ISSUE PAPER "A" - Final

BMP LIST AND SELECTION MATRIX

Date: November 4, 2004

To: Minnesota Stormwater Manual Sub-Committee

From: EOR and CWP

I. INTRODUCTION

The Stormwater Steering Committee (SSC) has stated its intent to produce a Minnesota Stormwater Manual that is an easy to use, state-of-the-art manual specifically suited to Minnesota's cold climate. The Manual should be a living document; one that is formatted for easy editing and expansion as the state-of-the-art of stormwater management continues to evolve. Following this lead, the EOR/CWP team proposes a user friendly approach to selection of Best Management Practices (BMPs) that highlights the functional components of stormwater management: pollution prevention, infiltration, sediment removal, peak flow control, and nutrient removal. A designer would be able to assess the needs of their site and select unique components to match the site needs. This approach moves away from a one-size fits all approach to one that is more tailored to the needs of a specific site or project.

This Issue Paper addresses the BMPs that should be included in the Minnesota Stormwater Manual, the use of a series of matrices to assist the user in selection of appropriate BMPs and the format that should be used in presenting the engineering detail sheets for structural BMPs. An attachment of website links to other sources of BMP information is also included as an early version of Appendix C in the Manual table of contents.

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II. BMP LIST

Background - The approach recommended in this Issue Paper is slightly different from many other manuals. The proposed concept uses a "functional components approach" wherein basic BMP components are selected and pieced together to achieve a desired outcome. For example, if a BMP is needed to reduce peak discharge and remove sediment, the "Ponds" BMP, Section 6, below is selected and the actual design components are then assembled based upon the material presented in the engineering design sheet. In this case, a pond with a specific outflow rate(s) and sufficient water quality storage is designed based on the design sheet guidance to meet both functions. This approach limits the inclusion of numerous individual BMP sheets in favor of categorical sheets with design variations included on each sheet. This should be a more user-friendly way of defining how BMPs can be designed to solve a particular problem.

The BMP lists follow a simple-to-more complex sequence, beginning with on-site pollution prevention and runoff minimization (Sections 1-2) and working upward in complexity to wetland systems (Sections 3-7). The final section on treatment supplements is a compilation of additional measures that could be used to enhance treatment (Section 8).

We propose to include detailed BMP fact sheets on bioretention (Section 3) through wetlands (Section 7). Sections 1-2 regarding pollution prevention and runoff minimization will include some descriptive language for the numerous practices listed, but will not contain engineering details. The final section on treatment supplements will similarly contain no detailed engineering, but will describe a process that designers should follow when considering the use of proprietary devices. Options would be presented in generic terms that avoid proprietary names.

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. The process set out in the manual will promote site design and practices that prevent pollution and minimize the increase in stormwater volume. The result will be smaller end-of-the pipe stormwater facilities. The manual should be prepared with these at the forefront so that the impacts of both stormwater runoff quality and quantity problems are considered prior to initiation of activity. The first two groupings are intended to address these two aspects of runoff management. We propose to describe these BMPs in the Manual in narrative terms, as opposed to preparing full engineering sheets as will be done for the structural BMPs.

1) *Pollution Prevention Practices* (water quality focus; see Matrix 1 in the BMP Selection Matrices section)

- Housekeeping (or other suitable term) including landscaping, street sweeping, pavement maintenance, catch basin maintenance and litter control
- Atmospheric controls including wind erosion and dust, as well as regulatory emission regulations

- Chemical controls including salt management, fertilizer/pesticide management and spill prevention
- Animal waste management
- Streambank stabilization

2) *Runoff Volume Minimization* (water quantity focus; see Matrix 2 in the BMP Selection Matrices section)

- Natural area conservation (reforestation, stream/shoreline/wetland buffers, open space design)
- Soil amendment
- Reduction of impervious surfaces including roof leader, parking lots, driveway and sidewalk disconnection, and reduced street width
- Grass channels in lieu of curb and gutter
- Rain barrels/cisterns
- Permeable pavement/lattice blocks
- Soakaway pits/drywells
- Stormwater planters
- Green roofs/rooftop gardens

3) *Temporary Construction Sediment Control* (water quality focus; see Matrix 3 in the BMP Selection Matrices section; reference MS4, NPDES, and local references and ordinances)

- Pre-construction
- Resource protection (buffers)
- Runoff control (sediment control basins)
- Perimeter controls (access and egress, inlet protection)
- Slope stabilization
- Rapid stabilization of exposed soils
- Inspection and maintenance

Structural BMPs - The BMPs contained in Sections 3-7 that follow will have a "design sheet" describing the engineering details for the BMP category. These BMPs are also the focus of the BMP Selection Matrices section that follows. Design variations would be part of the sheet compilation: for example, ponds are a single category, with variable features of pond design such as storage volume and physical configuration described within the design sheet.

