INVER GROVE HEIGHTS
Northwest Area

Chapter 5

Best Management Practices

Northwest Area (NWA) Inver Grove Heights Stormwater Manual

Best Management Practices

Chapter 5

Key Topics: Introduction to the selection of best management practices (BMPs), selection of BMP suite or specific practice, seven key factors in BMP selection, and comparative BMP information

Contents

I. Introduction

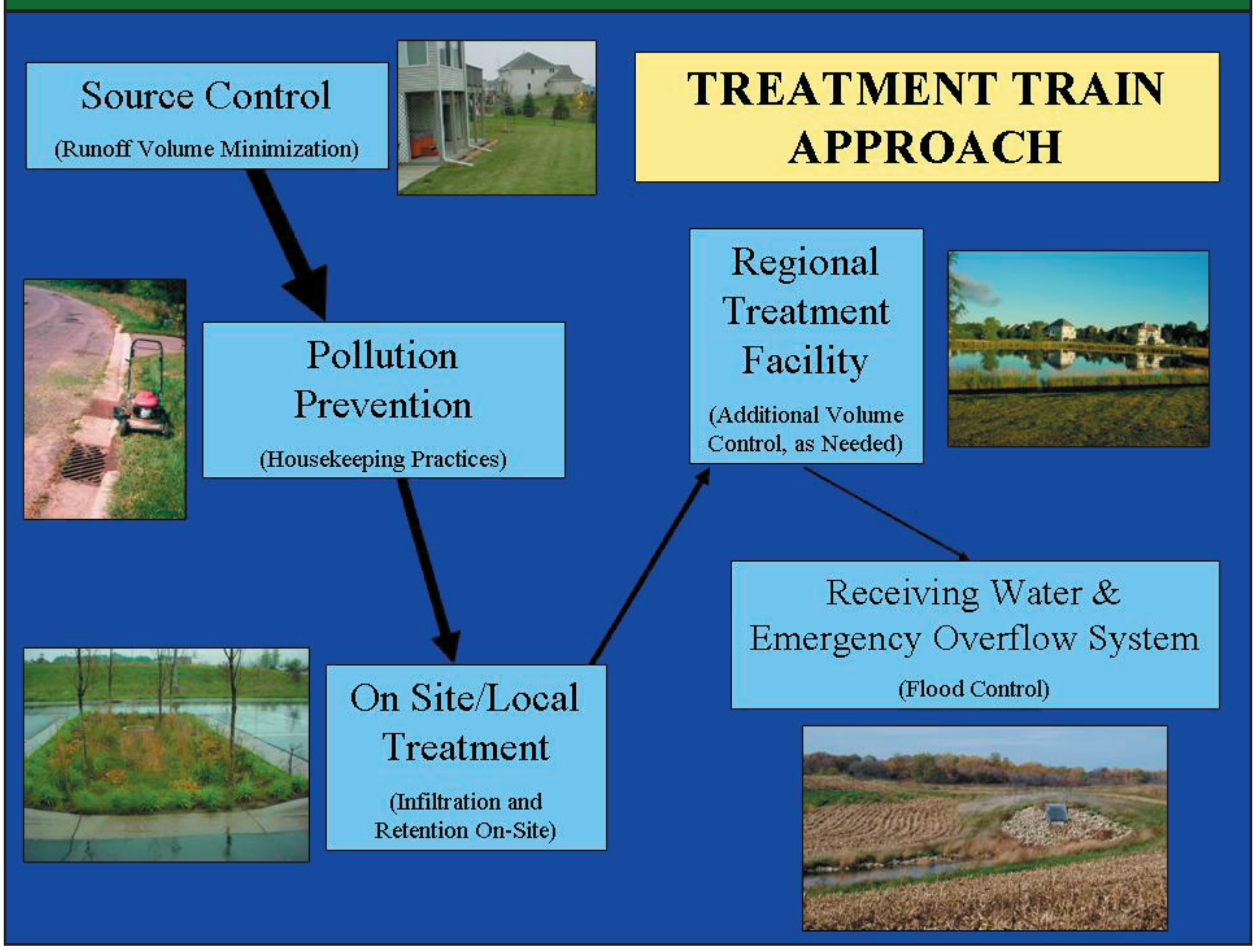
Chapter 5 is intended to provide the Designer with an introduction to the BMPs recommended for the NWA of Inver Grove Heights. The first section of the chapter identifies the BMPs and the second section introduces the Designer to the main factors that should be evaluated in selecting a BMP or group of BMPs to meet the City's stormwater management requirements. All of this information is summarized in a matrix that can be found at the end of the chapter (see Table 5.8). The intent of this matrix is to facilitate the evaluation of suitable BMPs for particular applications. More detailed information regarding individual design and construction considerations is provided in Chapter 8 of this Manual.

