6. District Standards and Recommended Methods

6.1 Approach

This WMP is structured to afford the District the highest degree of long-term flexibility. Flexibility is achieved by relying upon both existing and future supporting Guidance Documents to help provide direction to the District and its constituents during resource management and implementation activities.

District standards are based upon critical studies and plans (i.e., Guidance Documents) completed by the District (or others such as Washington County or the former Lower St. Croix Watershed Management Organization) which provide a framework for managing the resources within the SWWD. Analysis of resource data collected by the District also serves as the foundation for standards.

The approach to defining standards includes:

- Protection of a resource at a level appropriate to its identified ecological value and perceived societal value (e.g. state classification and regulations).
- Sufficient guidance and direction to municipalities while allowing long-term flexibility for the SWWD to readily adapt to new information and emerging issues.
- Ability to maintain WMP conciseness and ease of function by utilizing Guidance Documents for greater specificity.

The Stormwater Manual (volume 1.0) recently published by the Minnesota Pollution Control Agency provides substantial discussion of stormwater management issues and approaches. As such, the Stormwater Manual content has incidental overlap with much of the content of this section. The standards set forth herein take into consideration elements of the Stormwater Manual where appropriate. However, District-specific data, expectations, and concerns provide focus and relevance to developing WMP standards that is not otherwise available in the Stormwater Manual.

6.2 Guidance Documents

The standards are based in part upon existing Guidance Documents. The current studies and assessments considered Guidance Documents include:

- Comprehensive Wetland Management Plan (draft)
- Greenway Corridor Plan

- Lake Management Plans, including Ravine Lake and Powers Lake
- 2002 Engineers Report (defines preferred route for watershed overflow)
- Monitoring Program Plan
- Development / Design Standards Manual

Potential future guidance documents include:

- Lake or subwatershed specific Management or Implementation Plans for priority lakes
- Education Plan

Additional documents may be developed at the discretion of the District on an as needed basis.

6.3 Implementation of Standards, Applicability, Credits and Trading

6.3.1 Implementation

Once a city has amended their Local Water Management Plan (Local Plan) to incorporate this WMP, the implementation of standards specific to local controls is the responsibility of the city. Although some standards presented herein are likely to be refined and adjusted in the future by completion of, or revisions to, various Guidance Documents, the standards presented here are neither interim nor discretionary. (Future lake-specific management plans may revise the allowable loads in this WMP.) Dissemination of new Guidance Documents is discussed in the Chapter 7, Watershed District Administration.

The SWWD will adopt rules consistent with this WMP and implement the standards during the interim before Local Plans or approved local official controls are in place. The standards will be implemented through the review of development plans in coordination with the cities' review. The SWWD maintains general oversight responsibility for the water and natural resources in the watershed after local official controls are in place.

6.3.2 Applicability

The requirements presented within this Chapter and the review and/or issuance of a permit by the District is required for all land alterations, such as grading or filling which remove cover or disturb a surface area of one acre or more, regardless of impervious coverage. The SWWD may also apply these requirements on a case-by-case basis, at their discretion.

The standards and their general applicability are shown in Table 6.1. A description of the intended use for each standard is provided to further illustrate the intent and applicability of the standards.

Table 6.1 – Summary of standards and applicability to projects

Standard	New Development	Redevelopment	Public Improvement[1]
NPDES Minimum Water Quality*	Yes	Yes	Yes
Stormwater Peak Runoff Rate (Section 6.6.2)	Yes	Yes	Yes
Stormwater Runoff Volume (Section 6.6.3)	Yes	**No**	**No**
Allowable Total Phosphorus Load** (Section 6.6.4)	Yes	Yes	Yes
Wetland Protection Standard (Section 6.4.3)	Yes	Yes	Yes
Critical Storage Areas (Section 6.7)	Yes	**No**	Yes
Regional Assessment Locations (Section 6.8)	Yes	Yes	Yes
Utilization of Infiltration (Section 6.9)	Yes	Yes	Yes
Open Channel Stability (Section 6.10)	Yes	Yes	Yes
Bluff Buffers (Section 6.11)	Yes	Yes	**No**
Existing / Predevelopment Conditions	Un-urbanized; Curve Number less than or equal to 62. Annual infiltration as mapped.	Level of impervious cover and land use / land cover over a 10-year period prior to project initiation.	

1) Public Improvements are defined as linear projects (i.e. roadways) establishing impervious area cumulatively above one acre as a result of the project, even if the overall project is phased over several years. Exempted public improvements are defined as linear projects on existing infrastructure which does not increase impervious area above one cumulative acre. Examples include mill and overlay projects, or sewer or water system reconstructions.
*Minimum requirements as described in the current NPDES Phase II General Permit for construction sites according to amount of new impervious surface added as a result of proposed project.
**Load reduction requirements are allocated as per process outlined in Section 6.6. Assessment is over entire tributary area, not new impervious surface.

Through the application of standards discussed in this Chapter and summarized above in Table 6.1, the District employs a system of checks and balances to protect water resources while recognizing variability in site conditions and the type of projects. In all cases, the most limiting standard will be the basis against which a project will be reviewed.

The requirements presented within Chapter 6 apply to all land alterations (projects) which remove cover or disturb a surface area of one acre or more, regardless of impervious coverage.

6.3.3 Credits and Trading

The SWWD plans to implement nutrient trading and / or a credit-based system to catalyze the use of innovative stormwater practices and maximize the protection of priority resources (District policy WQ-3). The SWWD also envisions developing a credit-based system for reducing runoff volumes. Expectations are that these will be implemented through revision to the Stormwater Utility Fee.

6.4 Wetland Classification and Management

6.4.1 Overview

A draft Comprehensive Wetland Management Plan (CWMP) was prepared for the SWWD (distributed in February 2003). The draft CWMP is the Guidance Document which forms the basis for the wetland standards. The wetland classification and management standards within the draft CWMP provides a tailored approach for managing wetlands in the District based on their functional values. Wetland types and conditions are highly variable and the District believes that not all wetlands require the same degree or type of protection. Wetlands can function to provide valuable natural services including biodiversity, flood attenuation, groundwater recharge, and more. Protection strategies (i.e., management standards) depend on the wetland's role in the watershed.

The management standards are geared towards protection of a wetland’s functions, with the most sensitive wetlands afforded the highest level of protection. Wetlands within the watershed will also be provided the protection that federal and state laws require. The protection standards presented in this WMP are in addition to state and federal requirements. Regulation of activities potentially impacting individual wetlands will be based upon on a site-specific *delineation* of the wetland boundary as part of a proposed project.

All inventoried wetlands have been assigned a management class (Map 6.1). For each wetland management class, standards have been developed for allowable stormwater runoff inflows (water quality), allowable alterations to wetland hydroperiod (water quantity), wetland vegetation buffers, and wetland mitigation (replacement).

6.4.2 Classification and General Process

Assessment of wetland functions and values are based on a modified version of the Minnesota Routine Assessment Methodology (MNRAM). The MNRAM was developed by the Minnesota Interagency Wetland Group as a field evaluation tool to assess wetland functions on a qualitative basis. Wetland functions evaluated as part of the MNRAM assessment include: floral diversity, wildlife and fish habitat, surface hydrology, flood control, water quality, groundwater interaction, aesthetics, and educational use.