4) *Bioretention*

- Rain gardens
- Depressed parking lot islands

5) *Filtration* (can be pre-treatment or focus of full treatment)

- Media filters (surface, underground, perimeter/Delaware) described by media and function

- Surface flow (vegetative) filters including narrative on limitations for water quality improvement
- Combination media/vegetative filters

6) *Infiltration*
- Trenches
- Basins

7) *Ponds* (design based upon components needed to fulfill the desired function)
- Components include forebay/pre-treatment, 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

8) *Wetlands* (selection criteria similar to ponds)
- Components include pre-treatment (see also next section), various storage volumes (detention needed), biologic character
- Functions include primarily water quality and flow control, but could also include ecological factors

Supplemental Pre- and Post-Treatment BMPs - The final category of BMP presents those that are generally, but not always, included in the stormwater treatment train as a supplement to the primary treatment device. There is the possibility, however, that these devices could be the only BMP used. Our approach will be to describe these in less detail than the previous sections. Instead, the designer will be guided through a process of determining the function a generic device serves within the treatment train. Once manufacturers are involved, then each designer should be able to assess the proposed device against the needed function. We will also generically describe the proprietary device categories rather than listing individual companies and risking some omissions.

9) *Supplemental Treatment* (discussed for function within a treatment train)
- Proprietary sediment removal devices
- Catch basin inserts
- Wet vaults
- Chemical treatment* (ferric chloride, alum, polyacrylamides)
- Skimmers
- Sorbents
- Thermal protection (ex. maintain tree canopy)
- 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 discussions

Recommended MSC Action - The Emmons and Olivier Resources, Inc./Center for Watershed Protection (EOR/CWP) Team recommends that the Manual Sub-committee (MSC) adopt the above BMP lists as the working set included in the Manual, subject to input from the public on its need for additional information on other BMPs.

Options considered under this section were the inclusion of other BMPs in the list(s) and a different philosophical approach for presentation. The suggested BMP lists, as included in Sections 1-8, will be linked to additional design information via information provided in an attachment described in a later section.

III. BMP SELECTION MATRICES

Purpose - The purpose of this section is to provide selection matrices for stormwater best management practices (BMPs) to be included in the Minnesota Stormwater Manual.

This document guides the designer through eight steps to help in selecting the most appropriate BMP or combination of BMPs for a site. Each step includes an accompanying matrix with the groups of BMPs evaluated. The matrices provide initial screening of the BMPs as a precursor to concept design based on the unified sizing criteria developed in a later Issue Paper.

Steps in selecting BMPs - There are eight steps that are proposed for BMP selection, as follows:

Step 1. Establish Pollution Prevention Practices
Control the amount of pollution source material on the land's surface to prevent it from becoming mobilized by runoff.

Step 2. Design Site to Minimize Runoff
Reduce the need for structural practices by using site design techniques to reduce runoff.

Step 3. Select Temporary Construction Sediment Control Techniques
Assemble a set of measures to minimize the impact of site disturbance. Note that this step could just as easily be the last step after all of the BMP decisions are made and installation plans are being formulated. It is inserted here as Step 3 to emphasize the need for good planning.

Step 4. Identify Watershed Factors
Determine if the watershed has characteristics that may require special design considerations or constrain the BMP selection.

Step 5. Identify Climate and Terrain Factors
Consider the climatic region and the terrain.

Step 6. Evaluate Stormwater Treatment Suitability
Identify the BMPs that are best suited to meet the treatment needed as determined by the sizing criteria.

Step 7. Assess Physical Feasibility at the Site
Assess the physical feasibility of practices at the site.

Step 8. Identify Community and Environmental Factors
Consider the economic, community, and environmental factors.

Step 9. Identify Location-specific Restrictions and Setbacks
Identify additional location-specific restrictions.

Step 1. Establish Pollution Prevention Practices

The first step in protecting the environment during any development or redevelopment is to control the material that is subject to runoff of the surface of the land. Keeping the urban surfaces clean of debris, the storage and application of chemicals, exposure of unprotected soil and adequate air quality regulation are all pollution control elements that should be exercised before the BMP selection process even begins.

Matrix 1 lists the various categorical pollution prevention groups and some recommended methods to implement them. This list is not intended to be comprehensive in scope, but rather it suggests some measures that can be followed in a community to keep its urban surfaces clean.

Matrix 1. Pollution Prevention Methods.

