engineer responsible for certifying the as-built SWMP to schedule an inspection three (3) days prior to any stage of BMP construction, or other construction activity, requiring an inspection. For large, complicated projects, the applicant and the Town of Bluffton and the professional engineer responsible for certifying the as-built SWMP may agree during the pre-construction meeting to an alternative approach such as a weekly notification schedule. Any such agreement must be made in writing and signed by all parties. The Town of Bluffton will revert to the 3-day notification procedure if the agreement is not followed. The Town of Bluffton may or may not perform the requested inspection; however, the professional engineer responsible for certifying the as-built SWMP must inspect, gather requisite information for as-built documentation and approve the work prior to construction proceeding to next requisite inspection point.

Final Inspection. The applicant is required to contact the Town of Bluffton and the professional engineer responsible for certifying the as-built SWMP to schedule a final inspection one week prior to the completion of a BMP~~ construction to schedule a final inspection of the BMP~~. The professional engineer responsible for certifying the as-built SWMP shall provide an inspection report and punch-list items to be performed by applicant to The Town of Bluffton. Upon owner/applicant request and Town of Bluffton receipt of Final Inspection report and punch list from the professional engineer responsible for certifying the as-built SWMP, the Town of Bluffton will conduct a final inspection to review project work and~~,~~ punch-list and determine if any additional punch-list items are required to be performed. As-builts, all requisite paperwork, and close out materials must be submitted to and approved by the Town of Bluffton for final approval. ~~Final approval of the BMP will not be issued until As builts are submitted and approved by the Town of Bluffton and all requisite paperwork and close out materials have been submitted to and approved by the Town of Bluffton.~~

Inspection Requirements by BMP Type. Chapter 4 Stormwater Best Management Practices (BMPs) of this Manual provides details about the construction sequences for each BMP. After holding a pre-construction meeting and pre-clearing inspection, regular inspections will be made at the following specified stages of construction:

- **Infiltration Systems and Bioretention Areas** shall be inspected at the following stages to ensure proper placement and allow for infiltration into the subgrade:
  - During on-site or off-site percolation or infiltration tests;
  - Engineer approval of contractor submittals of Infiltration and Bioretention system materials to be used in construction;~~.~~
  - Upon completion of stripping, stockpiling, or construction of temporary sediment control and drainage facilities (drainage area to BMP must be protected with sediment control measures, and maintained~~,~~ at all times until final site stabilization is established);
  - Upon completion of excavation to the subgrade (keep construction equipment off bottom area of infiltration ~~area~~BMP within 2' of subgrade elevation);
  - Throughout the placement of perforated PVC/HDPE pipes (for underdrains and observation wells) including bypass pipes (where applicable), geotextile materials (generally fabric and high permeability), gravel, or crushed stone course (all stone to be clean, washed, no fines), Bio soil material as mixed and testing results, and backfill; and
  - Upon completion of final grading and establishment of permanent stabilization;
- **Flow Attenuation Devices**, such as open vegetated swales upon completion of construction;

- **Retention and Detention Structures**, at the following stages:

    - Upon completion of excavation to the sub-foundation and, where required, installation of structural supports or reinforcement for structures, including but not limited to the following:
    - During testing of the structure for water-tightness;
    - During placement of structural fill and concrete and installation of piping and catch basins;
    - During backfill of foundations and trenches;
    - During embankment construction; and
    - Upon completion of final grading and establishment of permanent stabilization.

- **Stormwater Filtering Systems**, at the following stages:

    - Upon completion of excavation to the sub-foundation and installation of structural supports or reinforcement for the structure;
    - During testing of the structure for water-tightness;
    - During placement of concrete and installation of piping and catch basins;
    - During backfill around the structure;
    - During prefabrication of the structure at the manufacturing plant;
    - During pouring of floors, walls, and top slab;
    - During installation of manholes/trap doors, steps, orifices/weirs, bypass pipes, and sump pit (when applicable);
    - During placement of the filter bed; and
    - Upon completion of final grading and establishment of permanent stabilization.

- **Green Roof Systems**, at the following stages:

    - During placement of the waterproofing layer, to ensure that it is properly installed and water-tight;
    - During placement of the drainage layer and drainage system;
    - During placement of the growing media, to confirm that it meets the specifications and is applied to the correct depth (certification for vendor or source must be provided);
    - Upon installation of plants, to ensure they conform to the planting plan (certification from vendor or source must be provided); and
    - At the end of the first or second growing season, to ensure desired surface cover specified in the Care and Replacement Warranty has been achieved.

- **Stormwater Wetlands**, at the following stages:

    - Upon completion of stripping, stockpiling, or construction of temporary sediment control and drainage facilities (drainage area to BMP must be protected with sediment control measures, and maintained at all times until final site stabilization is established);
    - During installation of the embankment, the riser/primary spillway, and the outlet structure; and
    - Within two (2) weeks of installation of landscaping plan and vegetative stabilization to ensure adequate stabilization of banks and slopes.

2.3.3 ~~Final Construction~~Notice of Termination (NOT) Inspection Reports

Upon notification ~~of~~by the applicant, the Town of Bluffton will conduct a final inspection to determine if the completed work is constructed in accordance with approved plans and the intent of this Manual and the ~~Unified Development Ordinance~~UDO. Within 21 days of ~~the final inspection~~construction site completion, the applicant must submit an as-built package, as required by the ~~Design~~ Manual and/or as-built submittal checklist, as provided by the Town of Bluffton. The as-built submittal must be certified by a registered professional engineer licensed in the state of South Carolina. For a project consisting entirely of work in the PROW, the submission of a Record Drawing certified by an officer of the project contracting company is acceptable if it details the as-built construction of the BMPs, related stormwater infrastructure, and land covers.

A registered professional engineer licensed in South Carolina is required to certify as-built SWMPs and state that "all activities including clearing, grading, site stabilization, the preservation or creation of pervious land cover, the construction of drainage conveyance systems, the construction of BMPs, and all other stormwater-related components of the project were accomplished in strict accordance with the approved SWMP and specifications. Furthermore, to the best of my knowledge and belief this as-built truly represents existing field conditions including but not limited to sizes, diameters, dimensions, horizontal location, line and grade, and elevation". As stated in Section 2.2.2 Resubmission of Stormwater Management Plans, all plan changes are subject to the Town of Bluffton approval. The as-built certification must be on the original SWMP.

Upon completion, these plans will be submitted to the Town of Bluffton for processing. The estimated time for processing will be two weeks (10 working days), after which the plans will be returned to the engineer. The Town of Bluffton will provide the applicant with written notification of the ~~final~~ NOT inspection results.

~~2.3.4 Inspection for Preventative Maintenance~~

~~The Stormwater Ordinance requires maintenance inspections for BMPs and landcovers to ensure their ongoing performance is in compliance with their original design. The inspection will occur at least once every three (3) years. Maintenance inspection forms are provided in Appendix F Maintenance Inspection Checklists. The Town of Bluffton will conduct these maintenance inspections, though it may, in certain circumstances, allow a property to self-inspect and provide documentation.~~

~~The Town of Bluffton will maintain maintenance inspection reports for all BMPs. The reports will evaluate BMP functionality based on the detailed BMP requirements of Stormwater Best Management Practices (BMPs) and inspection forms found in Appendix F Maintenance Inspection Checklists.~~

~~If, after an inspection by the Town of Bluffton, the condition of a BMP requires repairs and/or maintenance work to restore functionality of the BMP to meet its design intent, The Town of Bluffton will provide notice to the Owner of the required repairs and/or maintenance required and time frame in which the work is to be completed. If, after an inspection by the Town of Bluffton, the condition of a BMP presents an immediate danger to the public safety or health because of an unsafe condition or improper maintenance, the Town of Bluffton will take such action as may be necessary to protect the public and make the BMP safe. Any costs incurred by the Town of Bluffton will be assessed against the owner(s).~~

2.4 Inspections & Maintenance

2.4.1 Inspections & Maintenance Responsibilities

A site with an approved SWMP must also have a responsible party inspect and maintain the BMPs and land covers (Appendix R) according to the inspections and maintenance schedule in the SWMP and this

Manual. Land covers must be maintained in type and extent as approved. Approved BMPs must be kept in good condition, including all the engineered and natural elements of each practice, as well as conveyance features (e.g., grade surfaces, walls, drains, structures, vegetation, soil erosion and sediment control measures, and other protective devices). All repairs or restorations must be in accordance with the approved SWMP.

A declaration of covenants including an exhibit stating the owner's specific maintenance responsibilities must be recorded with the property deed at the Beaufort County ~~Record~~ Register of Deeds Office. An inspection and maintenance schedule for any BMP will be developed for the life of the project and shall state the inspection and maintenance to be completed, the time for completion, and who will perform the inspections and maintenance. The schedule will be printed on the SWMP and will appear as an exhibit in the declaration of covenants.

2.4.2 Inspection & Maintenance Agreements

Inspection and maintenance obligations are binding on current and future owners of a property subject to recorded covenants. The Town of Bluffton will not issue final approval of a complete set of the SWMP for private parcels until the applicant has executed a declaration of covenants providing notice of this obligation to current and subsequent owners of the land served by the BMP(s) and land covers (Appendix R). Inspection and maintenance agreements by regulated projects include providing access to the site and the BMP(s) at reasonable times for regular inspection by the Town of Bluffton and for regular or special assessments of property owners, as needed, to ensure that the BMP(s) is maintained in proper working condition and the land covers are retained as approved in the SWMP. An example of the declaration of covenants/maintenance agreement for a site with BMPs and designated land covers is provided ~~at the end of this chapter~~in Appendix O.

The applicant must record the agreement as a declaration of covenants with the ~~with the Town of Bluffton Recorder of Deeds~~Beaufort County Register of Deeds Office. The agreement must also provide that, if, after written notice by the Town of Bluffton to correct a violation requiring maintenance work, satisfactory corrections are not made by the owner(s) of the land served by the BMP within a reasonable period of time, not to exceed 45 to 60 days unless an extension is approved in writing by the Town of Bluffton, the Town of Bluffton may perform all necessary work to place the BMP in proper working condition. The owner(s) of property served by the BMP will be assessed the cost of the work and any penalties, and there will be a lien on any property served by the BMP, which may be placed on the tax bill and collected as ordinary taxes by the State.

2.4.3 Post-Construction BMP Inspection for Preventative Maintenance

The Stormwater Post-Construction Ordinance (Appendix A) and UDO Section 5.10.4 requires maintenance inspections for BMPs and landcovers to ensure their ongoing performance is in compliance with their original design. The inspection will occur at least once every three (3) years. The person responsible for maintenance of any structural BMPs shall submit an inspection report from a certified Post-Construction BMP Inspector, a registered South Carolina Professional Engineer or Landscape Architect to the Town of Bluffton. The reports will evaluate BMP functionality based on the detailed BMP requirements of Stormwater Best Management Practices (BMPs) and inspection forms found in Appendix F. Individual lot BMPs implemented as part of the Single-Family On-Lot Volume Control requirement are exempt from this submittal requirement.

Additionally, the Town of Bluffton will conduct post-construction inspections following steps outlined in the Town's Post-Construction BMP Standard Operating Procedures (SOP). The Town of Bluffton may maintain maintenance inspection reports for all BMPs.

If, after an inspection by the Town of Bluffton, the condition of a BMP requires repairs and/or maintenance work to restore functionality of the BMP to meet its design intent, the Town of Bluffton will provide notice to the Owner of the required repairs and/or maintenance and the time frame in which the work is to be completed. If, after an inspection by the Town of Bluffton, the condition of a BMP presents an immediate danger to the public safety or health because of an unsafe condition or improper maintenance, the Town of Bluffton may take such action as may be necessary to protect the public and make the BMP safe. Any costs incurred by the Town of Bluffton will be assessed against the owner(s).

2.5 As-Built Submittals

One set of as-built built drawings sealed by a registered professional engineer licensed in the state of South Carolina must be submitted within 21 days after completion of construction of the site, including all BMPs, land covers, and stormwater conveyances, as required by the procedure for handling close out documents for private development projects by the Town of Bluffton.

The following items must be completed and provided:

General Information:

- As-builts are to be submitted digitally in GIS, CAD and Geo-referenced PDF format
- The GIS/CAD file must include an annotation layer showing, at a minimum, inlet types, materials, structure depths, pipe lengths, and pipe diameters
- Words As-Built in or near the project title, on Plan set Cover Sheet
- Engineer's or surveyor's as-built certification statement, signature, date, ~~PE~~ seal
- As-built Signature/Approval block on the cover sheet
- As-builts shall have a coordinate system based on the South Carolina Coordinate System North American Datum of 1983 (NAD83)
- Elevations shown shall be based on the North American Vertical Datum of 1988 (NAVD88)
- Vicinity map
- Sheets numbered correctly
- Project ID number, Project Name, Permit number and name, address and contact information of project engineer
- All measurements and coordinates shall be shown on all drainage structures, detention and BMP structure outlets, outlet control structures and manholes
- Any change to design value elevations, dimensions (L, W, D), specifications or location shall be shown as mark-through of the original design value on the drawings and constructed/as-built value next to it and "boxed" in red ink
- Elevations to the nearest 0.1 ft
- All BMPs must be labeled and identified on as-builts as shown on approved plans.

Basins:

- At least two benchmarks on the plans
- Profile of the top of berm
- Cross-section of emergency spillway at the control section
- Profile along the centerline of the emergency spillway

- Cross-section of berm at the principle spillway
- Elevation of the principle spillway crest or top of structure elevations
- Elevation of the principle spillway inlet and outlet invert
- Riser diameter/dimensions and riser base size
- Diameter, invert elevation and sizes of any stage orifices, weirs or storm drain pipes
- Barrel diameter, length, and slope
- Types of material used
- Outfall protection length, width, depth, size of rip rap and filter cloth
- Size, location, and type of anti-vortex and trash rack device (height and diameter, elevations and spacing)
- Pipe cradle information
- On plan view show length, width and depth of pond and contours of the basin area so that design volume is specified
- As-built spot elevations within the disturbed area required for basin construction in sufficient detail to provide accurate as-built contours
- Core trench limits and elevations of bottom of cut off trench
- Show length, width, and depth of outfall rip rap
- Certification by a Geotechnical Engineer for compaction and unified soil classes
- Vegetation cover certification stating that the disturbed area of site has achieved ~~80~~70% or greater established, permanent stabilization
- Show location, plant types and size of planted landscaping per approved landscape plan
- Utility locations and elevations encountered, test pitted and/or relocation during contract work

Storm Drain Piping: *(no changes)*

Post-Construction BMP-Specific Details: *(no changes)*

Rainwater Harvesting: *(no changes)*

Irrigation Re-Use: *(no changes)*

2.6 References *(no changes)*

Chapter 3. Minimum Control Requirements

3.1 Introduction

This chapter establishes the minimum stormwater control standards necessary to implement the Southern Lowcountry Post-Construction Stormwater Ordinance (Appendix A) within the Town of Bluffton. The term "runoff reduction" is used throughout this chapter to describe the retention of the stormwater on site. The SWRv is used to describe the volume of stormwater to be retained on site.

Two levels of stormwater retention are prescribed, the 85th and the 95th percentile storm, and are assigned based on a site's subwatershed as identified by the U.S. Geological Survey Hydrologic Unit Code 12 (HUC-12) presented in Section 3.5.1 below. In addition, peak discharge control of the post-development 2-, 10-, and 25-year, 24-hour storms for the General and Savannah Watershed Protection Areas and 2-, 10-, 25-, 50- and 100-year, 24-hour storms for the Bacteria and Shellfish Watershed Protection Area to their pre-development flow shall be provided by a combination of structural controls, GI/LID practices and other non-structural BMPs. As well, requirements to manage the 100-yr, 24-hour storm event are provided in the extreme flood event section below. Further, this Manual and Appendices provide the framework and necessary tools to document the methods proposed by development plans to comply with these requirements. It should be noted that stormwater ponds are considered the least favorable structural best management practice to meet the SWRv and water quality requirements of this Manual.

3.2 Regulated Site Definition

According to the ~~Unified Development Ordinance~~UDO, the design criteria of this Manual shall be applicable to any new development, redevelopment or major substantial improvement activity, including, but not limited to, Development Plan applications, site plan applications, grading plan applications, public improvement projects, and subdivision applications that meet the applicability standards found in ~~Chapter~~Section 1.4.

The Southern Lowcountry stormwater design requirements are applied according to the flow chart in Figure 3.1 and should be determined as follows:

1) In sequence, first determine which HUC-12 watershed the project is in according to Table 3.1. Stormwater design criteria for the development follows the watershed area in which it is located. Next, determine the square feet of ~~impervious area~~land disturbance to occur ~~be created, added or replaced~~ as a part of the development. Does it equal or exceed 5,000 square feet? ~~or~~If the project is considered redevelopment/infill, determine how much impervious surface is to be added. Does it equal or exceed 2,000 square feet? If the answer is "yes" to either of these questions, the project plan must meet the requirements for stormwater management in this Manual for their respective watershed area.
2) If a project is a major substantial improvement, it must meet the water quality criteria for its respective watershed protection area to the maximum extent practicable (MEP) or obtain off-site stormwater credit. The terms MEP and off-site stormwater credit are further explained in Sections 3.9 and 3.10 below. Peak control requirements do not apply to major substantial improvement projects.