Wetlands were assigned a ranking for each function. Assessed wetlands were also categorized based on a wetland’s susceptibility (i.e., sensitivity) to stormwater runoff impacts. A wetland management classification system was developed based on assessed ranking and susceptibility, as well as other factors pertinent to the SWWD. Under this system, wetland quality—as indicated by floral diversity—was a primary factor for determining wetland management class if quality was high or moderately high. For wetlands of moderate to low quality, other criteria, such as floodplain management, took on equal or greater importance in classifying a wetland. The wetland management classes are shown below in Table 6.2.

Table 6.2 –Wetland classification

Management Category	*Characteristic Wetland Type and Quality*	*Guiding Management Principle*
Protect	<u>Good to Excellent Quality</u> – Rich Fen, Minerotrophic Tamarack Swamp, Wet Meadow, Wet Prairie, Sedge Meadow, Hardwood Seepage Swamp, Shrub Swamp, Floodplain Forest. Generally dominated by native species; invasive species sometimes present, but not dominant.	Preservation – avoid and buffer direct / indirect stormwater impacts
Manage 1	<u>Low to Moderate Quality</u> – Wet Meadow, Shrub Swamp, Sedge Meadow, Mixed Emergent Marsh, Cattail Swamp. Generally has significant, but not total, establishment of invasive species.	Minimize stormwater impacts. Within SWWD Greenway Corridor. Reclamation or restoration.
Manage 2	<u>Low to Degraded Quality</u> – wetlands dominated by invasive species, extensively drained, or otherwise altered.	Utilize for stormwater management, with appropriate treatment provided. Reclamation or restoration.

6.4.3 Wetland Protection Standards

Wetland resources are protected by a variety of state and federal programs, as referenced in Section 5.1.3. Projects which may potentially affect wetland resources must at minimum meet the requirements set forth by the various programs. In addition to these state and federal requirements, the SWWD has established standards for the following areas to further protect wetland resources:

Water Quality – Increased pollutant loads (e.g., sediment and phosphorus) delivered to wetland systems during and after land development can negatively impact plant communities and biota. Stormwater runoff pollutant load limits are established to reduce impacts to the existing characteristics of wetland types. Pre- and post-development calculations for loads reflect average annual conditions. Wetland water quality standards are shown in Table 6.3.

Water Quantity –To prevent impacts to high quality wetlands and capture available storage capacity of wetlands for flood control, wetland water quantity standards have been developed. Water quantity impacts can result from changes to incoming stormwater runoff discharge rate, the duration of sustained water levels resulting from a runoff event (i.e., inundation), and how dramatically the water level changes (i.e., bounce). Wetland water quantity standards are shown in Table 6.3.

Buffer Strips – Buffers are vegetated areas next to waterbodies which be planned to connect important upland habitats or waterbodies to wetlands. Buffers can consist of trees, shrubs, grasses, wildflowers, or a combination of plant forms. A major goal of the buffer standard is to maintain connections with adjacent undisturbed areas to promote linear corridors and increase overall habitat.

Wetland buffer strip requirements apply to any project which has a wetland (as defined by the United States Army Corps of Engineers Manual 1987) wholly or partially within the project limits or is immediately adjacent to the project limits and would receive untreated stormwater runoff. Wetland limits shall be determined by professional wetland delineation, and any wetland not currently identified will require a functional assessment. If a delineated wetland is 100 feet or less from the proposed project limits as indicated by construction boundary, buffer standards will apply.

The buffer width standards are summarized in Table 6.3. Buffer averaging can be used only when necessary, provided that the minimum buffer width is equal to or greater than one-half the average required buffer width. Additional buffer width is required for slopes greater than 15%; however, this additional width may be credited towards the overall average width. Buffer width must be expanded horizontally 3-feet per every 1% increase in slope above 15% or to top of bluff, whichever is less. Detailed design and planning requirements, limitations, and exceptions can be found in the draft CWMP; such criteria will be considered for inclusion in future design guidance documents by the SWWD.

Wetland Mitigation – Regardless of wetland classification, loss of wetland area (i.e. impacts) will be mitigated (i.e. replaced) on-site whenever practical. The project applicant is responsible for demonstrating that on-site mitigation is not technically feasible or sound by a sequencing analysis. Where on-site replacement is determined unsuitable, replacement of wetland impacts shall be located within the hydrologic subwatershed. In such cases, wetland replacements will target areas which exhibit flood prone conditions, as determined by the SWWD. Credits will be allowed for mitigating wetland impacts.

Excavation of a Manage 2 class wetland is not considered an impact for purposes of this WMP, unless that excavation occurs in a Type 3, 4, or 5 wetland, or results in conversion to a deepwater habitat. (However, Minnesota Rule 7050.0201 subpart 13a protects wetlands from physical alterations to prevent significant adverse impacts to designated uses as determined by the State.) Replacement of wetland impacts on projects by public road authorities are provided through the State wetland bank, or through a separate wetland bank managed by the Minnesota Department of Transportation Metro Division. Impacts to wildlife habitat are difficult to quantify, therefore, mitigation of wildlife impacts will be accomplished through maintaining connectivity to surrounding habitat areas. A summary of standards for wetland mitigation is shown in Table 6.3.

Table 6.3 – Protection standards for wetland management classes

Criteria	*Protect*	*Manage 1*	*Manage 2*
Water Quality[1]			
Phosphorus Inflow Load (average annual pounds)	Maintain predevelopment	60% post-development load reduction	60% post-development load reduction
Water Quantity[2,3]			
Storm bounce 10-year rainfall (4.2-inch)	Existing	Existing plus 1.0 foot	No limit
Discharge rate (inflow) 2-year (2.8-inch) & 100-year (6.3-inch) rainfall	Existing	Existing or less	Existing or less
Inundation period 1-year rainfall (2.4-inch)	Existing	Existing plus 2 days	Existing plus 7 days
Inundation period 2-year rainfall (2.8-inch)	Existing	Existing plus 14 days	Existing plus 14 days
Run-out control elevation (free flowing)	No change	0 to 1.0 feet above existing run out	0 to 4.0 feet above existing run out
Run-out control elevation (landlocked)	Based on SWWD Floodplain Map	Based on SWWD Floodplain Map	Based on SWWD Floodplain Map
Buffer Width			
Wetlands < 1 acre	75 feet	50 feet	25 feet
Wetlands > 1 acre	100 feet	75 feet	50 feet
Impact Mitigation			
Area replacement ratio	3:1	2:1	2:1
Volume replacement ratio	2:1	2:1	2:1

[1] Predevelopment phosphorus loads to be based on volume control standard as discussed in Section 6.6.3, which sets existing level of annual runoff volume. Maximum phosphorus runoff concentrations for predevelopment cannot exceed 0.320 mg/L.

[2] "Existing" means the existing hydrologic conditions. If there have been significant changes in conditions, it means the conditions which established the current wetland.

