Sochacki Park Subwatershed Assessment

Prepared for
Three Rivers Park District

September 2022

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Sochacki Park Subwatershed Assessment

September 2022

Contents

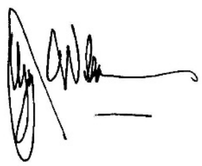
List of Tables

List of Figures

List of Appendices, Attachments, or Exhibits

Certifications

I hereby certify that this plan, specification, or report was prepared by me or under my direct supervision and that I am a duly licensed Professional Engineer under the laws of the state of Minnesota.



Greg Wilson
PE #: 25782

9/16/22
Date

Abbreviations

BCWMC	Bassett Creek Watershed Management Commission
BMP	Best Management Practice
Chl-a	Chlorophyll-a
LiDAR	Light Detection and Ranging
MSL	Mean Sea Level
MDNR	Minnesota Department of Natural Resources
MNRAM	Minnesota Routine Assessment Method for Evaluating Wetland Functions
NRCS	Natural Resources Conservation Service
OHW	Ordinary High Water
P8	Program for Predicting Polluting Particle Passage Thru Pits, Puddles, and Ponds
PWI	Public Waters Inventory
SD	Secchi Disc
SSURGO	Soil Survey Geographic Database
TRPD	Three Rivers Park District
TP	Total Phosphorus
USFWS	United States Fish and Wildlife Service

1 Executive Summary

Recent efforts to better understand the ecological health, and set appropriate goals for, the Sochacki Park wetlands (South and North Rice Ponds) has identified improvements that are likely necessary to improve the ecological health of the wetlands, improve aesthetics, and provide recreation and education opportunities. Many of the goals or metrics for ecological health are directly tied to improved wetland water quality (through nutrient reductions) and enhancements to vegetative diversity and integrity.

To better understand and evaluate the water quality treatment performance of the existing best management practices (BMPs) in the Sochacki Park subwatershed, Barr Engineering Co. (Barr) revised the existing Bassett Creek Watershed Management Commission's (BCWMC) P8 watershed model to reflect GIS subwatershed delineations and modeling inputs for each subwatershed and respective BMPs. We then updated the revised BCWMC P8 model with 2020 and 2021 growing-season climate data (hourly precipitation and daily temperatures) to develop the phosphorus (total and dissolved) and total suspended solids (TSS) loadings for the period. The available in-wetland water quality monitoring and watershed stormwater monitoring data of inflows and outflows were used to calibrate the watershed modeling, where possible.

We used the updated P8 modeling results and GIS mapping to identify high priority areas for implementing watershed BMPs. P8 modeling completed for the summers of 2020 and 2021 indicates that 20 and 17 percent of the current overall phosphorus load, in respective years, receives stormwater treatment before discharge to the three wetlands. Approximately 22 percent of the runoff phosphorus load in the Grimes Pond watershed receives stormwater treatment, while the respective levels of treatment in the direct drainage to North and South Rice Ponds are approximately 39 and 30 percent.

The calibrated watershed modeling was used to concurrently develop the water and phosphorus budgets to optimize the daily pond water quality modeling fit to the summer monitoring data associated with each pond. Subsequently, we used the water quality modeling results to assess the implications for the summer assimilation capacity (i.e., nutrient uptake and/or sedimentation) of each pond, and we used the water and phosphorus budgets to identify and develop implementation strategies for improving wetland water-quality. The short water residence times estimated for the watershed wetlands (averaging 38 days for Grimes Pond, 20 days for North Rice Pond and 8 days for South Rice Pond) limit the capacity to assimilate the summer runoff phosphorus loads from each direct drainage area, as well as the overall watershed.

A detailed analysis of the dissolved oxygen data, combined with the pond water quality modeling, confirmed that internal phosphorus loading can be an important source of phosphorus input to each pond during the summer. Internal phosphorus loading represented 32 percent of the summer phosphorus budget for Grimes Pond in 2020, as well as six and 24 percent of the respective summer phosphorus budgets for North Rice Pond in 2020 and 2021. Discharge from Grimes Pond represented 34 and 29 percent of the respective summer phosphorus budgets for North Rice Pond in 2020 and 2021. Internal phosphorus loading represented 8 and 9 percent of the respective summer phosphorus budgets for South Rice Pond in 2020 and 2021. Discharge from North Rice Pond represented 11 and 14 percent of the respective summer phosphorus budgets for South Rice Pond in 2020 and 2021.

Based on the calibrated watershed and pond water quality modeling, the following watershed BMPs and in-pond management options are recommended to substantially reduce the respective phosphorus loadings and enhance vegetative diversity and integrity for each pond:

- Install structural BMPs and/or pretreatment protection measures to prevent future sediment delivery and reduce nutrient loading into the wetland with design(s) intended to meet water quality goals. Untreated stormwater runoff from two discharge outfalls each to South Rice and Grimes Ponds, as well as one outfall to North Rice Pond, are prioritized for implementation.
- Complete in-pond alum treatments to control summer sediment phosphorus release following implementation of watershed BMPs.
- Clear clogged debris and develop annual maintenance plan for all inlet and outlet structures. Remove accumulated sediment and fill materials from BMPs and within, and adjacent to, each wetland. Reconfigure discharge outfall and stabilize erosion from stormwater conveyance entering northwest corner of Grimes Pond.
- Re-vegetate and control soil erosion from bare soil areas within the upland buffer area. If mountain bike activity in the adjacent upland area is currently supported, isolate potential soil disturbance and adjacent vegetation improvements to prevent erosion into surrounding wetland areas.
- Conduct controlled water level drawdowns in each wetland prior to the winter season to ensure that curly-leaf pondweed is decreased to less than 20 percent cover and to enhance overall vegetative diversity and integrity. Remove, treat, and control other non-native invasive species, where possible, and remove fill material and trash.
- Initiate, or increase the frequency of, street sweeping and fall leaf litter removal programs, with emphasis in subwatersheds that have direct drainage to the wetlands.

2 Introduction

Recent efforts to better understand the ecological health, and set appropriate goals for, the Sochacki Park wetlands (South and North Rice Ponds) has identified improvements that are likely necessary to improve the ecological health of the wetlands, improve aesthetics, and provide recreation and education opportunities. Many of the goals or metrics for ecological health are directly tied to improved wetland water quality (through nutrient reductions) and enhancements to vegetative diversity and integrity. Another goal involves stakeholder engagement throughout the development of the Sochacki Park subwatershed assessment.

2.1 Site and Wetland Description

Sochacki Park is surrounded by residential property, located within the City of Robbinsdale, west of the BNSF Railroad and east of June Ave N (Township 29, Range 24, and Sections 7 and 18) within Hennepin County. The park access road off 36th Ave N leads to a small parking lot at the north end of the park adjacent to an Xcel Energy utility line. A picnic structure and paved trails are located within the park. North Rice Pond, located south of the picnic structure, is identified in the Minnesota Department of Natural Resources (MN DNR) Public Water Inventory (PWI) as a Public Water Wetland 27-644W and South Rice Pond, located at the south end of the park, is identified as Public Water Wetland 27-645W. Grimes Pond, which shares the same PWI number as North Rice Pond, is located northeast of the railroad tracks. South Rice Pond extends beyond Sochacki Park to the south adjacent to Bassett Creek into the City of Golden Valley. A restored prairie is located near the upland edges between North and South Rice Ponds. In addition to the main paved trails, several unpaved paths are present throughout the park. Mounds and logs placed for mountain bike activity are present east of South Rice Pond. Figure 2-1 shows the pond bathymetry and provides the maximum depths of each pond.

2.2 Watershed Description

Figure 2-2 shows the subwatersheds and drainage for the Sochacki Park study area.

2.3 Water Quality Goals and Standards

Previously, the Bassett Creek Watershed Management Commission's (BCWMC) goal for Grimes, North Rice and South Rice Ponds was a management classification of Level III, meaning its water quality should support aesthetic viewing (BCWMC, 2004 and Barr Engineering, 2014). Level III goals were: (1) maximum total phosphorus (TP) concentration of 75 µg/L, (2) maximum chlorophyll *a* (Chl-a) concentration of 40 µg/L, and (3) minimum Secchi disc (SD) transparency of 1.0 meters (about 3 feet). Since Grimes and North Rice Ponds (27-644W) and South Rice Pond (27-645W) are considered wetlands, there are no MPCA water quality standards that apply, and BCWMC is currently managing water quality from the study watershed to improve biotic integrity and water quality in the main stem of Bassett Creek.

Based on literature and steering committee feedback, there was consensus that it was important to improve wetland water quality and ecology in all three ponds by making an initial harvest, followed by significant nutrient reductions to shift away from floating plant dominance and the resulting pond water anoxia (per Scheffer et al., 2003). As a result, the previous BCWMC water quality goals provide a benchmark for making this shift in wetland ecology that will also enhance vegetative diversity and integrity. It will also be important to control invasive species, both in wetland and upland areas, while controlling and/or removing sediment deposits.

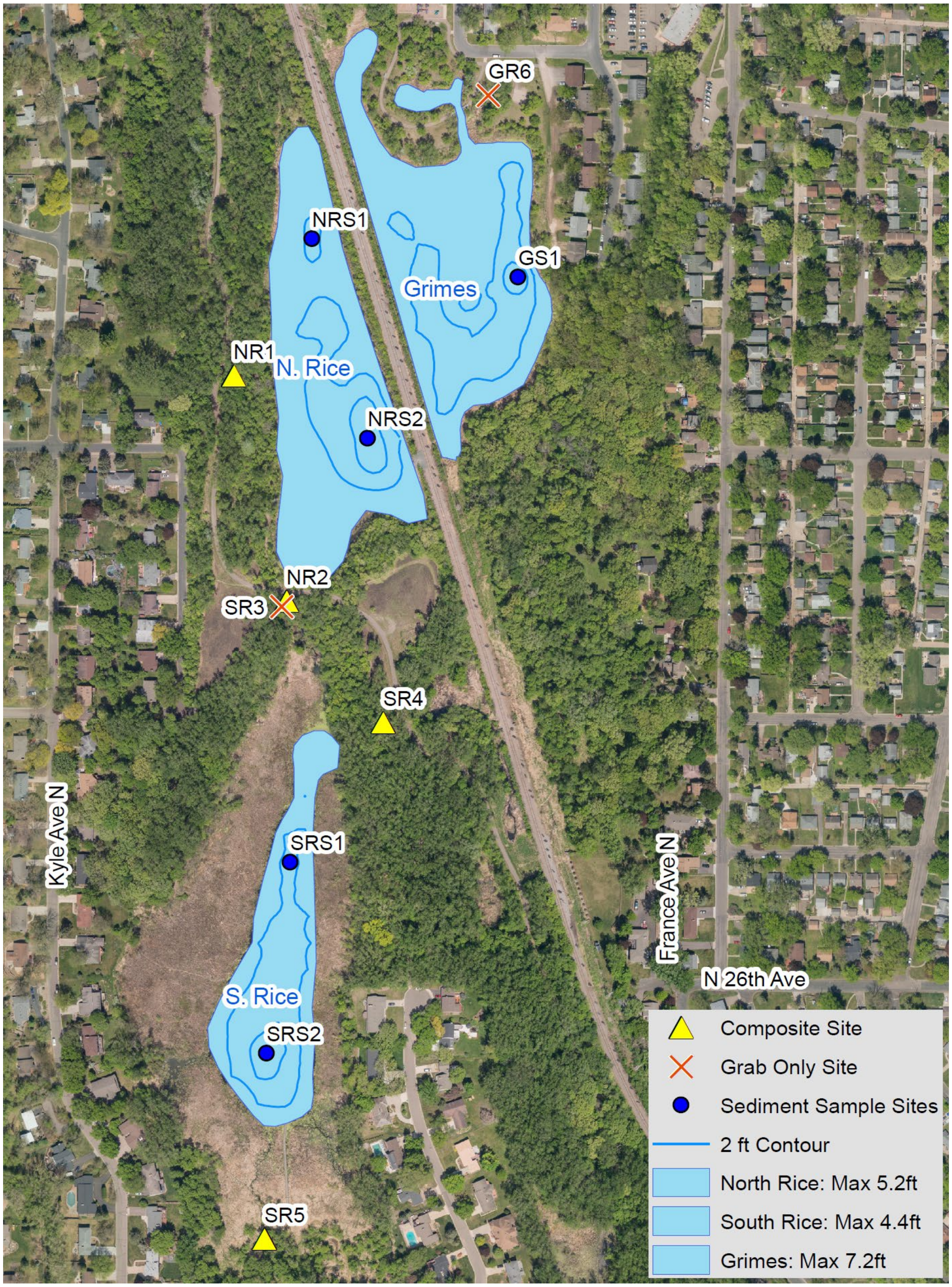
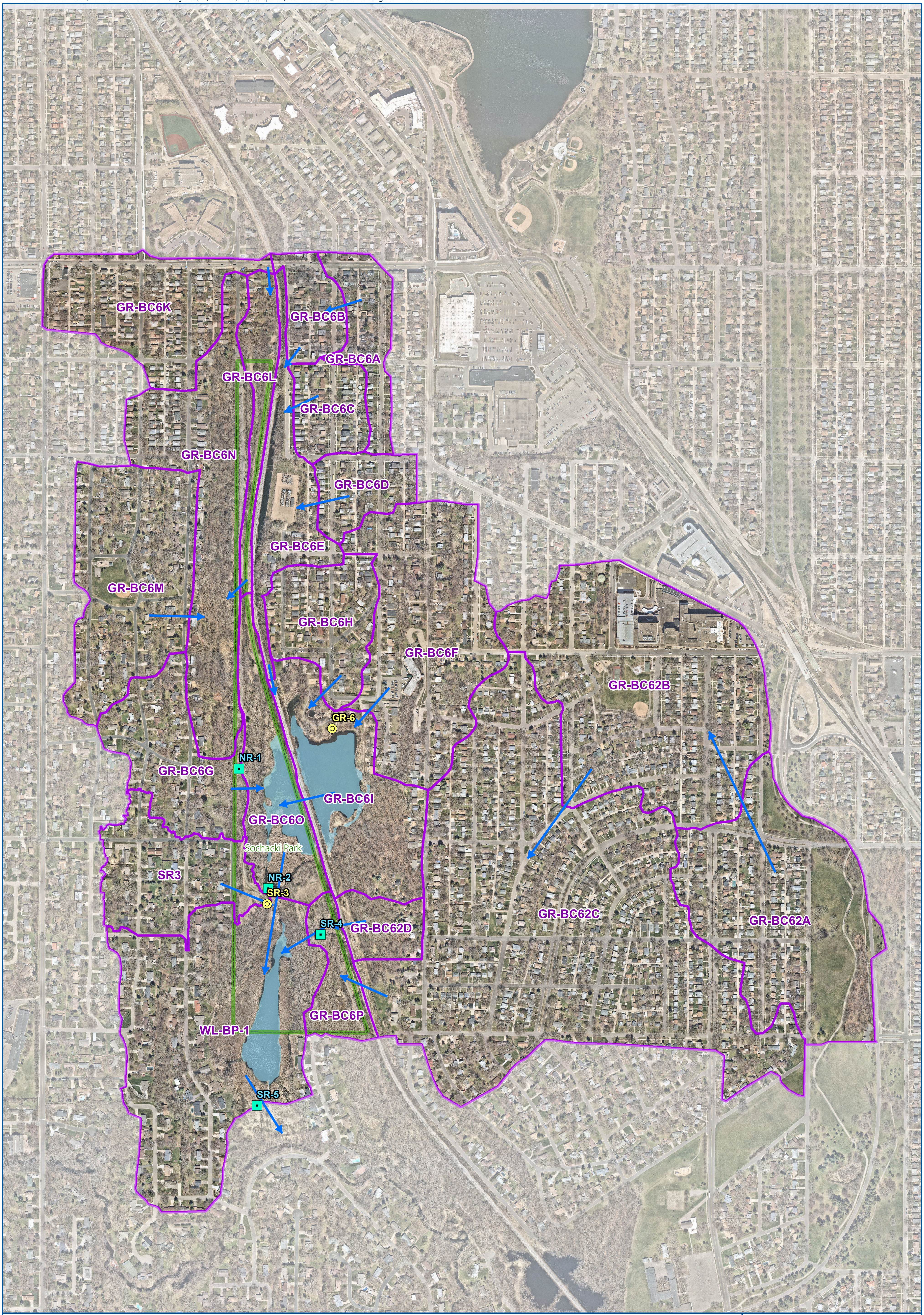