II. Using the Treatment Train Approach to BMP Selection

Introduction to Treatment Train

The basic premise for selection of a Best Management Practice (BMP) or group of BMPs is to follow the treatment train approach introduced in Chapter 1. Under the treatment train approach illustrated in Figure 5.1, stormwater management begins with simple methods that minimize the amount of runoff that occurs from a site and methods that prevent pollution from accumulating on the land surface and becoming

Figure 5.1 Treatment Train Approach to Stormwater Management



Source: Adapted from the Minnesota Stormwater Manual, 2005 available for wash-off. Even though we know that we will never be able to fully accomplish either of these goals, we can make substantial progress using the better site design techniques shown in Chapter 4 and the pollution prevention, volume minimization, temporary construction erosion control and supplemental techniques presented in Chapter 8.

After all of the efforts possible are made to minimize runoff and surface wash-off, we must recognize that some potential for runoff will occur. The next major BMP then becomes collection and treatment of runoff locally and regionally, either as stand-alone practices or in treatment train combinations. Finally, efforts at the level of the receiving water or for emergency overflow are at the tail end of the treatment train in the NWA. Some of the available BMPs are best used to reduce runoff volume, while others focus on water quality improvement. Some BMPs will be easier to implement, while others involve more detailed engineering evaluation and design. Chapter 8 presents detailed design guidance for categories of structural BMPs: bioretention devices, filtration practices, infiltration practices, stormwater ponds and stormwater wetlands.

Introduction to BMPs

This section introduces the Designer to the BMPs that are recommended for the Northwest Area. These BMPs are arranged in the following three categories:

- Non-structural or planning level BMPs;
- Structural BMPs; and
- Supplemental pre- and post-treatment BMPs.

As mentioned previously, additional design and construction information for these BMPs can be found in Chapter 8 of this Manual. Chapter 8 includes detailed BMP fact sheets on bioretention, filtration, green roofs, infiltration, pervious surfaces, rainwater harvesting, soil amendments, stormwater ponds and wetlands. Pollution prevention, runoff minimization and temporary construction runoff control practices will include some descriptive language for the numerous practices listed via "fact sheets," but will not contain engineering details. The final section on treatment supplements will similarly not contain detailed engineering, but will describe a process that designers should follow when considering the use of proprietary devices, inserts and chemical/ biological treatment.

Non-Structural or Planning Level BMPs

The first level of BMP application occurs at the planning stage and is intended to minimize the impact of development. These practices are intended to prevent pollution and minimize the increase in stormwater volume and are considered prior to initiation of construction or land altering activity.

1. **Better Site Design/Runoff Volume Minimization -** Refer to Chapter 4

2. **Pollution Prevention Practices (Water Quality Focus)**

- Residential, municipal and industrial/commercial practice categories
- Specific recommended practices include such things as:
    - Housekeeping including landscaping, street sweeping, snow management, pavement maintenance, catch basin maintenance, yard waste reduction and litter control
    - Atmospheric controls including wind erosion and dust, as well as regulatory emission regulations
    - Chemical control of hazardous waste and salt, fertilizer/pesticides, spills (including prevention), swimming pool drainage
    - Animal waste management
    - Public works activities including chemical and sanitary wastes, and sewer maintenance

3. Temporary Construction Sediment Control (Water Quality Focus)
These practices are described in terms of perimeter, slope, drainageway and "other" criteria, and include:

- Vegetated buffers
- Silt fence
- Access/egress and drainage inlet protection
- Soil and slope stabilization
- Exposed soil covers and reinforcement

Structural BMPs (On Site/Local Treatment and Regional Treatment)

These BMPs have design guidance describing the engineering details for the BMP category. This design guidance is used, for example, to size BMPs to function effectively and with the least amount of maintenance. Also note that some of these BMPs, such as bioretention, can be used either as a volume reduction technique to meet the 5-year volume requirement or used for pre-treatment into another BMP.

4. Green Roofs. Green roofs create green space for public benefit, energy efficiency, and stormwater retention/ detention. Green roofs involve growing plants in an engineered soil on roof tops. Two types of green roofs are:

- Extensive
- Intensive

5. Rainwater Harvesting. Rain water harvesting is the practice of collecting rain water from impermeable surfaces, such as rooftops, and storing for future use. The two main types of rainwater harvesting are:

- Rain barrels
- Cisterns

6. Pervious Surfaces. Pervious pavements reduce the amount of stormwater runoff generated on a site by allowing water to pass through surfaces that would otherwise be impervious. The most common types of pervious surfaces are:

- Porous Pavement
- Pervious Pavers
- Reinforced Soils

7. Filtration. Filtering practices have widespread applicability and are suitable for all land uses, as long as the contributing drainage areas are limited.

- Media (sand) filters (surface, underground, perimeter/Delaware filter)
- Surface (vegetative) flow (grass channels, dry or wet swales, filter strips)
- Combination media/vegetative filters

8. Bioretention. This BMP suite includes vegetated systems that provide a combination of filtration and infiltration into a bio-system consisting of plants and soil, including:

- Rain gardens
- Depressed parking lot/traffic islands

- Road medians
- Tree pits/stormwater planters

9. Infiltration. Stormwater infiltration practices capture and temporarily store stormwater before allowing it to infiltrate into the soil.