[3] Rainfall events are 24-hour duration. Values based on TP40 with exception of 100-year event.

NOTE: Wetlands which are clearly identified in historic local surface water management plans as integral to stormwater conveyance and management under full development may be granted a variance by the SWWD. However, all other applicable permits from other agencies still must be addressed as appropriate.

6.4.4 Intended Use

The SWWD intends to apply the standard to new development activities during the development review process. The SWWD expects that new developments will incorporate the minimum requirements into their site design. The application of this standard to redevelopment is also anticipated on a case-by-case basis.

Wetland water quantity and quality standards apply to a project where the primary receiving water body for discharge of stormwater is a wetland as defined by the United States Army Corps of Engineers Manual 1987. Any wetland not identified on Map 6.1 will require a professional delineation and functional assessment prior to project application. However, wetlands which are clearly identified in historic local surface water management plans as integral to stormwater conveyance and management under full development may be granted a variance by the SWWD. However, all other applicable permits still must be addressed as appropriate.

6.5 Receiving Water Classification and Management

6.5.1 Background

Classification of receiving waters includes lakes and waterways. Lakes are defined by the DNR as waters that are greater than 10 acres in area. Lakes are further categorized as shallow or deep. Shallow lakes are those which have a maximum depths less than 15 feet whereas deep lakes have maximum depths of 15 feet or greater.

Shallow lakes and deep lakes have different nutrient assimilation dynamics and respond differently to watershed inputs and other external factors. Shallow lakes generally are continually mixed through the open water season. The relatively small volume of water in a shallow lake means their water quality may be more reflective of the quality of stormwater runoff and other inputs. Sediments of shallow lakes are often stirred up by wind and wave action, or by rough fish such as carp. As such, nutrients that settle to the bottom are frequently resuspended, influencing water quality and catalyzing algal growth. The characteristics of shallow lakes affect the selection of appropriate management strategies.

In contrast to continually mixed shallow lakes, deep lakes typically develop thermal stratification due to density gradients in water. During times when a lake is stratified, anoxic conditions can develop at the bottom of a lake. Anoxic conditions release phosphorus from lake sediments which are then brought to the surface during times of mixing, contributing to algal blooms. Generally, the relatively large volume of water in deep lakes allows pollutants (i.e., phosphorus) to settle to the lake bottom and a portion of these to become permanently assimilated. As such, deep lakes tend to respond slower than shallow lakes to watershed inputs. However, phosphorus reserves can build up in a lake bottom, exacerbating future management efforts. Also, expanding a lake's drainage area can have significant adverse impact by accelerating nutrient loading and accumulation. The pollutant assimilation capacity of deep lakes can give false security to those concerned about water quality, because of a deep lake's slower response.

The most cost-effective lake management strategies focus on maintaining acceptable water quality before declines occur. Currently, identification of a water body as impaired for it's designated beneficial use is based on water quality thresholds meaningful to deep lakes. Broadly, an average growing season in-lake phosphorus concentration of 40 parts per billion (ppb) is the regulatory threshold for lakes deemed as fully supporting direct contact aquatic recreation such as swimming. Natural shallow lake dynamics inherently limit the ability to meet this 40 ppb threshold. Recognizing this dynamic, the MPCA is evaluating a different water quality threshold for shallow lakes. The proposed threshold for shallow lakes meeting designated beneficial use is 60 ppb total phosphorus. (These nutrient-based standards also have parallel thresholds based on water clarity and chlorophyll concentration.)

6.5.2 Classification Process

Lakes are classified by the SWWD based upon monitoring data (preferably long term). Thus, Bailey Lake is not included in the current classification system but may be if monitoring is implemented. Similarly, Gables Lake is not included; the Gables Lake watershed is privately owned and not expected to develop.

For SWWD receiving waters, the three classification categories are Class A, Class B, and Class C. Generally, the classification process is based on the water body's current level of nutrient enrichment and clarity, susceptibility to change due to adverse watershed inputs, the desired trophic state, and the extent of current urbanization within the contributing watershed. The placement of lakes in the classifications considers the relative capacity of a lake (i.e., drainage area, lake morphometry, etc.) to meet or support a state-designated beneficial use.

Class A These lakes are considered as those that have a reasonable chance of consistently maintaining or attaining in-lake phosphorus concentrations which meet a full-support designation. Monitored data during the growing season period reflect long term phosphorus concentrations below 40 ppb for priority deep lakes, and 60 ppb as a growing season average concentration for shallow lakes. Class A receiving waters (i.e., including the Mississippi River) are those that will support a balanced ecosystem (e.g. diverse aquatic plant communities, quality fishery) as well as serve as high quality recreation lakes for boating and aesthetics.

Class B These lakes generally demonstrate a reasonable chance of attaining the in-lake phosphorus goal for meeting their designated use. Monitored data reflect long term phosphorus concentrations between 60 and 100 ppb for the growing season for Class B lakes. The natural lake ecosystem may be considered as moderately disturbed. Lakes classified as Class B are those that may support some fishery but are also well suited for supporting wildlife, aesthetic enjoyment, and boating or other special purpose uses.

Class C These lakes, without considerable measures, do not have a reasonable potential to attain the in-lake phosphorus goal for meeting designated use. Class C lakes exhibit exceptionally high nutrient enrichment and long term monitoring data generally reflect phosphorus concentrations greater than 100 ppb as an average growing season concentration. The natural ecosystem is severely disturbed and considered out of balance. Due to their physical and nutrient characteristics, these lakes are limited in their recreational role and are best suited for flood control, landscape aesthetics, and wildlife habitat.

Class D These lakes do not currently have standards established, generally due to a lack of sufficient data. Gables and Bailey lakes are Class D, but may reclassify at a later date.

6.5.3 Management Standards and Implications

Every lake has a unique drainage area and responds differently to watershed inputs. Therefore, allowable nutrient loads and the necessary load reductions are tailored for classified lakes in the SWWD. Allowable nutrient loads are set according to regional reports and will be modified as necessary to comply with completed TMDLs._Current loads and allowable loads are set forth in Table 6.4.

The allowable loads correspond to maintaining or achieving a specific desired (expected) trophic state for the lake as shown in Figure 6.1. A specific discussion of each lake's quality and condition is presented in Section 4.3. The allowable loads are based on MnLEAP modeling to estimate a lake's mean trophic state index from reduced watershed inputs (i.e., phosphorus runoff concentration). A key implication is that the use of stormwater treatment practices which incorporate runoff volume reduction will be critical to attaining the required load reductions.

*NOTE: the MnLEAP model is based on data generally representative of deep lakes. Shallow lake models used for general planning purposes are uncommon. Future shallow lake assessments will benefit from models developed specifically for shallow water bodies. For example, PAMOLARE II is a model focusing on shallow lakes for eutrophication management. It can also be used for restoration purposes or it can be adapted to wetland conditions. PAMOLARE II also considers species competition (macrophytes and phytoplankton) and interactions between macrophytes and associated fish, such as common carp. Due to its complexity the model requires a large number of data.