Figure 2-1 Sochacki Park Ponds, Bathymetry and Monitoring Sites

Barr Footer: ArcGIS 10.9.1, 2022-09-10 14:43 File: I:\Projects\23\27\1769\Maps\Reports\Subwatershed_Assessment\Figure 1 - Subwatersheds and Storm Sewer.mxd User: GJW



Automated Monitoring Site
Grab Sample Site
Pipe
Flow Direction
Waterbodies
Sochacki Park
Subwatersheds
Municipal Boundary

0 300 600
Feet

Imagery: NearMap; May 6, 2022

BARR

SUBWATERSHEDS & STORM SEWER
Sochacki Park
Subwatershed Assessment
Three Rivers Park District

FIGURE 2-2

3 Monitoring

Figures 2-1 and 2-2 shows the automated and grab sample sites for watershed water quality monitoring. The automated monitoring sites included flow monitoring equipment to facilitate the development of pollutant load estimates. Figure 2-1 shows the wetland water quality and sediment monitoring sites. Continuous water level measurements were also collected at all three wetlands. Except for the sediment monitoring and testing, Three Rivers Park District (TRPD) staff performed all of the field sampling and analytical testing for this assessment.

3.1 Pond Monitoring

3.1.1 Total Phosphorus, Chlorophyll-a and Secchi Disc Transparency

Figures 3-1, 3-2 and 3-3 show the summer average TP, Chl-a and SD transparency data for Grimes Pond, North Rice Pond, and South Rice Pond, respectively. The results for all three ponds generally show that summer average TP concentrations greatly exceed the Level III goal, while summer average Chl-a and SD transparencies correspond well with the respective Level III goals. This data, together with observations of heavy growth of free-floating plants (duckweed and watermeal) across the surface of all three ponds, indicates that algae growth is being limited by the amount of sunlight that can reach the water profile. This phenomenon will also limit the growth of submerged plant growth in each pond. Nutrient reductions will be needed to shift away from floating plant dominance in each pond.

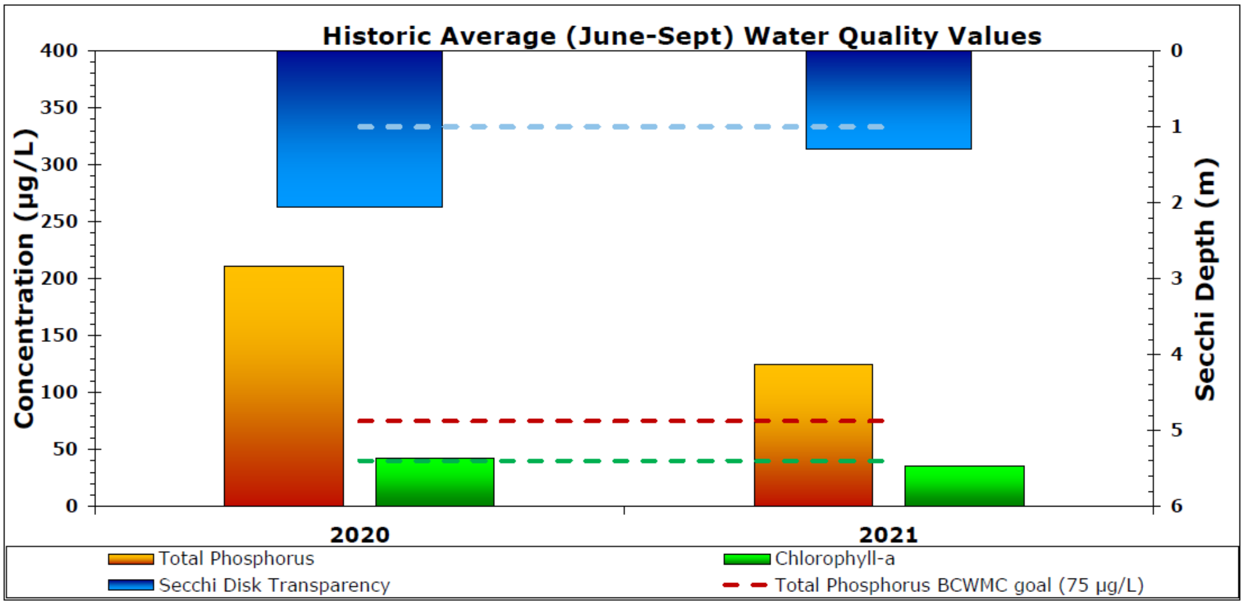


Figure 3-1 Grimes Pond Total Phosphorus, Chlorophyll-a, and Secchi Disc Transparency

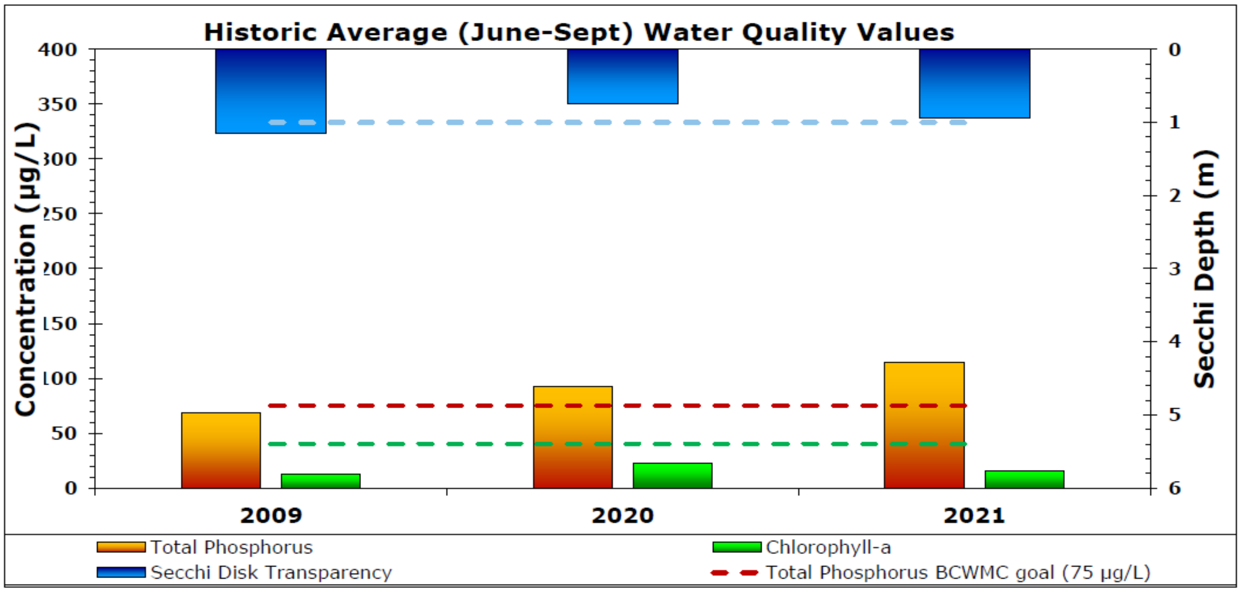


Figure 3-2 North Rice Pond Total Phosphorus, Chlorophyll-a, and Secchi Disc Transparency

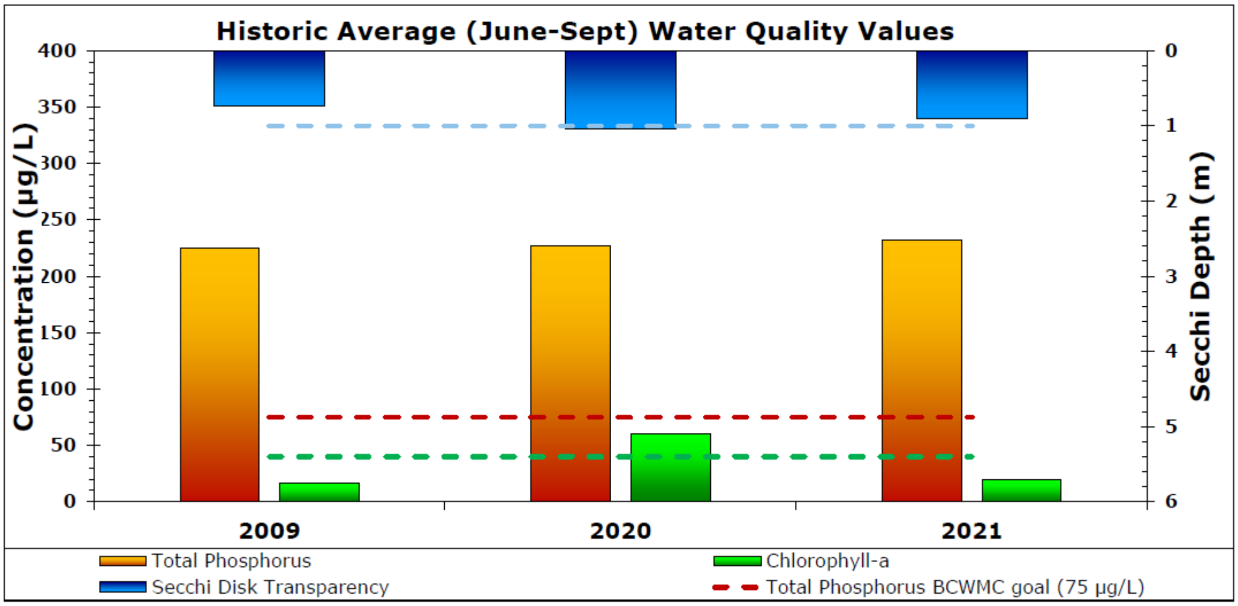


Figure 3-3 South Rice Pond Total Phosphorus, Chlorophyll-a, and Secchi Disc Transparency

3.1.2 Dissolved Oxygen

Continuous dissolved oxygen measurements were taken in all three ponds during July 2020, and again in July and early-August, 2021, as well as instantaneous measurements during each of the water quality sampling events. The continuous dissolved oxygen measurements showed that all three ponds were anoxic (completely devoid of oxygen) in 2020 and 2021. The instantaneous oxygen measurements indicated that April and June had higher levels, but rest of season was anoxic at all ponds. Due to low oxygen levels, bacteria do not efficiently break down decaying organic material and sediment chemistry will typically result in the release of phosphorus to the overlying pond water. In addition, anoxia under floating plant beds may boost the decline of submerged plants (Scheffer et al., 2003).

3.1.3 Sediment phosphorus

Figures 3-4 and 3-5 show how the respective mobile and organic fractions of phosphorus vary by depth in the sediment of each pond sampling location (shown in Figure 2-1). The mobile and organic fractions of sediment phosphorus are readily available for release under anoxic conditions and Figures 3-4 and 3-5 show that the concentrations at each sampling locations are elevated near the sediment-pond water interface. Results of the dissolved oxygen monitoring, combined with the pond sediment phosphorus data, confirmed that internal phosphorus loading, under anoxic conditions, can be an important source of phosphorus input to each pond during the summer months.