- Trenches
- Basins
- Dry wells
- Underground systems

10. Stormwater Ponds*.* Design based upon components needed to fulfill the desired function.

- Components include forebay/pretreatment, various storage volumes, physical configuration
- Functions include water quality (including thermal impact) and flow control (rate and volume), which determine whether they are wet/dry or some combination

11. Constructed Wetlands. Selection criteria is similar to stormwater ponds.

- Components include pre-treatment, various storage volumes (detention needed), biologic character
- Functions include primarily water quality and flow control, but could also include ecological factors

12. Soil Amendments. Soil amendments repair soil structure and restore the soil's ability to filter/infiltrate stormwater and produce healthier plants. Soil structure can be preserved by:

- Protecting native soils in-place
- Amending existing soils with compost
- Importing topsoil to amend graded soils
- Stockpiling topsoil and duff and reapplying post-grading activities (only applicable to sites that have original, undisturbed native topsoil)
- Stockpiling topsoils, reapplying and amending after construction

Supplemental Pre- and Post-Treatment BMPs

The final category of BMPs are those that are generally, but not always, included in the stormwater treatment train as a supplement to the primary treatment device. These are described in less detail than the previous sections. The designer will be guided through a process of determining the function a generic device serves within the treatment train and evaluating the proposed device against the needed function and manufacturer claims. Proprietary devices are generically described rather than listed as individual companies to avoid omission and claims of certification in the Manual.

13. Supplemental Pre- and Post-Treatment.

- Hydrodynamic
  - Proprietary sediment and oil/grease removal devices
  - Wet vaults
  - Skimmers

- Filtration
  - Catch basin inserts
  - Sorbents
  - Proprietary filtration devices

- Chemical/biological treatment
  - Chemical treatment * (ferric chloride, alum, polyacrylamides)
  - Biological additives (ex. chitosan)

    * Note that these chemical treatments could be limited in the State of Minnesota because of the potential toxic effects associated with them; care will be taken to assess these impacts in the BMP discussion.

III. Process for Selecting Best Management Practices

Designers need to carefully think through many factors to choose the most appropriate, effective and feasible practice(s) at a development site that will best meet the City's stormwater objectives. This chapter presents a flexible approach to BMP selection that allows a stormwater manager to select those BMPs most able to address an identified problem. Selecting an inappropriate best management practice (BMP) for a site could lead to adverse resource impacts, friction with regulators if a BMP does not work as anticipated, misperceptions about stormwater control success, and wasted time and money. Careful selection of BMPs will prevent the negative impacts of installing the wrong BMP at the wrong location. City staff can similarly use the BMP selection matrix (Table 5.8) to check on the potential efficiency of proposed BMPs.

Seven factors should be evaluated in the BMP selection process, as follows:

1. Investigate Pollution Prevention Opportunities. Evaluate the site to look for opportunities to prevent pollution sources on the land from becoming mobilized by runoff.

2. Design Site to Minimize Runoff. Determine which better site design techniques are required per the PUD and which additional techniques can be applied at the site to minimize runoff and therefore reduce the size of structural BMPs.

3. Select Temporary Construction Sediment Control Techniques. Check to see what set of temporary sediment control techniques will prevent erosion and minimize site disturbance during construction.

4. Identify Downstream Issues. Understand the context of the receiving water, landlocked basin, or downstream area to which the site drains. Depending on the conditions present in this area, certain BMPs may be promoted, restricted or prohibited, or special design or sizing criteria may apply.

5. Evaluate Stormwater Treatment Suitability. Not all BMPs will be able to mitigate the pre- and post-development difference in runoff volume for the 5-year 24-hour rainfall event so designers need to choose the type or combination of BMPs that will provide the desired level of treatment.

6. Assess Physical Feasibility at the Site. Each development site has physical constraints that influence the feasibility of different kinds of BMPs; designers confirm feasibility by assessing eight physical factors at the site.

7. Determine Any Site Restrictions and Setbacks. Check to see if any environmental resources or infrastructure are present that will influence where a BMP can be located at the development site.

These factors are described in more detail below.

Investigate Pollution Prevention Opportunities

Pollution prevention should be the first consideration during any development or redevelopment project. This step involves looking for opportunities to reduce the exposure of soil and other pollutants to rainfall and possible runoff.

Examples of pollution prevention practices include keeping urban surfaces clean, proper storage and handling of chemicals, and preventing exposure of unprotected soil and pollutants. More information on pollution prevention practices can be found in Chapter 8 of this Manual.

Design Site to Minimize Runoff

A range of better site design (BSD) techniques are described in Chapter 4 of this Manual. These can provide non-structural stormwater treatment, improve water quality and reduce the generation of stormwater runoff. These techniques reduce impervious cover and reduce the volume of stormwater runoff at a site, which can save space and reduce the cost of structural BMPs.

Select Temporary Construction Sediment Control Techniques

Construction sites can be a major source of sediment and nonpoint source pollutants if soils are exposed to erosion. Effective application of temporary sediment controls is an essential element of a stormwater management plan and helps preserve the long-term capacity and function of permanent stormwater BMPs. Designers should recognize that they will need to revisit and refine the erosion and sediment control plan throughout the design and construction period as more information on site layout and the type and location of BMPs becomes available.