6.5.4 Intended Use

The SWWD's intended uses are multiple and include:

1. Establishing reasonable expectations among residents of the District and lake users relative to lake water quality;

2. Providing an estimate of the load reduction required to achieve these expectations;

3. Developing additional scientific information through the development of lake specific management plans, to evaluate the practicability of the intended uses;

4. Apportion the responsibility for achieving the total phosphorus load reduction among new development and redevelopment in an equitable manner.

The anticipated process for allocation the required loads reductions are described in Section 6.6.4 Allowable Total Phosphorus Loads and will be applied to both new development and redevelopment as a requirement. Expectations are that the desired trophic state range and the total phosphorus load reduction required will be modified, as lake specific management plans are developed and the practicability of achieving the load reductions evaluated.

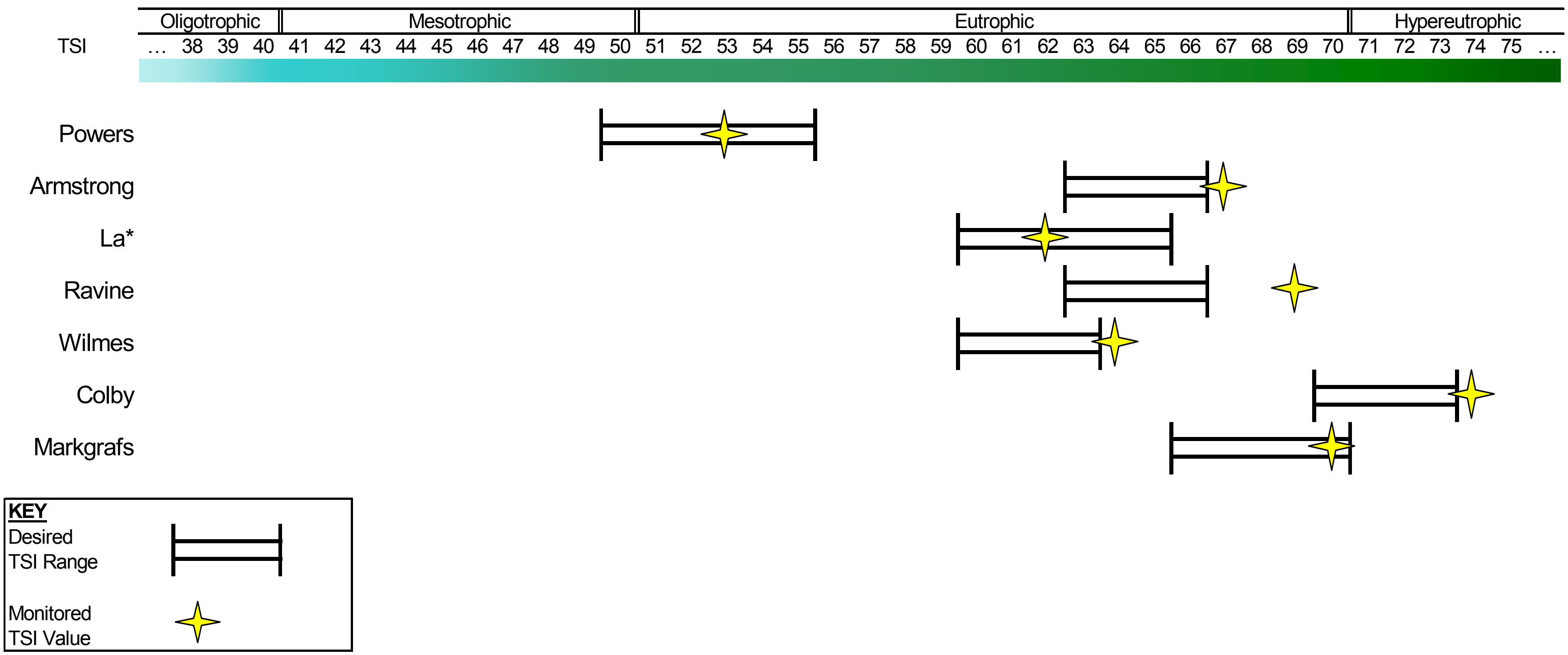
Table 6.4 – Receiving water classification

Receiving Water	Management Classification	Designated Beneficial Use[1]	On Impaired Waters List	Current Total P Load[2]	Maximum Allowable Total P Load	Maximum Allowable Total P Unit Load	Desired Trophic State Index Range[3]
Mississippi River#	Class A	Class 2C, 3B	Yes	-	-	0.22 lbs./ac./yr. #	Not applicable
St. Croix River	Class A	Class 1B, 2Bd, 3C	Yes				Not applicable
Powers Lake	Class A	Class 2B	No	92 lbs./year *	88 lbs./year	0.06 lbs./ac./yr.	50 – 55
O'Conners Lake**		Class 2B	No				
La Lake	Class A	Class 2D	No	134 lbs./year	134 lbs./year	1.65 lbs./ac./yr.	60 – 65
Armstrong Lake	Class B	Class 2B	No	202 lbs./year	101 lbs./year	0.18 lbs./ac./yr.	63 – 66
Ravine Lake	Class B	Class 2B	Yes	238 lbs./year	143 lbs./year	0.04 lbs./ac./yr.	63 – 66
Wilmes Lake	Class B	Class 2B	Yes	455 lbs./year	308 lbs./year	0.10 lbs./ac./yr.	60 – 63
Colby Lake	Class C	Class 2B	Yes	1,461 lbs./year	979 lbs./year	0.34 lbs./ac./yr.	70 – 73
Markgrafs Lake	Class C	Class 2B	Yes	350 lbs./year	264 lbs./year	0.61 lbs./ac./yr.	66 – 70
Bailey Lake**	Class D	Class 2B	No				
Gables Lake**	Class D	Class 2B	No				

[1] All Class 2 waters are protected for aquatic life and recreation
Class 2B waters beneficial use is for cool- and warm-water fisheries (not protected for drinking water); Class 2C waters beneficial use is for indigenous fish and associated aquatic community (not protected for drinking water); Class 2D waters beneficial use is for Wetlands (not protected for drinking water)
[2] Values reflect aggregate load; does not distinguish between watershed and in-lake sources of phosphorus load.
[3] Trophic Status Index (TSI) range is based on a logarithmic scale. Large changes in phosphorus loads are reflected as relatively small changes in TSI.
The established load for the Mississippi River is based on data calculated by the Metropolitan Council in their report, Regional Progress in Water Quality (2004). The standard will be modified as needed following completion of the Lake Pepin TMDL.
* See discussion in Section 4.3.5 for further elaboration of current loads to Powers Lake.
** Monitoring data at present is not sufficient to develop phosphorus load calculations or desired trophic state ranges.

General Note: Maximum allowable loads are subject to modification as a result of more detailed studies such as Lake Specific Management Plans or TMDL analysis.

Figure 6.1 – Monitored and desired trophic state index values for key lakes.



*La Lake is the only waterbody not part of a current or proposed stormwater drainage network.

6.6 Requirements for Land Development or Land Disturbance

6.6.1 Overview

As noted in Section 6.3, the requirements presented within this Chapter apply to all land alterations which remove cover or disturb a surface area of one acre or more, regardless of impervious coverage. However, some exceptions are noted for volume control requirements discussed in Section 6.9.