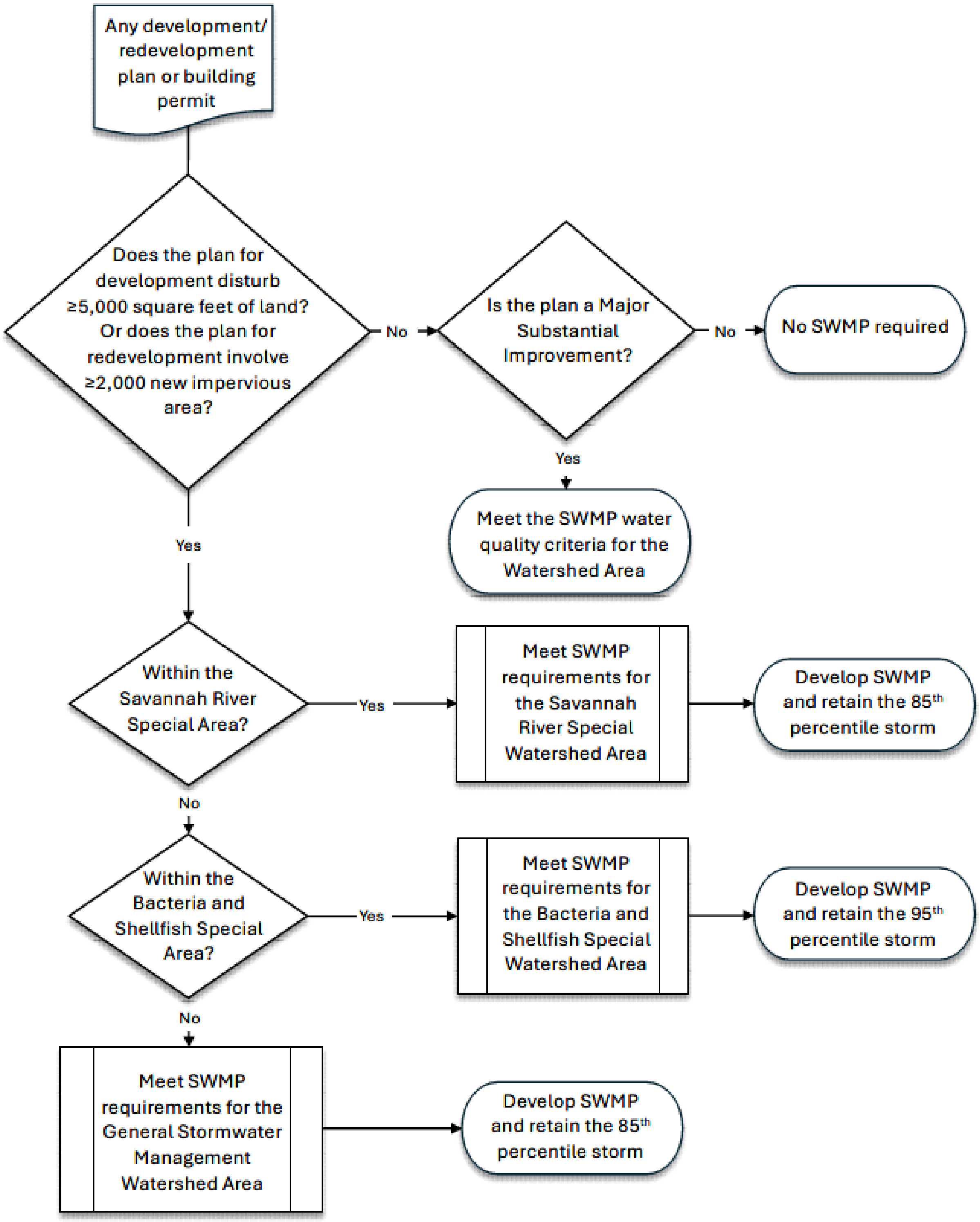


Figure 3.1. Southern Lowcountry Stormwater Design Manual applicability diagram.

3.3 Infill & Redevelopment

An infill project is one on a previously platted property that may or may not have stormwater management capacity in its original development plan. Regardless of size, infill that is part of a larger common plan of development (LCP), even through multiple, separate, and distinct land disturbing activities that may take place at different times and on different schedules must comply with this Manual. Such projects may include Planned Unit Developments (PUDs) that have stormwater systems built that do not meet the requirements of this Manual. If the proposed project meets the applicability criteria of Section 1.4.1, the stormwater plan review in this Manual is necessary. If the development's original stormwater management plan is sufficient to meet the current requirements of this Manual and is documented through approved plans and as-built drawings, or current field measurements and engineering calculations, no further stormwater requirements must be met. When the infill project is part of an original plan that does not meet the current stormwater requirements, the level of stormwater management that is provided in the current development may be credited toward the current volume and hydrologic analysis. Infill locations that, due to the municipal jurisdiction's zoning or land use requirements or site conditions, cannot meet the requirements of this Manual must complete the maximum extent practicable (MEP) evaluation in Section 3.9 for project approval.

Similarly, redevelopment may be credited for the level of stormwater in place. If the redevelopment's original stormwater management plan is sufficient to meet the current requirements of this Manual and is documented through approved plans and as-built drawings, or current field measurements and engineering calculations, no further stormwater requirements must be met. When the redevelopment is part of an original plan that does not meet the current stormwater requirements, the level of stormwater management that is provided in the current development may be credited toward the current volume and hydrologic analysis. Redevelopment projects that, due to the municipal jurisdiction's zoning or land use requirements or site conditions, cannot meet the requirements of this Manual must complete the ~~maximum extent practicable (MEP)~~MEP evaluation in Section 3.9 for project approval.

3.4 Single-Family On-Lot Volume Control

Individual lots outside of an LCP, regardless of size, and individual lots within an LCP, with greater than or equal to 5,000 sqft. of land disturbance, are required to retain the 95th percentile storm event on-site using Appendix T.

3.5 Stormwater Runoff Quality & Peak Discharge Control *(no changes)*

3.6 Southern Lowcountry Stormwater Management Performance Requirements

Stormwater management requirements of this Manual are intended to enhance the quality of development, protect and enhance stormwater quality and management, protect aquatic resources from the negative impacts of the land development process, address water quality impairments or a total maximum daily load, as identified by the South Carolina Department of ~~Health and~~ Environmental ~~Control~~Services (~~DHEC~~DES), or address localized flooding issues.

3.6.1 Watershed Protection Area Designations

Not all watersheds of the Southern Lowcountry region require the same level of post-construction stormwater management. Currently, three watershed protection areas are designated with specific unique stormwater management requirements based on the current and anticipated water quality control measures for their contributing watersheds. The Southern Lowcountry Post-Construction Stormwater Ordinance provides the Town of Bluffton the flexibility and authority to designate subwatersheds or drainage areas as Special Watershed Protection Areas that lead to more restrictive requirements or special criteria. Such special designations and criteria will be provided as Appendix P to this Manual.

In the Southern Lowcountry, impairments include recreational water use impairment from bacteria (*Enterococcus* for saltwater and *E. coli* for freshwater), aquatic life use impairment from turbidity or dissolved oxygen, and shellfish harvesting use impairment from fecal coliform bacteria. Stormwater best management practices for these types of impairments include erosion and sediment control for turbidity impairments, illicit discharge detection, vegetated conveyances, vegetated buffers, pet waste programs, and post-construction runoff control. Currently, Southern Lowcountry water quality impairments do not include nutrient impairments, but nutrients can also be addressed through erosion and sediment control and the stormwater best management practices outlined in this Manual.

Most of Beaufort County and the lower reaches of the Jasper County watersheds have shellfish receiving waters or are recreational waters and are therefore sensitive to bacteria impairments. Land development and redevelopment projects in these watersheds require greater scrutiny to ensure that low impact development methods are designed, implemented and maintained to be protective of these water uses.

Watersheds tributary to the Savannah River in the Southern Lowcountry include most of the freshwater wetlands of the region. River water quality is excellent and is a supply for drinking water for the City of Savannah and the Beaufort Jasper Water and Sewer Authority. Savannah River impairments downstream of the I-95 bridge are primarily aquatic life use due to low dissolved oxygen. Since the Savannah River is the boundary of Georgia and South Carolina, it is reasonable to align stormwater requirements within Jasper County with those in Chatham and Effingham Counties, GA. Stormwater permits for the Georgia jurisdictions require use of the Georgia Coastal Stormwater Supplement to the Georgia Stormwater Management Manual, which is primarily a green infrastructure/low impact development (GI/LID) design Manual with requirements specific to the Georgia coastal counties.

The remaining watersheds of the Southern Lowcountry are more upland areas and in agricultural or silvicultural use or are conservation lands. For these areas new development is subject to stormwater management requirements similar to previous county requirements. This Manual unifies stormwater management standards across the designated watersheds rather than differing across county or jurisdictional lines.

The map in Figure 3.2 outlines the boundaries of the three watershed protection areas of the Southern Lowcountry. Requirements specific to each area are further developed in this chapter. Table 3.1 lists the US Geological Survey 12-Digit Hydrologic Unit Code (HUC-12) for the watersheds in each area. To identify a site's HUC-12, refer to the South Carolina ~~DHEC~~DES Watershed Atlas, available online at https://gis.dhec.sc.gov/watersheds/. After identifying the site's HUC 12, use Table 3.2 to identify the watershed protection area.

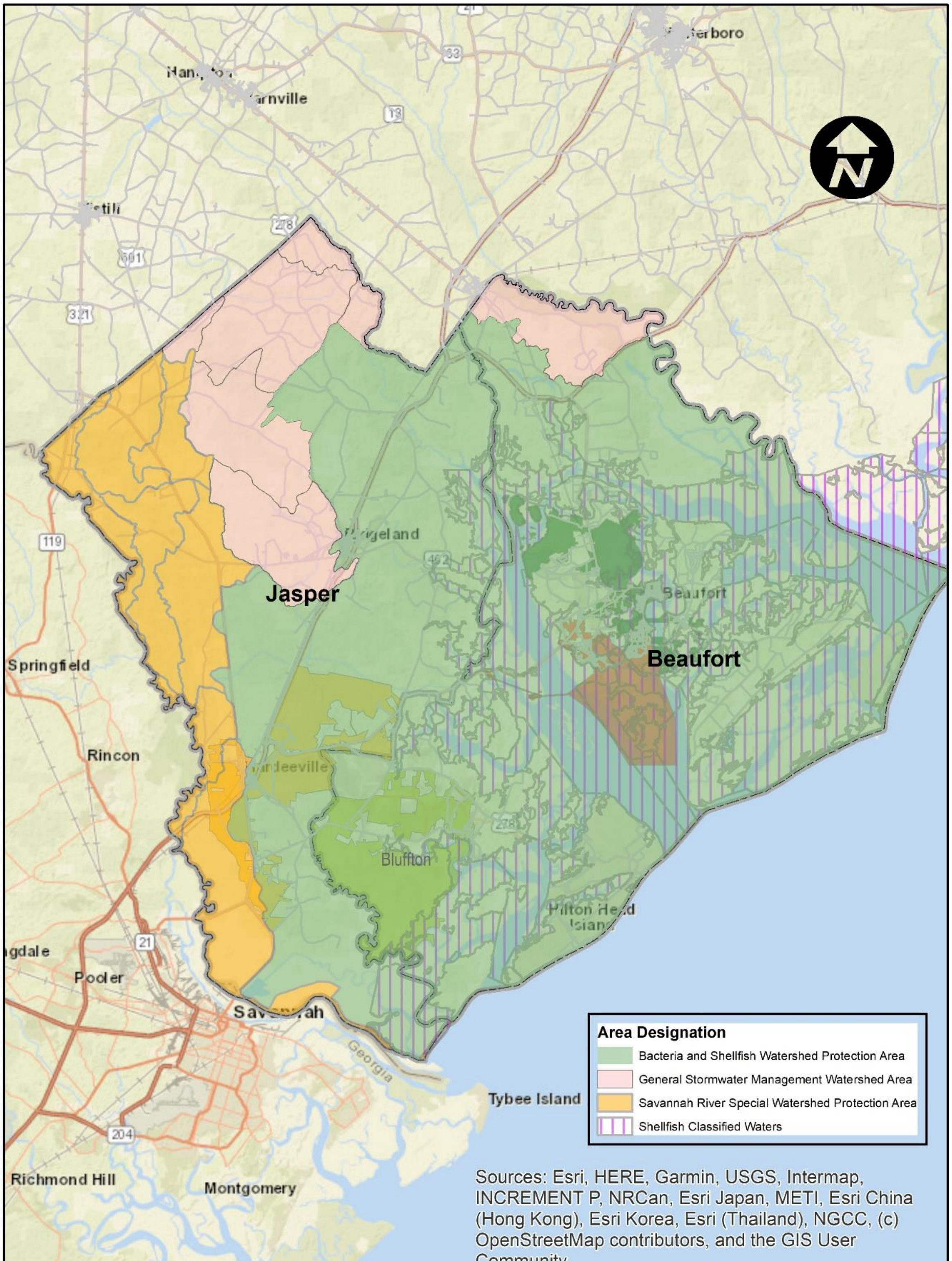


Figure 3.2. Watershed Protection Areas of the Southern Lowcountry.

Table 3.1. Watershed Protection Area HUC-12 Codes.

General Stormwater Management Watershed Areas		Savannah River Watershed Protection Area	
HUC-12 No.	Watershed Name	HUC-12 No.	Watershed Name
030502070704	Middle Combahee River	030601090107	Hog Branch-Savannah River
030502080301	Johns Pen Creek	030601090301	Cypress Branch
030502080302	Cypress Creek	030601090302	Black Swamp
030502080404	Mcpherson Creek-Coosawhatchie River	030601090303	Coleman Run
030502080405	Early Branch-Coosawhatchie River	030601090304	Sand Branch
030601100101	Gillison Branch	030601090305	Dasher Creek-Savannah River
030601100102	Upper Great Swamp	030601090307	Outlet Savannah River
Bacteria and Shellfish Watershed Protection Area			
HUC-12 No.	Watershed Name	HUC-12 No.	Watershed Name
030502070706	Lower Combahee River	030502080605	Boyd Creek-Broad River
030502071101	Wimbee Creek	030502080606	Colleton River
030502071102	Coosaw River	030502080607	Chechessee River
030502071103	Morgan River	030502080608	Broad River-Port Royal Sound
030502071104	Coosaw River-St. Helena Sound	030502100101	Harbor River-St. Helena Sound
030502080406	Bees Creek	030502100102	Harbor River-Trenchards Inlet
030502080407	Tulifiny River-Coosawhatchie River	030601090306	Wright River
030502080501	Battery Creek	030601100103	Lower Great Swamp
030502080502	Upper Beaufort River-Atlantic Intracoastal Waterway	030601100201	Upper New River-Atlantic Intracoastal Waterway
030502080503	Lower Beaufort River-Atlantic Intracoastal Waterway	030601100202	Lower New River-Atlantic Intracoastal Waterway
030502080601	Pocotaligo River-Broad River	030601100301	May River
030502080602	Huspa Creek	030601100302	Broad Creek
030502080603	Whale Branch	030601100303	Cooper River-Calibogue Sound
030502080604	Euhaw Creek	030601100304	Calibogue Sound

3.6.2 Overall Performance Requirements

Based on the watershed water quality criteria, its impairment status, or stormwater permit requirements, development and redevelopment stormwater management performance requirements will differ. These requirements are interpreted in terms of sizing and performance criteria. Table 3.2 presents a summary of the sizing criteria used to achieve the stormwater management performance requirements for each watershed protection area.

Table 3.2. Watershed Area Overall Performance Requirements.

General Stormwater Management Watershed Protection Areas	Savannah River Watershed Protection Area
Overall Performance Requirements	Overall Performance Requirements
• Water Quality: Implement Better Site Design, maintain pre-development hydrology of the site to the Maximum Extent Practicable (MEP) for the 85th percentile storm event. • Peak Control: Control post-development peak runoff discharge rate to pre-development rate for: 2-, 10- and 25-year, 24-hour design storm events. • Accommodate the 100-year, 24-hour storm event conveyance through the site and downstream without causing damage/inundation to structures. Provide 10% rule analysis. • As a pollutant removal minimum, intercept and treat stormwater runoff volume to at least an 80 percent reduction in total suspended solids load, 30 percent reduction of total nitrogen load and 60 percent reduction in bacteria load. • Complete a natural resources inventory for new site development applications.	• Water Quality: Implement Better Site Design, retain the 85th percentile storm event on-site to the MEP or obtain off-site credit. • Peak Control: Control post-development peak runoff discharge rate to pre-development rate for: 2-, 10- and 25-year, 24-hour design storm events. • Accommodate the 100-year, 24-hour storm event conveyance through the site and downstream without causing damage/inundation to structures. Provide 10% rule analysis. • As a pollutant removal minimum, intercept and treat stormwater runoff volume to at least an 80 percent reduction in total suspended solids load, 30 percent reduction of total nitrogen load and 60 percent reduction in bacteria load. • Complete a natural resources inventory for new site development applications.
Rationale	Rationale
The previous Jasper County stormwater design manual specified these overall performance requirements.	The Savannah River watershed adjoins Georgia counties that are subject to similar overall performance requirements as outlined in the Georgia Coastal Stormwater Supplement.