Table 5.1 lists the range of temporary erosion and sediment control techniques that could be considered in the erosion and sediment control plan for a site. The table indicates how each technique reduces erosion and sediment transport, when it is applied in the construction process, and provides some additional comments. More information on how to integrate erosion and sediment control in the context of site design is discussed in Chapter 4 of this Manual. More detailed design guidance on erosion and sediment control techniques can be found in Chapter 8 and *Protecting Water Quality in Urban Areas* (MPCA, 2000).

Table 5.1 Temporary Construction Erosion and Sediment Control Techniques

Technique	Practice	Application Benefit	When to Apply	Comments
Pre-construction	Site planning and grading	Minimizes soil disturbance and unprotected exposure	Planning	Expose only as much area as needed for immediate construction. The City requires a stormwater management plan be submitted with all permit applications. PUD requires staged construction and control techniques to preserve infiltration capacity at site and regional facilities. NPDES general permit for construction requires development of a Stormwater Pollution Prevention Plan (SWPPP) for projects disturbing >1 acre or part of a larger common development plan.
	Sequencing	Limits amount of soil exposed	Planning	
Resource protection	Wetland Buffers and Natural Areas Open Space	Establishes protective zone around valued natural resources	Early	Wetland buffer variable from 16-50 feet depending upon wetland management standard (see Table 5.2). PUD requires minimum of 20% of net developable area to be designated as Natural Area/Open Spaces at least 100 feet wide.

Table 5.1 Temporary Construction Erosion and Sediment Control Techniques

Technique	Practice	Application Benefit	When to Apply	Comments
Perimeter controls	Access and egress control	Minimizes transport of soil off-site	Early	Must be in place prior to commencement of construction activities. Section 420 of City Code requires fencing completely around the site when open excavation exceeds 20 feet and/or a slope of 2:1 or greater
	Inlet protection	Stops movement of soil into drainage collection system	Early	
Slope stabilization	Grade breaks	Minimizes rill and gully erosion	Early	NPDES general permit for construction requires no unbroken slopes > 75 ft. on 3:1 or steeper slopes
	Silt curtain	Stops sediment from moving	Early	
Runoff control	Stabilize drainageways	Minimizes increased erosion from channels	All construction phases	Possible to convert these into permanent open channel systems after construction
	Sediment control basins	Collects sediment that erodes from site before it leaves site or impacts resource	All construction phases	City code requires if site has larger than 10 acres disturbed at one time that sediment control basin(s) be constructed. Possible to convert these into post construction practices after construction

Table 5.1 Temporary Construction Erosion and Sediment Control Techniques

Technique	Practice	Application Benefit	When to Apply	Comments
Rapid stabilization of exposed soils	Seeding and mulch	Immediately establishes vegetative cover on exposed spoil	All construction phases	Apply seed as soils are exposed and blankets on steep slopes or as needed to control erosion until plants are established. City code requires all disturbed ground left inactive for 14 or more days to be stabilized. City code requires topsoil and turf reestablishment within twelve months of the issuance date of the building permit or as defined in land alteration permit.
	Blankets	Provides extra protection for exposed soil or steep slopes	All construction phases	
Inspection and maintenance	Formalized I&M program	Assures that BMPs are properly installed and operating in anticipated manner	All construction phases	Essential to proper BMP implementation. PUD requires: license contract allowing City inspections at any time, public easements for maintenance access, and covenants or maintenance agreements for all facilities not maintained by the City.

Identify Downstream Issues

The receiving surface waters in the NWA consist of landlocked wetlands and lakes. Given the landlocked nature of the area and the City's volume control standard, an indirect receiving water that must also be taken into consideration is the groundwater system. Designers should understand the nature and regulatory status of the waters that will receive runoff from the development site. The type of receiving water can influence the preferred BMP to use, and in some cases, may trigger increased treatment requirements. In general, all stormwater BMPs should be located outside of the shoreline and/or wetland buffer and they should be setback from wells and septic systems.

- **Does the site drain to a wetland?**
  Wetlands can be indirectly impacted by upland development sites, so designers should choose BMPs that can maintain wetland hydroperiods and limit phosphorus loads.

  The wetland types found in the NWA are identified in the Natural Wetland Resource Inventory (NRI) Report (2004). The NRI also assigns management classifications based on the susceptibility of these wetland types to stormwater impacts ranging from 1 (high susceptibility to stormwater bounce) to 4 (low susceptibility to stormwater bounce). This report also provides recommended buffer widths and stormwater quantity requirements based on the wetland classifications. Table 5.2 summarizes the wetland management standards adopted for the NWA.

Table 5.2 Wetland Management Standards

Management Classification	Buffer Strip (feet)	Structural Setback from Edge of Buffer (feet)	Stormwater Quantity Requirement
Manage 1	60	10	Storm Bounce - Maintain HWL at or below existing conditions for 100-year storm
Manage 2	30	10	Storm Bounce - Maintain HWL at or below existing conditions plus 0.5 feet for 100-year storm
Manage 3	20	10	no requirement
Manage 4	15	10	no requirement

Of the wetlands delineated in the Northwest Area, 16 would realize a storm bounce that exceeds the recommended stormwater quantity requirement even with the 5-yr volume control standard implemented. In order to prevent this undesired bounce, a higher stormwater management standard (or additional stormwater management storage) is required within these subwatersheds upstream of the existing wetlands.