District standards and requirements for all land development or disturbance activity, including redevelopment, involve on-site as well as regional considerations. (Regional considerations are detailed in Section 6.9.) This approach ensures that activities in the watershed are managed not only at the scale of a specific development (i.e., on-site), but regionally. Standards set forth in this WMP are intended to provide a sufficient level of detail to establish clear expectations for the member cities. Design manuals and other Guidance Documents will be utilized to add relevant detail and refine standards as appropriate. This approach provides flexibility for the WMP to incorporate and dovetail with state regulatory programs that address stormwater and water resources, such as TMDL studies and NPDES Phase II MS4 nondegradation loading assessments.

6.6.2 Stormwater Peak Runoff Rate

The on-site rate of stormwater runoff for proposed projects must not exceed the existing runoff rates for the 2, 10, and 100-year 24-hour duration rainfall event. Generally, TP40 and Bulletin 71 publications can both be used for modeling but the more conservative of the two (usually TP40) should always supercede. For drainage areas where timing of peak runoff is of particular concern, the District may require a critical duration event analysis. Where a project discharges to a natural channel or engineered swale, the project must also maintain or restrict runoff rates to ensure channel stability (see Section 6.9).

For new development projects, the allowable range of predevelopment Curve Numbers (CN) must not exceed a value of 62.

For new development projects, the allowable range of predevelopment Curve Numbers (CN) should fall within values of 52 – 62 and must not exceed a value of 62. These values are based on calculations from monitoring data collected within un-urbanized landlocked basins (SWWD’s 2004 Infiltration Monitoring Program Final Report, 2005). The CN values parallel those used for agricultural and undeveloped in calibrated XP-SWMM modeling (approximately 7% impervious cover).

As an on-going effort, the SWWD characterizes the watershed through continuous simulation hydrologic modeling based on parameters presented in Appendix D. Until a design standards manual is developed for event-based modeling, projects should generally be consistent at least the land use parameters as characterized in Appendix D. To further watershed wide modeling and evaluation, all projects must develop and submit to the District digitized drainage boundaries (in ESRI or GIS-compatible format), hydrologic parameters, and engineering drawings containing infrastructure data in electronic format.

For projects relying on ponding for rate control, the District expects pond design to incorporate guidance in the Minnesota Stormwater Manual and other applicable design guidance. New ponds must be designed with an identified emergency overflow at 1 foot above the 100-year, 24-hour event (6.3-inches). All drawings must clearly show the direction of overflow and provide for adequate flowage easements. A minimum freeboard of 3 feet above the 100-year high water elevation (resulting from runoff generated by the 100-year, 24-hour precipitation event) and lowest opening elevation of a dwelling or structure must be provided for new ponds.

The judicious use of the street system in addition to the primary stormwater trunk system, subject to safety and traffic considerations, for the conveyance of stormwater runoff is allowed. Information about the depth and direction of street flow as a function of the storm event magnitude should be provided to the District.

6.6.3 Stormwater Runoff Volume

The existing infiltration capacity for a specific area is primarily a function of the type of soils and amount of impervious surface. New developments are required to maintain the annual average predevelopment infiltration capacity of the site. The application of this requirement is to the entire development site, expressed as the maintaining the total runoff volume determined from typical climatic conditions. Annual average predevelopment runoff volumes will be calculated based on Map 6.2, which was derived from continuous runoff modeling based on land use and soil type. This requirement may be met through combining a variety of methods, including reducing / disconnecting impervious surfaces, the use of porous materials, soil decompaction following grading, and engineered infiltration systems. The use of innovative methods, subject to the approval of the SWWD, is encouraged.

Management and reduction of stormwater runoff volume is critical to protecting receiving water condition, preserving groundwater integrity (maintaining natural recharge and quality), and mitigating downstream flooding issues. For projects other than new developments, the District intends for reductions in stormwater runoff volume to be indirectly incorporated into site design through a system of allowable total phosphorus loads to receiving waters, regional assessment locations, and a potential credit system to provide incentives for minimizing runoff volume.

6.6.4 Allowable Total Phosphorus Loads

The SWWD believes that minimizing and disconnecting impervious surfaces and employing infiltration techniques will be the most cost-effective method for meeting allowable pollutant loads. On-site phosphorus export loads for projects that are within direct subwatersheds of receiving waters noted in Sections 6.4 and 6.5 (also see Maps 4.3-4.9) must meet the allowable load requirements set for the applicable water body.

Responsibility for achieving the load reduction necessary to attain the in-lake water quality nutrient goal is equally allocated between urbanized (already developed) and undeveloped portions of the watershed. The standard is to reduce post-project phosphorus levels, evaluated on a unit load basis (pound per acre per year), to meet the allowable load requirement. Redevelopments that drain to an existing stormwater pond must incorporate site practices to further reduce their unit loads in order to meet the allowable load requirement.

For those projects not directly draining to a receiving water (e.g., areas in the Central Draw subwatershed), the water quality treatment requirements set forth in the NPDES Phase II construction site permit shall apply for on-site treatment. Regional assessment locations will be evaluated and applied where appropriate. A load requirement for the St. Croix River and modified load requirement for the Mississippi River are anticipated in the future as the Lake St. Croix and Lake Pepin TMDLs are completed.

The current NPDES Phase II General Permit for construction activity will guide on-site requirements for sediment control during land disturbance activity. After construction, it is generally expected that adequate on-site sediment control will be achieved through control of phosphorus loads. Project sites utilizing infiltration for on-site treatment must implement appropriate sediment pretreatment as described in Section 6.8. For projects in landlocked basins or directly draining to a SWWD regional infiltration basin, predevelopment sediment loads must be maintained or reduced where practical.

Implementation of pollutant load reductions specified in a fully approved Lake Management Plan, TMDL or nondegradation plan will take precedence to these allowable pollutant load standards.

6.6.5 Best Management Practice Implementation

Best management practices (BMPs) can be non-structural or structural in nature. The SWWD intends to implement a system to actively encourage incorporating innovative BMPs into site design through a cost-share or credit-based system. However, a proposed project cannot claim load reduction benefits for any municipal non-structural BMPs, such as street sweeping, that may be performed in the project area.

Topics and information pertaining to better site design, BMPs, and stormwater credits are explored at length in the Minnesota Stormwater Manual (MSM). The SWWD expects to see the use of better site design to reduce impacts from urbanization. Decision flow charts for BMP selection processes are included in Appendix M. In addition to better site design approaches, the SWWD will review ways in which projects incorporate elements during construction which have long term benefits such as preventing or remediating soil compaction.

For projects relying on ponding for water quality treatment, the District expects pond design to conform to Nationwide Urban Runoff Program (NURP) criteria or MSM guidance. Minnesota Stormwater Manual provides a detailed overview (14 pages plus example calculations) of stormwater pond design. All water quality ponds are required to have a vegetated fringe or aquatic bench, maintenance access, mean depths of 3-4 feet, and a hydraulically efficient shape and configuration. Detailed design and sizing requirements will be provided in a stormwater design manual developed by the SWWD.