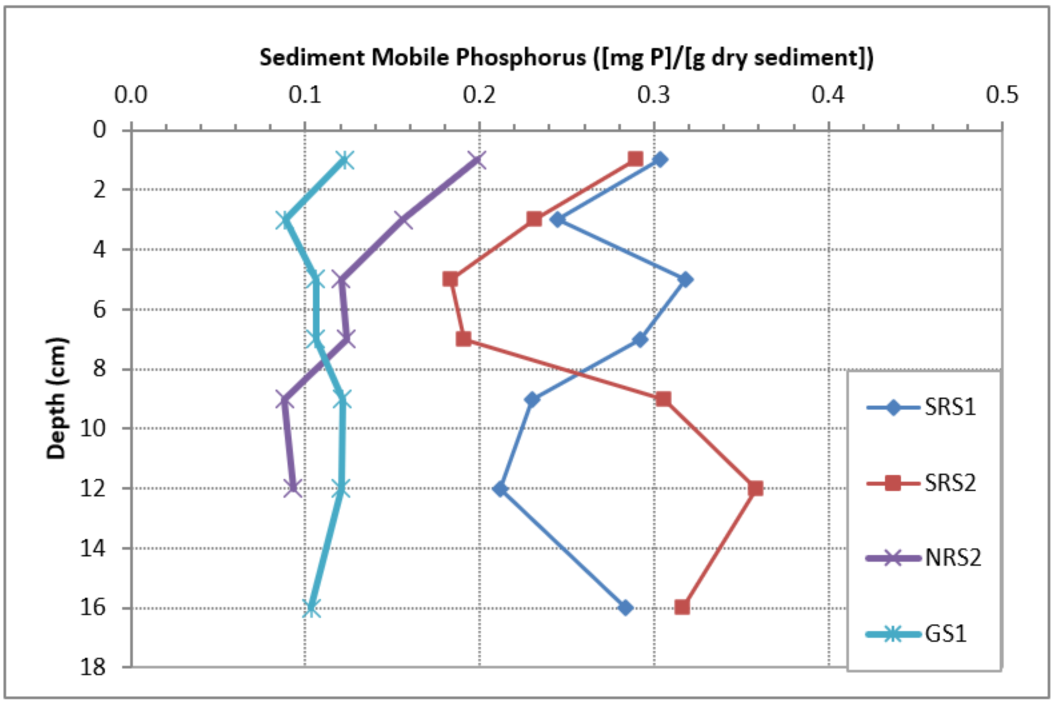


Figure 3-4 Sediment Mobile Phosphorus Concentrations

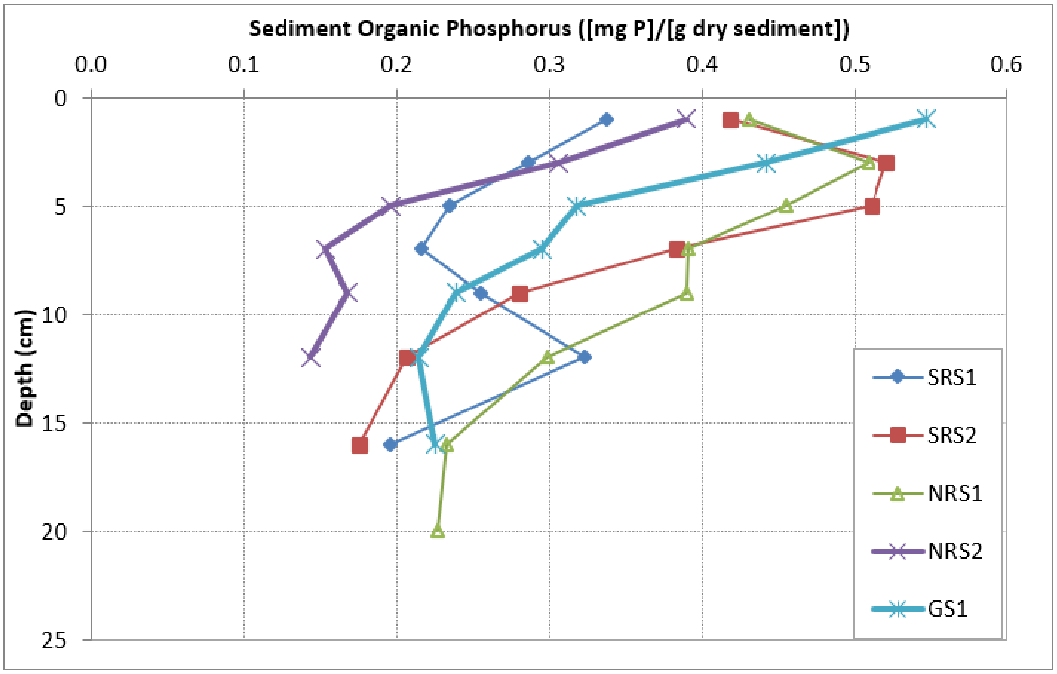


Figure 3-5 Sediment Organic Phosphorus Concentrations

3.1.4 Vegetation Surveys

TRPD conducted two surveys (early- and late-summer) each year of aquatic plants in all three ponds. Thick Coontail was noted, as well as large amounts of duckweeds and watermeal (see Figure 3-6). Invasive curly-leaf pondweed (CLP) was found in all 3 ponds, except in the spring, due to normal die off (see Figure 3-6).

Vegetation surveys 2020	% Frequency of Occurance					
	6/17/2020			8/26/2020		
	Grimes	North Rice	South Rice	Grimes	North Rice	South Rice
Ceratophyllum demersum (Coontail)	98	97	92	100	100	89
Potamogeton crispus (Culy-leaf Pondweed)	12	21	39			
Elodea canadensis (Elodea)			47			
Potamogeton spp (Narrow Pondweed spp)	28	45	68	9	14	5
Stuckenia pectinata (Sago Pondweed)	11	17		4	7	
Chara spp (Chara)	2					
Lemna trisulca (Star Duckweed)	30	48		16	80	
Lemna minor (Small Duckweed)	84	83	100	100	100	82
Spirodela polyrhiza (Greater Duckweed)	87	65	100	51	100	82
Wolffia columbiana (Watermeal)	96	89	100	100	100	89

Vegetation surveys 2021	% Frequency of Occurance					
	6/24/2021			9/1/2021		
	Grimes	North Rice	South Rice	Grimes	North Rice	South Rice
Ceratophyllum demersum (Coontail)	96	93	87	100	100	90
Potamogeton crispus (Culy-leaf Pondweed)	12	3	37			
Elodea canadensis (Elodea)			68			53
Potamogeton spp (Narrow Pondweed spp)	42	41	79	7		10
Stuckenia pectinata (Sago Pondweed)	9	10		2	3	
Chara spp (Chara)				2		
Lemna trisulca (Star Duckweed)	33	65		39	65	13
Lemna minor (Small Duckweed)	100	100	100	98	100	98
Spirodela polyrhiza (Greater Duckweed)	100	100	100	100	100	98
Wolffia columbiana (Watermeal)	100	100	100	100	100	98

Figure 3-6 2020 and 2021 Pond Vegetation Survey Results

3.1.5 Water Levels

Figure 3-7 shows the monitored water levels for each pond during the 2020 and 2021 monitoring seasons, as well as the corresponding precipitation amounts. The largest storm events during the monitoring period resulted in water level changes of about one foot in Grimes and North Rice Pond, while South Rice Pond experienced water level changes of about three quarters of a foot. The existing outlet infrastructure for Grimes Pond would accommodate a water level drawdown of approximately 2.5 feet using gravity flow into North Rice Pond, which in turn, could be drawn down by 3 to 3.5 feet through gravity flow to South Rice Pond. South Rice Pond can not be drawn down by gravity due to the tailwater conditions associated with Bassett Creek, so pumping would be required to draw the pond down.

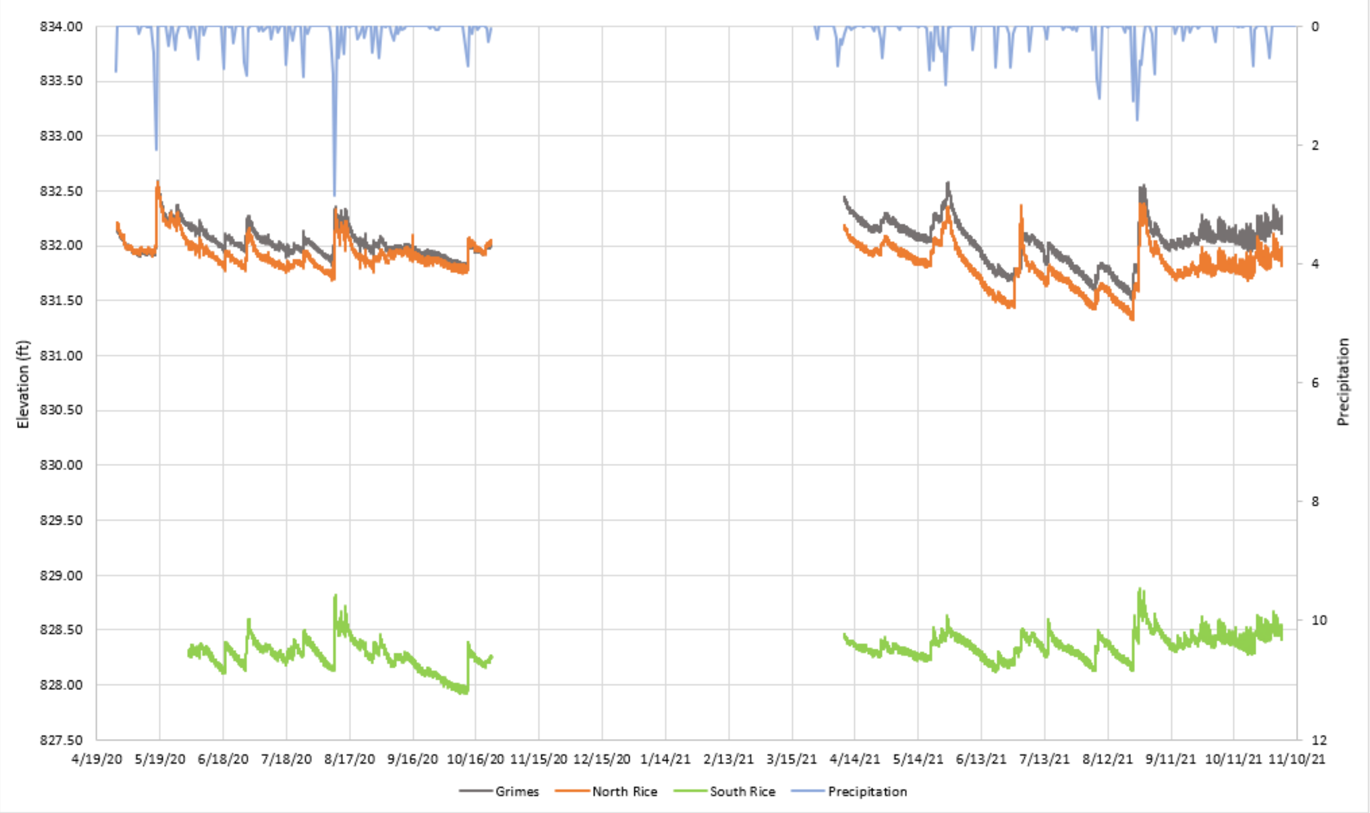


Figure 3-7 2020 and 2021 Pond Water Levels

3.2 Stormwater Monitoring

Stormwater water quality and flow monitoring data at each watershed station was used compute pollutant loadings. Table 3-1 show the respective annual pollutant loadings and flow-weighted mean concentrations for each watershed monitoring site (shown in Figure 2-1). Comparing the combined NR2 and SR4 TP loads to the SR5 TP load indicates that internal phosphorus load is significant in South Rice Pond during both years. This also confirmed by the high flow-weighted mean TP concentration at SR5 during each year. The high flow-weighted mean TP and SRP concentrations at SR4 also indicate that the existing stormwater treatment from Basin J is inadequate. The same corresponding data at NR2 confirms that North Rice Pond has significantly better water quality than the other two ponds.

Table 3-1 Stormwater Pollutant Loadings and Flow-Weighted Mean Concentrations

Site	Year	# of samples	Pollutant Loading					Flow-Weighted Mean Pollutant Concentration						
			TP (lbs/yr)	SRP (lbs/yr)	TN (lbs/yr)	TSS (lbs/yr)	Cl (lbs/yr)	TP (µg/L)	SRP (µg/L)	TN (mg/L)	TSS (mg/L)	Cl (mg/L)	Flow Volume (x 10^6 M3)	Annual Precipitation (inches)
NR1	2020	7	2	1	12	283	0	359	195	2.09	49	0	0.003	25.88
NR1	2021	8	4	2	21	994	27	396	229	2.22	105	3	0.004	23.43
NR2	2020	17	50	13	459	1,906	45,739	147	39	1.36	6	135	0.15	25.88
NR2	2021	13	63	36	546	2,307	92,479	119	68	1.03	4	174	0.24	23.43
SR4	2020	14	30	18	213	3,933	577	279	163	1.96	36	5	0.05	25.88
SR4	2021	8	64	49	253	1,769	2,531	367	282	1.44	10	14	0.08	23.43
SR5	2020	21	74	26	526	9,343	28,703	261	94	1.86	33	102	0.13	25.88
SR5	2021	13	57	23	379	8,522	25,625	315	124	2.09	47	141	0.08	23.43

4 Wetland Ecological Health Assessment

To evaluate wetlands and wetland condition within North and South Rice Ponds, a wetland evaluation site visit was performed on August 17, 2020. A qualitative review of wetlands and vegetation communities was performed within each basin. A wetland delineation within this area was previously approved under the Minnesota Wetland Conservation Act and the U.S. Army Corps of Engineers in 2016, which is valid for five years. In 2020, the previous delineation information was used where the evaluation areas overlap and extrapolated the boundaries in locations to complete the wetland delineation needed for this subwatershed assessment (see Figure 4-1). The boundary extrapolation used available desktop information, including recent aerial photography, topographic maps, National Wetland Inventory maps, and soil survey information, along with spot field checks documenting soils, vegetation, and hydrology within the wetlands and in the adjacent upland to determine the presence and extent of North and South Rice Ponds. The wetland documentation presented in this report is not intended to comprise a complete wetland delineation report. Also, agency wetland boundary and type concurrence and approval will not be requested for the purposes of this subwatershed assessment.

4.1 Site Characteristics

Prior to the August 17, 2020 site visit, the following desktop data were reviewed:

- Site topography – The surface topography of the land surrounding North and South Rice Ponds within Sochacki Park varies from an elevation of 850 feet mean sea level (MSL) at the north end to 828 feet MSL within South Rice Pond based on LiDAR data as shown in Figure 4-2.

- Bathymetry – bathymetry data collected by TRPD in 2020 shows North Rice Pond at a maximum water depth of 5.2 feet and South Rice Pond at a maximum water depth of 3.3 feet (Figure 2-1).

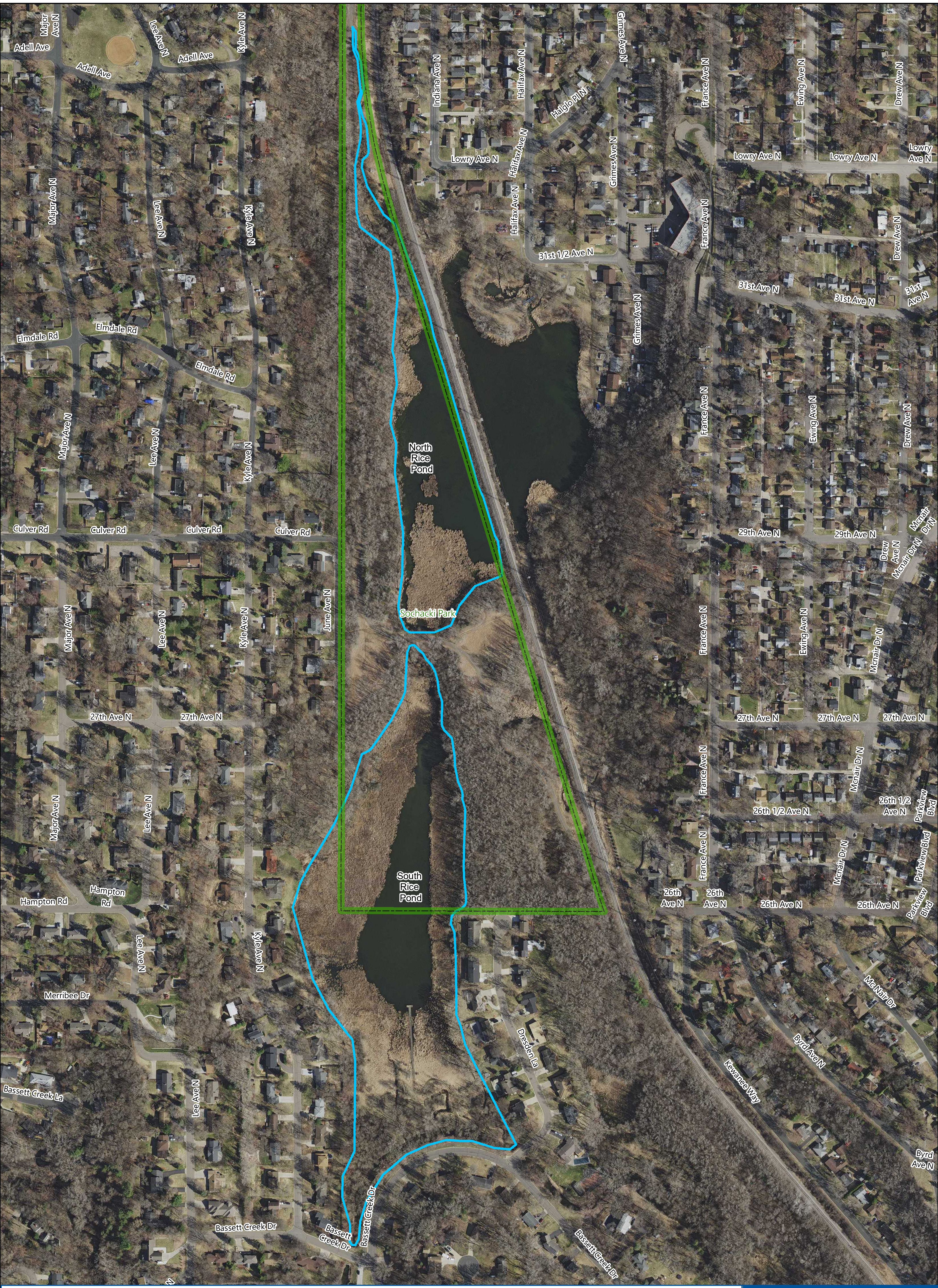
- National Wetland Inventory – The MN DNR update of the National Wetland Inventory (NWI) map (Figure 4-3) identifies:

    - North Rice Pond as a Type 5 PUBH freshwater pond and Type 3 PEM1C shallow marsh fringed with Type 6 PSSC shrub and Type 1 PFO1A floodplain forested communities, and

    - South Rice Pond as a Type 5 PABH shallow open water community and Type 3 PEM1F shallow marsh fringed with a Type 1 PFO1A floodplain forested community.