Bacteria and Shellfish Watershed Protection Area	
Overall Performance Requirements	
• Water Quality: Implement Better Site Design and retain the 95th percentile storm on-site with approved infiltration/filtering BMPs. Fulfill MEP requirements or, as a last resort, fulfill off-site credit and/or fee-in-lieu requirements. • As a pollutant removal minimum, intercept and treat stormwater runoff volume to at least an 80 percent reduction in total suspended solids load, 30 percent reduction of total nitrogen load and 60 percent reduction in bacteria load.	• Peak control: Control the post-development peak runoff discharge rate for the 2, 10, 25, 50 and 100-year, 24-hour design storm events to the pre-development discharge rates (subject to 10% rule analysis). • Accommodate the 100-year, 24-hour storm event conveyance through the site and downstream without causing damage/inundation to structures. • Provide 10% rule analysis. • Complete a natural resources inventory for new site development applications.
Rationale	
The Bacteria and Shellfish Watershed Protection Areas are either impaired or have TMDLs, or the receiving waters are classified for shellfish harvesting. These watersheds require greater protection due to their Clean Water Act status or water quality classification. The site's natural resource inventory is a necessary component of permit application.	

3.6.3-3.6.7 *(no changes)*

3.7 Erosion & Sediment Control (ESC) Requirements

The design and management of construction site runoff control measures for all qualifying developments as defined in the Southern Lowcountry Post-Construction Stormwater Ordinance (Appendix A) and Town of Bluffton UDO shall be in accordance with ~~SCDHEC~~SCDES NPDES General Permit for Stormwater Discharges from Construction Activities, the ~~SCDHEC~~SCDES Erosion and Sediment Reduction and Stormwater Management regulations and its most current version of standards, where applicable. The Town of Bluffton reserves the right to require additional erosion and sediment control or a higher standard of measure and make their requirement a condition of a development permit approval.

3.8 Retention Standard & Volume

This section provides the formulas and rationale for use of the runoff reduction method to compare predeveloped and post-development hydrology for projects submitted for approval to the Southern Lowcountry jurisdictions.

Runoff reduction is defined as “the total annual runoff volume reduced through canopy interception, soil infiltration, evaporation, transpiration, rainfall harvesting, engineered infiltration, or extended infiltration” (Hirschman, 2008). The formula to calculate the volume reduced through successive application of stormwater best management practices originates with the Natural Resources Conservation Service (NRCS) method of estimating direct runoff from storm rainfall and the curve number method of NEH Chapter 9 (NEH, 2004). As shown in Equation 3.1, rainfall event runoff (Q) is a function of depth of event rainfall (P) over the watershed, the initial abstraction (I_a) and the maximum potential retention (S).

Equation 3.1. Curve number runoff equation.

$$Q = \frac{(P - I_a)^2}{(P - I_a) + S}$$

$$I_a = 0.2S$$

$$Q = \frac{(P - 0.2S)^2}{(P + 0.8S)}$$

$$Q - R = \frac{(P - 0.2S)^2}{(P + 0.8S)}$$

$$S = \frac{100}{CN} - 1$$

Where:

Q = Runoff depth (in)

P = Depth of rainfall event for the designated watershed protection area (85th or 95th percentile rain event)

I_a = Initial abstraction (in)

S = Potential maximum retention after runoff begins (in)

CN = Runoff curve number
R = Retention storage provided by runoff reduction practices (in)

Not all stormwater BMPs provide runoff reduction equally. Through the crediting procedures of the Compliance Calculator found in Appendix H and the retention volumes required in this section, designers will be able to evaluate their proposed designs and submit for approval in a unified process across the Southern Lowcountry jurisdictions.[1]

Supplemental information on the terms below can be found in the *Low Impact Development in Coastal South Carolina: Planning and Design Guide*, and the Georgia Stormwater Management Manual (Ellis, K. et al., 2014; ARC, 2016).

The Stormwater Retention Volume (SWRv) is the volume of stormwater runoff that is required to be retained, post-development. It is calculated as shown in Equation 3.2 for the entire site and for each site drainage area (SDA). The SDA is defined as the area that drains to a single discharge point from the site or sheet flows from a single area of the site. A development site may have multiple SDAs and runoff coefficients.

Equation 3.2. Stormwater retention volume (SWRv) equation

$$\boldsymbol{SWRv = \frac{P \times [(Rv_I \times I) + (Rv_C \times C) + (Rv_N \times N)]}{12}}$$

Where:

SWRv = Volume required to be retained (cubic feet)
P = Depth of rainfall event for the designated watershed protection area (85th or 95th percentile rain event)
Rv_I = Runoff coefficient for impervious cover and BMP cover based on SCS hydrologic soil group (HSG) or soil type
I = Impervious cover and BMP surface area (square feet)
Rv_C = Runoff coefficient for compacted cover based on soil type
C = Compacted cover surface area (square feet)
Rv_N = Runoff coefficient for forest/open space based on soil type
N = Natural cover surface area (square feet)
12 = Conversion factor (inches to feet)

	Rv Coefficients			
	A soils	**B Soils**	**C Soils**	**D Soils**
Forest/Open Space (R_{VN})	~~0.02~~0	~~0.03~~0	~~0.04~~0	~~0.05~~0
Managed Turf *(Rv_C)*	0.15	0.20	0.22	0.25
Impervious Cover (R_{vI})	0.95	0.95	0.95	0.95
BMP	0.95	0.95	0.95	0.95

[1] Compliance Calculator instructions are found in Appendix G

For purposes of ~~determining~~calculating the SWRv, the surface area of a ~~non-infiltrating~~ BMP utilized for water quality or retention ~~or~~ shall be assigned a runoff coefficient of 0.95 as shown in the table above. BMPs used solely for detention, such as storage practices and stormwater ponds may be assigned a runoff coefficient of 0 when calculating the SWRv. ~~its permanent pool shall not be calculated as part of the impervious cover.~~ For purposes of determining pre-/ post development peak discharge rates, the surface area of ~~a non-infiltrating~~all BMPs ~~or its permanent pool~~ shall be calculated as part of the impervious cover.

The Compliance Calculator in Appendix H uses best available pollutant removal efficiencies for total suspended solids, total nitrogen and fecal indicator bacteria. Use of the compliance calculator allows the designer to evaluate alternative designs to arrive at compliance with the runoff reduction and pollutant removal requirements and clearly summarize them for the Town of Bluffton plan reviewer. The compliance calculator output is a necessary submittal for a plan reviewer to evaluate selected BMPs to demonstrate compliance with the watershed protection area standards of this Manual.

3.8.1 Total Suspended Solids, Nutrients, & Bacteria *(no changes)*

3.8.2 Hydrologic & Hydraulic Analysis

In order to prevent an increase in the duration, frequency and magnitude of downstream overbank flooding and scouring, this Manual requires that enough stormwater detention be provided on a development site to control the post-development peak runoff discharge to the predevelopment runoff rates for the 2, 10, 25, 50 and 100 -year, 24-hour storm events, unless deemed detrimental through the 10% rule analysis. The capacity of the existing downstream receiving conveyance system for all off-site discharge points must be determined to be adequate. An analysis of the downstream conveyance capacity to accommodate the site's post development 25- and 100-year, 24-hour peak flow shall be provided in the engineering report. Discharge to the public right-of-way of the SC State highway system shall comply with the SCDOT Requirements for Hydraulic Design Studies. Necessary upgrades within the public right-of-way due to inadequate capacity for the post-development 25-yr flow must be identified during the permit application process. ~~Upgrades to the downstream system to accommodate the 100-yr 24-hour flow must be considered through the MEP process outlined in Section 3.9.~~ Documentation supporting safe passage of the 100-yr post development flow to the downstream point where the detention or storage area comprises 10% of the total drainage area ~~and an analysis of the surrounding neighborhood area to identify any existing capacity shortfalls or drainage blockages~~ is required for plan approval. This analysis is called the 10% analysis rule in Section 3.8 of this Manual.

~~The recommended 2, 10, 25, 50 and 100-year, 24-hour storm event values from Appendix F of the South Carolina DHEC Storm Water Management BMP Handbook, July 31, 2005 for Beaufort and Jasper Counties are in Table 3.4[2].~~

~~Table 3.4. Rainfall depth (inches) for the Southern Lowcountry.~~

	~~Return Period (years)~~

~~[2] Until SCHEC~~SCDES ~~updates its Stormwater Management BMP Handbook rainfall table to the NOAA Atlas 14 values, the Southern Lowcountry region shall use the Handbook Appendix F rainfall table for 24 hour storm events.~~

~~County~~	~~2~~	~~10~~	~~25~~	~~50~~	~~100~~
~~Beaufort~~	~~4.5~~	~~6.9~~	~~8.4~~	~~9.7~~	~~11.0~~
~~Jasper~~	~~4.2~~	~~6.4~~	~~7.8~~	~~9.0~~	~~10.2~~

In this Manual, Appendix I – General Design Criteria and Guidelines provides the acceptable methodologies and computer models for estimating runoff hydrographs before and after development, as well as design criteria for stormwater collection systems and land cover (Appendix R) designations. The following are the acceptable methodologies and computer models for estimating runoff hydrographs before and after development. These methods are used to predict the runoff response from given rainfall information and site surface characteristic conditions. The design storm frequencies used in all of the hydrologic engineering calculations will be based on design storms required in this Manual unless circumstances make consideration of another storm intensity criterion appropriate:

- Rational Method (limited to sites under 10 acres) Note: ~~DHEC~~DES, nor this manual, allows the Rational Method when conducting analysis for stormwater being routed to/through BMP structures. However, it is allowed for culvert crossings with a drainage area of less than 10 acres.
- Urban Hydrology for Small Watersheds TR-55
- Storage-Indication Routing
- HEC-1, WinTR-55, TR-20, ICPR v3 or 4 and SWMM computer models

These methods are given as valid in principle and are applicable to most stormwater management design situations in the Southern Lowcountry.

The following conditions should be assumed when developing predevelopment, pre-project, and post-development hydrology, as applicable:

- The design storm duration shall be the 24-hour rainfall event, using the NRCS (SCS) Type III rainfall distribution with a maximum six-minute time increment.
- The rainfall intensity – duration – frequency curve shall be determined from the most recent version of the Hydrometeorological Design Studies Center's Precipitation Frequency Data Server (NOAA Atlas).
- The predeveloped, post development, and redevelopment peaking factor shall be 323.
- For new development sites the predeveloped condition shall be calculated as a composite CN based on the HSG and current land use conditions (NEH, 2004).
- For infill and redevelopment sites, the predeveloped condition shall be calculated as a composite CN based on the HSG and the land cover type (Appendix R) and hydrologic condition at the time of the project's initial submittal.
- Antecedent Runoff Condition (ARC) II is the average adjustment factor for calculations using TR-55. ARC III is to be used for wetter conditions such as areas that receive irrigation water harvested from stormwater ponds and for poorly drained soils.

Project designs must include supporting data and source information. All storm sewer systems shall be analyzed for both inlet and outlet control (including tailwater effects) by using the following:

a. Equations and nomographs as shown in the Federal Highway Administration (FHWA) Hydraulic Design Services (HDS) publication No. 5.

b. Computer programs that calculate the actual hydraulic grade line for the storm sewer system can be used, provided all losses (friction, bend, junction, etc.) are taken into account using the appropriate loss coefficient (K) values.

c. Design tailwater condition elevation shall be supported by a reasonable resource and/or analysis.

d. Allowable headwater. The allowable headwater of all culverts, pipe systems, open channels, bridges and roadway culverts shall be established following the SCDOT Requirements for Hydraulic Design Studies.

All culverts, pipe systems, and open channel flow systems shall be sized in accordance with the design criteria found in Appendix I – General Design Criteria and Guidelines~~Hydrology and Hydraulics Design Requirements~~.

3.8.3 Maintenance Easements *(no changes)*

3.9 Extreme Flood ~~Requirement: 10% Rule~~Protection

Flooding problem areas exist in many locations in the Southern Lowcountry to the point that stormwater infrastructure has become overwhelmed where controls were never adequately designed or installed to control runoff. The ability to maintain a system is also suspected to contribute to some of the frequent flooding. Acceptable means of determining the hydrology may include a variety of data sources including topographic survey, LiDAR data, and USGS quad maps. Acceptable means of determining runoff of the study area may include applicable methods previously identified in this manual, USGS regression equations (including Streamstats, if applicable), watershed lag method, and flows utilized in effective FEMA models. Hydraulic routing parameters such as channel geometry, pipe sizes, invert elevations, bridge dimensions, etc. may be obtained using topographic survey, field reconnaissance, or other methods acceptable to the Town of Bluffton.

Additional resources for this exercise may include Coastal Stormwater Supplement to the Georgia Stormwater Management Manual, Spreadsheet for the South Carolina Synthetic Unit Hydrograph Method. Attenuation patterns of other stormwater ponds in the contributing drainage area of the watershed should not be assumed without valid documentation.

The peak discharge generated by the 100-year, 24-hour storm event under post-development conditions is considered the extreme peak discharge. The intent of the extreme flood protection is to prevent flood damage from infrequent but large storm events, maintain the boundaries of the mapped 100-year floodplain, and protect the physical integrity of the best management practices as well as downstream stormwater and flood control facilities. The 100-yr flow is to be used in the routing of runoff through the drainage system and stormwater management facilities to determine the effects on the facilities, adjacent property, and downstream. Emergency spillways of best management practices should be designed appropriately to pass the resulting flows safely. Documentation supporting safe passage of the 100-year post-development flow shall be provided by the applicant/engineer. Demonstration of safe passage of the 100-year, 24-hour storm shall include a stage /storage analysis of the system, an inflow/outflow comparison of the system, and construction of a table showing peak stage elevations in comparison to finished floor elevations of adjacent buildings/structures/infrastructure. The table should also include peak stage and overtopping elevations of pipe/culvert crossings to determine if the crossing requires upgrades or the peak discharge rate will need to be limited to the capacity of the downstream system. Safe passage to the receiving water also requires that there be no additional downstream flooding or other environmental impacts (e.g., stream channel enlargement, degradation of habitat).

Individual single-family lots outside of an LCP, regardless of size, and individual lots within an LCP, subject to this Manual, are exempt from this requirement.

3.10 10% Rule

In order to prevent an increase in the duration, frequency and magnitude of downstream ~~extreme~~ flooding over existing conditions, an evaluation must be provided to include downstream analysis to the point where the project comprises 10% of the total contributing drainage area. ~~The 10% rule evaluation must address existing conveyance system capacity and "pinch points" where a pipe/culvert would be overtopped and where the pipe/culvert will need to be upgraded or the peak discharge rate will need to be limited to the capacity of the downstream system.~~

The 10% rule recognizes the fact that a structural BMP control providing detention has a "zone of influence" downstream where its effectiveness can be felt. Beyond this zone of influence, the structural control becomes relatively small and insignificant compared to the runoff from the total drainage area at that point. Based on studies and master planning results from a large number of sites, that zone of influence is considered to be the point where the drainage area controlled by the detention or storage facility comprises 10% of the total drainage area. For example, if the drainage control drains 10 acres, the zone of influence ends at a point where the total drainage area is 100 acres or greater (ARC, 2016).

~~Demonstration of safe passage of the 100-year, 24-hour storm shall include a stage storage analysis of the system, an inflow/outflow comparison of the system, and construction of a table showing peak stage elevations in comparison to safe freeboards to structures of the system and adjacent buildings/structures/infrastructure. Safe passage to the receiving water also requires that there be no additional downstream flooding or other environmental impacts (e.g., stream channel enlargement, degradation of habitat).~~

Typical steps in the application of the 10% rule are:

1. Determine the target peak flow for the site for predevelopment conditions from the 10-, 25-, 50-, and 100-year storms.
2. Using a topographic map, determine the lower limit of the zone of influence (10% point) in the watershed.
3. Using a hydrologic model, determine the predevelopment peak flows and timing of those peaks at each tributary junction beginning at the pond outlet and ending at the next tributary junction beyond the 10% point.
4. Change land use on the site to post-development and rerun the model for the 10-, 25, 50-, and 100-year storms.