The minimum sediment and erosion control requirements of the District are those specified in the current NPDES Phase II General Permit for construction activity, as established by the Minnesota Pollution Control Agency. The SWWD retains the option of establishing additional requirements on a case-by-case basis.

For any proposed structural BMP in the SWWD, a narrative maintenance plan must be developed and submitted. The maintenance plan should be formally included as part of the Developer's Agreement with the appropriate city.

6.6.6 Intended Use

The SWWD intends to apply the standard to new development and redevelopment activities during the development review process. The SWWD expects that new developments will incorporate the minimum requirements of the current NPDES Phase II General Permit for construction site activities into their site design.

6.7 Critical Storage Areas

6.7.1 Overview

Critical storage areas within the watershed include topographic depressions in the landscape as well as floodplains adjacent to waters and waterways. These areas provide important functions in controlling the rate of runoff, and in cases, the volume of runoff due to high infiltration capacity of soils. The District has identified existing floodplain elevations and areas known to serve as critical storage areas. Currently the Northern and West Draw subwatersheds have critical storage area mapping completed, as shown in Appendix E. Loss of the critical storage areas can cause increases in downstream flood elevations and other impacts and are undesirable. However, the District encourages multiple uses for floodplains and critical storage areas (e.g. recreation) where possible.

6.7.2 Control of Critical Storage Areas

Generally, existing 100-year flood levels of District water resources must be maintained. Filling or development in identified critical storage areas, identified through hydrologic modeling and other means, is not allowed unless equivalent storage is demonstrated and provided within the same subwatershed. Equivalent storage is intended to mean providing the same reduction in peak flow, runoff volume or other important hydrologic characteristics.

6.7.3 Intended Use

The critical storage areas and floodplain elevations are intended to apply to new development projects and public improvement projects such as roads (or crossings).

6.8 Regional Assessment Locations

6.8.1 Requirement and Rationale

Minimum on-site requirements are detailed in section 6.6. In addition to the minimum on-site requirements, land development, private and all non-exempt public improvement projects are intended to have an evaluation of the potential project affects at key locations within the watershed. The District has designated these key locations as regional assessment locations, which are located throughout the SWWD (see Table 6.5 and Map

6.3). The objective of the regional assessment locations is to establish a framework for characterizing and managing water resources at a regional level rather than solely at a site-specific (on-site) level.

These locations will be used by the SWWD to assess and evaluate the potential regional implications of proposed projects in aggregate and are expected to be modified as additional, future information is developed through modeling or monitoring. Maximum allowable peak flow rates, runoff volumes, pollutant loads, uppermost water elevations, or other criterion are probable reasons for establishing regional assessment locations. Peak flow rates presented in Table 6.5 are benchmark targets based on best available modeling efforts. They are presented to guide (but not necessarily regulate) engineering decisions and should be interpreted in the context of modeling tools which have an inherent level of uncertainty.

Often, projects which meet on-site requirements for stormwater rate control can adversely affect downstream flooding due to changing peak flow timing. Other times, substantial regional benefit can be gained where upstream drainage areas have high storage and infiltration capacity.

Land alteration and other projects one acre or greater will be evaluated against the nearest relevant downstream regional assessment location.

More stringent requirements or alternative design approaches may be required—such as a 96-hour delay of discharge—to ensure that private and public projects do not have unanticipated adverse downstream regional impacts. Alternatively, key project sites shown to have critical improvement potential to regional assessment locations may be requested to include additional on-site management techniques beyond those in Section 6.4. Site-specific modifications to ameliorate or improve regional assessment location conditions will be developed on a case-by-case basis, and will likely be subject to trading or credits.

Evaluating project impacts to relevant downstream regional assessment locations will occur during the District's review process. The nearest relevant downstream assessment point will be evaluated. The District will incorporate electronic data (submitted by the project agent) into a regional watershed model to evaluate potential impacts. If on-site controls for stormwater management are met without adverse downstream impact, then the project is acceptable. However, if downstream condition at the relevant assessment location is questionable or worsened, the District will outline measures to the project agent that ameliorate the regional impact. Through the evaluation process, the need for additional on-site design measures is "flagged" in advance of project development. The District will consider constructing a credit system to provide incentives for projects to include measures to achieve downstream benefits.

Last, a regional assessment approach can potentially provide a broader benefit to the Mississippi River. Regional assessment locations across the watershed can help identify runoff contributions from municipalities to the Mississippi River. While one municipality's impact may be relatively small, the cumulative impacts of many can be relatively significant.

Table 6.5 – Regional assessment locations.

NOTE
(1) The phrase "risk assessment process" as identified in the Criterion column means application of a procedure to assess risk similar or equivalent to "Risk Assessment for Encroachment Design" as identified in Figure C(1) 5-892.255 of the Mn/DOT State Aid Manual.
(2) Where maximum flow rate is listed as a criterion, it is intended to represent an estimated benchmark target based on best available modeling.

Number	Location	Importance of the Location	Criterion
1	At I-94, flow from Oakdale and Lake Elmo to Woodbury	Safety at road crossing. Location for assessing long-term water quantity and water quality changes and flow between communities.	Application of Mn/DOT risk assessment process. Maximum intercommunity flow of 406 cfs from a 6.3-inch (100-year, 24-hour) precipitation event. Load and runoff volume trends at MS1 monitoring station.
2	Powers Lake Inlet	Critical storage location.	Storage sufficient for the runoff volume from the 6.3-inch (100-year, 24-hour) precipitation event.
3	Wilmes Lake	Critical storage location.	Storage sufficient for the runoff volume from the 6.3-inch (100-year, 24-hour) precipitation event.
4	Golden Eagle Trail	Critical storage location. (Flow control by pump station.)	Storage sufficient for the runoff volume from the 6.3-inch (100-year, 24-hour) precipitation event.
5	Colby Lake	Critical storage location.	Storage sufficient for the runoff volume from the 6.3-inch (100-year, 24-hour) precipitation event.
n/a	Receiving waters with the SWWD (lakes and rivers per Table 6.4)	Maximum allowable total phosphorus load.	As per Table 6.4.
n/a	Multiple Depressional Areas	Critical storage locations for stormwater runoff	As per Appendix E.
6	Inlet to Bailey Lake	Location for assessing long-term water quantity and water quality changes.	Load and runoff volume trends at MS2 monitoring station.
7	Crossing at Mile Drive to Bailey Lake	Safety at road crossing and location for assessing long-term change in hydrology.	Application of risk assessment process. Maximum allowable peak discharge to be determined.