Category	Practice	Method
Housekeeping	Street sweeping	Sweep streets frequently, especially in watershed portion draining directly to a nutrient impacted waterbody such as a lake
	Landscaping	Use native vegetation to cover and stabilize exposed soil; can be used to improve aesthetics of BMPs such as ponds
	Pavement maintenance	Repair pavement that is deteriorating to prevent movement of debris with runoff
	Catch basin maintenance	Make sure that water properly enters the catch basin and remove debris and sediment (see also later section on catch basin inserts)
	Litter control	Institute a litter control plan for your community; provide litter containers at sites where litter is a problem; work with local commercial centers to control litter
Construction sediment control (see also Step 3)	Erosion control practices	Follow local, state and federal regulatory requirements for control of erosion during construction activities
Atmospheric control	Wind erosion	Institute a local program for wetting of open construction surfaces or other sources for windblown pollutants
	Emission regulation	Follow local, state and federal requirements for control of regulated air emissions
Chemical management	Salt storage and application	Properly store and apply salt during the snow season; cover all salt and mixed salt/sand storage and mixing areas; train all drivers on proper application techniques and rates
	Fertilizer and pesticide management	Follow state and federal regulatory requirements on fertilizer and pesticide storage and application; institute local educational program
	Spill prevention and clean-up	Formalize a public works spill prevention and clean-up plan

Animal waste	Waste disposal	Mandate animal waste clean-up within the community
	Nuisance wildlife	Eliminate or control nuisance gatherings of waste-generating wildlife, such as geese
Bank stabilization	Erosion repair	Immediately repair any erosion occurring on a streambank or lakeshore

Step 2. Design Site to Minimize Runoff

Site design techniques can provide non-structural stormwater treatment, improving water quality and reducing the generation of stormwater. These site design techniques are often used in conjunction with structural BMPs. However, the reduced imperviousness and reduced volume of runoff can lead to savings in the space and costs required for structural BMPs.

The factors to be considered with site design techniques are described below and summarized in Matrix 2. Please note that many of the matrices are not filled in. Some example entries were included to show the general idea for filling information into the boxes. However, the completion of the matrices will not occur until much more discussion is held with the MSC and the public on the desired approach.

- **Reduced Stormwater Volume**

Question to answer - What capability does this technique have to minimize the volume of stormwater runoff?

Possible answers - Low, Medium, High

Rating factors - Techniques recommended for volume reduction do the following:

- Preserve natural hydrology (need to define "natural" as pre-development, pre-settlement or before retro-fit)
- Promote infiltration of runoff
- Decrease runoff by reducing imperviousness

To receive a high or medium capability, at least two of these factors must be true.

- **Recharge Credit** (Note - application of "credits" will be subject to the design approach chosen by the MSC)

Question to answer - Is this technique recommended to receive a direct recharge credit?

Possible answers - Yes, No

Rating factors - Techniques recommended for a recharge credit do both of the following:

- Preserve natural hydrology
- Promote infiltration of runoff

Some of the recommended techniques qualify for credits in other states (MD, GA, or NY). Techniques that reduce impervious cover do not necessarily qualify for a direct credit, but do indirectly reduce the size of the structural practice required.

- **Water Quality Credit**

Question to answer - Is this technique recommended to receive a water quality credit?

Possible answers - Yes, No

Rating factors - Techniques recommended for a water quality credit do the following:

- Promote infiltration of runoff
- Settle particulate material in a permanent storage pool
- Achieve suitable removal efficiencies for pollutants beyond particulates

- **Cost Benefit**

Question to answer - Does the technique represent a real or perceived cost benefit for the developer?

Possible answers - (range)

High savings	+ + +
Moderate savings	+ +
Small savings	+
Equal	=
Small added cost	-
Moderate added cost	- -
High added cost	- - -

Rating factors: Factors considered in determining the potential savings include:

- Reduction in quantity of materials required for development
- Amount of developable land used for site design technique
- Increased property values
- Long-term maintenance costs

- **Local Feasibility**

Question to answer - Is it feasible to implement this technique with current local codes or design guidelines?

Possible answers - Required, Promoted, Constrained, Experimental

Rating factors - In local jurisdictions, site design techniques may be:

- *Required* by local or state law or design guidelines
- *Promoted* in most communities by design guidelines
- *Constrained* by current local codes that pose barriers to implementation or specifically prohibit the technique.
- *Experimental* in most communities. The technique may not specifically be addressed in design guidelines and/or may require special approval.

- **Reliability**

Question to answer - How reliable is the continued operation of this practice in a well-maintained, as-designed state?