5. Design the structural control facility such that the 10-, 25-, 50-, and 100-year facility outflows do not increase the peak flows at the outlet and each tributary junction. ~~overbank flood protection (25-year) post-development flow is adequately conveyed to the lower limit of the zone of influence and the Extreme Flood (100-year) post-development flow does not impact any existing structures within the area of zone of influence.~~ If the ~~overbank flood protection (25-year)~~ post-development facility outflows do increase the peak flows at the outlet and each tributary junction ~~is not adequately conveyed to the lower limit of the zone of influence and/or Extreme Flood (100-year) post-development flow is shown to impact any structure~~, the structural control facility must be redesigned or one of the following options considered:
    a. Work with the Town of Bluffton to reduce the flow elevation through channel or flow conveyance structure improvements downstream.
    b. Obtain a flow easement from downstream property owners to the 10% point.
    c. Request a detention waiver from Town of Bluffton. This waiver would be for water quantity control only and best management practices to achieve water quality goals will still be required.

Individual single-family lots outside of an LCP, regardless of size, and individual lots within an LCP, subject to this Manual, are exempt from this requirement.

3.11 Maximum Extent Practicable

Maximum extent practicable (MEP) is the language of the Clean Water Act that sets the standards to evaluate efforts pursued to achieve pollution reduction to the Waters of the United States. The MEP refers to management practices; control techniques; and system, design, and engineering methods for the control of pollutants. It allows for considerations of public health risks, societal concerns, and social benefits, along with the gravity of the problem and the technical feasibility of solutions. The MEP for stormwater management is achieved, in part, through a process of selecting and implementing different design options with various structural and non-structural stormwater best management practices (BMPs), where ineffective BMP options may be rejected, and replaced when more effective BMP options are found (DOEE, 2019).

The Owner/Applicant must be aware that the first priority for the proposed development is to meet the required stormwater retention volume (SWRv) and peak flow requirements according to the Southern Lowcountry Stormwater Design Manual. Meeting the SWRv and peak flow requirements is attainable on any site depending on a number of factors including percent of proposed impervious area and green space conserved and/or provided. The proposed development site may have constraints or limitations that prevent Design Manual requirements from being met. It is for these projects that the MEP evaluation and waiver consideration will be required. Several site and stormwater design iterations may be necessary to ensure that Maximum Extent Practicable is achieved.

Through application of stormwater best management practices on site and/or at an off-site property within the same stormwater drainage catchment, land development projects should be able to comply with the Southern Lowcountry Stormwater Design Manual. It is the applicant's responsibility to demonstrate to the greatest extent that the requirements of this Manual can be met for the proposed development. The applicant must fully demonstrate that the requirements of the Manual are not possible or feasible before entering into a MEP analysis, and only after the concurrence of the Town of

Bluffton based on the project submittals, documentation and discussions. The Owner/applicant must realize that if the requirements of the Manual cannot be met, the site may not be conducive for development, as proposed, in the interest of public safety and welfare.

This evaluation is intended to be evaluated, considered and presented ~~during the concept review stage~~ as part of the Stormwater Management Plan submittal for the proposed development.

1) Present a SWMP for the proposed development that meets stormwater retention volume (SWRv), and peak flow requirements for channel and extreme flood protection for the proposed development and identify the reasons that this plan cannot be implemented.
2) Demonstrate why SWRv cannot be achieved by a reduction of impervious and disturbed area and/or increase in green space area on site.
3) Demonstrate how Better Site Design (BSD) has been implemented to the maximum extent practicable or document site restrictions that prevent BSD application.
    a. What efforts have been made to reduce impervious cover in the project limits of disturbance?
    b. ~~Are~~What natural assets, such as forests, wetlands, and areas of environmental or archaeological significance, are protected or conserved within the Development? Provide the cumulative acreage of land cover within the development that is protected.
    c. ~~Is stream restoration considered?~~
    d. Are structural and non-structural BMPs used in this project? Provide a completed compliance calculator showing structural and non-structural BMPs used.
4) List site restrictions that prevent or otherwise limit effective use of stormwater BMPs, retention of the SWRv and/or meeting the required peak discharge limits.
5) Provide SWRv and Pollutant Load reductions (via the compliance calculator) for alternatives analyzed as compared to pollutant load reductions for full SWRv.
~~6) What site limitations prevent retention of the SWRv or meeting the required peak discharge limits?~~
6) Is there off-site opportunity and capacity in the same drainage catchment to meet the volume/peak flow and/or SWRv requirements for the site's contributing drainage area(s)?
7) Do the publicly maintained stormwater drainage system and/or existing natural drainage courses have sufficient capacity for the development site's extreme flood peak flow?
~~9) Develop a cost versus aggregated stormwater retention volume achieved curve for the site's contributing drainage area (e.g. cost vs. % SWRv met). A minimum of five cost points with various BMP iterations/%SWRv met are necessary for the curve. One of the cost points shall be for 100% of the SWRv. If it's available, off-site capacity cost may be included in your evaluation. Identify the inflection point of the cost curve to select the optimal solution where increased cost does not result in increased effectiveness. What is the projected cost to meet the SWRv with filtering BMPs with underdrains and green roofs? What alternatives have been considered to reduce impervious and disturbed area and/or increase green space area on site.~~
8) The ~~optimum aggregated~~maximum extent practicable retention value and BMP selection and size analysis must be submitted as a part of the stormwater management plan for the project.
9) Offsite stormwater volume retention credit or fee-in-lieu documents will be required for project completion.

The MEP submittal must provide documentable evidence of the process the applicant has performed that demonstrates the restrictions to the use and implementation of BMPs to meet the requirements of this Manual in whole or in part.

3.12 Off-Site Stormwater Management *(no changes)*

3.13 Fee-in-Lieu

Fee-in-lieu (FIL) is, as the name suggests, a program that allows developers to pay a FIL if they cannot meet the SWRv requirement on their site whereby a developer can purchase units of SWRv for the needed volume through a monetary contribution to the FIL program. ~~where an entity with the responsibility of managing stormwater runoff pays a fee-in-lieu of physically managing and maintaining stormwater on site or off site. Based on the cost of treatment, long term maintenance/repair/replacement and inspection costs, a representative cost of treating stormwater can be established, and that money can go to larger scale and more efficient practices being implemented (ARC, 2016). The developer provides a fee~~ When a development project cannot accommodate the SWRv due to on-site constraints identified in the approved MEP analysis, that developer could opt to pay fee-in-lieu to the Town of Bluffton ~~(or its assigned entity)~~ for the shortfall of required SWRv according to the established FIL fee schedule. The money collected through FIL payments would then be used by the Town to install green infrastructure practices (water quality BMPs) or for other qualified uses per the site selection criteria and hierarchy that is outlined in Section 3.13.3. In general, the goal is to install water quality BMP practices or fund other qualified uses that protect water quality within the same HUC-12 watershed as the original project by water quality BMP installation/treatment of at least the same amount of stormwater runoff that is not feasible to manage on-site or to create a conservation area that protects a qualified natural resource that would otherwise require the same SWRv treatment if developed. This approach allows for more flexibility in siting BMPs where soils and watershed characteristics are more appropriate for green infrastructure practices or creating conservation areas, while still achieving the goal of treating the water quality volume from the 95th percentile event (1.95-inch event) for any new development or redevelopment project. ~~that will help cover cost of installation and long-term operation and maintenance of the stormwater practice. A fee-in-lieu program can be administered through the Town of Bluffton, a public/private initiative, or a private bank. Any fee-in-lieu program must have an Enterprise Fund and ability to oversee construction activities (e.g. programs managed by the Town of Bluffton) or be able to collect fees and dedicate those funds to stormwater related projects. In-lieu fees typically need to cover higher municipal prevailing wage and public bidding costs. The off-site mitigation practices must be implemented in the same HUC-12 watershed as the original project (or more restrictive limits, at the discretion of the Town of Bluffton). Therefore, careful accounting must take place to ensure that each site using off-site mitigation to meet pollutant removal requirements has corresponding off-site controls in the same watershed (CWP, 2012).~~

3.13.1 Unit of Measure

Fee-in-lieu payment is based and equal to a unit of SWRv in cubic feet or designating a conservation area/easement area that protects a qualified natural resource that would otherwise require the same SWRv treatment if developed.

3.13.2 Unit Cost

The monetary value for a unit of SWRv is based on the current and typical costs for the land as well as associated costs for design, construction, construction management, Town program management, post-construction inspection, and ongoing maintenance of water quality BMP practices. The SWRv FIL rate can be found in the Town's Master Fee Schedule, under Section VII "Stormwater Management Fees", allowing for annual review and updates as needed based on the Consumer Price Index (CPI) or based on updated information regarding the cost of water quality BMP construction and maintenance, changes in the construction industry, availability of supplies, etc. If the developer and/or private property owner take responsibility for maintaining the BMP or provide land, then the associated cost for a unit of SWRv could be lessened accordingly.

3.13.3 Qualified Uses of Fund, Eligible Projects

The Stormwater FIL Program may be supplemented by other funding sources, such as SWU fees or grants, if the Town requires additional revenue to fund program activities. However, the funds collected from the sale of SWRv units via the FIL program are only eligible for certain uses, including:

1. The construction and maintenance of Impervious Restoration Program water quality BMPs by the Town
2. Purchase of land for increased conservation areas, application of Better Site Design to the approved Master Plan, buffers, undisturbed open space, and natural resource of significance areas
3. Purchase of development rights

Impervious Restoration Program water quality BMPs that are currently available and eligible for implementation using FIL Program funds, as well as any special conditions, include:

- Bioretention
- Permeable Pavement
    - *Only Town of Bluffton approved permeable pavers with adequate subsurface storage*
- Infiltration Practice
- Rainwater Harvesting
    - *Requires verification of no groundwater influence and an operation and maintenance plan*
- Tree Planting and Preservation
- Proprietary Practices
    - *Upon Town of Bluffton review and approval*
- Permanent Conservation/Easement Areas of Qualified Natural Resources
    - *Where features protected and not disturbed by development process are recorded in conservation areas or easements that are in addition to other required protections from Federal, State, County, and Town agencies/requirements/restrictions.*

Water Quality BMPs or other mitigation measures to protect water quality that are built or purchased with FIL Program funds should be installed in the same major drainage basin as the site for which the fee was assessed so that the "balance" of SWRv units is not negative and resulting in a cumulative impact to water quality in the basin. This includes eight major basins within the Town of Bluffton municipal limits.

The May River watershed is divided into five major basins, where the first four are identified in the "2020 May River Watershed Action Plan Update and Modeling Report." If no projects are immediately available in one of these major basins, an adjacent major basin in the May River watershed can be targeted.

1. Stoney Creek
2. Rose Dhu Creek

3. Duck Pond
4. Palmetto Bluff
5. Old Town

The remainder of the municipal town limits are divided into the following three major basins based on other watershed boundaries. If no projects are immediately available in one of these major basins, only Okatie River and Colleton River can be pursued for alternative project locations.

1. New River (*west and south of May River watershed*)
2. Okatie River (*north central*)
3. Colleton River (*northeastern corner, remainder that is north of May River but east of Okatie River*)

3.13.4 Long-Term Operations and Maintenance

A "Permanent Stormwater Facility Maintenance and Responsibility Agreement" (Appendix O) is needed for any stormwater BMP installed as part of the FIL program to ensure continued function of the BMP. BMPs installed as part of the FIL program must adhere to requirements of Section 2.4.2 of this Manual and are subject to the Stormwater Post-Construction Ordinance (Appendix A).

If the property owner removes the BMP, they will be required to offset the SWRv units elsewhere on their site or purchase new SWRv units to offset the ones from the removed practice.

3.14 Detention Waivers

Individuals seeking a detention waiver from the requirements of the Town of Bluffton UDO and this ~~Design~~ Manual may submit to the Town of Bluffton UDO Administrator a request for a waiver in accordance with the Southern Lowcountry Stormwater Design Manual.

(1) Request of a Waiver at Staff Level
A written request for a waiver is required and shall state the specific waiver sought and the reasons, with supporting data, a waiver should be granted. The request shall include all information necessary to evaluate the proposed waiver. Requests must outline the need for such a waiver. Cost shall not be considered cause for a waiver. The applicant will address the criteria below for consideration of a waiver approval:

a. What exceptional circumstances to the site are evident that on-site or off-site stormwater management requirements cannot be met?
b. What unnecessary hardship is being caused?
c. How will denial of the waiver be inconsistent with the intent of the Ordinance?
d. How will granting the waiver comply with the intent of the Ordinance?
e. How are state and federal regulations still being met?

(2) Review of Waivers
The Town of Bluffton UDO Administrator will conduct a review of the request and will issue a decision within thirty (30) working days of receiving the request.

~~(3) Fee-in-Lieu Requirement~~

~~a. If a Waiver is granted, the applicant must submit a fee in lieu of meeting stormwater requirements as determined by the Town of Bluffton for regional stormwater projects.~~

(3) Appeal of Decision

Any person aggrieved by the decision of the UDO Administrator concerning a waiver request may appeal such decision in accordance with the Town of Bluffton established process.

3.15 References *(no changes)*

Chapter 4. Stormwater Best Management Practices (BMPs)

4.1 Standard Stormwater BMP Design Sections

This chapter summarizes and outlines performance criteria for 13 stormwater best management practice (BMP) categories that include:

- Bioretention
- Permeable Pavements
- Infiltration
- Green Roofs
- Rainwater Harvesting
- Impervious Surface Disconnection
- Open Channel Systems
- Filtering Systems
- Storage Practices
- Ponds
- Stormwater Wetlands
- Tree Planting and Preservation
- Proprietary Practices

Following these criteria is the criteria to credit for stormwater benefit the use of conservation areas and open space preservation.

Additional detailed information on many aspects of BMP design is found in Appendix M – References and Resources of this Manual. These resources may be useful for those looking to develop greater understanding of individual BMPs or stormwater design in general. Recommendations in these resources may be used to inform BMP designs; however, where conflicts occur between these resources and the Manual, the requirements of the Manual prevail.

4.1.1 Format of Standard Stormwater BMP Design Sections *(no changes)*

4.1.2 Standard Nomenclature

In this chapter, and throughout the ~~guidebook~~Manual, the terms, *must* or *shall*, denote required aspects of BMPs or their design and implementation. The term, *should*, denotes a recommendation, however, justification may be necessary for design or implementation that does not correspond to certain recommendations.

4.2 Summary of BMP Stormwater Management Capabilities, Site Applicability, & Physical Feasibility

Stormwater management requirements for a given site vary based on the site's location, and minimum control requirements discussed in detail in Section 3.5.

4.2.1 Stormwater Retention & Water Quality Treatment *(no changes)*

4.2.2 Site Applicability *(no changes)*

4.2.3 Site Conditions & Physical Feasibility

While some BMPs can be applied almost anywhere, others require specific conditions to be most effective. Physical feasibility refers to the physical site conditions necessary to effectively design and install a BMP. Table 4.2 includes the feasibility factors listed below.

- Contributing Drainage Area (CDA): Volume of water received by a practice can affect BMP performance. This column indicates the contributing drainage areas that typically apply for each BMP.
- Slope: This column describes the influence that site slope can have on the performance of the BMP. It indicates the maximum slope on which the BMP should be installed.
- Minimum Head: This column provides an estimate of the minimum amount of elevation difference needed within the BMP, from the inflow to the outflow, to allow for gravity operation.
- Minimum Depth to Seasonal High Water Table: This column indicates the minimum distance that should be provided between the bottom of the stormwater management practice and the top of the water table.
- Soils: This column describes the influence that the underlying soils (i.e., hydrologic soil groups) can have on the performance of the stormwater management practice.

Infiltration rates modeled in hydrologic and hydraulic computations must be verified by a licensed professional (geotechnical engineer or soil scientist).

Table 4.2. Feasibility limitations for BMPs.

BMP	Contributing Drainage Area	Slope	Minimum Head	Minimum Depth to Water Table	Soils
Bioretention	Up to 2.5 acres	Up to 5%[2]	4 - 5 feet	0.5 feet	All soils[3]
Permeable Pavement	Up to 5 times the practice surface area	Up to 5%	1 – 4 feet	0.5 feet	All soils[3]
Infiltration	Up to 2 acres	Up to 6%[2]	2 feet	0.5 feet	Must drain within 72 hours
Green Roof	Green roof area + 100%	Up to 30%[4]	N/A	N/A	N/A
Rainwater Harvesting	No limit	No limit	N/A	N/A	N/A
Disconnection	Up to 1,000 ft^2 per downspout	Up to 5%	N/A	N/A	All soils
Open Channels	Up to 2.5 acres	Up to 4%[2]	Varies	Varies	All soils
Filtration	Up to 5 acres	Up to 6%	2 – 10 feet	0.5 feet	All soils
Storage Practices	Varies	No limit	5 feet	0.5 feet	All soils
Ponds	Greater than 10 acres[1]	Up to 15%	6 – 8 feet	No limit	Slow-draining soils preferred

Stormwater Wetlands	Varies	Up to 8%[2]	2 – 4 feet	No limit	Slow-draining soils preferred

[1] CDA can be smaller if practice intersects the water table.

[2] Check dams may be necessary to create sufficient ponding volume.

[3] Slow-draining soils (< 0.5"/hr.) may require an underdrain and designed to drain within 48 hr.

[4] Roof slope.