Number	Location	Importance of the Location	Criterion
8	Basin west of Bailey Lake, to Bailey Lake	Safety at road crossing and location for assessing long-term change in hydrology.	Application of MnDOT risk assessment process. Maximum allowable peak discharge to be determined.
9	Basin east of Bailey Lake, to Bailey Lake	Safety at road crossing and location for assessing long-term change in hydrology.	Application of MnDOT risk assessment process. Maximum allowable peak discharge to be determined.
10	Bailey Lake and Outlet of Bailey Lake Lift Station to CD-P85	Critical storage location and regional infiltration for volume reduction.	Storage sufficient for the runoff volume from the 6.3-inch (100-year, 24-hour) precipitation event at full pump operation of 150 cfs.
11	At outlet of CD-P86, flow from north half of watershed to Mississippi River	Critical storage location and regional infiltration for volume reduction.	Storage sufficient for the runoff volume from the 6.3-inch (100-year, 24-hour) precipitation event at full pump operation of 150 cfs.
12	West Draw eastern tributary - Flow from Woodbury to Cottage Grove	Inter-community flow, and natural channel outlet.	25 cfs for the 6.3-inch (100-year, 24-hour) precipitation event, to be allocated between tributaries. Storage sufficient for the runoff volume from the 6.3-inch (100-year, 24-hour) precipitation event; maximum permissible velocity and / or tractive force analysis.
13	West Draw western tributary - Flow from Woodbury to Cottage Grove	Inter-community flow, lift station location and natural channel outlet.	
14	70th street (Cottage Grove)	Safety at road crossing. Location for assessing water quantity trends before and after completion of CD-P85 and CD-P86 overflow system.	Application of MnDOT risk assessment process. Control point for CD-P85 / CD-P86 basin. Headwaters for 90th Street monitoring station. Benchmark criteria to be determined.
15	80th street (Cottage Grove)	Location for assessing water quantity trends.	Control point for CD-P85 / CD-P86 basin. Benchmark criteria to be determined.

Number	Location	Importance of the Location	Criterion
16	Glendenning Avenue	Future assessment point reserved for West Draw Subwatershed.	Maximum peak discharge, volume and / or pollutant loads may be developed.
17	Railroad crossing, southeast of Jamaica Avenue	Future assessment point reserved for Central Draw Subwatershed.	Maximum peak discharge, volume and / or pollutant loads may be developed.
18	Ravine Lake outlet	High water levels in Regional Park.	Storage sufficient for the runoff volume from the 6.3-inch (100-year, 24-hour) precipitation event.
19	Crossing under T.H. 61 / T.H. 10.	Discharge to Mississippi River and pollutant load from the watershed.	Load delivered to the Mississippi River as a proportion of land area within the District compared to the total drainage area at the discharge location and Lake Pepin considerations (to be determined).
20	Outlet of Glendenning Pond		
21	Glen Road Pond (8th Ave. and High St.), St. Paul Park		
22	Terminus of 10th Avenue, Newport		
23	O'Conners Lake	Landlocked basin	Storage sufficient for the runoff volume from the 6.3-inch (100-year, 24-hour) precipitation event.
24	Trout Brook at Afton State Park	Outlet of Trout Brook to St. Croix River	Load delivered to the St. Croix River (to be determined)

6.8.2 Intended Use

The SWWD expects to use the regional assessment locations for multiple purposes including:

1. Assessing long-term trends in water quality, quantity and other resource management issues;

2. Setting benchmark targets, based on best available modeling tools;

3. Evaluating the potential affects of new development on a regional basis and evaluating the need for additional on-site or regional mitigation measures; and

4. Determining the success of resource management activities.

The SWWD intends to complete the technical analysis necessary to evaluate the implications of development, land alternation, comprehensive plans, and other activities, at the regional assessment locations. Regional assessment locations may be modified by the SWWD to ensure adequate geographic representation and to respond to emerging issues.

6.9 Utilization of Infiltration

6.9.1 Overview

This section provides guidance and standards for the use of infiltration facilities. Requirements for runoff volume control are detailed in Section 6.6. Additionally, the District intends for stormwater runoff volume reductions to be incorporated into site design through allowable load limits to protect receiving waters, criterion established at regional assessment locations, and incentives including a potential credit system.

The District recognizes the delicate balance between stormwater management practices and potential impacts to groundwater sources. As such, the SWWD considers two perspectives— on-site and regional— for evaluating risk and establishing a management framework for stormwater infiltration facilities. Also, a decision flow chart for screening source water contamination potential from infiltration is presented in Appendix M. Note that Section 3.2.1.5 discusses groundwater concerns specific to Lake Elmo and Oakdale, and certain activities are regulated by the Minnesota Department of Health.

6.9.2 On-site Infiltration

Many areas of the watershed are favorable for implementing on-site infiltration (Map 6.4, as developed in Washington County's report "Integrating Groundwater and Surface Water Management", 2005). On-site infiltration facilities are generally considered those which receive drainage from up to ten acres, or can provide temporary maximum storage for up to one inch of runoff depth generated from the total contributing impervious area. These facilities are intended to mimic the natural predevelopment hydrology of a project area and reduce the impacts associated with urbanization.

In these situations, the risk for groundwater impact is generally considered less than for larger, regional infiltration facilities. This is due in part to the smaller volume of stormwater received by these facilities. Smaller facilities are less likely to infiltrate groundwater to the depth used as a source for drinking water supply (e.g., evapotranspiration effects).

Many sources of information are available for guiding the design and application of infiltration facilities, including the Minnesota Stormwater Manual, the Minnesota Department of Health (MDH), Guidance for Infiltration Design (SWWD), Site Evaluation for Stormwater Infiltration (Wisconsin DNR conservation practice standard 1002), Stormwater Plants (MPCA), and more. Typical infiltration rates to be used for event-based design are presented in the State Stormwater Manual or developed by the SWWD through their infiltration monitoring program.

The SWWD requires that on-site infiltration systems must be designed off-line and must completely draw down within 48 hours after a rain event to prevent nuisance standing water conditions. Stormwater entering infiltration systems must be treated to substantially remove coarse sediment and other debris on an annual basis. Sheet flow of runoff over vegetation or routing through swales is preferred (25-50 feet). However, use of structural units such as hydrodynamic separators for sediment reduction upstream of infiltration is accepted.

Monitoring data at constructed infiltration trenches in the watershed has shown a substantial decline in infiltration rates after only a few years (see Section 4.4). While pre-treating inflow for solids removal can be effective for promoting the longevity of infiltration systems, periodic maintenance will also benefit a constructed system. A maintenance plan must be submitted for any on-site system which specifies how the facility will be kept operational. The maintenance plan must include a reference to member cities' NPDES MS4 annual structural pollution control inspection procedure.

The District will consider developing allowable methods to calculate net annual TP from on-site infiltration systems as part of a design manual. However, all load reduction evaluations should either qualitatively or quantitatively address uncertainty in precipitation (e.g., rainfall before complete drawdown) as well as declines in infiltration capacity over time.