Table 5.3 should be used to identify any wetlands on your site that will need further volume reductions beyond the 5-yr volume control standard. Detailed site modeling for post development conditions with all BMPs and LID in place may show more or less infiltration volume requirement than identified in the table. Stormwater modeling including all BMPs should be completed to demonstrate that the wetlands will not exceed the bounce criteria. Site plans and modeling will be reviewed by the city to ensure that the final design meets the stormwater quantity requirement for wetland management.

Table 5.3 Wetlands that Exceed the Stormwater Quantity Requirement

Subwatershed Name	NRI - Management Class	Excess Bounce Above Recommendation (feet)	Protection Method	Special Volume Control Standard (in. above 5-year standard)	Special Volume Control Standard (ft^3 above 5-year standard)
BP-032	2	0.2	Higher Standard	0.4	15650
EP-010b	2	0.8	Higher Standard	0.5	58820
EP-013	2	0.9	Higher Standard	0.5	79199
EP-016b	2	0.2	Higher Standard	0.4	20446
EP-027f	2	0.2	Higher Standard	0.7	15085
EP-031b	1	0.1	Higher Standard	0.3	14537
EP-039	2	0.6	Higher Standard	0.4	56224
EP-060b	2	0.4	Higher Standard	0.5	42719
EP-071	1	2.7	Regional Basin	None	390299
EP-073a	1	2.7	Regional Basin	None	152519
EP-080a	1	0.3	Higher Standard	0.7	336195
EP-080b	1	0.4	Higher Standard	0.6	37906
F-001	1	1.2	Regional Basin	None	56142
F-002	2	0.2	Higher Standard	0.4	9597
F-025	1	0.5	Higher Standard	1.2	333438
SP-16	1	0.6	Higher Standard	0.5	35416

Most developing areas will see a decrease in upland depressional storage (storage naturally present in un-graded landscapes) which will be mitigated with infiltration BMPs and LID techniques. Three wetlands will likely see major losses of depressional storage available in their watersheds, F-001, EP-073a, and EP-071. For these watersheds (and potentially others) developers would be especially well served to maintain or enhance some of these low-lying features as larger regional infiltration areas.

► **Does the site drain to a lake?**

Existing statewide minimum shoreline standards affect lakes in the NWA. These standards set guidelines for the use and development of shoreland property, including a sanitary code, minimum lot size, minimum water frontage, building setbacks, building heights, and subdivision regulations.

Additionally, lakes in the NWA have wetland fringes that have been designated into wetland management categories in the NWI. See Table 5.4 and the previous section for additional information regarding these areas.

Designers should choose BMPs that limit sediment and nutrient loading into lakes (especially phosphorus).

Table 5.4 Lakes in the NWA and Wetland Fringe Management Categories		
Lake Name	**DNR Identifier**	**Wetland Fringe Management Category***
Dickman	19-46P	Manage 4
Hornbean	19-47P	Manage 4
Marcott	19-41P	Manage 1
Unnamed	19-36P	Manage 4
Unnamed	19-54P	Manage 1
*For more information on these management categories see Table 5.2 or the NRI Report (BRAA, 2004).		

► **Is the site within a ground water drinking water source area?**
Sites located in aquifers used for drinking water supply require BMPs that can recharge aquifers at the same time they prevent ground water contamination from polluted stormwater, particularly when it is generated from potential stormwater hotspots (PSH).

Evaluate Stormwater Treatment Suitability

Not all BMPs will be able to meet the City's stormwater management standards on their own. Designers first need to determine which of the stormwater management requirements (i.e. volume control, peak discharge, pretreatment requirements, wetland bounce and duration) apply to the development site (see Table 5.5) and then choose the type or combination of BMPs that can be used to achieve them.

This is the stage in BMP selection process where designers often find that a single BMP may not satisfy all stormwater treatment requirements. The alternative is to use a combination of BMPs arranged in a series or treatment train, or add supplemental practices to the primary BMP that provide additional pre- or post-treatment.

► **Can the BMP provide volume control?**
BMPs that infiltrate runoff into the soil will be needed to meet the City's volume control standard. Designers may want to use some of the better site design techniques presented in Chapter 4 to reduce the volume of stormwater runoff generated under post-development conditions.

► **Can the BMP be used to satisfy the pretreatment requirements of other BMPs?**
Pretreatment is required to protect the BMP from clogging and groundwater contamination that may occur. Some BMPs may also be used to satisfy the pretreatment requirements for other BMPs. See Chapter 7 for more details on pretreatment requirements.

► **Can the BMP effectively control peak discharges?**
Generally, only ponds, wetlands and infiltration basins have the capacity to control peak discharge events that cause flooding at the site (e.g., 10-year 24-hour and 100-year 24-hour storm events). Once again, if a BMP cannot meet peak discharge requirements, it can be used in combination with one that does to meet all sizing criteria.

► **Can the BMP accept runoff from potential stormwater hotspots (PSHs)?**
Designers may need to give more consideration to the selection of BMPs at sites designated as PSHs since the land use and associated on-site activities have the potential to generate higher pollutant runoff loads compared to other land uses. A more detailed discussion on PSHs can be found in Chapter 6.