Irrigation from ponds is not included as a specific best management practice in this M*anual* but is included as Rainwater Harvesting (§4.5). Requirements and guidance for irrigation use of retained stormwater have been included in Hydrologic and Hydraulic Analysis (ARC requirements in §3.7.2); Ponds (§4.10); and Rainwater Harvesting Treatment and Management Requirements (Appendix J). The Rainwater Harvesting Calculator in Appendix K will be used to determine the SWRv credit for ponds used for irrigation, and then these ponds are entered in the Compliance Calculator in Appendix H as rainwater harvesting. Instructions for these entries in the Compliance Calculator are included in Appendix G Compliance Calculator Instructions.

4.3 Bioretention

Bioretention				
Definition: Practices that capture and store stormwater runoff and pass it through a filter bed of engineered filter media composed of sand, soil, and organic matter. Filtered runoff may be collected and returned to the conveyance system or allowed to infiltrate into the soil.				
Site Applicability		**BMP Performance Summary**		
Land Uses	**Required Footprint**	**WQ Improvement:** Moderate to High		
		TSS[1]	**Total N[1,]**	**Bacteria[1,2]**
▪ Urban ▪ Suburban ▪ Rural	Small to Large	85%–100%	75%–100%	80%–100%
		Runoff Reduction		
Construction Costs	**Maintenance Burden**	**Volume**		
Moderate	Moderate	High		
Maintenance Frequency:		***SWRv***		
Routine	Non-Routine	No Underdrain	IWS	Standard
Quarterly	Every 2–3 years	100% of Sv	75% of Sv	60%
Advantages/Benefits		**Disadvantages/Limitation**		
▪ Easily incorporated into new development ▪ High community acceptance ▪ Good for small, highly paved drainage areas (i.e. parking lots)		▪ Maximum CDA is 1 to 2.5 acres ▪ Requires pretreatment to prevent clogging ▪ Requires detailed landscape planning ▪ Not appropriate for steep slopes		
Components		**Design considerations**		
▪ Pretreatment ▪ Conveyance system ▪ Ponding area ▪ Soils/Filter Media/Mulch ▪ Observation Well/Monitoring Port ▪ Plants		▪ Maximum ponding depth 18 inches ▪ Minimum filter media bed depth 18 inches ▪ ~~Depth to seasonal high water table must be at least 6 inches below bottom of practice~~ ▪ Underdrain system needed if ex soil infiltration rate < 0.5"/hr		
Maintenance Activities				
▪ Mow turf cover periodically ▪ Replace mulch as needed to maintain depth of mulch		▪ Replace plant material, as needed ▪ Replace soil if it becomes clogged ▪ Clean conveyance system(s)		

[1]*Credited pollutant load removal*
[2]*In order to receive the full credit for bacteria removal a minimum media depth of 24" is required.*

Bioretention areas, shallow depressional areas that are filled with an engineered soil media and are planted with trees, shrubs, and other herbaceous vegetation, are one of the most effective stormwater management practices that can be used to reduce post-construction stormwater runoff rates, volumes, and pollutant loads. They also provide a number of other benefits, including improved aesthetics, wildlife habitat, urban heat island mitigation, and improved air quality. See Figure 4.1 for an example image.

They are designed to capture and temporarily store stormwater runoff in the engineered soil media, where it is subjected to the hydrologic processes of evaporation and transpiration, before being conveyed back into the storm drain system through an underdrain or allowed to infiltrate into the surrounding soils. The engineered soil media is comprised of sand, soil, and organic matter.

Typically, bioretention systems are not designed to provide stormwater detention of larger storms (e.g., 2-, 10-, 25-year), but in some circumstances that may be possible. Bioretention practices should generally be combined with a separate facility to provide those controls.

Figure 4.1. Bioretention in parking lot (photo credit: Center for Watershed Protection, Inc.).

Definition. *(no changes)*

4.3.1 Bioretention Feasibility Criteria

Bioretention can be applied in most soils or topography, since runoff simply percolates through an engineered soil bed and is infiltrated or returned to the stormwater system via an underdrain. Key constraints with bioretention include the following:

Required Space *(no changes)*

Site Topography *(no changes)*

Available Hydraulic Head *(no changes)*

Water Table

For bioretention to function at its best, the entire ~~B~~bioretention area ~~must~~should be separated from the water table to ensure that groundwater does not intersect with the stone layer or filter bed and limit the bioretention's functional storage volume. ~~Mixing can lead to possible groundwater contamination or failure of the bioretention facility.~~ To fully utilize a bioretention area and count its entire design storage volume, ~~A~~a separation distance of no less than 0.5 feet of the seasonally high groundwater table cannot be included in the volume calculations. Where this is not possible, portions of the practice below or within 0.5 feet of the seasonally high groundwater table cannot be included in the volume calculations. Bioretention areas that intersect the groundwater table and include an underdrain must be installed with an internal water storage design (see Internal Water Storage in Section 4.3.4 Bioretention Design Criteria) so that the underdrain system discharges above the groundwater level. In all cases, at least 12 inches of filter media must be located above the seasonally high groundwater table.

Tidal Impacts *(no changes)*

Soils and Underdrains

Soil conditions do not typically constrain the use of bioretention, although they do determine whether an underdrain is needed. Underdrains shall be required if the measured permeability of the underlying soils is less than 0.5 inches per hour. When designing a bioretention practice, designers must verify soil permeability by using the on-site soil investigation methods provided in Appendix B for Geotechnical Information Requirements for Underground BMPs. Impermeable soils will require an underdrain.

~~For fill soil locations, g~~Geotechnical investigations are required to support modeled infiltration rates and determine if it is necessary to use an impermeable liner and/or underdrain.

Contributing Drainage Area *(no changes)*

Pollutant Hotspot Land Uses *(no changes)*

No Irrigation or Baseflow *(no changes)*

Setbacks *(no changes)*

Proximity to Utilities *(no changes)*

Minimizing External Impacts *(no changes)*

Economic Considerations *(no changes)*

4.3.2 Bioretention Conveyance Criteria *(no changes)*

4.3.3 Bioretention Pretreatment Criteria *(no changes)*

4.3.4 Bioretention Design Criteria *(no changes)*

Design Geometry *(no changes)*

Inlets and Energy Dissipation *(no changes)*

Ponding Depth *(no changes)*

Side Slopes *(no changes)*

Filter Media
The filter media of a bioretention practice consists of either in-situ soils which meet infiltration criteria specified above or an engineered soil mixture that has been carefully blended to create a filter media that maintains long-term permeability while also providing enough nutrients to support plant growth. The final filter media shall consist of a well-blended mixture of medium to coarse **sand**, **loam soil**, and an **organic amendment** (compost). The sand maintains the desired permeability of the media while the limited amount of loam soil and organic amendments are considered adequate to help support initial plant growth. It is anticipated that the gradual increase of organic material through natural processes will continue to support plant growth without the need to add fertilizer, and the root structure of maturing plants and the biological activity of the media will maintain sufficient long-term permeability.

The following is the recommended composition of the three media ingredients:

- **Sand (Fine Aggregate).** *(no changes)*
- **Loam Soil.** *(no changes)*
- **Organic Amendments.** *(no changes)*

Complete Filter Media *(no changes)*

Filter Media Depth *(no changes)*

Surface Cover *(no changes)*

Choking Layer *(no changes)*

Geotextile
If the available head is limited, or the depth of the practice is a concern, geotextile fabric may be used in place of the choking layer, but is not recommended unless design considerations govern. An appropriate geotextile fabric that complies with the latest edition of AASHTO M-288 Class 2 requirements and has a permeability of at least an order of magnitude (i.e., 10 times) higher than the soil subgrade permeability must be used. Geotextile fabric may be used on the sides and bottom of bioretention areas as well, particularly when bioretention is placed in silt/clay soils where fine particles could impact the filter media.

Underdrains *(no changes)*

Internal Water Storage (IWS) *(no changes)*

Observation Wells *(no changes)*

Underground Storage Layer (optional) *(no changes)*

Impermeable Liner (optional) *(no changes)*

Material Specifications
Recommended material specifications for bioretention areas are shown in Table 4.6. Bioretention material specifications.

Table 4.6. Bioretention material specifications.

Material	Specification	Notes
Filter Media	▪ See Table 4.5 and Table 4.6	Minimum depth of 24 inches (18 inches for standard design). To account for settling/compaction, it is recommended that 110% of the plan volume be utilized.
Mulch Layer	Use aged, shredded hardwood bark mulch	Lay a 2- to 3-inch layer on the surface of the filter bed.
Alternative Surface Cover	Use river stone or pea gravel, coir and jute matting, or turf cover.	Lay a 2- to 3-inch layer of to suppress weed growth.
Topsoil for Turf Cover	Loamy sand or sandy loam texture, with less than 5% clay content, pH corrected to between 6 and 7, and an organic matter content of at least 2%.	3-inch tilled into surface layer.
Geotextile or Choking Layer	An appropriate geotextile fabric that complies with AASHTO M-288 Class 2, latest edition, requirements and has a permeability of at least an order of magnitude (10 times) higher than the soil subgrade permeability must be used	Can use in place of the choking layer where the depth of the practice is limited. Geotextile fabric may be used on the sides and bottom of bioretention areas as well.
	Lay a 2- to 4-inch layer of choker stone (e.g., typically No.8 or No.89 washed gravel) over the underdrain stone.	
Underdrain Stone	1-inch diameter stone must be double-washed and clean and free of all fines (e.g., ASTM D448 No. 57 or smaller stone).	At least 2 inches above and below the underdrain.
Storage Layer (optional)	To increase storage for larger storm events, chambers, perforated pipe, stone, or other acceptable material can be incorporated below the filter media layer.	
Impermeable Liner (optional)	Where appropriate, use a PVC Geomembrane liner or equivalent material of an appropriate thickness.	
Underdrains, Cleanouts, and Observation Wells	Use 4- or 6-inch rigid schedule 40 PVC pipe, or equivalent corrugated HDPE for small bioretention BMPs, with three or four rows of 3/8-inch perforations at 6 inches on center. Multiple underdrains may be necessary for bioretention areas wider than 40 feet, and each underdrain is recommended to be located no more than 20 feet from the next pipe or the edge of the bioretention.	Lay the perforated pipe under the length of the bioretention cell and install non-perforated pipe as needed to connect with the storm drain system or to daylight in a stabilized conveyance. Install T's and Y's as needed, depending on the underdrain configuration. Extend cleanout pipes to the surface of ponding.
Plant Materials	See Section 4.3.5 Bioretention Landscaping Criteria	Establish plant materials as specified in the landscaping plan and the recommended plant list.

Signage *(no changes)*

Specific Design Issues for Streetscape Bioretention (B-2) *(no changes)*

Specific Design Issues for Engineered Tree Boxes (B-3) *(no changes)*

Specific Design Issues for Stormwater Planters (B-4) *(no changes)*

Specific Design Issues for Residential Rain Gardens (B-5) *(no changes)*

BMP Sizing *(no changes)*

4.3.5 Bioretention Landscaping Criteria *(no changes)*

4.3.6 Bioretention Construction Sequence *(no changes)*

4.3.7 Bioretention Maintenance Criteria *(no changes)*

4.3.8 Bioretention Stormwater Compliance Calculations *(no changes)*

4.3.9 References *(no changes)*

4.4 Permeable Pavement Systems

<table>
<tr><th colspan="8">Permeable Pavement Systems</th></tr>
<tr><td colspan="8">Definition: Paving systems that capture and temporarily store the SWRv by filtering runoff through voids in an alternative pavement surface into an underlying stone reservoir. Filtered runoff may be collected and returned to the conveyance system or allowed to partially (or fully) infiltrate into the soil.</td></tr>
<tr><th colspan="2">Site Applicability</th><th colspan="6">BMP Performance Summary</th></tr>
<tr><th>Land Uses</th><th>Required Footprint</th><th colspan="6">WQ Improvement: Moderate to High</th></tr>
<tr><td rowspan="3">Urban
Suburban
Rural</td><td rowspan="3">Small</td><th colspan="2">TSS[1]</th><th colspan="2">Total N[1]</th><th colspan="2">Bacteria[1]</th></tr>
<tr><td colspan="2">80-100%</td><td colspan="2">45-100%</td><td colspan="2">30-100%</td></tr>
<tr><th colspan="6">Runoff Reduction</th></tr>
<tr><th>Construction Costs</th><th>Maintenance Burden</th><th colspan="6">Volume</th></tr>
<tr><td>High</td><td>High</td><td colspan="6">Moderate</td></tr>
<tr><th colspan="2">Maintenance Frequency:</th><th colspan="6">SWRv</th></tr>
<tr><th>Routine</th><th>Non-Routine</th><th colspan="3">Standard Design</th><th colspan="3">Enhanced Design</th></tr>
<tr><td>2-4 times per year</td><td>Every 2-3 years</td><td colspan="3">30%</td><td colspan="3">100%</td></tr>
<tr><th colspan="2">Advantages/Benefits</th><th colspan="6">Disadvantages/Limitation</th></tr>
<tr><td colspan="2">Reduces runoff volume, attenuates peak runoff rate and outflow
Reduces slick surfaces during rain
Water quality enhancement from filtration of stormwater</td><td colspan="6">Sediment-laden runoff can clog pervious pavement, causing it to fail
Incorrect installation practices can clog pores</td></tr>
<tr><th colspan="2">Components</th><th colspan="6">Design considerations</th></tr>
<tr><td colspan="2">Open graded pavement mix or pavers with open surfaces
Bedding course
Open-graded base material
Underdrain (where required)
Subgrade with minimal compaction</td><td colspan="6">Same basic considerations as any paved area
Infiltration rate of native soil of < 0.5 in./hr determines need for underdrain
Depth to seasonal high water table must be at least 6 inches below bottom of practice
Not appropriate for heavy or high traffic areas
Accessibility, aesthetics, maintainability</td></tr>
<tr><th colspan="2">Installation Considerations</th><th colspan="6">Maintenance Activities</th></tr>
<tr><td colspan="2">Proper construction sequencing and installation is crucial to ensure proper functioning
Subgrade cannot be overly compacted</td><td colspan="6">Vacuum or jet wash to increase pavement life and avoid clogging
Ensure that contributing area is clear of debris and sediment.</td></tr>
</table>

[1]*Credited pollutant load removal*

Permeable pavement systems represent alternative paving surfaces that capture and temporarily store the design volume by filtering runoff through voids in the pavement surface into an underlying stone reservoir (see Figure 4.11). Filtered runoff may be collected and returned to the conveyance system, or it may be allowed to infiltrate into the soil. Permeable pavement systems may also provide stormwater detention of larger storms (e.g., 2- to 25-year).

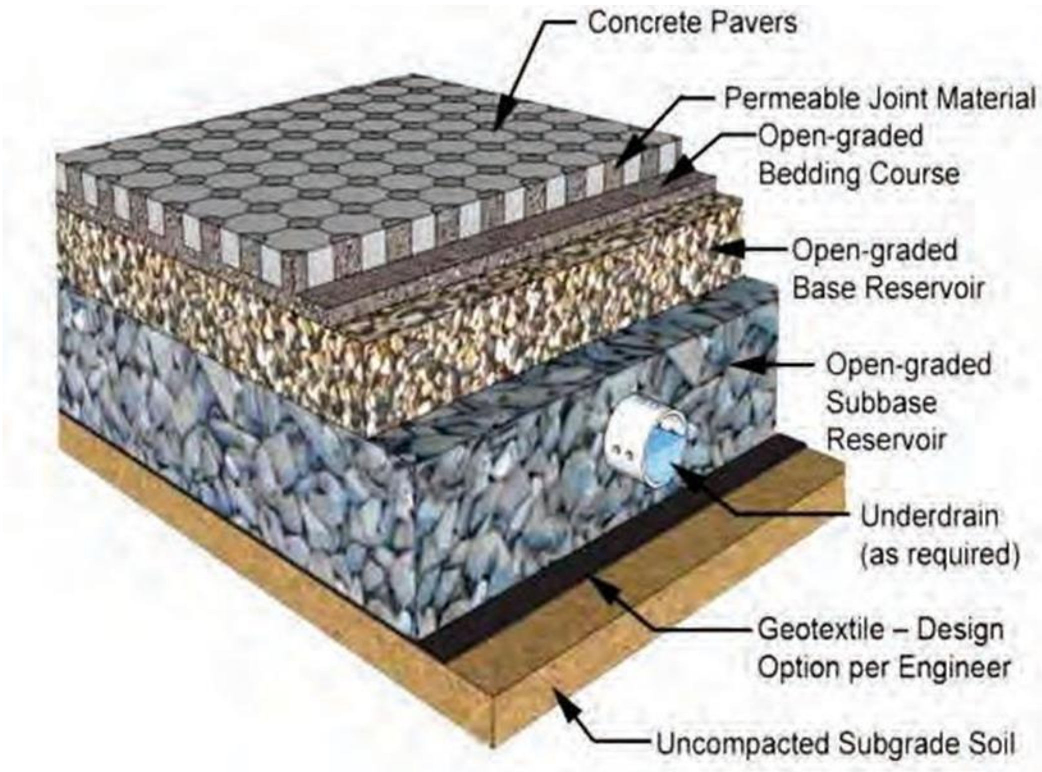


Figure 4.11. Cross-section of permeable pavement (source: ICPI).

