Chapter 5 Stormwater Management Practices

5.1 Introduction

Chapter 4 of this manual guides the permit applicant through the site design process, including conceptual, preliminary, and final phases. This process modifies traditional practices currently in use in the City of Chattanooga—shifting the focus from "end-of-pipe" and "single-purpose solutions" to an integrated design, which includes combinations of BMP options discussed in Chapter 5. The goal of Chapter 4 is to help the applicant meet the new stormwater regulations by creating a more efficient site plan that blends preservation, restoration, building, and management practices found in Chapter 5.

Chapter 5 provides detailed guidance for the proper design and application of structural BMPs as well as BMPs that preserve and restore the intrinsic value and hydrological performance of the land. This manual incorporates the landscape itself, typically underused as a BMP. These landscape-based BMPs require a new approach to site design where landforms, soils, and vegetation are used together with structural BMPs to effectively achieve the required SOV, water quality, and other site-specific goals. Applicants/ owners are strongly encouraged to integrate and combine the BMPs presented in Chapter 5 to achieve the required stormwater management goals and to optimize preservation and restoration of natural features that play key roles in hydrologic processes.

The BMPs described in this chapter are organized into four sections and are presented in a sequential order, which reflects the development process:

(1) 5.2 Damage Prevention and Protection Practices
(2) 5.3 Structural BMPs
(3) 5.4 Restoration Practices
(4) 5.5 Management Measures

It is important to note that because Damage Prevention and Protection and Restoration Practices (the landscape-based BMPs) must take into account a number of site-specific variables, they are presented as guidelines, rather than fixed specifications. Criteria checklists and Protocol 5 are provided to ensure that effective BMPs are chosen, designed, constructed, and maintained, in accordance with site-specific constraints and opportunities. Additionally, many of the Protection and Restoration BMPs are similar in subject matter, but different enough to warrant their own section or subsection. Because of this, concepts found within the write-ups may be repetitive.

The write-up of each BMP provides an overview of the BMP in fact sheet summary and then reviews in detail the functions, design, and construction requirements, as well as necessary management of the BMPs under the following headings:

(1) Description
(2) Applicability Matrix Summary
(3) Applicable Protocols
(4) Design Considerations
(5) Construction Considerations or Sequence
(6) Operations and Maintenance
(7) Criteria Checklists

The BMPs presented in Chapter 5 are the most relevant to the Chattanooga region and provide guidance for a developer or large property owner to meet Chattanooga's recently adopted stormwater management regulations.

5.2 Damage Prevention and Protection Practices

Protective BMPs are tested ways to preserve the hydrologic functions of existing site resources. They are to be integrated into the overall design before the program and plans are fixed, hence, they are the first grouping of BMPs discussed in Chapter 5. If not planned for in advance, the stormwater benefits these resources provide may be lost during development.

Landscape-based BMPs are often the least familiar and most underutilized stormwater management practices. Preservation of existing areas with key hydrologic functions, floodplains, forests, meadows, existing natural drainage, etc., can be some of the most economical and efficient BMPs available. It is also understood that during the construction process, some protected areas may need to be temporarily accessed. These "areas of minimal disturbance" are accounted for within each of the Damage Prevention and Protection BMPs. Any disturbance within a protected area will require some level of remediation.

Because these measures must take into account a number of site-specific variables, they are presented as a discussion of options. Criteria checklists and Protocol 5 are available to help determine if the protected area in question is applicable for preservation or will need additional restoration measures discussed in Section 5.4.

When calculating the stormwater benefits of specific protective BMPs, the applicant should note that **the area of the protective BMPs is excluded from the project area used to calculate the SOV and water quality requirements**. **Chapter 7 provides detailed information regarding calculations.**

5.3 Structural Design Measures

Structural design measures presented herein are engineered BMPs designed to capture and manage a given SOV, through infiltration, slow release, and/or capture and reuse. These BMPs are widely prevalent and in common use throughout the southeastern region of the United States. However, as with any

constructed system, and as with all BMPs presented, they depend on proper design, siting, application, construction, and maintenance.

Thirteen structural BMPs are described in this section. Many of these "structures" are natural system-based and include both planted vegetation and engineered soil as part of their function management. Although classified as "structural," they can and should be viewed as "green structures" or "green infrastructure."

The effective application of engineered BMPs can provide significant stormwater benefits. When calculating stormwater benefits of specific structural BMPs, the applicant should note that **calculation support for demonstration of SOV and water quality is found under the Design Considerations heading of each structural BMP write-up. Chapter 7 provides detailed information regarding calculations.**

5.4 Restorative Practices

Although restorative measures are not typically considered a BMP or included as part of the site development process, they offer the potential to solve a variety of hydrologic issues. Restoration of soils and natural vegetation can increase the ability of a landscape to naturally reduce runoff volume and velocity. Restorative BMPs include reestablishing natural flow paths, naturalizing existing swales and drainage ditches, enhancing existing natural cover types or establishing new natural cover types, and amending disturbed soils.

Because these measures must take into account a number of site-specific variables, they are presented as a discussion of options. Criteria checklists and Protocol 5 are available to determine appropriate actions required for the proposed restoration area and continued maintenance efforts. Restoration is a practice that happens over time. Much of the maintenance includes monitoring and removal of non-native invasive species, especially during the establishment period.

When calculating the stormwater benefits of specific restorative BMPs, the applicant should note that **a percentage of the area slated for a restorative BMP can be counted toward a reduction of the total SOV of the project area as well as any tree over 1 inch in caliper planted. Additionally, the curve number used to calculate water quality requirements is adjusted. Chapter 7 provides detailed information regarding calculations.**

5.5 Management Measures

Each of the first three BMPs discussed has its own management measures. Additional management strategies, not specific to any one BMP, can significantly improve water quality.