Table 5.5 Stormwater Treatment Suitability for Selected BMPs

BMP Group		Volume Control	Used for Pre-treatment	Peak Discharge	PSH
Bioretention		Varies[1]	Varies[2]	Yes	Varies[2]
Filtration	Surface	Varies[1]	Yes	Yes	Yes
Filtration	Under-ground	No	Yes	Yes	Yes
Infiltration	Trench	Yes	No	Yes	Yes, additional pretreatment requirements
Infiltration	Basin	Yes	No	Yes	Yes, additional pretreatment requirements
Ponds		No[2]	Yes	Yes	Yes
Wetlands		Varies[2]	No	Yes	Yes, additional pre-treatment requirements
Supplemental BMPs		Varies	Yes	No	Yes

[1] May be provided by infiltration
[2] When impermeable liners are required or pool intercepts groundwater

Assess Physical Feasibility at the Site

By this point, the list of possible BMPs has been narrowed and now physical factors at the site are assessed to whittle it down even further. Table 5.6 indicates eight physical factors at the site that can constrain, restrict or eliminate BMPs from further consideration.

► **Is there enough space available for the BMP at the site?**
BMPs vary widely in the amount of surface area of the site they consume, which can be an important factor at intensively developed sites where space may be limiting and land prices are at a premium. In some instances, underground BMPs may be an attractive option in highly urban areas. Some general rules of thumb on BMP surface area needs are presented in Table 5.6, expressed in terms of contributing impervious area or total area.

► **Is the drainage area at the site suitable for the proposed BMP?**
Table 5.6 shows the minimum or maximum recommended drainage areas for each group of BMPs. If the drainage area of the site exceeds the maximum, designers can consider subdividing the drainage area and/or use multiple smaller BMPs of the same type, or modify the design. The minimum drainage area thresholds for ponds and wetlands are not quite as flexible, although smaller drainage areas can work if designers can confirm the presence of ground water or baseflow that can sustain a normal pool and incorporate design features to prevent clogging.

► **Will soils limit BMP options at the site?**
Low infiltration rates limit the use of infiltration practices and certain kinds of bioretention designs. Designers should consult the design guidance in Chapter 8 to determine minimum soil infiltration rates and testing procedures for each kind of BMP. Table 5.6 references USDA-NRCS Hydrologic Soil Groups A to D. Further geotechnical testing may be needed to confirm soil permeability and depth to ground water. The designer should strive to locate BMPs on those portions of the site with the most permeable material and situate the building/impervious surfaces on the least permeable portions of the site.

Table 5.6: Physical Feasibility of the Site

BMP Group		Surface Area[1]	Drainage Area	Soils Infiltration Rate[5]	Head	Separation from Bedrock	Depth to Seasonally High Water Table	Max. Slope[3]	Ultra-Urban
Bioretention		7-10% Min 200 ft^2	5 ac max 0.5-2 ac preferred	Any soil. Use underdrain in C, D [4]	1-4 ft	3 ft	3 ft	20%	Yes
Filtration	Surface	Varies based on depth	10 ac max	media part of design[4]	2-6 ft	0 ft if enclosed	3 ft for vegetated; 0 ft if enclosed	20%	Possible
Filtration	Under-ground	Negligible, except for access	5 ac max 0.5-2 ac preferred						Yes
Infiltration	Trench	Varies based on depth	5 to 10 ac max	Any soil.	2-12 ft	Min. 3 ft	Min. 3 ft	15%	Possible
Infiltration	Basin		5-50 ac max		2-12 ft				No
Ponds		1-3%	25 ac min[2]	A or B soils may require liner	3-10 ft	0 ft (shallow soil limits design)	0 ft (except if hotspot or aquifer)	25%	No
Wetlands		2-4%	25 ac min[2]	A or B soils may require liner	3-10 ft	0 ft	0 ft (except if hotspot or aquifer)	25%	No

Table 5.6: Physical Feasibility of the Site

BMP Group	Surface Area[1]	Drainage Area	Soils Infiltration Rate[5]	Head	Separation from Bedrock	Depth to Seasonally High Water Table	Max. Slope[3]	Ultra-Urban
Green Roofs	Up to 100%	Any	Engineered Soils	NA	NA	NA	30%	Yes
Pervious Pavements	Up to 100%	Any	Any soil. Use underdrain in C, D [4]	NA	3 ft	3 ft	2%	Yes
Rainwater Harvesting	0-2%	Dependant on Application	Any soil.	NA	NA	NA	None	Yes
Soil Amendments	Up to 100%	Any	Any Soil	NA	NA	NA	None	Yes

[1] Surface area as a function of contributing impervious area, except for ponds and wetlands, where it is a function of entire drainage area.

[2] 10 acres may be feasible if groundwater is intercepted and/or if water balance calculations indicate a wet pool can be sustained.

[3] Slope is defined as the slope across the proposed location of the practice

[4] Infiltration gallery could be designed to provide limited recharge

[5] If infiltration practice being used to meet IGH standards ensure that it meets the 72-hour drawdown requirement.

- **Is enough head present at the site to drive the BMP?**
  Head is defined as the elevation difference between the inflow and outflow point of a BMP that enables gravity to drive the BMP.