Possible answers - High, Medium, Low

Rating factors - Reliability is based on:

- Operation and maintenance requirements for the technique
- Possibility of the measure being undone (e.g. an individual homeowner could reconnect a storm drain instead of letting it drain over vegetation)
- Legal protections (e.g. conservation easement protecting forest conservation area)

- **Land Use**

Question to answer - For which land use areas is the technique recommended?

Possible answers -

- LDR – low density residential
- MDR - medium density residential
- HDR - high density residential
- C/O - commercial/office
- HS - Hot Spot

Rating factors - Straightforward selection of land use type.

Matrix 2: Techniques to Reduce Runoff During Site Design and Layout

Site Design Technique	Reduce SW Volume	Recharge Credit	WQ Credit	Cost Benefit	Local Feasibility	Reliability	Land Use
Natural Area Conservation							
Reforestation							
Stream and Shoreline Buffers							
Soil Amendments							
Impervious Surface Disconnection							
Open Space Design							
Grass Channels							
Reduced Street Width							
Reduced Sidewalks							
Smaller and vegetated Cul-de-sac							
Shorter Driveways							
Green Parking Lots							
Rooftop Runoff Storage							
Permeable Pavers							
Stormwater Planters							
Green Rooftops							

Step 3. ***Select Temporary Construction Sediment Control Techniques***

Construction sites can be one of the largest sources of nonpoint source pollution, especially sediment, during the period of time when the soil is exposed to erosion. Control of these sites during this exposure is essential to proper stormwater management.

Many sources of information on the control of construction site runoff are available and will be referenced in Appendix C of the final Manual. Matrix 3 below lists several practices that should be part of temporary construction site sediment control. Only general descriptions of these practices will be given in the Manual because the details associated with these practices are available in many other publications.

The selection criteria for use of specific temporary construction sediment control techniques rely upon two factors.

- **How BMP Reduces Erosion**

Question to answer - What is the reason I would chose to use this practice(s)?

Possible answers - The target pollutant or condition causing a problem can be identified.

Rating factors - Identify the key target(s).—I am not sure what you mean by this

- **When to Apply**

Question to answer - When in the construction sequencing do I use this practice?

Possible answers - Planning, early-medium-late-post construction.

Rating factors - Determined by site conditions and target identified in previous step.

Information sources - Step 3 is a critical step in development and redevelopment. It could easily be added after all of the other BMP selection steps, but was inserted here because of the importance in considering erosion control before looking at the more structural BMPs. The MSC stressed the need to use other available sources of information unless information does not exist. In the case of temporary sediment control associated with construction, several very good sources of information are available. They include the following that should be referenced for details of selection and design:

- Minnesota Department of Transportation (Mn/DOT), *Standard Specifications for Construction*, 2000 Edition (not available electronically; currently being updated)
- USDA-NRCS, *National Engineering Handbook*
- Minnesota Local Road Research, *Erosion Control Handbook for Local Roads* [http://www.mnltap.umn.edu/pdf/erosioncontrolhandbook.pdf
- Mn/DOT *Erosion Control Handbook (2002)*
- Metropolitan Council, *Minnesota Urban Small Sites BMP Manual*, [http://www.metrocouncil.org/environment/Watershed/BMP/manual.htm]
- MPCA, *Protecting Water Quality in Urban Areas*, [http://www.pca.state.mn.us/water/pubs/sw-bmpmanual.html]

Matrix 3: Temporary Construction Sediment Control Techniques

Technique	Practice	How BMP Reduces Erosion	When to Apply BMP	Comments
Pre-construction	- site planning and grading	- minimizes soil disturbance and unprotected exposure	- planning	- expose only as much area as needed for immediate construction
	- sequencing	- limits amount of soil exposure	- planning	
Resource protection	- tree and water resource buffers	- establishes protective zone around valued natural resources	- early	- buffer variable from a few feet to 100' depending upon resource being protected
Runoff control	- stabilize drainageways	- minimizes increased erosion from channels	- all construction phases	
	- sediment control basins	- collects sediment that erodes from site before it leaves site or impacts resource	- all construction phases	- possible to transform these into permanent basins after construction
Perimeter controls	- access and egress control	- minimizes transport of soil off-site	- early	
	- inlet protection	- stops movement of soil into drainage collection system	- early	
Slope stabilization	- grade breaks	- minimizes rill and gully erosion	- early	
	- silt curtain	- stops sediment from moving	- early	
Rapid stabilization of exposed soils	- seeding	- immediately establishes vegetative cover on exposed spoil	- all construction phases	- apply seed as soils are exposed
	- blankets	- provides extra protection for exposed soil or steep slopes	- all phases as needed	- apply blanket as exposed soil cover until plants established
Inspection and maintenance	- formalized I&M program	- assures that BMP is properly installed and operating in anticipated manner	- all construction phases	- essential to proper BMP implementation

Step 4. Identify Watershed Factors

Determine if the watershed and receiving water characteristics require special design considerations that affect the BMP selection. The BMP design is influenced by the type and condition of the receiving waters downstream. Higher pollutant removal may be needed to protect the downstream resources, leading to a shorter BMP selection list. Matrix 3 lists considerations for the special watersheds described below.