Management measures include programs and activities that may be implemented to support pollutant removal efforts by the City.

When evaluating the stormwater benefits of management measures, the applicant should consult the BMP narrative during development of the proposed management activity.

Benefits

SOV credits are associated with each BMP and the use of these measures can reduce the hydrologic curve number, thereby reducing water quality requirements. However, there are a number of other benefits beyond reduction of requirements that should be taken into account when choosing which combination of BMPs to employ. Below is a perfunctory discussion of the benefits of this type of approach. Primary benefits include project profitability after construction, reduced construction costs, and improved stormwater performance.

1. Using BMPs as site amenities and as green infrastructure may add value to the development, generating higher sales or rents.

2. Reducing project SOV with landscape-based BMPs lessens the need for more expensive stormwater management interventions (i.e., structural BMPs) and can lower construction costs.

3. Using less infrastructure by treating stormwater close to the source (less subsurface piped conveyance) and reducing pervious surface (e.g., narrower and shorter roads) can fulfill the same site program and potentially lower construction costs.

4. An integrated design approach that connects the BMPs used on the site into a system creates redundancy, thereby adding resilience to the system.

5. BMPs can serve multiple purposes. For example, protected areas can also be parks or nature trails.

6. BMPs that mimic and/or incorporate existing hydrologic regimes take advantage of what works best on a particular site and adapt to natural stormwater systems beyond the site.

Applicability Matrix

All sections within Chapter 5 include a discussion of the BMP selection process, including a matrix that compares the key applications and functions of each BMP to help applicants/owners choose BMPs that are appropriate for their project site. Figure 5-1 provides an overview of BMP applicability from which applicants/owners may begin to consider which BMPs are appropriate for their project site.

BMP	Applicability	Volume Reduction	Water Quality[1]	Peak Rate Reduction	Recharge	Runoff Temperature Mitigation	Heat Island	Habitat Creation	Maintenance Burden[2]	Cost[3]
Protect Undisturbed & Healthy Soils; 5.2.1	U/S/R	H	H	H	H	M	M	H	L	L
Preserving Land Forms; 5.2.1.1	U/S/R	H	H	H	H	M	M	H	L	L
Protecting Erodible Soils on Steep Slopes; 5.2.1.2	U/S/R	H	M	H	H	M	M	H	L	L
Protect/Incorporate Natural Flow Paths; 5.2.2	U/S/R	H	H	M	H	M	M	H	L	L
Protect and Preserve Riparian Corridors; 5.2.3	U/S/R	H	H	M	L	M	M	H	L	L
Protect and Preserve Natural Vegetation; 5.2.4	U/S/R	H	H	H	H	H	H	H	L	L
Protect Historic or Specimen Trees; 5.2.4.1	U/S/R	M	L	M	M	H	H	M	L	L
Pervious Pavement; 5.3.1	U/S/R	H	H	H	H	H	M	L	L	M
Infiltration Bed; 5.3.2	U/S/R	H	H	H	H	H	L	L	L	M
Infiltration Trench; 5.3.3	U/S/R	H	H	M	H	H	M	L	L	M
Bioretention; 5.3.4	U/S/R	L/H	H	M	L/H	H	M	H	L/M/H	L/M/H
Vegetated Swale; 5.3.5	U/S/R	H	H	M	M	M	M	M	L	L
Vegetated Filter Strip; 5.3.6	U/S/R	L	M	M	L	M	M	L	L	L
Infiltration Berm; 5.3.7	S/R	H	H	H	H	M	M	M	L	L
Green Roof; 5.3.8	U/S/R	M	H	H	L	H	H	M	L/M	M/H
Runoff Capture and Reuse; 5.3.9	U/S/R	H	H	H	L	H	L	L	M/H	M/H
Disconnected Impervious Area; 5.3.10	U/S/R	H	L	H	H	H	H	L	L	M
Stormwater Planter Box; 5.3.11	U/S	L	M	H	M	H	M	L	M/H	L/M
Manufactured Devices[4] ; 5.3.12	U/S/R	L/M/H	L/M/H	L/M/H	L/M/H	L/M/H	L/M/H	L/M/H	L/M/H	L/M/H
Naturalize and Retrofit Existing Detention Basins; 5.3.13	U/S/R	H	H	H	H	H	H	H	L	L
Recreate Natural Flow Patterns; 5.4.1	U/S/R	M/H	M/H	M	M	M	M	H	M	L/M/H
Naturalize Swales and Drainage Ditches; 5.4.1.1	S/R	H	H	M	M	H	H	M	M	L/M/H
Enhance Native Cover Types; 5.4.2	U/S/R	H	H	M	M	H	H	H	L	L
Cover Type Change; 5.4.2.1	U/S/R	H	H	M	H	H	H	M	M	L
Amend and Restore Disturbed Soils; 5.4.3	U/S/R	H	H	M	H	M	M	H	L	L
Street Sweeping; 5.5.1	U/S	L	M	L	L	L	L	L	M/H	L/M

[1]In the context of this chapter, water quality refers to Total Suspended Solid reduction. Additional water quality ratings for other pollutants of concern are found in Chapter 7 of this guide.

[2]Maintnenance burden varies with complexity of design options.

[3]Cost may vary - initial costs may be relatively high and low over long-term.

[4]Ratings vary widely depending on type and application of manufactured device.

Figure 5-1. BMP Applicability Matrix