Definition *(no changes)*

Porous Asphalt *(no changes)*

Pervious Concrete *(no changes)*

Permeable Pavers

Permeable pavers (PP) are solid structural units (e.g., blocks, bricks) that are designed and installed in a way that provides regularly spaced openings through which stormwater runoff can rapidly pass through the pavement surface and into the underlying stone reservoir. The regularly spaced openings, which generally make up between 8% and 20% of the total pavement surface, are typically filled with pea gravel (i.e., ASTM D 448 Size No. 8, 3/8 inch to 1/8 inch). Typical PP systems consist of the pavers, a 1.5- to 3-inch thick fine gravel bedding layer and an underlying stone reservoir.

Design Configurations *(no changes)*

4.4.1 Permeable Pavement Feasibility Criteria *(no changes)*

4.4.2 Permeable Pavement Conveyance Criteria *(no changes)*

4.4.3 Permeable Pavement Pretreatment Criteria *(no changes)*

4.4.4 Permeable Pavement Design Criteria *(no changes)*

Type of Surface Pavement *(no changes)*

Pavement Bottom Slope *(no changes)*

Internal Geometry and Drawdowns *(no changes)*

Reservoir Layer *(no changes)*

Underdrains *(no changes)*

Observation Wells

All permeable pavement practices must include at least one observation well, per system. The observation well is used to observe the rate of drawdown within the reservoir layer following a storm event and to facilitate periodic inspection and maintenance. The observation well should consist of a well-anchored, perforated 4- to 6-inch diameter PVC pipe. There should be no perforation within 1 foot of the surface. If the permeable pavement has an underdrain, tie the observation well into any Ts or Ys in the underdrain system. The observation well should extend vertically to the bottom of the reservoir layer and extend upwards to be flush with the surface (or just under pavers) with a lockable cap.

Infiltration Sump (optional, required for enhanced designs with an underdrain) *(no changes)*

Filter Layer (optional) *(no changes)*

Geotextile (optional) *(no changes)*

Material Specifications

Permeable pavement material specifications vary according to the specific pavement product selected. A general comparison of different permeable pavements is provided in Table 4.13, but designers should consult manufacturer's technical specifications for specific criteria and guidance. Table 4.14 provides general material specifications for the component structures installed beneath the permeable pavement. Note that the size of stone materials used in the reservoir and filter layers may differ depending on the type of surface material.

Table 4.13. Permeable pavement specifications for a variety of typical surface materials.

Material	Specification	Notes
Permeable Pavers (PP)	Void content, thickness, and compressive strength vary based on type and manufacturer Open void fill media: aggregate, topsoil and grass, coarse sand, etc.	Pavers must be designed specifically to be permeable. Reservoir layer required to support the structural load.
Pervious Concrete (PC)	Void content: 15–20% Thickness: Typically 4–8 inches Compressive strength: 2.8–28 MPa Open void fill media: None	May not require a reservoir layer to support the structural load, but a layer may be included to increase the storage or infiltration. Requires certified supplier and installer.
Porous Asphalt (PA)	Void content: 15–20% Thickness: Typically 3–7 inches (depending on traffic load) Open void fill media: None	Reservoir layer required to support the structural load. Requires certified supplier and installer.

Table 4.14. *(no changes)*

Permeable Pavement Sizing *(no changes)*

Structural Design *(no changes)*

Detention Storage Design *(no changes)*

4.4.5 Permeable Pavement Landscaping Criteria *(no changes)*

4.4.6 Permeable Pavement Construction Sequence *(no changes)*

Soil Erosion and Sediment Controls *(no changes)*

Permeable Pavement Installation *(no changes)*

1.-9. *(no changes)*

10. Installation of Porous Asphalt
The following has been excerpted from various documents, most notably Jackson (2007):

- Install porous asphalt pavement similarly to regular asphalt pavement. The pavement should be laid in a single lift over the filter course. The laying temperature should be between 230°F and 260°F, with a minimum air temperature of 50°F, to ensure the surface does not stiffen before compaction.
- Complete compaction of the surface course when the surface is cool enough to resist a 10-ton roller. One or two passes of the roller are required for proper compaction. More rolling could cause a reduction in the porosity of the pavement.
- The mixing plant must provide certification of the aggregate mix, abrasion loss factor, and asphalt content in the mix. Test the asphalt mix for its resistance to stripping by water using ASTM D1664. If the estimated coating area is not above 95%, additional anti-stripping agents must be added to the mix.
- Transport the mix to the site in a clean vehicle with smooth dump beds sprayed with a non-petroleum release agent. The mix shall be covered during transportation to control cooling.
- Test the ~~full~~ permeability of the pavement surface by performing ASTM test C1701, Standard Test Method for Infiltration Rate of In Place Pervious Concrete in at least three (3) locations spaced evenly throughout the pavement area. ~~application of clean water at a rate of at least 5 gallons per minute over the entire surface. All water must infiltrate directly, without puddle formation or surface runoff.~~
- Inspect the facility 18 to 30 hours after a significant rainfall (0.5 inch or greater) or artificial flooding to determine if the facility is draining properly.

11. Pervious Concrete Installation
The basic installation sequence for pervious concrete is outlined by the National Ready Mixed Concrete Association (NRMCA; NRMCA, 2004). Concrete installers are required to be certified by a recognized pervious concrete installers training program, such as the Pervious Concrete Contractor Certification Program offered by the NRMCA. The basic installation procedure is as follows:

- Drive the concrete truck as close to the project site as possible.

- Water the underlying aggregate (reservoir layer) before the concrete is placed, so the aggregate does not draw moisture from the freshly laid pervious concrete.
- After the concrete is placed, approximately 3/8 to 1/2 inches is struck off, using a vibratory screed. This is to allow for compaction of the concrete pavement.
- Compact the pavement with a steel pipe roller. Care should be taken to ensure over-compaction does not occur.
- Cut joints for the concrete to a depth of 1/4 inch.
- The curing process is very important for pervious concrete. Concrete installers should follow manufacturer specifications to the extent allowed by on-site conditions when curing pervious concrete. This typically requires covering the pavement with plastic sheeting within 20 minutes of the strike-off and may require keeping it covered for at least 7 days. Do not allow traffic on the pavement during the curing period.
- Remove the plastic sheeting only after the proper curing time.
- Test the permeability of the pavement surface by performing ASTM test C1701, Standard Test Method for Infiltration Rate of In Place Pervious Concrete in at least three (3) locations spaced evenly throughout the pavement area.
- Inspect the facility 18 to 30 hours after a significant rainfall (0.5 inch or greater) or artificial flooding, to determine if the facility is draining properly.

12. Permeable Interlocking Concrete Paver Installation
The basic installation process is described in greater detail by Smith (2006):

- Place edge restraints for open-jointed pavement blocks before the bedding layer and pavement blocks are installed. Permeable interlocking concrete pavement systems require edge restraints to prevent vehicle loads from moving the paver blocks. Edge restraints may be standard curbs or gutter pans, or precast or cast-in-place reinforced concrete borders a minimum of 6 inches wide and 18 inches deep, constructed with Class A3 concrete. Edge restraints along the traffic side of a permeable pavement block system are recommended.
- Place the double-washed No. 57 stone in a single lift. Level the filter course and compact it into the reservoir course beneath with at least four passes of a 10-ton steel drum static roller until there is no visible movement. The first two passes are in vibratory mode, with the final two passes in static mode. The filter aggregate should be moist to facilitate movement into the reservoir course.
- Place and screed the bedding course material (typically No. 8 stone).
- Fill gaps at the edge of the paved areas with cut pavers or edge units. When cut pavers are needed, cut the pavers with a paver splitter or masonry saw. Cut pavers no smaller than 1/3 of the full unit size.
- Pavers may be placed by hand or with mechanical installers. Fill the joints and openings with stone. Joint openings must be filled with ASTM D448 No. 8 stone; although, No. 8P or No. 9 stone may be used where needed to fill narrower joints. Remove excess stones from the paver surface.

- Compact and seat the pavers into the bedding course with a minimum low-amplitude 5,000-pound-foot, 75- to 95-Hz plate compactor.
- Do not compact within 6 feet of the unrestrained edges of the pavers.
- The system must be thoroughly swept by a mechanical sweeper or vacuumed immediately after construction to remove any sediment or excess aggregate.
- Inspect the area for settlement. Any blocks that settle must be reset and re-inspected.
- Test the permeability of the pavement surface by performing ASTM test C1781, Standard Test Method for Surface Infiltration Rate of Permeable Unit Pavement Systems in at least three (3) locations spaced evenly throughout the pavement area.
- Inspect the facility 18 to 30 hours after a significant rainfall (0.5 inch or greater) or artificial flooding to determine whether the facility is draining properly.

13. Construction Supervision
Supervision before, during, and after construction by a qualified professional is recommended to ensure permeable pavement is built in accordance with these specifications. **ASTM test C1781 or C1701 must be performed following installation to ensure initial pavement permeability of at least 6 inches per hour in at least three (3) locations spaced evenly throughout the pavement area.** Inspection checklists that require sign-offs by qualified individuals should be used at critical stages of construction to ensure the contractor's interpretation of the plan is consistent with the designer's intent.

Construction phase inspection checklist for permeable pavement practices can be found in Appendix E Construction Inspection Checklists.

Some common pitfalls can be avoided by careful construction supervision that focuses on the following key aspects of permeable pavement installation:

- Store materials in a protected area to keep them free from mud, dirt, and other foreign materials.
- The CDA should be stabilized prior to directing water to the permeable pavement area.
- Check the aggregate material to confirm it is clean and washed, meets specifications and is installed to the correct depth. Aggregate loads that do not meet the specifications or do not appear to be sufficiently washed may be rejected.
- Check elevations (i.e., the invert of the underdrain, inverts for the inflow, and outflow points) and the surface slope.
- Make sure the permeable pavement surface is even, runoff spreads evenly across it, and the storage bed drains within 48 hours.
- Ensure caps are placed on the upstream (but not the downstream) ends of the underdrains.
- Inspect the pretreatment structures (if applicable) to make sure they are properly installed and working effectively.
- Once the final construction inspection has been completed, log the GPS coordinates for each facility and submit them for entry into the BMP maintenance tracking database.

Runoff diversion structures are recommended to protect larger permeable pavement applications from early runoff-producing storms, particularly when up-gradient conventional asphalt areas drain to the permeable pavement. This can help reduce the input of fine particles often produced shortly after conventional asphalt is laid.

4.4.7 Permeable Pavement Maintenance Criteria *(no changes)*

4.4.8 Permeable Pavement Stormwater Compliance Calculations *(no changes)*

4.4.9 References *(no changes)*

4.5 Infiltration Practices *(no changes)*

4.6 Green Roofs *(no changes)*

4.7 Rainwater Harvesting

<table>
<tr><th colspan="5">Rainwater Harvesting</th></tr>
<tr><td colspan="5">Definition: Rainwater harvesting systems store rainfall and release it for future use. Rainwater that falls on a rooftop or other impervious surface is collected and conveyed into an above- or below-ground tank (also referred to as a cistern) or settling pond, where it is stored for non-potable uses.</td></tr>
<tr><th colspan="2">Site Applicability</th><th colspan="3">BMP Performance Summary</th></tr>
<tr><th>Land Uses</th><th>Required Footprint</th><th colspan="3">WQ Improvement: Moderate to High</th></tr>
<tr><td rowspan="3">▪ Urban
▪ Suburban
▪ Rural</td><td rowspan="3">Small</td><th>TSS[1]</th><th>Total N[1]</th><th>Bacteria[1]</th></tr>
<tr><td>Varies*</td><td>Varies*</td><td>Varies*</td></tr>
<tr><th colspan="3">Runoff Reduction</th></tr>
<tr><th>Construction Costs</th><th>Maintenance Burden</th><th colspan="3">Volume</th></tr>
<tr><td>Low to Moderate</td><td>Moderate</td><td colspan="3">Varies*</td></tr>
<tr><th colspan="2">Maintenance Frequency:</th><th colspan="3">SWRv</th></tr>
<tr><th>Routine</th><th>Non-Routine</th><td colspan="3" rowspan="2">100% of Available Storage Volume</td></tr>
<tr><td>Quarterly</td><td>Every 3 years</td></tr>
<tr><th colspan="2">Advantages/Benefits</th><th colspan="3">Disadvantages/Limitation</th></tr>
<tr><td colspan="2">▪ Reduces runoff rates and volume
▪ Can provide for/supplement irrigation needs</td><td colspan="3">▪ Stored water must be used on regular basis to maintain capacity
▪ Stagnant water can breed mosquitos</td></tr>
<tr><th colspan="2">Components</th><th colspan="3">Design considerations</th></tr>
<tr><td colspan="2">▪ Pretreatment
▪ Conveyance
▪ First flush diverter
▪ Cistern (storage tank)
▪ Overflow
▪ Low water cutoff</td><td colspan="3">▪ Plumbing codes (for indoor tanks)
▪ Size based on CDA, local rainfall patterns, and projected harvest rainwater demand
▪ Location and elevation of cistern
▪ Tank manufacturer's specifications
▪ Irrigation system and application rates</td></tr>
<tr><th colspan="5">Maintenance Activities</th></tr>
<tr><td colspan="2">▪ Inspect/clean pretreatment devices and first flush diverts
▪ Clear gutter/downspouts</td><td colspan="3">▪ Inspect and clean storage tank
▪ Maintenance log required</td></tr>
</table>

[1]Credited pollutant load removal

**Varies according to rainwater harvesting storage capacity and demand*

Rainwater harvesting systems store rainfall for future, non-potable water uses and on-site stormwater disposal/infiltration. By providing a reliable and renewable source of water to end users, rainwater harvesting systems can also have environmental and economic benefits beyond stormwater management (e.g. increased water conservation, water supply during drought and mandatory municipal water supply restrictions, decreased demand on municipal or groundwater supply, decreased water costs for the end-user, potential for increased groundwater recharge, supply of water post storm/hurricane in case of failed municipal infrastructure etc.).

Definition *(no changes)*

4.7.1 Rainwater Harvesting Feasibility Criteria *(no changes)*

4.7.2 Rainwater Harvesting Conveyance Criteria *(no changes)*

4.7.3 Rainwater Harvesting Pretreatment Criteria *(no changes)*

4.7.4 Rainwater Harvesting Design Criteria *(no changes)*

4.7.5 Rainwater Harvesting Landscaping Criteria

If the harvested water is to be used for irrigation, the design plan elements must include the proposed delineation of planting areas to be irrigated, the planting plan, and quantification of the expected water demand. The default water demand for irrigation is 1.0 inches per week over the area to be irrigated during the months of ~~May~~ <u>March</u> through ~~October~~ <u>November</u> only. Justification must be provided if larger volumes are to be used.

4.7.6 Rainwater Harvesting Construction Sequence *(no changes)*

Installation *(no changes)*

Construction Supervision

Construction phase inspection checklist for rainwater harvesting practices ~~and the Stormwater Facility Leak Test form~~ a can be found in Appendix E <u>–</u> Construction Inspection Checklists.

4.7.7 Rainwater Harvesting Maintenance Criteria *(no changes)*

4.7.8 Rainwater Harvesting Stormwater Compliance Calculations *(no changes)*

4.7.9 References *(no changes)*

4.8 Impervious Surface Disconnection *(no changes)*

4.9 Open Channel Systems

<table>
<tr><th colspan="7">Open Channel Systems</th></tr>
<tr><td colspan="7">Definition: Vegetated open channels that are designed to capture and treat or convey the design storm volume (SWRv).</td></tr>
<tr><th colspan="2">Site Applicability</th><th colspan="5">BMP Performance Summary</th></tr>
<tr><th>Land Uses</th><th>Required Footprint</th><th colspan="5">WQ Improvement: Moderate to High</th></tr>
<tr><td rowspan="3">▪ Suburban
▪ Rural</td><td rowspan="3">Moderate</td><th colspan="2">TSS[1]</th><th colspan="2">Total N[1]</th><th>Bacteria[1]</th></tr>
<tr><td colspan="2">50-80%</td><td colspan="2">25-70%</td><td>30-80%</td></tr>
<tr><th colspan="5">Runoff Reduction</th></tr>
<tr><th>Construction Costs</th><th>Maintenance Burden</th><th colspan="5">Volume</th></tr>
<tr><td>Low</td><td>Low</td><td colspan="5">Low</td></tr>
<tr><th colspan="2">Maintenance Frequency:</th><th colspan="5">SWRv</th></tr>
<tr><td>Routine</td><td>Non-Routine</td><td>O-1a</td><td>O-1b</td><td>O-2</td><td>O-3</td><td>O-4</td></tr>
<tr><td>Quarterly</td><td>Every 10-15 years</td><td>10%</td><td>20%</td><td>60%</td><td>0%</td><td>0%</td></tr>
<tr><th colspan="2">Advantages/Benefits</th><th colspan="5">Disadvantages/Limitation</th></tr>
<tr><td colspan="2">▪ Less expensive than curb and gutter
▪ Relatively low maintenance requirements
▪ Provides pretreatment if used as part of runoff conveyance system
▪ Provides partial infiltration of runoff in some soils
▪ Good for small drainage areas</td><td colspan="5">▪ Must be carefully designed to achieve low flow rates in the channel (< 1.0 ft/s)
▪ May re-suspend sediment
▪ May not be acceptable for some areas because of standing water in channel</td></tr>
<tr><th colspan="2">Components</th><th colspan="5">Design considerations</th></tr>
<tr><td colspan="2">▪ Channel geometry
▪ Dense vegetation
▪ Check dams, as needed)</td><td colspan="5">▪ Maximum drainage area of 2.5 acres
▪ Slopes (<4% unless using O-4)
▪ Runoff velocities must be non-erosive
▪ Vegetation must withstand both relatively high velocity flows and wet/dry periods.</td></tr>
<tr><th colspan="7">Maintenance Activities</th></tr>
<tr><td colspan="2">▪ Mow grass to 3 or 4 inches high
▪ Inspect for, and correct, formation of rills and gullies</td><td colspan="5">▪ Clean out sediment accumulation in channel
▪ Ensure that vegetation remains well established</td></tr>
</table>

[1]*Credited pollutant load removal*

Often found along roadsides, parking lots, and property boundaries, open channels can provide stormwater conveyance, capture and/or treatment. One of the most visible stormwater BMPs, they are often part of stormwater conveyance systems.