[Note: Additional details will be added to this section following the established of the Watershed-based approach to be determined in Paper E.]

- **Special Designation Waters, including Outstanding Resource Value Waters (ORVW), Scientific and Natural Areas (SNA), Mississippi National River and Recreation Area (MNRRA), Wild and Scenic Rivers, and Mississippi Critical Areas.**

Question to answer - Does the site discharge into a special designation water directly or as an upstream input? If yes, how effective can the BMP be in protecting the quality of the receiving water?

Possible answers - High, medium, low

Rating factors - These waters have been established to afford extra protection to water considered of significant value to the state. Extra protection in many cases is the application of BMPs to assure that water quality impacts do not occur. Attention must be placed in this evaluation to pick BMPs that will accomplish that goal.

- **Lake and Wetland Protection**

Question to answer - How suitable is this BMP for use in a watershed with lake and pond protection concerns?

Possible answers - The acceptability of a BMP is determined as high, medium or low by its phosphorus removal rate.

Rating factors - *Removal Rate*	*Rating*
> 60%	High
40-60%	Medium
< 40%	Low

- **Trout Stream Protection**

Question to answer - How suitable is this BMP for use in a watershed with trout stream protection concerns?

Possible answers - High, medium, low

Rating factors - The suitability of a BMP for sensitive and trout stream protection is assessed using the following four factors:

- Thermals impacts from a BMP (quantify acceptable increase?)
- Minimum of 80% sediment removal (per EPA guidance)
- Channel protection
- Infiltration to ensure base flow

- **Aquifer, Wellhead and Source Water Protection**

Question to answer - How suitable is this BMP for use in a watershed with aquifer, wellhead, and surface water supply protection needs?

Possible answers - High, medium, low

Rating factors - The key concerns for areas that recharge aquifers for public water supply are:

- Providing the recharge of unpolluted stormwater
- Preventing the contamination of groundwater with hotspot runoff

Matrix 4A: Watershed Factors

BMP Group	Protected Waters				
	Special Designation Waters*	**Lake Protect-ion**	**Wetland Protect-ion**	**Trout Stream Protection**	**Aquifer, Wellhead, Source Water Protection**
Bioretention					
Filtration					
Infiltration					
Ponds					
Wetlands			Medium Provide control for channel protection. Use a large pool to improve phosphorus removal.	Medium Provide control for channel protection. Restrict in-stream practices.	Medium May require liner if A soils present. Provide 2-4' separation from water table. Pre-treat hot spot runoff.
Supplemental Treatment Practices					

* Includes (among others) Outstanding Resource Value Waters (ORVW), Scientific and Natural Areas (SNA), Mississippi National River and Recreation Area (MNRRA), Wild and Scenic Rivers, and Mississippi River Critical Area

- **Impaired Waters**

For sites where the downstream waters are impaired, a specific pollutant may be of concern. These sites may have a TMDL (Total Maximum Daily Load) for sediment, nitrogen, phosphorus, bacteria, or metals.

Question to answer - How effective is this BMP at removal of the pollutant causing an impairment?

Possible answers - High, medium, low

Rating factors -

Removal Rate	*Rating*
> 60%	High
40-60%	Medium
< 40%	Low

Matrix 4B: Watershed Factors

BMP Group	**Impaired Waters***					
	Sediment	**Ther-mal**	**DO**	**P**	**Bacteria (E.coli.)**	**Metals**
Bioretention						
Filtration						
Infiltration						
Ponds						
Wetlands	High			Medium	Use long detention times to encourage removal.	Pre-treat runoff to remove metals
Supplemental Treatment Practices						

* Chloride impaired waters discussed in cold climate section

Step 5. Identify Climate and Terrain Factors

Consider the climatic region and the terrain. The climatic and terrain differences across the state will lead to local design modifications or local BMP preferences. Matrix 4 can be used to assist in the selection of BMPs to address these special conditions.

- **Karst and Fractured Bedrock**

Question to answer - Is karst or fractured bedrock geology present in the area of interest? If yes, how suitable is this BMP for reducing pollution that might flow directly into the local groundwater system?

Possible answers - High, medium, low level of protection

Rating factors - The degree to which a BMP can remove contaminating chemical and biological material determines the answer above. The assumption must be made that anything recharging the groundwater in a karst or fractured bedrock area will become part of the drinking water source for the locale.