- **Will depth to bedrock or the water table constrain the proposed BMP?**
  Bioretention, infiltration and some filtering practices need a minimum separation distance from the bottom of the practice to bedrock (or the water table) to function properly. The Minnesota Pollution Control Agency's Construction General Permit (CGP) requires a minimum distance of three feet between the bottom of an infiltrating BMP and the seasonally saturated water table. Other BMPs do not require as much separation distance, although the cost and complexity of construction of most BMPs increases sharply at development sites where the bedrock or water tables are close to the surface.

- **Is the slope at the proposed BMP site a design constraint?**
  Sites with extremely steep slopes can make it hard to locate suitable areas for BMPs. Table 5.6 outlines maximum slope recommendations for BMPs, which refers to the gradient where the BMP will actually be installed. Designers will need to carefully scrutinize site topographic and grading plans to find suitable locations, and if this does not work, the grading plan may need to be changed to meet slope thresholds.

- **Is the BMP suitable for ultra-urban sites?**
  BMP selection for ultra-urban development and redevelopment sites is challenging, since space is extremely limited, land is expensive, soils are disturbed, and runoff volumes and pollutant loadings are great. These sites do, however, present a great opportunity for making progress in stormwater management where it has not previously existed. Table 5.6 compares the general suitability of BMPs for ultra urban sites.

Determine Any Site Restrictions and Setbacks

The last step in BMP selection checks to see if any environmental resources or infrastructure are present that will influence where a BMP can be located on the site (i.e., setback or similar restriction). Table 5.7 presents an overview of the site-specific conditions that impact where a BMP can be located on a site.

Table 5.7 Restrictions and Setbacks

Factor	Considerations
Jurisdictional Wetland U.S Army Corps of Engineers (USACE) Section 404 Permit And Minnesota Department of Natural Resources And Local Governments under the Wetland Conservation Act	► Wetlands should be delineated prior to siting stormwater BMPs. Demonstrate that the impact to a wetland complies with all of the following principles in descending order of priority: avoid direct or indirect impacts, minimize impact by limiting the degree or magnitude of activity, replace unavoidable impacts through restoration or creation ► Always check with local, state and federal jurisdictions for appropriate regulations ► Natural wetlands should not be used for stormwater treatment, unless they are severely impaired, and construction would enhance or restore wetland functions. ► Direct pipe outfalls to wetlands should be restricted. The discharge of untreated stormwater to a wetland should be avoided. ► BMPs are restricted in the wetland buffer. ► For sensitive bogs and fens, BMPs should be designed for site-based nutrient load reduction. ► The Wetland Conservation Act applies to wetlands that do not fall under DNR (Public Waters) or USACE.

Table 5.7 Restrictions and Setbacks	
Factor	**Considerations**
Shoreland Management DNR and Local Governments State Floodplain Management Act	▶ Check state and local shoreland development ordinances regarding BMP setbacks from the shoreline and any required buffers
100-year Floodplain	▶ Grading and fill for BMP construction is strongly discouraged within the ultimate 100-year floodplain, as delineated on FEMA flood insurance rate maps, FEMA flood boundary and floodway, or more stringent local maps. ▶ Floodplain fill cannot raise the 100-year water surface elevation by more than a tenth of a foot.
Water Wells - private and municipal	▶ Observe local wellhead protection zones and minimum setbacks. ▶ Consult the Minnesota Department of Health, County health department and local water utility. ▶ MN DOH Rule 4725.4350 requires a 50 foot setback between stormwater ponds and water supply wells ▶ If not otherwise regulated, a similar 50 foot setback for infiltration BMPs is advisable ▶ No infiltration of confirmed stormwater hotspot runoff. Infiltration of potential stormwater hotspot (PSH) runoff should be restricted and have suitable pretreatment
Septic Systems	▶ Recommended setback is 35 feet minimum from a drain field. ▶ Consult the Minnesota Department of Health and County health department.
Utilities	▶ Call the **Gopher State One** to locate existing utilities prior to design. ▶ Consider the location of proposed utilities to serve the development. ▶ Structural controls are discouraged within utility easements or the right of way for public or private utilities.
Roads	▶ Consult local/county highway or public works department for any setback requirement from local/county roads. ▶ Consult MNDOT guidelines for setback from State roads. ▶ Approval may be needed to discharge stormwater to a local, county or state owned storm drain or channel.
Structures	▶ Consult the local review authority for the BMP setback from structures. ▶ Recommended setbacks for each BMP group are provided in Chapter 8 of this manual.

IV. BMP Selection Matrix

Table 5.8 is a BMP selection matrix that can be used as a guide for the identification of suitable BMPs for a particular application.