    - Additional wetland areas are identified in the NWI within Sochacki Park, which were not evaluated as part of this assessment.

- Water resources - As described above, both North (27-644W) and South (27-645W) Rice Ponds are identified in the PWI as Public Water Wetlands (Figure 4-4). In addition, Bassett Creek is a Public Water Watercourse located south of South Rice Pond. The MN DNR regulates public waters above the Ordinary High Water (OHW) elevation. The MN DNR website does not list established OHW elevations for either North or South Rice Ponds.



Sochacki Park

2020 Wetland Delineation

N

0 300 600

Feet

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WETLAND DELINEATION

Sochacki Park
Subwatershed Assessment
Three Rivers Park District

FIGURE 4-1

Sochacki Park

2020 Wetland Delineation

2 Foot Contours, Hennepin County, 2011

10-Foot Contour

2-Foot Contour

0 300 600

Feet

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SITE TOPOGRAPHY

Sochacki Park
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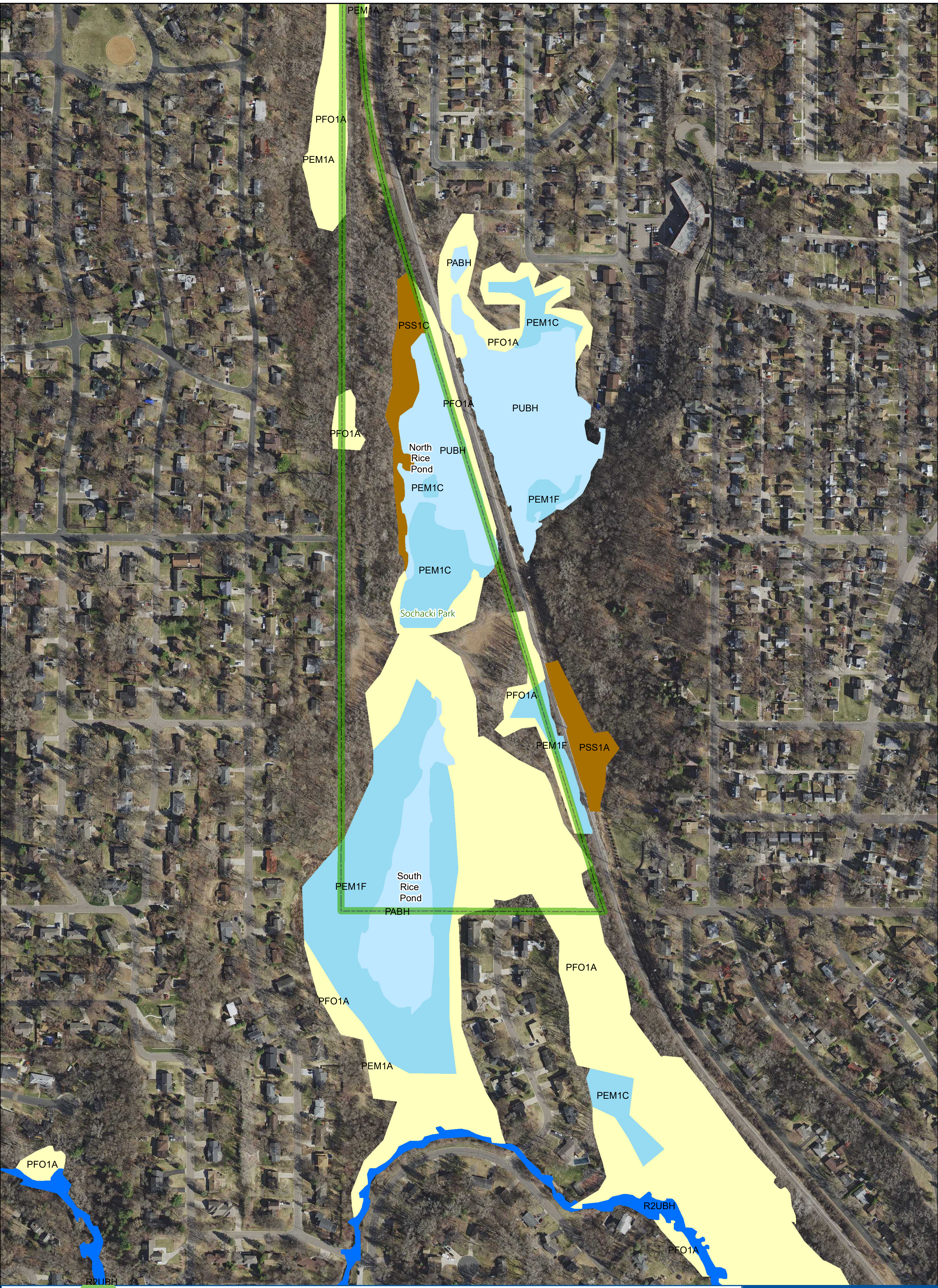
FIGURE 4-2



Sochacki Park
1 - Seasonally Flooded Basin or Floodplain Forest
3 - Shallow Marsh
5 - Shallow Open Water
6 - Shrub Swamp
Riverine Systems

0 300 600
Feet

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NATIONAL WETLAND INVENTORY
Sochacki Park
Subwatershed Assessment
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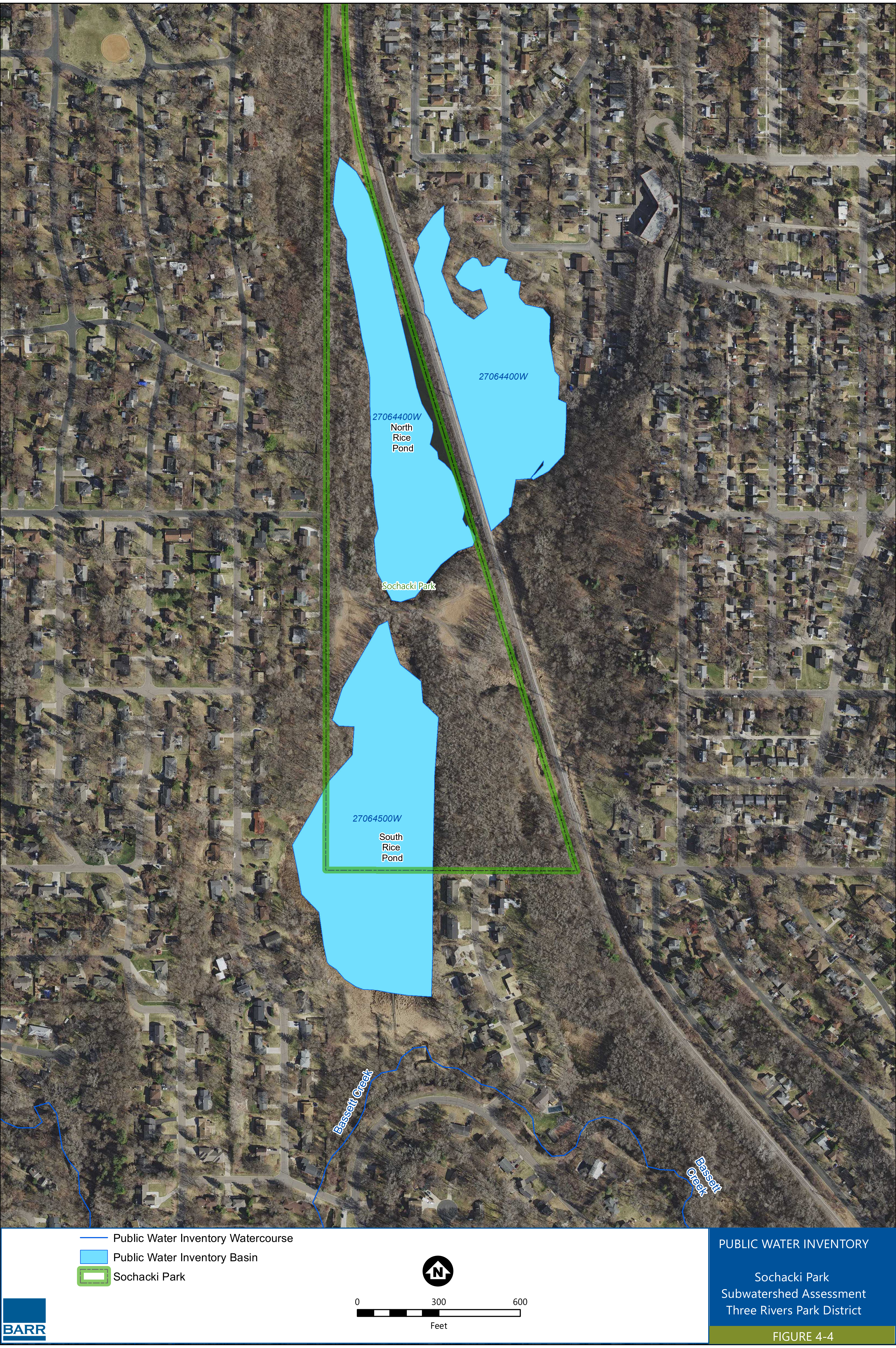
FIGURE 4-3



PUBLIC WATER INVENTORY

Sochacki Park
Subwatershed Assessment
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FIGURE 4-4

The study area is located within the Grimes Lake subwatershed (GRL-001) of the Bassett Creek minor watershed (#20095), in the Mississippi River – Twin Cities Major Watershed #20.

- Soil resources – Soil information for the site was obtained from the U.S. Department of Agriculture Natural Resources Conservation Service (NRCS) Soil Survey Geographic Database (SSURGO). The soil map unit names and hydric classifications are labeled in Figure 4-5.
    - The northern fringe of North Rice Pond is mapped with Udorthents, wet substratum, 0 to 2 percent slopes. The southern portion of North Rice Pond is mapped with Houghton and Muskego soils, depressional, 0 to 1 percent slopes with a hydric classification presence of 100 percent. Muskego muck is very deep, very poorly drained soils formed in herbaceous organic material over sedimentary peat on glacial lake plains, flood plains, and till plains. Houghton muck is very deep, very poorly drained soil formed in herbaceous organic materials in depressions and drainageways on lake plains, out wash plains, ground moraines, end moraines, till plains, and floodplains.
    - Most of the South Rice Pond is similarly mapped with Houghton and Muskego soils. The southern edge of South Rice Pond is mapped with Suckercreek fine sandy loam, 0 to 2 percent slopes, occasionally flooded with a 90 percent hydric classification presence. Suckercreek loam is very deep, poorly drained and very poorly drained soils formed in alluvium on flood plains.

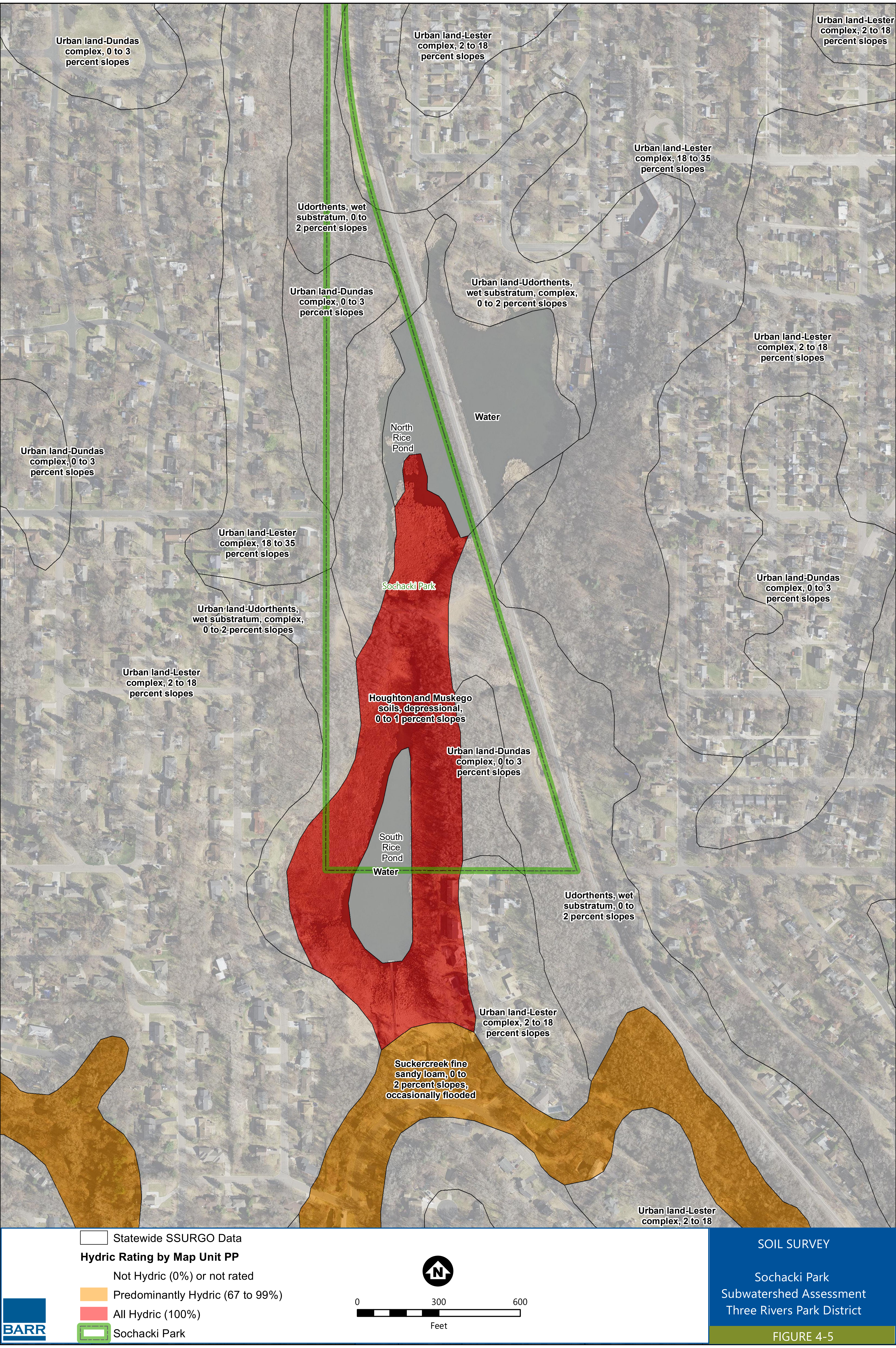
4.2 Wetland Descriptions

The wetland boundaries and types of North and South Rice Ponds were verified during the site visit on August 17, 2020. Wetland boundaries were documented using a global positioning system with sub-meter accuracy and community types were classified using the USFWS Cowardin System—*Classification of Wetlands and Deepwater Habitats of the United States* (Cowardin et al., 1979), the *USFWS Circular 39 system* (Shaw and Fredine, 1956), and the Eggers and Reed Wetland Classification System—*Wetland Plants and Plant Communities of Minnesota and Wisconsin* (Eggers and Reed, 2015). Table 4-1 provides a summary of wetland classifications and sizes and is followed by narrative descriptions of each pond.