Figure 4.33. Open channel (photo: Center for Watershed Protection, Inc.)

Definition. *(no changes)*

4.9.1 Open Channel Feasibility Criteria *(no changes)*

4.9.2 Open Channel Conveyance Criteria *(no changes)*

4.9.3 Open Channel Pretreatment Criteria *(no changes)*

4.9.4 Open Channel Design Criteria

Channel Geometry. – Ponding Depth. *(no changes)*

Dry Swale Filter Media. Dry swales may require replacement of native soils with a prepared filter media if geotechnical analysis shows that in-situ soils do not provide the necessary infiltration rates. The filter media provides adequate drainage, supports plant growth, and facilitates pollutant removal within the dry swale. At least 18 inches of filter media must be added above the choker stone layer (and no more than 6 feet) to create an acceptable filter. The recipe for the filter media is identical to that used for bioretention and is provided in Section 4.3 Bioretention. The batch receipt confirming the source of the filter media must be submitted to the Town of Bluffton inspector. One acceptable design adaptation is to use 100% sand for the first 18 inches of the filter and add a combination of topsoil and compost, as specified in Appendix C – Soil Compost Amendment Requirements, for the top 4 inches, where turf cover will be maintained.

Dry Swale Drawdown. – RSC Sizing. *(no changes)*

4.9.5 Open Channel Landscaping Criteria *(no changes)*

4.9.6 Open Channel Construction Sequence *(no changes)*

4.9.7 Open Channel Maintenance Criteria *(no changes)*

4.9.8 Open Channel Stormwater Compliance Calculations *(no changes)*

4.9.9 References *(no changes)*

4.10 Filtering Systems

4.10.1 Filtering System Feasibility Criteria *(no changes)*

4.10.2 Filtering System Conveyance Criteria *(no changes)*

4.10.3 Filtering System Pretreatment Criteria *(no changes)*

4.10.4 Filtering System Design Criteria *(no changes)*

4.10.5 Filtering System Landscaping Criteria *(no changes)*

4.10.6 Filtering System Construction Sequence

Soil Erosion and Sediment Control. *(no changes)*

Filter Installation. The following is the typical construction sequence to properly install a structural sand filter. This sequence can be modified to reflect different filter designs, site conditions, and the size, complexity, and configuration of the proposed filtering application.

1. **Stabilize Contributing Drainage Area. – 5. Excavate and Grade** *(no changes)*

6. **Install Filter Structure. Install filter structure in design location** and check all design elevations (i.e., concrete vaults for surface, underground, and perimeter sand filters). Upon completion of the filter structure shell, inlets and outlets must be temporarily plugged and the structure filled with water to the brim to demonstrate water tightness. Maximum allowable leakage is 5% of the water volume in a 24-hour period. ~~See Appendix E Construction Inspection Checklists for the Stormwater Facility Leak Test form.~~ If the structure fails the test, repairs must be performed to make the structure watertight before any sand is placed into it.

7. **Install Base Material Components. – 11. Final Inspection** *(no changes)*

Construction phase inspection checklist for filters ~~and the Stormwater Facility Leak Test form~~ can be found in Appendix E Construction Inspection Checklists.

4.10.7 Filtering System Maintenance Criteria *(no changes)*

4.10.8 Filtering System Stormwater Compliance Calculations *(no changes)*

4.10.9 References *(no changes)*

4.11 Storage Practices *(no changes)*

4.12 Ponds

<table>
<tr><th colspan="5">Ponds</th></tr>
<tr><td colspan="5">Definition: Stormwater storage practices that consist of a combination of a permanent pool, micropool, or shallow marsh that promote a good environment for gravitational settling, biological uptake, and microbial activity.</td></tr>
<tr><th colspan="2">Site Applicability</th><th colspan="3">BMP Performance Summary</th></tr>
<tr><th>Land Uses</th><th>Required Footprint</th><th colspan="3">WQ Improvement: Moderate to High</th></tr>
<tr><td rowspan="3">▪ Urban
▪ Suburban
▪ Rural</td><td rowspan="3">Medium</td><th>TSS[1]</th><th>Total N[1]</th><th>Bacteria[1]</th></tr>
<tr><td>80%</td><td>30%</td><td>60%</td></tr>
<tr><th colspan="3">Runoff Reductions</th></tr>
<tr><th>Construction Costs</th><th>Maintenance Burden</th><th colspan="3">Volume</th></tr>
<tr><td>Moderate</td><td>Moderate</td><td colspan="3">Low</td></tr>
<tr><th colspan="2">Maintenance Frequency:</th><th colspan="3">SWRv</th></tr>
<tr><th>Routine</th><th>Non-Routine</th><td colspan="3" rowspan="2">0%</td></tr>
<tr><td>At least annually</td><td>Every 5–7 years</td></tr>
<tr><th colspan="2">Advantages/Benefits</th><th colspan="3">Disadvantages/Limitation</th></tr>
<tr><td colspan="2">▪ Moderate to high pollutant removal
▪ Can be designed as a multi-functional BMP
▪ Cost effective
▪ Good for sites with high water table and/or poorly drained soils
▪ Wildlife habitat potential
▪ High community acceptance when integrated into a development</td><td colspan="3">▪ Requires large amount of flat land (1-3% of CDA)
▪ Must be properly designed, installed, and maintained to avoid nuisance problems
▪ Routine sediment cleanout may be needed
▪ Potential for thermal impacts downstream</td></tr>
<tr><th colspan="2">Components</th><th colspan="3">Design considerations</th></tr>
<tr><td colspan="2">▪ Conveyance
▪ Forebay
▪ Ponding area with available storage
▪ Micropool
▪ Spillway system(s)
▪ Liners, as needed</td><td colspan="3">▪ CDA of at least 10 acres and slopes <15%
▪ Use CN adjustment factor ARC III for CDA that are irrigated with harvested rainwater
▪ Minimum length to width ratio = 3:1
▪ Maximum depth of permanent pool = 8’
▪ 3:1 side slopes or flatter around pond perimeter</td></tr>
<tr><th colspan="5">Maintenance Activities</th></tr>
<tr><td colspan="2">▪ Remove debris from inlet and outlet structures
▪ Maintain side slopes/remove invasive vegetation</td><td colspan="3">▪ Monitor sediment accumulation and remove periodically</td></tr>
</table>

[1] *Credited pollutant load removal*

Stormwater ponds are widely applicable for most land uses and are best suited for larger drainage areas (Figure 4.47); however, they should be considered for use after all other upland retention opportunities have been exhausted and there is still a remaining treatment volume or runoff from larger storms (i.e., 2- to 25-year or flood control events) to manage.

Stormwater ponds receive no retention credit and should be considered mainly for management of larger storm events. Stormwater ponds have both community and environmental concerns (see Section 4.12.1 Pond Feasibility Criteria) that should be considered before choosing stormwater ponds as the appropriate stormwater practice on site.

Figure 4.50. Wet Pond (photo: Denise Sanger)

Definition. *(no changes)*

4.12.1 Pond Feasibility Criteria *(no changes)*

4.12.2 Pond Conveyance Criteria
Internal Slope. – Emergency Spillway. *(no changes)*

Adequate Outfall Protection. The design must specify an outfall that will be stable for the ~~25~~100-year design storm event. The channel immediately below the pond outfall must be modified to prevent erosion and conform to natural dimensions in the shortest possible distance. This is typically done by placing appropriately sized riprap over geotextile fabric, which can reduce flow velocities from the principal spillway to non-erosive levels (3.5 to 5.0 feet per second) depending on the channel lining material. Flared pipe sections, which discharge at or near the stream invert or into a step pool arrangement, should be used at the spillway outlet.

When the discharge is to a manmade pipe or channel system, the system must be adequate to convey the required design storm peak discharge.

If a pond daylights to a channel with dry weather flow, care should be taken to minimize tree clearing along the downstream channel, and to reestablish a forested riparian zone in the shortest possible distance. Excessive use of riprap should be avoided.

The final release rate of the facility shall be modified if any increase in flooding or stream channel erosion would result at a downstream structure, highway, or natural point of restricted streamflow.

Inlet Protection. – Dam Safety Permits. *(no changes)*

4.12.3 Pond Pretreatment Criteria *(no changes)*

4.12.4 Pond Design Criteria

Pond Storage Design. – Stormwater Pond Benches. *(no changes)*

~~**Liners.** When a stormwater pond is located over highly permeable soils, a liner may be needed to sustain a permanent pool of water. If geotechnical tests confirm the need for a liner, acceptable options include the following:~~

1. ~~a clay liner following the specifications outlined in Table 4.49;~~
2. ~~a 30-mil poly liner;~~
3. ~~bentonite;~~
4. ~~use of chemical additives; or~~
5. ~~an engineering design, as approved on a case-by-case basis by Town of Bluffton.~~

~~A clay liner must have a minimum thickness of 12 inches with an additional 12-inch layer of compacted soil above it, and it must meet the specifications outlined in Table 4.49. Other synthetic liners can be used if the designer can supply supporting documentation that the material will achieve the required performance.~~

~~Table 4.49. Clay Liner Specifications~~

~~**Property**~~	~~**Test Method**~~	~~**Unit**~~	~~**Specification**~~
~~Permeability~~	~~ASTM D2434~~	~~cm/s~~	~~1×10^{-6}~~
~~Plasticity Index of Clay~~	~~ASTM D4318~~	~~%~~	~~Not less than 15~~
~~Liquid Limit of Clay~~	~~ASTM D2216~~	~~%~~	~~Not less than 30~~
~~Clay Particles Passing~~	~~ASTM D422~~	~~%~~	~~Not less than 30~~
~~Clay Compaction~~	~~ASTM D2216~~	~~%~~	~~95% of standard proctor density~~

~~Source: DCR (1999). VA~~

Required Geotechnical Testing. – Pond Drain. *(no changes)*

Safety Features.

- The principal spillway opening must be designed and constructed to prevent access by small children.

- End walls above pipe outfalls greater than 48 inches in diameter must be fenced to prevent a falling hazard.
- Storage practices must incorporate an additional 1 foot of freeboard above the emergency spillway, or 2 feet of freeboard if design has no emergency spillway, for the 100-year storm.
- The emergency spillway must be located so that downstream structures will not be impacted by spillway discharges.
- ~~Both the safety bench and the aquatic bench should be landscaped with vegetation that hinders or prevents access to the pool.~~
- Warning signs prohibiting swimming must be posted.
- Where permitted, fencing of the perimeter of ponds is discouraged. The preferred method to reduce risk is to manage the contours of the stormwater pond to eliminate drop-offs or other safety hazards. Fencing is required at or above the maximum water surface elevation in the rare situations when the pond slope is a vertical wall.
- Side slopes to the pond shall not be steeper than 3H:1V, and shall terminate on a ~~15 foot wide~~ safety bench. Both the safety bench and the aquatic bench ~~may~~should be landscaped to prevent access to the pool. ~~The bench requirement may be waived if slopes are 4H:1V or flatter.~~

Maintenance Reduction Features – Water Balance Testing *(no changes)*

4.12.5 Pond Landscaping Criteria

Pond Benches. The perimeter of all deep pool areas (4 feet or greater in depth) must be surrounded by two benches:

- A safety bench that ~~extends 8 to 15 feet outward from the normal water edge to the toe of the pond side slope. The maximum slope of the safety bench shall be 6%~~is landscaped to prevent access to the pool.
- An aquatic bench that ~~extends up to 10 feet inward from the normal shoreline and~~ has a maximum depth of 18 inches below the normal pool water surface elevation, planted with native aquatic plant species.

Landscaping and Planting Plan. A landscaping plan must be provided that indicates the methods used to establish and maintain vegetative coverage in the pond and its buffer (see Section 4.3.5 Bioretention Landscaping Criteria for extended landscaping and planting details). Minimum elements of a landscaping plan include the following:

- Delineation of ~~pondscaping~~landscaping zones within both the pond and buffer.
- Selection of corresponding plant species.
- The planting plan.
- The sequence for preparing the wetland benches (including soil amendments, if needed).
- Sources of native plant material.
- The landscaping plan should provide elements that promote diverse wildlife and waterfowl use within the stormwater wetland and buffers.

- Woody vegetation may not be planted or allowed to grow within 15 feet of the toe of the embankment nor within 25 feet from the principal spillway structure.
- A vegetated buffer should be provided that extends at least 25 feet outward from the maximum water surface elevation of the pond. Permanent structures (e.g., buildings) should not be constructed within the buffer area. Existing trees should be preserved in the buffer area during construction.
- The soils in the stormwater buffer area are often severely compacted during the construction process, to ensure stability. The density of these compacted soils can be so great that it effectively prevents root penetration and, therefore, may lead to premature mortality or loss of vigor. As a rule of thumb, planting holes should be three times deeper and wider than the diameter of the root ball for bare root and ball-and-burlap stock, and five times deeper and wider for container-grown stock.
- Avoid species that require full shade or are prone to wind damage. Extra mulching around the base of trees and shrubs is strongly recommended as a means of conserving moisture and suppressing weeds.

For a list of recommended aquatic plants for South Carolina, consult Clemson's fact sheet entitled "Aquatic & Shoreline Plant Selection" available online at https://hgic.clemson.edu/factsheet/aquatic-shoreline-plant-selection/. For more guidance on planting trees and shrubs in pond buffers, consult Cappiella et al. (2006).

4.12.6 Pond Construction Sequence *(no changes)*

4.12.7 Pond Maintenance Criteria *(no changes)*

4.12.8 Pond Stormwater Compliance Calculations *(no changes)*

4.12.9 References *(no changes)*

4.13 Stormwater Wetlands *(no changes)*

4.14 Tree Planting & Preservation

<table>
<tr><th colspan="17">Tree Planting and Preservation</th></tr>
<tr><td colspan="17">Definition: Existing trees can be preserved or new trees can be planted to reduce stormwater runoff.</td></tr>
<tr><th colspan="2">Site Applicability</th><th colspan="15">BMP Performance Summary</th></tr>
<tr><th>Land Uses</th><th>Required Footprint</th><th colspan="15">WQ Improvement: Moderate to High</th></tr>
<tr><td rowspan="3">▪ Urban
▪ Suburban
▪ Rural</td><td rowspan="3">Small</td><th colspan="5">TSS[1]</th><th colspan="5">Total N[1]</th><th colspan="5">Bacteria[1]</th></tr>
<tr><td colspan="5">N/A</td><td colspan="5">N/A</td><td colspan="5">N/A</td></tr>
<tr><th colspan="15">Runoff Reductions</th></tr>
<tr><th>Construction Costs</th><th>Maintenance Burden</th><th colspan="15">Volume</th></tr>
<tr><td>Low</td><td>Low</td><td colspan="15">Low</td></tr>
<tr><th colspan="2">Maintenance Frequency:</th><th colspan="15">SWRv*</th></tr>
<tr><th>Routine</th><th>Non-Routine</th><th colspan="3">T-1 Small</th><th colspan="3">T-1 Large</th><th colspan="3">T-2 Small</th><th colspan="3">T-2 Large</th><th colspan="3">T-2 Special</th></tr>
</table>

At least annually	Every 10–15 years	5 ft^3	10 ft^3	10 ft^3	20 ft^3	30 ft^3

Advantages/Benefits	**Disadvantages/Limitation**
▪ High community acceptance ▪ Relatively low maintenance requirements ▪ Increases property value ▪ Easily incorporated with other practices ▪ Excellent for soils	▪ Preserved trees must be protected during construction ▪ Must be within LOD ▪ Must maintain tree health and replace trees as necessary
Components	**Design considerations**
▪ Inventory of existing trees ▪ Identification of trees to preserve or plant ▪ Preference for Special trees ▪ Average tree spread	▪ Inventory of existing trees ▪ Identification of trees to preserve or plant ▪ Preference for Special trees ▪ Slope-steep slopes must be terraced/benched ▪ Maintenance access

Maintenance Activities	
▪ If staked during establishment, remove stakes within 1 year of planting	▪ Maintain appropriate mulch cover ▪ Ensure tree health and replace trees as necessary

[1]*Credited pollutant load removal*

**Per planted/preserved tree*

Easily combined with other practices, tree planting and preservation provide stormwater interception, beauty, and shade, thereby increasing aesthetics and property values. See Figure 4.57

Figure 4.57. Tree Planting and Preservation in Bioretention (photo: Center for Watershed Protection)

Definition. *(no changes)*

4.14.1 Preserving Existing Trees during Construction

The preferred method for increasing tree cover at a development site is to preserve existing trees during construction, particularly where mature trees are present. Existing trees are preserved during construction through a four-step process:

1. Inventory existing trees.
2. Identify trees to preserve.
3. Protect trees and soil during construction.
4. Protect trees after construction.