Table 5.8 Best Management Practices Matrix

	Non-Structural or Planning Level BMPs										Structural BMPs (On-Site/Local Treatment and Regional Treatment)																			Supplemental Pre- and Post-Treatment BMPs		
	Better Site Design	Pollution Prevention			Temporary Construction Sediment Control						Green Roofs	Rain-water Harvest	Pervious Surfaces	Filtration		Bioretention				Infiltration				Storm-water Ponds		Constructed Wetlands			Soil Ammend-ments	Supplemental Treatment		
Use Assessment Parameter (see Chapter 7 for details of parameter)	See Chapter 4 for Techniques	Residential	Municipal	Industrial/Commercial	Pre-Construction	Perimeter	Slope	Drainageway	Other [2]	Inspect/maintain	Extensive/Intensive	Rain Barrels/Cisterns	Porous Pavements, Permeable Pavers and Reinforced Soil	Media (sand)	Vegetative	Infiltration/recharge	Filtration/partial recharge	Infiltration/filtration/recharge	Filtration	Infiltration Basin	Infiltration Trench	Dry Well	Underground System	With Extended Detention	Without Extended Detention (ex. Walker Pond)	Shallow Wetland	ED Shallow Wetland	Pond/wetland System		Chem./Biological Treatment	Filtration devices	Hydrodynamic Devices
1. Pollution Prevention	●	●	●	●	●	●	●	●	●	●					◐				◐													
2. Design to Minimize Runoff [3]	●													◐	◐	●	●	●	◐	●	●	●	●			◐	◐	◐	●			
3. Temporary Construction Sediment Control			●	●	●	●	●	●	●	●			○	●	●	◐	◐	◐	●	○	○	○	○	●	●	◐	◐	●		◐	●	●
4. Identify Downstream Uses																																
- Wetland	●	●	●	●		●	●	●	●		●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	◐	◐	●	●	●		
- Lake	●	●	●	●		●	●	●	●		●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●		

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	Non-Structural or Planning Level BMPs										Structural BMPs (On-Site/Local Treatment and Regional Treatment)																			Supplemental Pre- and Post-Treatment BMPs		
	Better Site Design	Pollution Prevention			Temporary Construction Sediment Control						Green Roofs	Rain-water Harvest	Pervious Surfaces	Filtration		Bioretention				Infiltration				Storm-water Ponds		Constructed Wetlands			Soil Ammend-ments	Supplemental Treatment		
Use Assessment Parameter (see Chapter 7 for details of parameter)	See Chapter 4 for Techniques	Residential	Municipal	Industrial/Commercial	Pre-Construction	Perimeter	Slope	Drainageway	Other²	Inspect/maintain	Extensive/Intensive	Rain Barrels/Cisterns	Porous Pavements, Permeable Pavers and Reinforced Soil	Media (sand)	Vegetative	Infiltration/recharge	Filtration/partial recharge	Infiltration/filtration/recharge	Filtration	Infiltration Basin	Infiltration Trench	Dry Well	Underground System	With Extended Detention	Without Extended Detention (ex. Walker Pond)	Shallow Wetland	ED Shallow Wetland	Pond/wetland System		Chem./Biological Treatment	Filtration devices	Hydrodynamic Devices
5. Evaluate SW Treatment Suitability																																
- Volume Control	●						◐	◐	◐		●	●	●		◐	●	●	●	◐	●	●	●	●						●			
- Pretreat-ment	●	●	●	●		●	●	●	●	●			○	●	●	○	○	○	●	○	○	○	○	●	●	●	●	●	●	●	●	●
- Peak discharge			●				●		◐		●		●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●			
- PSH³	◐	●	●	●									◐	●	◐	◐	◐	◐	◐	◐	◐	◐	◐	●	●	●	●	●				
6. Assess Physical Feasibility at the Site⁴																																
- Limited Space Availability	●	●	●	●																											◐	◐
- Drainage area																										○	○	○				

Table 5.8 Best Management Practices Matrix

	Non-Structural or Planning Level BMPs										Structural BMPs (On-Site/Local Treatment and Regional Treatment)																			Supplemental Pre- and Post-Treatment BMPs		
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Use Assessment Parameter (see Chapter 7 for details of parameter)	See Chapter 4 for Techniques	Residential	Municipal	Industrial/Commercial	Pre-Construction	Perimeter	Slope	Drainageway	Other[2]	Inspect/maintain	Extensive/Intensive	Rain Barrels/Cisterns	Porous Pavements, Permeable Pavers and Reinforced Soil	Media (sand)	Vegetative	Infiltration/recharge	Filtration/partial recharge	Infiltration/filtration/recharge	Filtration	Infiltration Basin	Infiltration Trench	Dry Well	Underground System	With Extended Detention	Without Extended Detention (ex. Walker Pond)	Shallow Wetland	ED Shallow Wetland	Pond/wetland System		Chem./Biological Treatment	Filtration devices	Hydrodynamic Devices
- Soils Infiltration Rate						●	●	●						●	●				●	○	○	○	○			◐	◐					
- Head							◐												●													
- Depth to water table/ bedrock	●													●	●	○	○	○	●	○	○	○	○	○	○	●	●					●
- Slope	●					●	●	●								◐	◐	◐	◐													
- Ultra-urban land use	●	●	●			●	●							●	●	●	●	●	●				●	○	○	○	○	○			●	●

● = Recommended
◐ = Recommended with conditions (see Chapter 8)
○ = Not recommended;
Empty space = neutral

[1] See Chapter 8 descriptions
[2] Other includes drainage inlets, trees, and waterbodies
[3] PSH = “potential stormwater hotspot”
[4] See Table 5.6

V. References

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