Table 4-1 Wetland Summary

Wetland ID	Approximate Area (acres)	Circular 39 Wetland Type [1]	Cowardin Wetland Type [2]	Eggers & Reed Wetland Community Type [3]
North Rice Pond	7.30	Type 5/3/6	PABH/EMC/SSC	Shallow open water/shallow marsh/shrub-carr
South Rice Pond	17.33	Type 5/3/1	PABH/EMC/FOA	Shallow open water/shallow marsh/floodplain forest

[1]Shaw and Fredine. 1956.
[2]Cowardin, L.M., V. Carter, F.C. Golet, and R.T. LaRoe. 1979.
[3]Eggers, S.D. and Reed, D.M. Version 3.2 July 2015.



BARR

SOIL SURVEY

Sochacki Park
Subwatershed Assessment
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FIGURE 4-5

The following is a narrative description of North and South Rice Ponds (see Figures 4-6 and 4-7, respectively). Descriptions highlight key findings from the desktop review, information obtained from TRPD's 2020 aquatic vegetation and bathymetric survey, as well as information obtained during the August 17, 2020 wetland evaluation site visit.

Figure 4-6 August 17, 2020 Photograph of North Rice Pond

Figure 4-7 August 17, 2020 Photograph of South Rice Pond

4.2.1 North Rice Pond

Based on the site review, North Rice Pond was identified as a Type 5/3/6 PABH/EMC/SSC shallow open water/shallow marsh/shrub-carr. This wetland receives hydrology from surrounding residential neighborhoods, through an inlet pipe at the northwest, and through a culvert from Grimes Lake located east of the railroad. The outlet is a channelized flow through a culvert under a paved trail between North and South Rice Ponds. The wetland was inundated with as much as 5.2 feet of surface water within the shallow open water community. Open water surrounding the shallow marsh floating mats was observed to be approximately one to two feet deep with saturated floating mats.

The shallow open water community of North Rice Pond contains native submergent vegetation including coontail (*Ceratophyllum demersum*), narrow pondweed (*Potomogeton spp*.), sago pondweed (*Stuckenia pectinata*), and floating native vegetation including star duckweed (*Lemna trisulca*), small duckweed (*Lemna minor*), greater duckweed (*Spirodela polyrhiza*), and watermeal (*Wolffia columbiana*) based on the results of point intercept surveys conducted by TRPD on June 17 and August 26, 2020. One non-native invasive species, curly-leaf pondweed (*Potomogeton crispus*) was documented within the shallow open water community of North Rice Pond.

The shallow marsh community is comprised of floating mats within and along the edge of the open water, dominated by narrow leaf cattail (*Typha angustifolia*) and purple loosestrife (*Lythrym salicaria*), both of which are non-native invasive species. Native species identified within the shallow marsh community include dark green bulrush (*Scirpus atrovirens*), pointed broom sedge (*Carex scoparia*), small duckweed, watermeal, sandbar willow (*Salix interior*), and red osier dogwood (*Cornus alba*) growing within the floating mats. Additional species on the floating mats were not identified due to lack of access.

The shrub-carr community is vegetated by sandbar willow, meadow willow (*Salix amygdaloides*), reed canary grass (*Phalaris arundinacea*), jewelweed (*Impatiens capensis*), clearweed (*Pilea pumila*) and common buckthorn (*Rhamnus cathartica*). Some buckthorn was observed to have been previously removed at the south end of North Rice Pond, though young shoots are coming back.

Soils documented within the wetland are muck soils consistent with mapped soils. Soils near the wetland boundary include clay loam below a shallow muck surface. Adjacent upland soils are clay loam and sandy loam along steep slopes. Steep slopes define the wetland boundary with saturated soils at the toeslope of the wetland boundary. Some soil erosion was observed at the north inlet location near the paved trail. The wetland boundary on the east edge is defined by the steep railroad grade.

Hydrophytic tree species were present in the adjacent forested upland area, though wetland soil and hydrology indicators were lacking. The wetland boundary documented for this study is consistent with the previously approved wetland boundary for the Blue Line LRT project.

Surrounding upland areas are forested with oak (*Quercus spp*.), elm (*Ulmus sp*.) cottonwood (*Populus deltoides*), boxelder (*Acer negundo*), green ash (*Fraxinus pennsylvanica*), gray dogwood (*Cornus racemosa*), sumac (*Rhus sp*.), honeysuckle (*Lonicera spp.*). The forested herbaceous layer includes burdock (*Arctium minus*), Kentucky bluegrass (*Poa pratensis*), sweet clover (*Melilotus officianalis*), and Virginia creeper

(*Parthenocissus quinquefolia*). A restored prairie area between North and South Rice Ponds includes bee balm (*Monarda fistulosa*), stiff goldenrod (*Solidago rigida*), Indian grass (*Sorghastrum nutans*), big bluestem (*Andropogon gerardii*), black eyed Susan (*Rudbeckia hirta*), and juniper (*Juniperus virginiana*).

4.2.2 South Rice Pond

Based on the site review, South Rice Pond was identified as a Type 5/3/1 PABH/EMC/FOA shallow open water/shallow marsh/floodplain forest. This wetland receives overflow from North Rice Pond and overland flow from surrounding residential neighborhoods and upland areas in the park. A cattail marsh located at the northeast of South Rice Pond has a low-lying outlet partially draining it to South Rice Pond, though the outlet was observed to be clogged with sticks and leaves.

South Rice Pond was inundated with as much as 4.4 feet of surface water within the shallow open water community. Surface water at the west and east edges of the pond was observed to be approximately one foot deep with saturated floating mats and one inch of surface water near the wetland boundary. Steps have been constructed on steep slopes for access to the wetland toward a dilapidated boardwalk within portions of the floating mats.

The shallow open water community of South Rice Pond contains native submergent vegetation including coontail (*Ceratophyllum demersum*), Canada waterweed (*Elodea canadensis*), narrow pondweed (*Potomogeton spp*.), and floating native vegetation including small duckweed (*Lemna minor*), greater duckweed (*Spirodela polyrhiza*), and watermeal (*Wolffia columbiana*) based on the results of point intercept surveys conducted by TRPD on June 17 and August 26, 2020. One non-native invasive species, curly-leaf pondweed (*Potomogeton crispus*) was documented within the shallow open water community of South Rice Pond.

The shallow marsh community is comprised of floating mats along pond edges, dominated by narrow leaf cattail (*Typha angustifolia*), purple loosestrife (*Lythrym salicaria*), and reed canary grass (*Phalaris arundinacea*), all of which are non-native invasive species. Native species identified within the shallow marsh community include lake sedge (*Carex lacustris*), nodding burr-marigold (*Bidens cernua*), and arrowhead (*Saggitaria latifolia*).

The floodplain forest vegetation includes red osier dogwood, willow, elm, green ash, boxelder, cottonwood, common buckthorn, and reed canary grass. The southern edge of the wetland boundary of South Rice Pond extends to Bassett Creek into a subwatershed beyond the study area.

Soils documented within the wetland are muck soils consistent with mapped soils. Soils near the wetland boundary include clay loam below a shallow muck surface. Adjacent upland soils are loam along steep slopes. Steep slopes define the wetland boundary with saturated soils at the toeslope of the wetland boundary. The wetland boundary documented for this study is consistent with the previously approved wetland boundary for the Blue Line LRT project.

Surrounding upland areas are forested with oak (*Quercus spp*.), black walnut (*Juglans nigra*), elm (*Ulmus sp*.) cottonwood (*Populus deltoides*), boxelder (*Acer negundo*), green ash (*Fraxinus pennsylvanica*), garlic mustard (*Allaria petiolata*), broad leaf nightshade (*Circaea lutetiana*), white snakeroot (*Ageratina altissima*), dandelion (*Taraxicum officianale*), common ragweed (*Ambrosia artimesiifolia*), sticktight (*Hackelia virginiana*), and purple bellflower (*Campanula sp.*). Dense buckthorn is present throughout the adjacent upland buffer. Well-travelled paths meander along the upland buffer. Chunks of concrete have also been dumped in the adjacent upland. Mounds and logs have been placed for mountain bike activity within the upland area of the park east of South Rice Pond.

4.3 MNRAM Functional Analysis

Functional assessments were conducted on both North and South Rice Ponds using the Minnesota Routine Assessment Method for Evaluating Wetland Functions (MNRAM) version 3.4. Comprehensive guidance with functional rating formulas, full text, and the wetland management classification flow chart are provided for reference in Appendix A. The results of this assessment are summarized in Table 4-2 for North Rice Pond and Table 4-3 for South Rice Pond. Appendix B provides the full summaries and site response forms.

4.3.1 North Rice Pond

Table 4-2 North Rice Pond MNRAM Summary

North Rice Pond Wetland functional ratings:	
Exceptional	• Groundwater interaction functional index
Moderate	• Flood and stormwater attenuation • Downstream water quality • Maintenance of characteristic wildlife habitat structure • Maintenance of characteristic fish habitat • Aesthetics/recreation/education/cultural values • Wetland sensitivity to stormwater and urban development
Low	• Overall weighted average vegetative diversity and integrity • Maintenance of wetland water quality • Maintenance of hydrologic regime • Maintenance of characteristic amphibian habitat • Additional stormwater treatment needs
Overall wetland management classification: Manage 2	

North Rice Pond was rated **moderate** for flood and stormwater attenuation, downstream water quality, maintenance of characteristic wildlife habitat structure, maintenance of characteristic fish habitat, aesthetic/recreation/education/cultural values, and wetland sensitivity to stormwater and urban development. The shallow open water community was also rated as **moderate** for vegetative diversity and integrity, while the shallow marsh and shrub-carr communities were rated as **low** quality due to a dominance of non-native invasive vegetation, making the overall weighted average vegetative diversity and integrity rating **low**. Other **low** ratings for North Rice Pond functions include maintenance of hydrologic regime, maintenance of wetland water quality, maintenance of characteristic amphibian habitat, and additional stormwater treatment needs. Since the groundwater interaction of this wetland is primarily recharge and the wetland is within a wellhead protection area, the ground water functional index is **exceptional**.

4.3.2 South Rice Pond

Table 4-3 South Rice Pond MNRAM Summary

South Rice Pond Wetland functional ratings:	
Exceptional	• Groundwater interaction functional index
Moderate	• Maintenance of hydrologic regime • Flood and stormwater attenuation • Downstream water quality • Maintenance of characteristic wildlife habitat structure • Maintenance of characteristic fish habitat • Aesthetics/recreation/education/cultural values • Wetland sensitivity to stormwater and urban development
Low	• Overall weighted average vegetative diversity and integrity • Maintenance of wetland water quality • Maintenance of characteristic amphibian habitat • Additional stormwater treatment needs
Overall wetland management classification: Manage 2	

South Rice Pond was rated **moderate** for maintenance of hydrologic regime, flood and stormwater attenuation, downstream water quality, maintenance of characteristic wildlife habitat structure, maintenance of characteristic fish habitat, aesthetic/recreation/education/cultural values, and wetland sensitivity to stormwater and urban development. The shallow open water community was also rated as **moderate** for vegetative diversity and integrity, while the shallow marsh and floodplain forest communities were rated as **low** quality due to a dominance of non-native invasive vegetation, making the overall weighted average vegetative diversity and integrity rating **low**. Other **low** ratings for South Rice Pond functions include maintenance of wetland water quality, maintenance of characteristic amphibian habitat, and additional stormwater treatment needs. Since the groundwater interaction of this wetland is primarily recharge and the wetland is within a wellhead protection area, the ground water functional index is **exceptional**.

4.4 North Rice Pond potential wetland improvements

Suggested improvements to North Rice Pond include:

- Remove, treat, and control non-native invasive species, including curly leaf pondweed, narrowleaf cattail, purple loosestrife, common buckthorn, and reed canary grass in the wetland. Common buckthorn, sweet clover, and honeysuckle in the upland buffer.
- Remove accumulated sediment and fill materials within and adjacent to the wetland.
- Install pretreatment protection measures to prevent future sediment delivery and reduce nutrient loading into the wetland.
- Encourage community involvement in the protection and appreciation of the wetland and surrounding park, which may include:
    - coordinating seasonal community clean up events and invasive species removal
    - native planting projects
    - educational signage documenting restoration areas in progress with inspiration for park users to pick up trash and prevent damage
    - hold community education events such as birding and wildlife observation, cultural education, etc.
- Control soil erosion and re-vegetate bare soil areas along shoreline and upland buffer including eroding soil found at the north inlet location near the paved trail.

Implementation of some or all proposed improvements could result in the overall wetland management classification increase from Manage 2 to Manage 1 and the following functional rating improvements:

- change in maintenance of hydrologic regime from low to moderate
- change in maintenance of wetland water quality from low to moderate

- change in maintenance of wildlife habitat structure from moderate to high
- change in aesthetics/recreation/education/cultural from moderate to high
- change in overall weighted average vegetative diversity and integrity from low to high

Table 4-4 summarizes the potential functional ratings with implementation of improvements. Appendix C provides the full summaries and site response forms for these proposed results.

Table 4-4 North Rice Pond Proposed Improvements MNRAM Summary

North Rice Pond wetland functional ratings for proposed improvements:	
Exceptional/ High	• Groundwater interaction functional index • Maintenance of characteristic wildlife habitat structure • Aesthetics/recreation/education/cultural values • Overall weighted average vegetative diversity and integrity
Moderate	• Flood and stormwater attenuation • Downstream water quality • Maintenance of characteristic fish habitat • Wetland sensitivity to stormwater and urban development • Maintenance of hydrologic regime • Maintenance of wetland water quality
Low	• Maintenance of characteristic amphibian habitat • Additional stormwater treatment needs
Overall wetland management classification: Manage 1	

The proposed wetland functional ratings for North Rice Pond are based on the following assumptions:

- The shallow open water community rating changes from moderate to high assuming curly-leaf pondweed is decreased to less than 20 percent cover.
- The shallow marsh community rating changes from low to moderate assuming purple loosestrife is reduced to 20-50 percent cover and cattails comprise 40 – 85 percent cover.
- The shrub-carr community rating changes from low to moderate assuming buckthorn, reed canary grass, and other non-native species comprise 20 – 50 percent cover.