Inventory Existing Trees. – Protect Trees and Soil During Construction. *(no changes)*

Protect Trees After Construction. Maintenance covenants, as described below, are required to ensure that preserved trees are protected. Additionally, trees credited for stormwater retention must be included in the stormwater management plan. If trees die, they must be replaced with a tree of similar mature spread no longer than 6 months from time of death in an appropriate location.

4.14.2 Planting Trees *(no changes)*

4.14.3 Tree Inspection Criteria *(no changes)*

4.14.4 Tree Maintenance Criteria *(no changes)*

4.14.5 Tree Stormwater Compliance Calculations *(no changes)*

4.14.6 References *(no changes)*

4.15 Proprietary Practices *(no changes)*

4.16 Conservation Area

If a site includes a Conservation Area which is protected under a conservation easement or equivalent form of protection, a portion of the conservation area may be "removed" from the site for the purposes of calculating the stormwater retention volume (SWRv). There are four scenarios that could qualify for a conservation area credit. The portion of the conservation area that is eligible to be removed from the SWRv calculation is any area that is not already protected from development by any Federal, State, County, and/or Town agency/code/requirement/restriction.

The process of "removing" a portion of the conservation area is completed with the following revision to Equation 3.2 (SWRv equation), as shown in equation 4.32.

Equation 4.32. Stormwater retention volume (SWRv) equation for conservation areas

$$SWRv = \frac{P \times \left[\left(R_{V_I} \times I\right) + \left(R_{V_C} \times C\right) + \left(R_{V_N} \times N\right)\right]}{12} \times \left(\frac{A_T - (A_C \times Credit)}{A_T}\right)$$

Where:

SWRv = Volume required to be retained (cubic feet)

P = Depth of rainfall event for the designated watershed protection area (85th or 95th percentile rain event)

Rv_I = Runoff coefficient for impervious cover and BMP cover based on SCS hydrologic soil group (HSG) or soil type

I = Impervious cover surface area (square feet)

Rv_C = Runoff coefficient for compacted cover based on soil type

C = Compacted cover surface area (square feet)

Rv_N = Runoff coefficient for forest/open space based on soil type

N = Natural cover surface area (square feet)

12 = Conversion factor (inches to feet)

A_T = Total site area, sum of I, C, and N (square feet)

A_C = Total area of conservation easement or equivalent form of protection (square feet)

Credit= Credit awarded for the type of conservation – 100% for Scenarios 1 and 4, and 50% for Scenarios 2 and 3 below (insert credit as a fraction – 1.0 or 0.5).

There are four scenarios that could qualify for a conservation area credit. All conservation areas must have a contiguous area of 10,000 square feet or more to be eligible for these credits.

Scenario 1: Natural Conservation Area

Scenario 1 is applicable if a portion of the post-developed area is left in its natural condition and protected, in perpetuity, by a conservation easement or equivalent form of protection. If this scenario is applicable, subtract 100% of the protected natural area from the total site area when calculating the SWRv, using Equation 4.32 above.

Scenario 2: Reforestation/Revegetation

Scenario 2 is applicable if a portion of the post-developed area employs site reforestation/revegetation and is protected, in perpetuity, by a conservation easement or equivalent form of protection. If this application is used alone, subtract 50% of the reforested/revegetated area from the total site area when calculating the SWRv, using Equation 4.32 above.

Scenario 3: Soil Restoration

Scenario 3 is applicable if a portion of the post-developed area employs soil restoration and is protected, in perpetuity, by a conservation easement or equivalent form of protection. If this application is used alone, subtract 50% of the soil restoration area from the total site area when calculating the SWRv, using Equation 4.32 above.

Scenario 4: Reforestation/Revegetation & Soil Restoration

Scenario 4 is applicable if the same portion of the post-developed area employs site reforestation/revegetation as well as soil restoration and is protected, in perpetuity, by a conservation easement or equivalent form of protection, subtract 100% of the acres of development with restored soils in a reforested and revegetated area from the total site area when calculating the SWRv, using Equation 4.32 above.

4.16.1 ~~Scenario 1: Natural Conservation Area~~Planning and Design Criteria – Reforestation/Revegetation

~~Scenario 1 is applicable if a portion of the post-developed area is left in its natural condition and protected, in perpetuity, by a conservation easement or equivalent form of protection. If this scenario is applicable, subtract 100% of the protected natural area from the total site area when calculating the SWRv.~~ Site reforestation/revegetation refers to the process of planting trees, shrubs and other native vegetation in disturbed pervious areas to restore them to their pre-development conditions. The process can be used to help establish mature native plant communities (e.g., forests) in pervious areas that have been disturbed by clearing, grading and other land disturbing activities.

The reforestation/re-vegetation process used on a development site must meet all of the following criteria to be eligible for the stormwater management "credits" described above:

General Planning and Design

- Reforested/revegetated areas should not be disturbed after construction (except for disturbances associated with landscaping or removal of invasive vegetation).
- Reforested/revegetated areas should be protected, in perpetuity, from the direct impacts of the land development process by a legally enforceable conservation instrument (e.g., conservation easement, deed restriction).

Landscaping

- A soil test should be performed to determine what type of vegetation can be supported by the soils in the area to be reforested/revegetated and/or what soil amendments will be required.
- A landscaping plan should be prepared by a qualified licensed professional for all reforested/revegetated areas. The landscaping plan should be reviewed and approved by the local development review authority prior to construction.
- Landscaping commonly used in site reforestation/revegetation efforts includes native trees, shrubs and other herbaceous vegetation. Because the goal of the site reforestation/revegetation process is to establish a mature native plant community (e.g., forest), managed turf cannot be used to landscape reforested/revegetated areas.
- Methods used for site reforestation/revegetation should achieve at least 75 percent vegetative cover one year after installation.

A long-term vegetation management plan should be developed for all reforested/revegetated areas. The plan should clearly specify how the area will be maintained in an undisturbed, natural state over time. Plan should include method for watering during plant establishment period of one to two years.

4.16.2 Reforestation/RevegetationPlanning and Design Criteria – Soil Restoration

Scenario 2 is applicable if a portion of the post-developed area employs site reforestation/revegetation and is protected, in perpetuity, by a conservation easement or equivalent form of protection. If this application is used alone, subtract 50% of the reforested/revegetated area from the total site area when calculating the SWRv. Soil restoration refers to the process of tilling and adding compost and other amendments to soils to restore them to their pre-development conditions, which improves their ability to reduce post-construction stormwater runoff rates, volumes and pollutant loads. The soil restoration process can be used to improve the hydrologic conditions of pervious areas that have been disturbed by clearing, grading and other land disturbing activities.

The soil restoration process used on a development site must meet all of the following criteria to be eligible for the stormwater management "credits" described above:

General Planning and Design

- To avoid damaging existing root systems, soil restoration should not be performed in areas that fall within the drip line of existing trees.

- Compost should be incorporated into existing soils, using a rototiller or similar equipment, to a depth of 18 inches and at an application rate necessary to obtain a final average organic matter content of 8%-12%. Required application rates can be determined using a compost calculator, such as the one provided on the following website: https://www.soilsforsalmon.org/resources. Other calculations are available online.
- Only well-aged composts that have been composted for a period of at least one year should be used to amend existing soils. Composts should be stable and show no signs of further decomposition.
- Composts used to amend existing soils should meet the following specifications (most compost suppliers will be able to provide this information):
    - Organic Content Matter: Composts should contain 35%-65% organic matter.
    - Moisture Content: Composts should have a moisture content of 40%-60%.
    - Bulk Density: Composts should have an "as-is" bulk density of 40-50 pounds per cubic foot (lb/cf). In composts that have a moisture content of 40%-60%, this equates to a bulk density range of 450-800 pounds per cubic yard (lb/cy), by dry weight.
    - Carbon to Nitrogen (C:N) Ratio: Composts should have a C:N Ratio of less than 25:1.
    - pH: Composts should have a pH of 6-8.
    - Cation Exchange Capacity (CEC): Composts should have a CEC that exceeds 50 milliequivalents (meq) per 100 grams of dry weight.
    - Foreign Material Content: Composts should contain less than 0.5% foreign materials (e.g., glass, plastic), by weight.
    - Pesticide Content: Composts should be pesticide free.
- Biosolids (except Class A biosolids) and composted animal manure should not be used to amend existing soils.
- Composts used to amend existing soils should be provided by a member of the U.S. Composting Seal of Testing Assurance program. Additional information on the Seal of Testing Assurance program is available on the following website: http://www.compostingcouncil.org.

Landscaping

- Vegetation commonly planted on restored pervious areas includes turf, shrubs, trees and other herbaceous vegetation. Although managed turf is most commonly used, site planning and design teams are encouraged to use trees, shrubs and/or other native vegetation to help establish mature native plant communities (e.g., forests) in restored pervious areas.
- Methods used to establish vegetative cover within a restored pervious area should achieve at least 75 percent vegetative cover one year after installation.
- To help prevent soil erosion and sediment loss, landscaping should be installed immediately after the soil restoration process is complete. Temporary irrigation may be needed to quickly establish vegetative cover on a restored pervious area.

4.16.3 ~~Scenario 3: Soil Restoration~~Other Design Considerations

~~Scenario 3 is applicable if a portion of the post-developed area employs soil restoration and is protected, in perpetuity, by a conservation easement or equivalent form of protection. If this application is used alone, subtract 50% of the soil restoration area from the total site area when calculating the SWRv.~~
When conducting sitewide hydrologic and hydraulic analysis for the 2, 10, 25, 50, and 100-year, 24-hour

storm events to control post-development peak runoff discharge to the predevelopment runoff rates, do NOT remove the conservation area. It should be included in the analysis to adequately size stormwater detention for the site.

- *Reforestation/Revegetation & Natural Conservation Area*: Assume that the post-development hydrologic conditions of any restored and reforested/revegetated areas and natural conservation areas are equivalent to those of a similar cover type (e.g., meadow, brush, woods) in good condition.
- *Soil Restoration*: Assume that the post-development hydrologic conditions of any restored pervious areas are equivalent to those of open space (e.g., lawns, parks, golf courses) in good condition.

~~4.16.4 Scenario 4: Reforestation/Revegetation & Soil Restoration~~

~~Scenario 4 is applicable if the same portion of the post-developed area employs site reforestation/revegetation as well as soil restoration and is protected, in perpetuity, by a conservation easement or equivalent form of protection, subtract 100% of the acres of development with restored soils in a reforested and revegetated area from the total site area when calculating the SWRv.~~

Chapter 5. Erosion & Sediment Control

Sedimentation involves three basic geologic processes: erosion, transportation, and deposition. These are natural geologic phenomena; however, land development activities may initiate severe, highly undesirable and damaging alterations in the natural sedimentation cycle by drastically accelerating the erosion and transportation process. Receiving waters are the final destination for sediment transport and deposition. However, natural streams and lakes are not capable of handling the excessive sediments created by this accelerated cycle. Therefore, excessive sediment loads result in turbid waters and heavy deposition over the substrate. The impact of these events directly affects the propagation of aquatic life, which relies on clear substrates and water to feed and reproduce. Sediment-laden waters affect human activities through the degradation of waters used for aquatic recreation and sport fishing and complicate water treatment processes. Consequently, minimizing the occurrence of erosion and effective control of sediment transport is imperative to all.

5.1 Sedimentation Cycle *(no changes)*

5.2 Factors Influencing Erosion *(no changes)*

5.3 Concepts of Erosion & Sediment Control

Principles of erosion and sedimentation control are based on minimizing the effects of the soil and climatologic factors just discussed. None of the following concepts provide a singular solution for controlling those factors, nor can they all be performed at every site. However, the integration of as many concepts as possible provides the most effective erosion and sedimentation control:

A. Compatible Site Planning
- Minimize development within sensitive areas (e.g. highly erosive soils).
- Limit the length and steepness of the designed slopes.
- Maintain natural vegetative cover when possible.

B. Disturbed Areas Reduction
- Minimize the extent of the disturbed area and the duration of exposure.
- Phase or stage development so that only the areas that are actively being developed are disturbed.
- Minimize large or critical area grading during the season of maximum erosion potential.

C. Disturbed Areas Protection
- Complete grading as quickly as possible.
- Establish permanent vegetation as soon as possible on disturbed areas.
- Divert runoff from disturbed areas.

D. Sediment Retention within Site Boundaries
- Filter runoff as it flows from a disturbed area.
- Impound sediment-laden runoff temporarily so that the soil particles are deposited onsite.

The NPDES Phase II storm water regulations enacted by the Clean Water Act of 1972 and promulgated by Stormwater Phase II Final Rule (1999) require that any activity disturbing an acre or greater of land, or a smaller project part of a larger common plan for development or sale, obtain NPDES construction permit coverage. This regulation differs somewhat from the South Carolina state regulations relating to areas of disturbance. Any land disturbing activity in the Town of Bluffton that meets the aforementioned criteria of one acre or more of disturbance will need to ~~will~~ comply with the state process for permitting. Application and issuance of an approved permit under the South Carolina state regulations for erosion and sedimentation control will meet the requirements for coverage under NPDES Phase II as well (~~SCDHEC~~SCDES, ~~2012~~2021).

5.4 General Criteria

All construction site activities must adhere the ~~SCDHEC~~SCDES General Permit SC0010000 for Large and Small Site Construction Activities. In addition, the Town of Bluffton will require as a minimum, implementation of the following construction site BMPs:

Single Family Development, not part of a larger common plan of development:

1. Silt Fencing buried a minimum of 6 inches below disturbed grade, where applicable;
2. In areas where more than two feet of fill material has been placed or in areas adjacent to all wetlands, silt fencing meeting the requirements of SCDOT must be used;
3. Temporary gravel driveways a minimum of 15 feet by 10 feet, where applicable; and
4. Sediment barriers surrounding all catch basins or drop inlets on site and sediment ~~socks~~tubes on all catch basins or drop inlets adjoining to the site. Sediment tubes containing rubber tires are not permitted for use as inlet protection.
5. Two rows of silt fence are required between land disturbing activities and adjacent wetland buffers.

Single Family and Multi-Family Development, part of a larger common plan of development, and Non-residential Development:

1. Silt Fencing buried a minimum of 6 inches below disturbed grade;
2. Temporary gravel driveways a minimum of 15 feet by 10 feet;
3. Sediment barriers surrounding all catch basins or drop inlets on site and sediment ~~socks~~ tubes on all catch basins or drop inlets adjoining to the site. Sediment tubes containing rubber tires are not permitted for use as inlet protection;
4. Flow dissipation devices, such as check dams, in all swales and ditches;
5. Temporary stabilization shall be placed within 7 days after construction activity is complete unless construction activity is going to resume within 21 days;
6. Floating pump suctions for all temporary or permanent ponds or pumping of excavations;
7. Discharge velocities shall be reduced to provide non-erosive flows from dewatering for all temporary or permanent ponds or pumping of excavations;
8. No more that 25 Nephelometric turbidity units (NTU) difference between upstream and downstream monitoring sites for surface water(s) receiving stormwater discharge(s). Stormwater discharge(s) not directly received by a surface water shall have a value of no more than 25 NTU's.
9. Site inspections must be performed by a Town of Bluffton qualified individual. Copies of inspection reports shall be provided to the Town of Bluffton within 7 days of inspection;
10. Temporary stockpile areas and appropriate BMPs to be identified on plans; and
11. Two rows of silt fence are required between land disturbing activities and adjacent ~~wetlands~~ wetland buffers.

5.5 References

South Carolina Department ~~of Health and~~ Environmental ~~Control~~ Services(~~DHEC~~SCDES). ~~2012~~2021. NPDES General Permit for Stormwater Discharges from Construction Activities SCR100000. Retrieved from: https://des.sc.gov/sites/des/files/media/document/BOW_NPDESStormwaterDischargesGP_01292021_0.pdf ~~https://www.scdhec.gov/sites/default/files/docs/Environment/docs/CGP-permit.pdf~~

Chapter 6. Enforcement & Violations *(no changes)*