- **Calcareous fens**

Question to answer - Is there a calcareous fen that will be impacted by the drainage from the area in question? If yes, the fen is likely to have special protections afforded under Minnesota law and must be adequately protected.

Possible answers - High, medium, low level of protection

Rating factors - Calcareous fens rely upon groundwater recharge and movement through calcium-rich bedrock. Reducing recharge or otherwise altering the hydrology of the area draining to or recharging a calcareous fen could adversely impact its unique character. An assessment should be made of the likelihood of changing the hydrology and water quality character of water draining to the fen area.

- **High Snowfall**

Question to answer - Is the area in question in part of the state that typically experiences extremely high snowfall levels (these will be identified in the precipitation frequency Issue Paper)? If yes, how suitable is the BMP under the conditions this presents?

Possible answers - High, medium, low

Rating factors - Consideration must be given to the fact that this BMP could be covered with large amounts of snow and/or ice. This snow will inhibit performance throughout the winter and will generate significant water volume when it melts. An acceptable BMP should be able to handle frozen conditions and large spring snowmelt events.

- **Low Rainfall**

Question to answer - Is the site being considered in the southwest portion of the state that typically experiences low annual rainfall? If yes, how suitable is this BMP under low water conditions?

Possible answers - High, medium, low

Rating factors - Consideration must be given for the fact that water moving into and through the BMP will be minimal, and that it could be highly concentrated due to the lack of runoff volume.

Matrix 5: Climate and Terrain Factors

BMP Group	Karst	Fractured Bedrock	Calcareous fens	High Snowfall	Low Rainfall
Bioretention					
Filtration					
Infiltration					
Ponds					
Wetlands	Geotechnical analysis needed; implement max ponding depth; require poly or clay liner.			Use salt-tolerant vegetation	Water budget calculations will likely show this to be unsuitable.
Supplemental Treatment Practices					

Step 6. Evaluate Stormwater Treatment Suitability

This step identifies the BMPs that are best suited to meet the treatment needed as determined by the unified sizing criteria. The concept of unified sizing criteria adoption for the state will be discussed by the MSC at its February 2005 meeting.

- **Recharge**

Question to answer - Does the BMP have the ability to meet the recharge requirement under the unified sizing criteria?

Possible answers - Yes, no

Rating factors - Site design techniques listed in Matrix 1 may be used in conjunction with BMPs that do not meet the recharge requirement to achieve full treatment.

- **Water Quality**

Question to answer - Does the BMP have the ability to meet the water quality treatment requirement? Note – The recommended treatment practices will all provide some level of water quality treatment.

Possible answers -

Removal Rate	*Rating*
> 60%	High
40-60%	Medium
< 40%	Low

- **Channel Protection**

Question to answer - Does the BMP have the ability to meet the channel protection requirement in the unified sizing criteria?

Possible answers - Yes, no

Rating factors - BMPs that cannot meet the channel protection requirement as stand alone practices should not be eliminated from consideration, as they can be used as part of the treatment system.

- **Peak Discharge**

Question to answer - Does the BMP have the ability to meet the peak discharge requirement in the unified sizing criteria?

Possible answers - Yes, no

Rating factors - If a BMP does not provide peak discharge control, it can be used in series with other BMPs.

- **Accept Hotspot Runoff**

Question to answer - Does the BMP have the ability to accept hotspot runoff (runoff from a site likely to produce extremely polluted conditions)?

Possible answers - Yes, no

Rating factors - Design restrictions may be needed as noted or additional measures may be needed to protect downstream waters from potential spills.

- **Accepts Snow Storage**

Question to answer - Does the BMP have the capability to accept snow storage? Can it function effectively if frozen conditions exist?

Possible answers - Yes, no

Rating factors - Piling snow into or onto a BMP can affect its ability to perform effectively. An assessment must be made whether snow can be stored on or near this BMP and what the impact of doing so means to operational effectiveness.

Matrix 6: Stormwater Treatment Suitability

BMP Group	Recharge	Water Quality	Channel Protection	Peak Discharge	Hot Spot Runoff	Snow Storage
Bioretention						
Filtration						
Infiltration						
Ponds						
Wetlands	Varies	Yes	Yes	Yes	Yes – with pre-treatment	Yes
Supplemental Treatment Practices						

Step 7. Assess Physical Feasibility at the Site

This step assesses the physical feasibility of BMPs at the site. By this point in the selection process, the list of possible BMPs has been narrowed and eight site specific criteria can be considered.

- **Surface Area**

Question to answer - How much surface area (space) is required at the site to implement this BMP?