- The wetland soil condition (Question #15) changes from low to moderate assuming fill material and sediment deposits are removed.
- The stormwater runoff (Question #20) rating changes from moderate to high assuming directed stormwater runoff is pre-treated and detained to approximately the standards of the National Urban Runoff Program (NURP).
- Bare soil areas within the upland buffer area are re-vegetated and soil erosion is controlled (Questions #24 and #25).
- Nutrient loading (Question #28) rating changes from low to moderate assuming nutrients are reduced to meet BCWMC water quality goals.
- Human influences (Question #53) changes from low to moderate with reductions in nutrient inputs, trash clean up, and vegetative diversity and integrity improvements as described in above assumptions.

4.5 South Rice Pond potential wetland improvements

Suggested improvements to South Rice Pond include:

- Remove, treat, and control non-native invasive species, including curly leaf pondweed, narrowleaf cattail, purple loosestrife, common buckthorn, and reed canary grass in the wetland. Common buckthorn, sticktight, and garlic mustard in the upland buffer.
- Remove accumulated sediment and fill materials within and adjacent to the wetland.
- Install pretreatment protection measures to prevent future sediment delivery and reduce nutrient loading into the wetland.
- Clear clogged debris from inlet and outlet structures.
- Re-build boardwalk and steps.
- If mountain bike activity in the adjacent upland area is intended to continue, consider isolating potential soil disturbance and adjacent vegetation improvements to prevent erosion into surrounding wetland areas.
- Control soil erosion and re-vegetate bare soil areas along shoreline and upland buffer. Consider defining designated specific trails and maintaining them to prevent bare soil and erosion disturbance from meandering undesignated trails along the slope of the pond buffer. These can be further defined with wood rails or designated rock placement to allow access to the water edge at specific locations.

- Encourage adjacent residential property owners to provide wider naturalized wetland buffer protection by avoiding mowing near the shoreline and establishing native vegetation in their back yards.
- Encourage community involvement in the protection and appreciation of the wetland and surrounding park, which may include:
    - coordinating seasonal community clean up events and invasive species removal
    - native planting projects
    - educational signage documenting restoration areas in progress with inspiration for park users to pick up trash and prevent damage
    - hold community education events such as birding and wildlife observation, cultural education, etc.

Implementation of some or all proposed improvements could result in the overall wetland management classification increase from Manage 2 to Manage 1 and the following functional rating improvements:

- change in maintenance of wetland water quality from low to moderate
- change in maintenance of characteristic fish habitat structure from moderate to high
- change in aesthetics/recreation/education/cultural from moderate to high
- change in overall weighted average vegetative diversity and integrity from low to high

Table 4-5 summarizes the potential functional ratings with implementation of improvements. Appendix C provides the full summaries and site response forms for these proposed results.

The proposed wetland functional ratings for South Rice Pond are based on the following assumptions:

- The shallow open water community rating changes from moderate to high assuming curly-leaf pondweed is decreased to less than 20 percent cover.
- The shallow marsh community rating changes from low to moderate assuming purple loosestrife is reduced to 20-50 percent cover and cattails comprise 40 – 85 percent cover.
- The floodplain forest community rating changes from low to moderate assuming buckthorn, reed canary grass, and other non-native species comprise 20 – 50 percent cover.
- The sediment delivery (Question #18) changes from moderate to high assuming fill material and sediment deposits are removed.

Table 4-5 South Rice Pond Proposed Improvements MNRAM Summary

South Rice Pond wetland functional ratings for proposed improvements:	
Exceptional/ High	• Groundwater interaction functional index • Maintenance of characteristic fish habitat • Aesthetics/recreation/education/cultural values • Overall weighted average vegetative diversity and integrity
Moderate	• Maintenance of hydrologic regime • Flood and stormwater attenuation • Downstream water quality • Maintenance of characteristic wildlife habitat structure • Wetland sensitivity to stormwater and urban development • Maintenance of wetland water quality
Low	• Maintenance of characteristic amphibian habitat • Additional stormwater treatment needs
Overall wetland management classification: Manage 1	

- The stormwater runoff (Question #20) rating changes from moderate to high assuming directed stormwater runoff is pre-treated and detained to approximately the standards of the National Urban Runoff Program (NURP).
- Nutrient loading (Question #28) rating changes from low to moderate assuming nutrients are reduced to meet BCWMC water quality goals.
- Upslope shoreline vegetation conditions (Question #34) rating changes from moderate to high assuming bare soil areas with erosion issues are revegetated and adjacent residential property owners avoid mowing to the shoreline and/or establish native vegetation along the shoreline buffer.
- Human influences (Question #53) changes from low to moderate with reductions in nutrient inputs, trash clean up, removal of fill material, and vegetative diversity and integrity improvements as described in above assumptions.

5 Watershed and Pond Water Quality Modeling

To better understand and evaluate the water quality treatment performance of the existing best management practices (BMPs) in the Sochacki Park subwatershed, the existing Bassett Creek Watershed Management Commission's (BCWMC) P8 watershed model was revised to reflect GIS subwatershed delineations and modeling inputs for each subwatershed and respective BMPs. The revised BCWMC P8 model was then updated with 2020 and 2021 growing-season climate data (hourly precipitation and daily temperatures) to develop the phosphorus (total and dissolved) and total suspended solids (TSS) loadings for the period. The available in-wetland water quality monitoring and watershed stormwater monitoring data of inflows and outflows were used to calibrate the watershed modeling, where possible.

The updated P8 modeling results and GIS mapping were used to identify high priority areas for implementing watershed BMPs. P8 modeling completed for the summers of 2020 and 2021 indicates that 20 and 17 percent of the current overall phosphorus load, in respective years, receives stormwater treatment before discharge to the three wetlands. Approximately 22 percent of the runoff phosphorus load in the Grimes Pond watershed receives stormwater treatment, while the respective levels of treatment in the direct drainage to North and South Rice Ponds are approximately 39 and 30 percent. Figure 5-1 highlights the subwatershed area that are currently receiving some level of stormwater treatment with structural BMPs. Most of the subwatersheds that drain directly into the three ponds are not receiving stormwater treatment that would substantially reduce annual total phosphorus loadings.

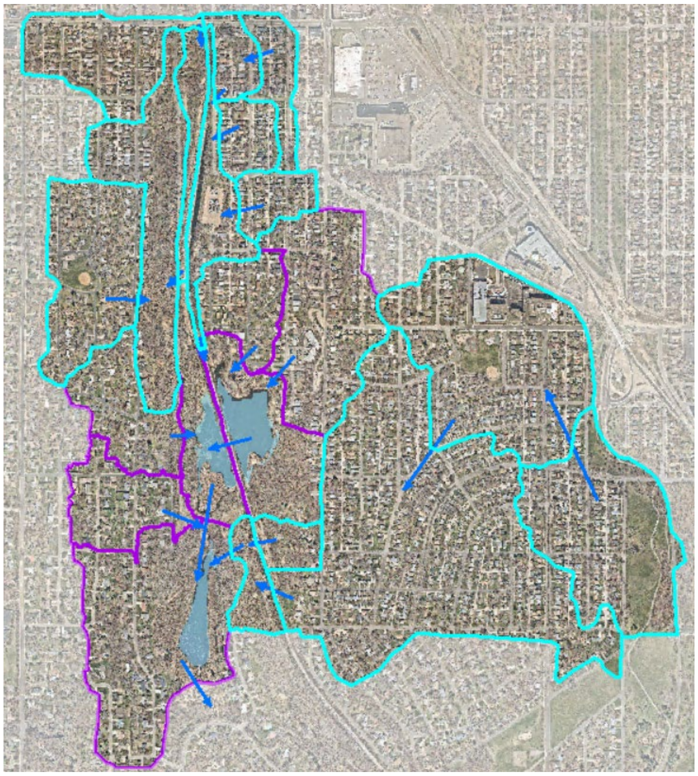

Figure 5-1 Existing Subwatersheds (Highlighted) Receiving Stormwater Treatment

The watershed modeling was calibrated and used to concurrently develop the water and phosphorus budgets that optimized the daily pond water quality modeling fit to the summer monitoring data associated with each pond. Figure 5-2 shows how the predicted pond water quality would ordinarily correspond with the water quality monitoring observations for each pond in 2020 and 2021, based on the calibrated watershed phosphorus load modeling, alone. Figure 5-2 shows that, except for Grimes Pond in 2021, each pond experienced two or more monitoring events where the monitored TP concentrations greatly exceeded the predicted TP concentration, based only on the watershed modeling. The difference in the TP concentrations during each of these pond monitoring events can be attributed to internal phosphorus loading from sediment phosphorus release. The mass balance modeling results were used to estimate and summarize the total internal phosphorus load during each summer for each pond.

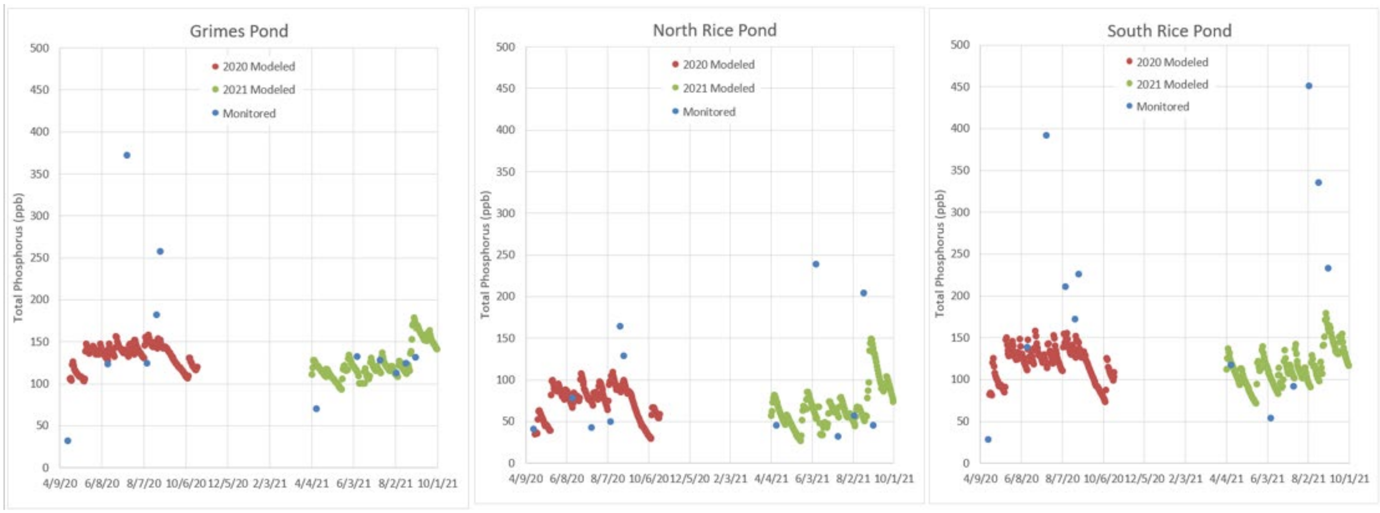

Figure 5-2 Calibrated Water Quality Monitoring and Modeling Results

A detailed analysis of the dissolved oxygen data, combined with the pond water quality modeling, confirmed that internal phosphorus loading can be an important source of phosphorus input to each pond during the summer. Internal phosphorus loading represented 32 percent of the summer phosphorus budget for Grimes Pond in 2020, as well as six and 24 percent of the respective summer phosphorus budgets for North Rice Pond in 2020 and 2021 (see Figure 5-3). Figure 5-3 shows that discharge from Grimes Pond represented 34 and 29 percent of the respective summer phosphorus budgets for North Rice Pond in 2020 and 2021. Internal phosphorus loading represented 8 and 9 percent of the respective summer phosphorus budgets for South Rice Pond in 2020 and 2021. Discharge from North Rice Pond represented 11 and 14 percent of the respective summer phosphorus budgets for South Rice Pond in 2020 and 2021.

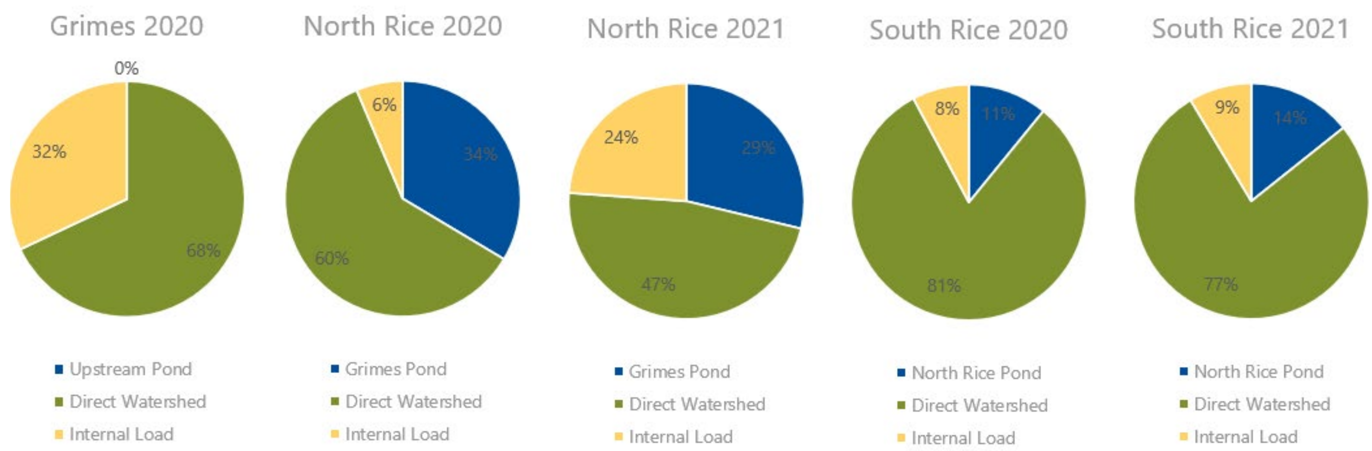

Figure 5-3 Modeled Annual TP Sources For Each Pond

The calibrated water quality modeling was used to assess the implications for the summer assimilation capacity (i.e., nutrient uptake and/or sedimentation) of each pond, and the water and phosphorus budgets were used to identify and develop implementation strategies for improving wetland water-quality. The short water residence times estimated for the watershed wetlands (averaging 38 days for Grimes Pond, 20 days for North Rice Pond and 8 days for South Rice Pond) limit the capacity to assimilate the summer runoff phosphorus loads from each direct drainage area, as well as the overall watershed.

The calibrated water quality modeling was used to simulate how implementation of watershed BMPs, combined with in-lake alum treatment, would improve water quality in each of the three ponds. Table 5-1 shows how much the average summer total phosphorus concentrations would improve following implementation of the recommended watershed structural BMPs and in-lake alum treatment in each pond (further discussed in Section 6).