6.9.3 Regional Infiltration

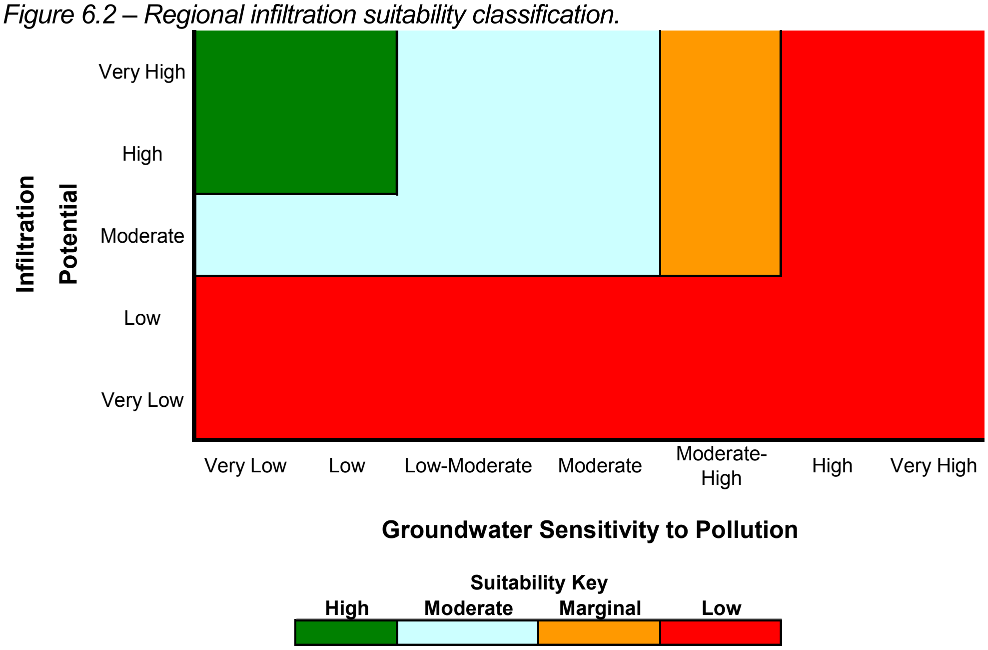
Regional infiltration facilities are generally considered those which receive drainage from greater than ten acres, or can provide temporary maximum storage for more than one inch of runoff depth from the total contributing impervious area. These facilities generally tend to concentrate runoff into one location and as such do not truly mimic the natural predevelopment hydrology of a project area. Regional infiltration basins typically serve primarily to provide flood control benefits and mitigate downstream water level issues.

The concentrated volume of water diverted to centrally located regional infiltration basins may increase the risk for groundwater impact. Monitoring of deep groundwater levels near regional infiltration facilities in the SWWD illustrates a noticeable interaction between surface water and groundwater elevations (see Section 4.4 for more details).

A screening tool is available to guide the use and placement of regional infiltration systems, given the nature of the geology underlying the watershed. The screening tool suggests the suitability of an area for regional infiltration and is illustrated both as Figure 6.2 and Map 6.5. The tool balances the physical capacity to incorporate infiltration against how quickly infiltrated water may reach deep groundwater sources (Prairie du Chien – Jordan aquifer).

All proposed new regional infiltration basins require a sediment yield analysis (not the same as soil loss). Appropriate treatment of stormwater must be provided or demonstrated to ensure that predevelopment sediment loads are maintained or reduced. Regional infiltration should not be used in areas of low suitability. Where suitability is marginal or low, regional infiltration basins should have contingency plans developed for how to manage and respond to chemical spills that may enter the drainage network.

Figure 6.2 – Regional infiltration suitability classification.



This scheme presented in Figure 6.3 (and reflected in Map 6.5) was developed by combining criteria developed from two separate sources. The x-axis utilizes data as developed in Washington County's Prairie du Chien-Jordan Aquifer Sensitivity to Pollution table (Minnesota Geologic Survey). The y-axis utilizes infiltration potential data as mapped for Washington County's "Integrating Groundwater and Surface Water Management" (2005). The labels on each axis are as presented in the original sources of data.

It is noteworthy that a regional infiltration basin identified as CD-P85 ultimately receives the stormwater runoff from the entire Northern Subwatershed. This natural depressional storage area is located in an area of moderate to marginal suitability given the criteria presented in this section. The SWWD has performed monitoring at this location, which is generally summarized in Section 4.4. As new information and awareness regarding surface water and groundwater interactions is developed (e.g. sinkholes), the SWWD intends to work with member cities to determine appropriate actions to protect resources.

6.9.4 Intended Use

The SWWD intends to apply the threshold criteria for on-site versus regional infiltration basins to new development activities during the development review process. The application of this standard to redevelopment is also anticipated on a case-by-case basis. The SWWD expects that new developments will meet minimum requirements by incorporating a variety of approaches into the overall site design and not rely solely on engineered facilities to reduce impacts of urbanization.

6.10 Open Channel Stability

6.10.1 Overview

An open channel is often an integral component of urban drainage system design. Open channels include the following types of channels or their combination: natural channel (waterway), constructed channel, ditch, or swale. The use of an open channel for conveying stormwater runoff can present a unique design challenge. Although peak runoff rates can be controlled, new developments often result in concentrated runoff discharge points. Runoff needs to be conveyed, while reasonably ensuring that the channel remains “stable” (see policy EC-2).

A practical method for the review of development proposals is needed to evaluate the potential for stream channel stability problems. Several engineering methods can be used to evaluate channel stability (see Technical Release 25, Design of Open Channels, Natural Resources Conservation Service). The primary differences between the methods are whether the method should be applied to channels with rigid or mobile boundaries, the type of material (particle size) being transported, and whether the bed and bank materials are cohesive and / or vegetated.

The “allowable velocity approach” is the recommended method for initial use within the SWWD watershed, to assess natural waterway stability. The method is a reasonable starting point to identify whether there is a potential for erosive velocities. More detailed engineering analysis should be applied if the allowable velocity approach indicates that particle movement (i.e., erosion) may occur. Particle movement (erosion) occurs when the shearing forces of the flow exceed the critical tractive forces of the soil. Suitable lining materials and channel protection methods include: synthetic or natural blankets, bioengineering using grassy or woody vegetation such dogwood or willow tree species, or hard armoring as a last resort.

6.10.2 Requirement

Where new or increased discharges to open channels are proposed, it must be demonstrated that design velocities will not cause channel instability. Appropriate energy dissipation at the outfall will be required. A maintenance plan should be developed to illustrate how accumulated sediment will be handled or how channel failures will be remediated. Where possible, open channels should include buffers of herbaceous vegetation and should provide connectivity with adjacent upland habitat.

For channels three feet or less in depth, one half of foot of freeboard shall be provided. For channels deeper than three feet and up to five feet in depth, one foot of freeboard shall be provided.

6.10.3 Intended Use

The SWWD intends to apply a channel stability standard to projects proposing the use of a natural channel as an outlet, or proposing a concentrated point of discharge where one formerly did not exist. This stability standard will serve as a measure to reasonably ensure protection of the channel. The SWWD also expects to apply the standard to those projects initiated by the SWWD.

6.11 Bluff and Ravine Buffers

Areas within the SWWD and in particular along the Mississippi and St. Croix Rivers are characterized by steep slopes which drain directly to a watercourse. Opportunities for stormwater facilities can be limited because flow is often not concentrated and bedrock is near the surface. A minimum buffer width of 60 feet is required for new developments along areas defined as a bluff or ravine (slopes generally exceeding 15% along a watercourse) within the SWWD.

The SWWD intends to apply the standard to new development and redevelopment activities during the development review process. The SWWD expects that developments will incorporate the minimum requirements into their site design.