Possible answers - Area must be quantified.

Rating factors - Surface area required is presented as a percentage of the impervious area draining to a site, as the space required for a practice varies significantly.

- **Drainage Area**

Question to answer - What is the maximum drainage area for which this BMP is suitable?

Possible answers - Area must be quantified.

Rating factors - This column presents the minimum or maximum recommended drainage areas for the BMP. If the drainage area is slightly above the maximum, design modifications can be made or multiple BMPs can be used. Minimum drainage areas can be flexible depending on the availability of groundwater or baseflow, and the mechanisms employed to prevent clogging.

- **Soils**

Question to answer - What soil considerations are necessary for this BMP to work effectively?

Possible answers - Hydrologic soil groups A-D can be used for generalized infiltration rates. Permeability requirements should be listed, if available.

Rating factors - The soil considerations are based on the USDA-NRCS hydrologic soil groups. Detailed geotechnical testing may be required to determine permeability and groundwater depth.

- **Elevation Difference (head)**

Question to answer - How much elevation difference is needed from inflow to outflow for the BMP to perform correctly?

Possible answers - Difference must be quantified based on design.

Rating factors - This is an estimate of the elevation difference between the BPM inflow and its outflow needed to allow the BMP to operate with gravity.

- **Depth to Bedrock**

Question to answer - Will shallow bedrock affect the performance of the BMP? If yes, what is the minimum depth to bedrock needed for adequate performance?

Possible answers - Depth must be quantified if it is a possible problem.

Rating factors - Practices that require excavation or infiltration may have associated minimum depths. This could also be a factor in karst areas where some soil overlies the karst bedrock.

- **Depth to Water Table**

Question to answer - Is a high water table likely to impede BMP performance? If yes, what is the minimum depth needed to the seasonally high water table from the bottom of the BMP?

Possible answers - Depth must be quantified if it is a possible problem.

Rating factors - Some BMPs require separation from groundwater to incorporate adequate infiltration distance or to assure that an adequate storage volume above permanently standing water is available.

- **Slope**

Question to answer - What are the constraints on the slope of the ground where the practice is located?

Possible answers - The slope of the land surface where the BMP is located, as well as that where it discharges, must be quantified.

Rating factors - The site where a BMP is located has certain physical requirements for it to be secure and operate properly. The downstream discharge situation must also be a consideration to prevent erosion and flooding.

- **Ultra-urban (highly developed urban land)**

Question to answer - Is this BMP well-suited to ultra-urban sites?

Possible answers - Yes, no.

Rating factors - Ultra-urban sites have limited space and disturbed soils, and they are frequently redevelopment projects. Extremely high levels of runoff and associated contaminants are common.

Matrix 7: Physical Feasibility at the Site

BMP Group	Surface Area	Drainage Area	Soils	Head	Depth to Bedrock	Depth to Water Table	Slope	Ultra-Urban
Bioretention								
Filtration								
Infiltration								
Ponds								
Wetlands	Low	25 acres minimum	A soils may require liner	3 to 5 feet		4 feet if hotspot or aquifer	No restriction	Generally not practical
Supplemental Treatment Practices								

Step 8. Identify Community and Environmental Factors

This step incorporates the economic, community, and environmental factors needed to adequately select BMPs.

- **Ease of Maintenance**

Question to answer - What is the relative ease of maintenance of this BMP?

Possible answers - High, Medium, Low

Rating factors - All BMPs require routine inspection and maintenance throughout their lifecycle. The ease of maintenance is based on four criteria:

- Frequency and cost of scheduled maintenance
- Chronic maintenance problems
- Reported failure rates
- Monitoring needs

- **Community Acceptance**

Question to answer - What is the level of community acceptance of this BMP?

Possible answers - High, Medium, Low

Rating factors - Community acceptance is evaluated using four factors:

- Market and preference surveys
- Reported nuisance problems
- Visual aesthetics
- Land consumption

The community acceptance can often be improved by site specifics such as the landscape plan.

- **Construction Cost**

Question to answer - What is the relative construction cost per impervious acre treated?

Possible answers - High, Medium, Low

Rating factors - A community or watershed organization may not be willing to pay a high price for a specific BMP even though it provides the treatment that is needed. An expensive sub-grade treatment train or extensive landscaping could be viewed as excessive.

- **Habitat Quality**

Question to answer - What relative habitat quality can be achieved with this BMP if installed and landscaped appropriately?

Possible answers - High, Medium, Low

Rating factors - Criteria for assessing wildlife and wetland habitat quality include:

- Size
- Water features
- Wetland features
- Vegetative cover
- Buffer

- **Nuisances**

Question to answer - What nuisance issues are commonly associated with this BMP?