Table 5-1 Average Summer Monitored and Modeled TP Following BMP Implementation

Monitoring/Modeling Scenario	Grimes Pond Avg. Summer TP	North Rice Pond Avg. Summer TP	South Rice Pond Avg. Summer TP
Existing 2020 and 2021 Summer Average TP (ppb)	168	104	230
Predicted TP Conc. Following BMP Implementation (ppb)	130	75	121
Percent TP Reduction Following BMP Implementation	23%	28%	47%

6 Wetland Improvement Options

6.1 Recommendations

Based on the wetland assessment and calibrated watershed and pond water quality modeling, the following watershed BMPs and in-pond management options are recommended to substantially reduce the respective phosphorus loadings and enhance vegetative diversity and integrity for each pond:

- Install structural BMPs and/or pretreatment protection measures to prevent future sediment delivery and reduce nutrient loading into the wetland with design(s) intended to meet water quality goals. Untreated stormwater runoff from two discharge outfalls each to South Rice and Grimes Ponds, as well as one outfall to North Rice Pond, are prioritized for implementation.
- Complete in-pond alum treatments to control summer sediment phosphorus release following implementation of watershed BMPs.
- Clear clogged debris and develop annual maintenance plan for all inlet and outlet structures. Remove accumulated sediment and fill materials from BMPs and within, and adjacent to, each wetland. Reconfigure discharge outfall and stabilize erosion from stormwater conveyance entering northwest corner of Grimes Pond.
- Re-vegetate and control soil erosion from bare soil areas within the upland buffer area. If mountain bike activity in the adjacent upland area is currently supported, isolate potential soil disturbance and adjacent vegetation improvements to prevent erosion into surrounding wetland areas.
- Conduct controlled water level drawdowns in each wetland prior to the winter season to ensure that curly-leaf pondweed is decreased to less than 20 percent cover and to enhance overall vegetative diversity and integrity. Remove, treat, and control other non-native invasive species, where possible, and remove fill material and trash.
- Initiate, or increase the frequency of, street sweeping and fall leaf litter removal programs, with emphasis in subwatersheds that have direct drainage to the wetlands.

6.2 Conceptual Design and Estimated Water Quality Benefit

Figure 6-1 shows the location of all the potential structural BMPs in the watershed. The proposed BMP located at SR-4 involves dredging and expansion of an existing stormwater pond (Basin J) and pretreatment cell, as well as downstream channel stabilization (see Figure 6-2), while the other proposed BMPs would involve implementation of new stormwater ponds at each of the other three locations shown in Figure 6-1.

Figure 6-3 includes a photo and schematic as examples of the important elements of the stormwater ponds envisioned for future implementation. The expectation is that the pretreatment provided by these two-cell pond systems will ensure that most of the ongoing operation and maintenance effort will not need to involve dredging, due to excess sedimentation in the main treatment cell. Both outfalls entering the GR-6 BMP location currently have CDS units that have recently been maintained and can be available for stormwater pretreatment of the respective subwatersheds.

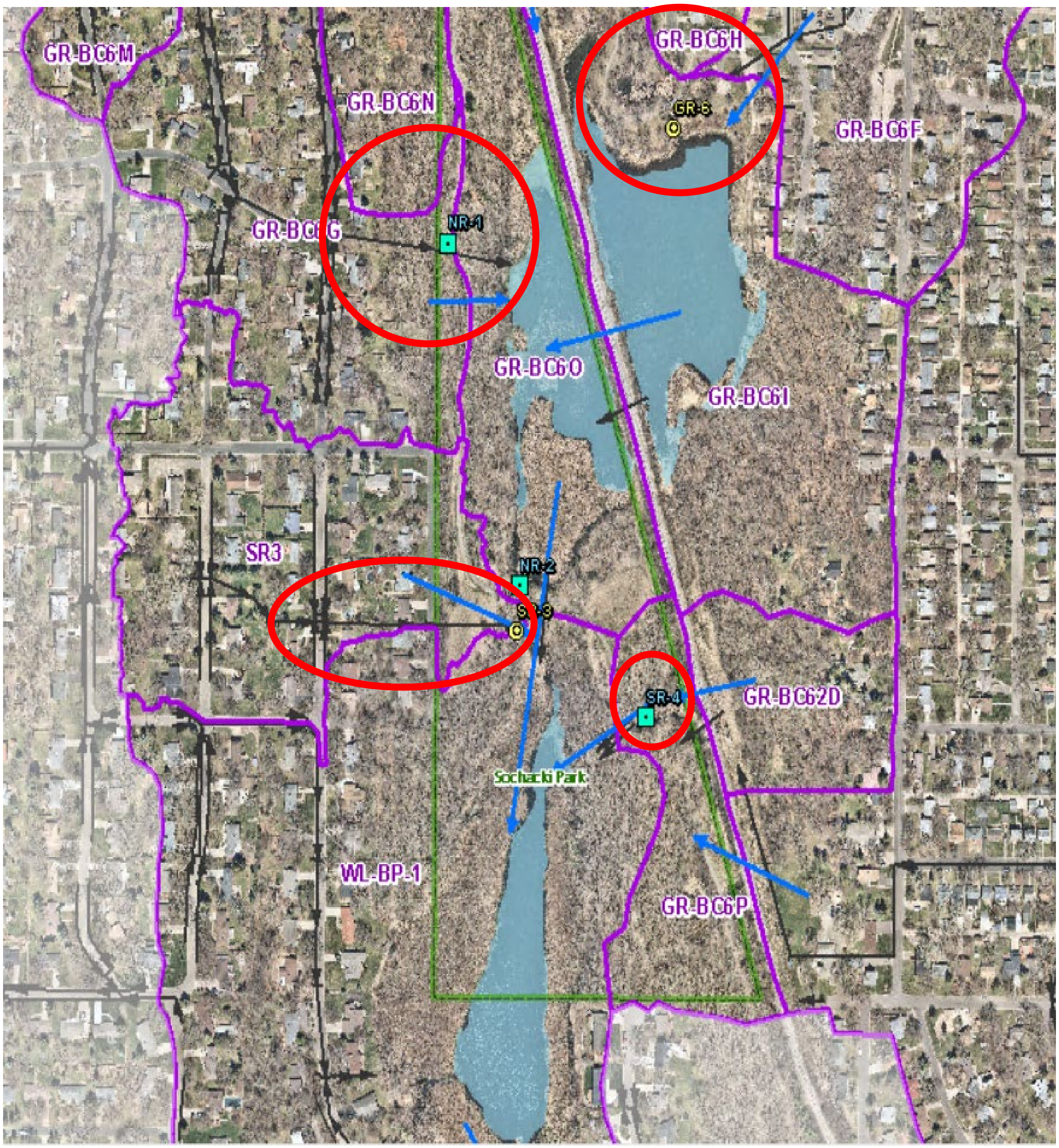

Figure 6-1 Recommended Sochacki Park Subwatershed Locations for Structural BMPs

For the majority of the BMPs evaluated, the updated P8 modeling was used to evaluate the proposed BMPs and estimate the annual total phosphorus removals. The model was run for the same water years that cover the monitored two-year consecutive climatic period (2020 and 2021 water years: 10/1/2019 – 9/30/2021). To evaluate the potential impact of an alum treatment, it was assumed that a combined alum and sodium aluminate treatment would reduce the estimated internal phosphorus load in each wetland by 80 percent.

Figure 6-2 Basin J Downstream Outlet Channel Erosion and Construction Debris

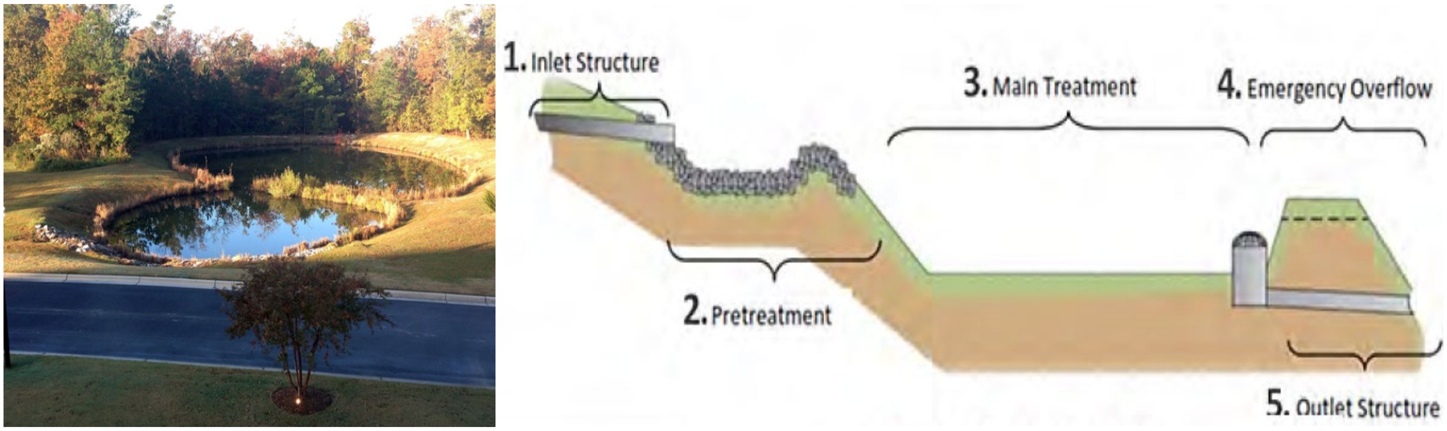

Figure 6-3 Example Stormwater Pond Treatment Elements

6.3 Estimated Cost-Benefit of Wetland Improvement Options

Planning level cost estimates were developed for the various BMPs based on the conceptual design of each project. Although the point estimate of cost was used for the cost-benefit analysis, there is cost uncertainty and risk associated with this concept-level cost estimate. The costs reported for the BMPs include engineering, design, and permitting (20 percent), construction management (15 percent), and estimated legal costs (5 percent). The costs do not include any wetland mitigation costs, assume that the excavated soils are not contaminated, and the projects do not require significant utility modifications or relocations. The range of probable costs presented reflects the level of uncertainty, unknowns, and risk due to the concept nature of the individual project designs. Based on the current level of design (planning level estimate), the cost range is expected to vary by -20 percent to +40 percent from the planning level point opinion of cost.

Appendix D includes the itemized planning level cost estimates for most of the water quality improvement options evaluated. These more detailed cost estimates should be reviewed and considered when planning and budgeting for the larger CIP projects and/or applications for grant funding.

A cost-benefit assessment was completed for each BMP to assist with prioritizing and select the preferred and most cost-effective BMPs to help achieve the necessary phosphorus load reductions. The capital costs (engineering, design, and construction) were annualized assuming a 20-year life span at a 4 percent interest rate. Although this timeframe is commonly used for these cost-benefit assessments, the actual lifespan of ponds, other BMPs, and infrastructure can be significantly longer if maintained regularly. Annual operation and maintenance costs were estimated for each project, assuming 1 percent of the capital cost. The benefit was estimated as an annualized cost per pound of total phosphorus removed per year.

Table 6-1 summarizes the potential wetland improvement options, estimated annual total phosphorus removal, planning level capital cost estimate, annualized cost-benefit, and recommended sequence for implementation of each improvement option. Items marked with “NA” in Table 6-1 are associated with options that are intended to address wetland habitat and are not applicable or quantified for TP load reductions. It is assumed that enhanced street sweeping in untreated subwatersheds would be incorporated into each City’s operations, so planning level costs for this improvement option were not estimated.

Table 6-1 Summary of Potential Improvement Option Benefit and Planning Level Costs

BMP ID/Location	Annual TP Removal (lbs/yr)	Planning Level Capital Cost Estimate	Annualized Cost-Benefit ($/lb TP Removed/yr)	Recommended Sequence for Implementation
Revegetate/control upland soil erosion	NA	$10,000	NA	1a
Street sweeping in untreated subwatersheds	NA	NA	NA	1b
Clear inlet/outlet debris, remove sediment deltas and stabilize erosion	NA	$100,000	NA	1c
Conduct pond water level drawdowns	NA	$154,000	NA	1d
Dredge/expand existing SR4 pond (Basin J) and stabilize outlet channel	33.5	$304,000	$760	2a
Construct stormwater pond at GR-6	14.9	$456,000	$2,600	2b
Construct stormwater pond at NR-1	3.8	$191,000	$4,200	2c
Construct stormwater pond at SR-3	3.7	$261,000	$5,900	2d
Alum treatment of Grimes, North and South Rice Ponds	11.2	$203,000	$1,500	3

It is expected that the following funding sources will be available for implementation of some of the recommended improvement options:

- BWSR Clean Water Funds
- Conservation Partners Legacy (for habitat components)
- Hennepin County Opportunity or Stewardship grants
- MPCA grants and MN Public Facilities Authority funds
- MnDNR short term action request grants
- Partner CIP funds (for potential grant match)

References

Bassett Creek Watershed Management Commission. 2004. *Bassett Creek Watershed Management Plan*. Prepared by Barr Engineering Company for the Bassett Creek Water Management Commission.

Barr Engineering. 2014. *2013 Lake Water Quality Study. Northwood Lake, North Rice Pond, and South Rice Pond.* Prepared for Bassett Creek Watershed Management Commission.

Cowardin, L.M., V. Carter, F.C. Golet, and R.T. LaRoe. 1979. *Classification of Wetlands and Deepwater Habitats of the United States.* U.S. Fish and Wildlife Service, FWS/OBS079/31.

Eggers, S.D. and Reed, D.M. Version 3.2 July 2015. *Wetland Plants and Plant Communities of Minnesota and Wisconsin.* U.S. Army Corps of Engineers, Saint Paul District. Saint Paul, Minnesota.

Scheffer, M., S. Szabo, A. Gragnani, E.H. van Nes, S. Rinaldi, N. Kautsky, J. Norberg, R.M.M. Roijackers and R.J.M. Franken. 2003. Floating plant dominance as a stable state. PNAS, 100:7, p. 4040–4045.

U.S. Fish and Wildlife Service. 1956. *Wetlands of the United States Circular 39.* U.S. Government Printing Office, Washington, D.C.

Appendix A

MNRAM Guidance for Wetland Assessments and Management Classifications

Sochacki Park Subwatershed Assessment

Comprehensive General Guidance

for
Minnesota Routine Assessment Method (MnRAM)
Evaluating Wetland Function, Version 3.4 (beta)

9/15/2010

Table of Contents

1.0 Introduction to MnRAM

1.1 History

The Minnesota Routine Assessment Method (MnRAM) for Evaluating Wetland Functions originally was devised soon after the passage of the Wetland Conservation Act (WCA) in 1991. An interagency wetland workgroup sought to fill the need for a practical assessment tool that would help local authorities make sound wetland management decisions as they assumed responsibility for regulating wetland impacts.

Although the original version was soon updated to MnRAM Version 2.0 (in 1998), the fundamental approach of applying descriptive rather than numeric ratings was maintained. In subsequent years, development of heavily quantitative methods on the national level and demand for a more refined procedure on the local level led to the formation of another workgroup in January 2002. Starting with both the MnRAM Version 2.0 and a database version sponsored by an EPA grant, the workgroup examined every function, question by question, with the goal of developing a numeric model.