Possible nuisance issues include -

- Mosquitoes
- Trash/debris
- Frequent maintenance
- Landscaping concerns

Rating factors - The extent of the nuisance conditions will usually dictate local community acceptance.

Matrix 8: Community and Environmental Factors

BMP Group	Ease of Maintenance	Community Acceptance	Construction Cost	Habitat Quality	Nuisances
Bioretention					
Filtration					
Infiltration					
Ponds					
Wetlands	Medium	Medium-High	Medium	High	Maintain vegetation
Supplemental Treatment Practices					

Step 9. Identify Location-Specific Restrictions and Setbacks

The following additional location-specific restrictions could impact the selection of BMPs:

- Conservation Areas
- Buffers
- Utilities
- Roads
- Structures
- Water Wells (private and municipal)
- Septic Systems
- Sinkholes
- Floodplain
- Jurisdictional wetland
- Stream channel
- Shoreland and lakeshore
- Steep slopes

Matrix 9: Location-specific Restrictions and Setbacks

Factor	Considerations
Conservation Areas	
Buffers	
Utilities	
Roads	
Structures	
Water Wells - private and municipal	
Septic Systems	
Sinkholes	
Floodplain	
Jurisdictional wetland	
Stream channel	
Shoreland and lakeshore	
Steep slopes	

Recommended MSC Action - The EOR/CWP Team recommends that the MSC adopt the matrices as developed above, subject to input from the public on its need for additional assistance in BMP selection and refinement as details are developed to fill the matrices.

Options considered under this section were additional (or fewer) matrices and a different method of presentation for the matrices.

IV. LINKS TO OTHER DESIGNS

The attachment to this Issue Paper contains a comprehensive list of other references that can be electronically accessed for additional design assistance. MSC action on this item is not required. This attachment will form the basis for Appendix C in the Manual. This information is presented in response to the charge by the SSC to use existing information to the extent possible in support of the Minnesota effort.

V. ENGINEERING DESIGN SHEET FORMAT

The content of each design sheet is another factor upon which the Manual Sub-Committee must decide. Following is a recommended content list for the major BMP categories listed above in Sections 3-7. As previously mentioned, the Non-structural/Planning Level and Supplemental Treatment BMPs will be described when they are presented.

1) Title
2) Definition
    a. Description
    b. Function within stormwater treatment train
    c. Optional names (also known as…)
    d. Design variations and schematics
        i. A
        ii. B
        iii. C
3) Water Quality (for each variation)
    a. Mechanisms: ex. screening, filtration, settling, biological, chemical
    b. Pollutant removal: pollutant, typical % reduction, mean outflow concentration
    c. Other water quality benefits
4) Water Quantity (for each variation)
    a. Water balance: inflow = infiltration (or filtration) + evaporation + outflow + transpiration
    b. Rates: infiltration, evaporation, filtration, outflow
    c. Storage: permanent vs. temporary detention
    d. Emergency overflow
5) Design Considerations (for each variation)
    a. Sizing: tables, computations, etc.
    b. Details: CADD
6) Major Design Elements
    a. Feasibility
    b. Pretreatment
    c. Landscaping/vegetation
    d. Safety
    e. Erosion control

7) Maintenance
    a. Routine minor maintenance
    b. Inspection for major maintenance and/or repairs
    c. Major maintenance
    d. Replacement
8) Cost Determinations
    a. Construction costs
    b. Operational costs
    c. Inspection costs
    d. Maintenance costs
9) Minnesota Sites
    a. Regional (statewide) examples
    b. Pictures
10) Links to Other Manuals (drawn from the attachment)

Recommended MSC Action - The EOR/CWP Team recommends that the MSC adopt the above content for each of the design engineering sheets developed for BMP groups.

Options considered under this section included other elements to contain in the design sheets. After thorough evaluation relative to the goals of the Manual, the ones listed above were chosen to be recommended to the MSC.

VI. SUMMARY OF RECOMMENDEDED MSC ACTIONS

The following recommendations for MSC action were made in this paper:

BMP List - The Emmons and Olivier Resources, Inc./Center for Watershed Protection (EOR/CWP) Team recommends that the Manual Sub-committee (MSC) adopt the suggested BMP lists as the working set included in the Manual, subject to input from the public on its need for additional information on other BMPs.

BMP Selection Matrices - The EOR/CWP Team recommends that the MSC adopt the matrices as developed above, subject to input from the public on its need for additional assistance in BMP selection and refinement as details are developed to fill the matrices.

Engineering Design Sheet Format - The EOR/CWP Team recommends that the MSC adopt the suggested content for each of the design engineering sheets developed for BMP groups.