1.2 Functions and Values

Because land use decisions involving wetlands typically consider both functions and values, MnRAM has always included some value-related questions. Although a primary focus in this version of MnRAM is on the functional aspect of wetlands, some strictly value-related aspects are included, such as "Aesthetics" and "Commercial Uses." Value-related considerations are incorporated into some of other evaluated functions, as well. WCA Rules Chapter 8420.0103 sets out the functions and public values that are to be considered; these include public recreation and education.

1.3 User Advisories

MnRAM provides an organized, consistent procedure to document observations and conclusions about wetland processes. It is a systematic way of documenting best professional judgment. MnRAM would be considered a Tier 2 assessment methodology, a rapid assessment method. MnRAM is intended for routine planning and inventory applications as well as for project-specific evaluations. Using it requires experience and training in wetland science, since professional judgment is incorporated in several questions.

Current scientific understanding of wetlands and indicators limits our ability to predict which wetlands are ecologically sound; other limiting factors include time, expertise, and training of the people performing the evaluation. For more difficult or controversial sites, it is recommended that a diverse team of professionals conduct the evaluation together or that other more detailed assessment methods be considered.

A preliminary review of reference material such as soil data, topography, watersheds, inlets, outlets, land uses, aerial photographs, and other information is recommended prior to assessing a wetland. Establishing the history and setting of the wetland under evaluation will speed the field assessment. Questions that can potentially be answered utilizing other information sources, maps in the office, or digital data in a Geographic Information System (GIS) are marked with a "~" in the margin (in the printed version) or in red text (in the digital format). With training, practice, and experience, the fieldwork for an evaluation of a small wetland (< 1 acre), under normal circumstances (assuming background information regarding topography, watersheds, inlets and outlets, land use, etc. has been previously gathered) in an area familiar to the evaluator(s) can be completed in less than one hour.

Wetland assessments using this methodology cannot be conducted without a site visit. Even with photos, maps, and written notes, questions will arise that should only be answered at the site. Bringing the database into the field on a laptop will prove to be the most efficient way to document wetland conditions. For uncomplicated sites, paper score sheets are available which correspond to a Microsoft Excel™ spreadsheet containing the formulas for computing the functional indices. Immediate field data-entry reduces the potential for interpretation and data-entry errors compared to gathering data in the field and trying to translate that into an assessment later.

1.4 Assessment Sites

This assessment method is intended to be applied to existing wetlands or potential restoration sites. If evaluating a wetland to determine the functions based on some projected conditions, it is necessary to assess the current status of the wetland/basin, as well. See Section 1.11 for more about using MnRAM for regulatory purposes.

1.5 MnRAM Database

The full MnRAM methodology has been programmed into a Microsoft Access™ database within which all data can be entered and stored. The database computes each functional indices using a formula. One of the fundamental benefits of a database program and this methodology in particular is that information is tabulated and stored for each of the 72 wetland parameters evaluated as well as the wetland location, other general information, and computed functional indices. The database can store records for multiple wetlands, grouped into projects or kept individually available. Wetland data can then easily be compiled into a single, central database. In addition, the database allows for the ability to analyze individual pieces of data for selected groups of wetlands or all wetlands within the database or to evaluate groups of parameters on groups of wetlands. Flexibility for conducting analyses is one of the most powerful aspects of this methodology.

1.6 Wetland Ranking

MnRAM uses numeric ranking; great care should be taken to use the results in light of local conditions and based on a landscape-level management plan. People, not the assessment, will decide what combination of functions are the most important. Each wetland is part of an integrated ecological system that should not be thought of as a group of distinct packages, but really an assemblage of interactive elements.

1.7 Wetland Management Classification

Determining the relative value of each function is an activity that must take place after the assessment is complete, in a management and planning context. A basic framework for applying wetland functions and values information to management is supplied in an associated document entitled “Management Classification.” This is one basic method of applying the results of a complete assessment of wetlands within a defined management area (e.g. watershed, city, county, etc.) where the wetland functions are the basis for various management strategies.

Standards are suggested that could be applied to meet the general goals of each classification level.

The management classification includes an approach for dealing with watersheds that have few high-quality wetlands remaining. In short, if the best wetlands in an area rate "Medium" using MnRAM, an adjustment of the scale for ranking wetlands is imperative. These policy-based decisions are discussed in the management classification document.

For ease of use, both the "classic" and "increased protection" Management Classification results are shown on the summary page of the database. Other options for using the data, or for modifying the management classification scheme, are possible. Landscape differences, local values, and community preferences will guide the final determination for how the data collected via MnRAM are used.

1.8 Reference Standard Wetlands

Reference standard wetlands were defined in MnRAM 2.0 as those judged to have the highest level of overall sustainable functional capacity for that type in the Wetland Comparison Domain. In that method, the wetland under investigation was to have been compared to the reference wetland before the evaluation took place.

In the later versions of MnRAM, it is not necessary to have pre-established physical reference standard wetlands. As an assessment tool, MnRAM may be part of an initial effort to inventory local wetlands and establish such reference sites. A subject wetland will fall into place on a watershed-based ranking after many wetlands have been evaluated. Only in comparison with these compiled results will planning watershed priorities be possible.

1.9 Functional Ratings

MnRAM was developed using the concept of ideal theoretical, pre-European-settlement wetland condition as the baseline. In highly urban or agricultural watersheds, few basins may fall into the High category. Local authorities will need to take this into account when establishing a scale for management decisions (see "Wetland Management Classification," above).

Each wetland function will be rated with a numeric index according to the formulas or decision trees accompanying this methodology. The scoring system is from 0.001 to 1.0 signifying low to high[1], respectively; in the instances where an exceptional rating applies, a score of 2 accentuates the rarity. For yes-no questions, yes will receive a score of 1 and no will receive a score of zero*. Each wetland function then receives an index score with ratings as follows:

Functional Ratings	Question Score	Functional Index Score
• **Exceptional:**	**2.0**	**1.01 - 2.00**
• **High:**	**1.0**	**0.66 - 1.00**
• **Medium:**	**0.5**	**0.33 - 0.65**
• **Low:**	**0.1**	**0.001 - 0.32**
• **Not Applicable:**	**N/A**	**0.0**

[1] Ammann and Stone, 1991

* Some questions worded yes-no are actually yes-not applicable; use caution when scoring by hand.

MnRAM includes numeric as well as general ratings. The numeric ratings are based on standardized formulas to achieve consistency among users and are, in effect, placeholders for the general rating categories of exceptional, high, medium, and low. Great care should be taken when interpreting the results. In particular, the general and numeric ratings should not be summed or averaged across different functions (or for different wetlands). Mixing the ratings of disparate functions (or different wetlands) can be misleading if not meaningless. The primary intent of MnRAM is to provide a function-by-function rating for individual wetlands (or plant communities). See discussion below regarding comparison of different wetlands.

1.10 Comparison of Two or More Wetlands

The optimum method of comparison using MnRAM ratings is that between wetland plant communities of the same type ("apples to apples") where a reference standard wetland is used. "Wetland type" refers to the wetland plant communities described in MnRAM.[2] A reference standard wetland includes the highest functioning example(s) of a specific plant community within a watershed or ecoregion. It serves as the baseline for comparing the MnRAM ratings among examples of the same plant community. For example, the reference standard hardwood swamp may have four high, two medium, and two low ratings while the hardwood swamp within a particular project site may have two medium and six low ratings. Or, if a particular function(s) is of most concern, the MnRAM rating for that specific function can be compared between examples of the same plant community within the study area.

Comparisons between examples of the same plant community type can be valid without a reference standard wetland. Because there is no baseline for the highest functioning example of a particular wetland plant community type, care must be taken to place the subject wetland in the proper context. For example, all the sedge meadows within an agricultural site may be lower functioning due to agricultural impacts, while all the sedge meadows within a northern Minnesota site may be high functioning because of the lack of disturbances.

Comparisons of function-by-function MnRAM ratings between different wetland plant community types ("apples to oranges") are problematic because different wetland plant community types function differently. Not all wetlands are flow-through wetlands, or shoreland wetlands, or provide fish habitat, or support amphibians, or have a woody canopy. While some functions are provided by nearly all wetlands, the process and intensity of those functions can be different among different plant community types. Great care is advised when drawing conclusions from "apples to oranges" comparisons. The greater the disparity between wetland plant community types, the less valid the comparison becomes. Comparing the functional levels of, for example, a precipitation-driven bog versus a floodplain forest is of little utility.

For planning purposes, the wetland function(s) of greatest concern in a particular study area could be identified. MnRAM analyses could then identify those wetlands ranked exceptional or high for that function(s).

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[2] Further refinement of this approach is to define "wetland type" as the wetland plant community + HGM classification (e.g., depressional, slope, lacustrine fringe, organic flat). For example, sedge meadow communities on slopes may have a different water source and hydroperiod than those in depressions.

1.11 Uses of MnRAM for Regulatory Purposes

MnRAM is a qualitative approach to identifying wetland functions. Because the input is qualitative the output is qualitative. Therefore, MnRAM ratings should not be used to quantify impacts or compensatory mitigation.

Evaluating the pre- and post-project condition of a particular wetland is often part of the regulatory process. Be advised that MnRAM is typically not sensitive enough to show changes in the functional ratings that are commensurate with the differences between pre- and post-project conditions.

Determining general compensatory mitigation needs based on a MnRAM analysis of a wetland that is proposed to be impacted is appropriate for regulatory purposes. For example, if the wetland to be impacted has four high ratings and four medium ratings, the focus of the compensation would be to design and establish compensation that replaces those specific high and medium functional ratings. This is a qualitative measure, not a quantitative one.

MnRAM has four options for the vegetative diversity/integrity function ranging from individual ratings for each plant community to averaging the ratings of two or more plant communities. For regulatory purposes, the individual rating for vegetative diversity/ integrity should be used (unless all of the plant communities have the same rating for this function). Averaging high and low ratings, for example, yields a medium rating that obscures the presence of the high-rated plant community. Averaging is not appropriate because the high-rated plant community may prompt important regulatory considerations such as avoidance or special consideration for compensatory mitigation. A second option for the vegetative diversity/integrity function—highest-rated plant community—is also appropriate for regulatory purposes.

1.12 Wetland functions/value characteristics evaluated:

1. Maintenance of Characteristic Vegetative Diversity/Integrity
2. Maintenance of Hydrologic Regime
3. Flood/Stormwater Attenuation
4. Downstream Water Quality
5. Maintenance of Wetland Water Quality
6. Shoreline Protection
7. Maintenance of Characteristic Wildlife Habitat Structure
8. Maintenance of Characteristic Fish Habitat
9. Maintenance of Characteristic Amphibian Habitat
10. Aesthetics/Recreation/Education/Cultural
11. Commercial Uses
12. Ground Water Interaction

Additional Evaluation Information

1. Restoration Potential
2. Sensitivity to Stormwater & Urban Development
3. Additional Stormwater Treatment Needs

Each characteristic is described in more detail in the Formulas section.

2.0 Wetland Classification Systems

This section summarizes methods that can be utilized to classify wetland resources. The last part of this section describes critical wetland resource designations.

2.1 Dominant Vegetation

Identify and record the dominant plant species within each plant community using the 50/20 Rule[3], along with rare, endangered, or threatened species. For each plant species, record the scientific name, common name, typical stratum, and regional indicator status[4] for each wetland; preferably these should be stored in the project Microsoft® Access database. The definitions of hydrologic indicator status are:

OBL: Obligate Wetland Plants occur almost always (estimated probability >99%) in wetlands under natural conditions, but may also occur rarely (estimated probability <1%) in nonwetlands.

FACW: Facultative Wetland Plants occur usually (estimated probability 67% to 99%) in wetlands, but also occur (estimated probability 1% to 33%) in nonwetlands.

FAC: Facultative Plants have a similar likelihood (estimated probability 33% to 67%) of occurring in both wetlands and nonwetlands.

FACU: Facultative Upland Plants occur sometimes (estimated probability 1% to 33%) in wetlands, but occur more often (estimated probability >67% to 99%) in nonwetlands.

UPL: Obligate Upland Plants occur rarely (estimated <1%) in wetlands, but occur almost always (estimated probability >99%) in nonwetlands under natural conditions.

Note: Categories were originally developed and defined by the USFWS National Wetlands Inventory. Regional panels assigned the indicator status for individual plant species. The three facultative categories are subdivided by (+) and (-) modifiers.

2.2 Topographic Setting

Classify each inventoried wetland by its topographic setting[5] based on a field evaluation and review of available stormwater infrastructure data:

Floodplain: (8420.0110, subp. 19) A floodplain wetland is a wetland located in the floodplain of a watercourse, with no well defined inlets or outlets, including tile systems, ditches, or natural watercourses. This may include the floodplain itself when it exhibits wetland characteristics.

[3] The 50/20 Rule, detailed in the 1987 Corps of Engineers Wetland Delineation Manual, describes a method of considering dominance within each stratum. All dominants are treated equally in characterizing the plant community to determine whether hydrophytic vegetation is present. The most abundant plant species (when ranked in descending order of abundance and cumulatively totaled) that immediately exceed 50 percent of the total dominance measure for a given stratum, plus any additional species comprising 20 percent or more of the total dominance measure for that stratum are considered dominant species for the stratum. Dominance measures include percent areal coverage and basal area, for example.

[4] in accordance with *The National List of Plant Species that Occur in Wetlands* (Reed, 1988).

[5] as defined in Minnesota Rules Chapter 8420.0110 (Wetland Conservation Act).

Flow-through: (8420.0110, subp. 20) A flow-through wetland has a well-defined outlet and one or more well defined inlets.

Isolated: (8420.0110, subp. 28) An isolated wetland is without a well-defined inlet or outlet.

Riverine: (8420.0110, subp. 43) A riverine wetland is a wetland contained in the banks of a channel that may contain moving water or that forms a connecting link between two bodies of standing water.

Shoreland: (8420.0110, subp. 44a) A shoreland wetland is a wetland located along the shoreline of a lake or edge of a deepwater habitat.

Tributary: (8420.0110, subp. 48) A tributary wetland has a well-defined outlet but is lacking a defined inlet.

Other: A wetland that does not fit into one of the three previously mentioned groups.

2.3 Circular 39

The *Wetlands of the United States* was published in 1959 by the U.S. Fish and Wildlife Service and is commonly referred to as "Circular 39"[6]. The Circular 39 Classification System was the first method that the U.S. Fish and Wildlife Service used to classify wetland basins in the U.S. It is composed of 20 wetland types of which eight are found in Minnesota. Wetland plant community types and some common vegetation found in each wetland type are provided in Table 2.1. A general description of each wetland type is provided below.

2.3.1 TYPE 1: SEASONALLY FLOODED BASIN, FLOODPLAIN FOREST

Soil is covered with water or is waterlogged during variable seasonal periods, but usually is well-drained during much of the growing season. This wetland type is found both in upland depressions and in overflow bottomlands. In uplands, basins or flats may be filled with water during periods of heavy rain or melting snow.

Vegetation varies greatly according to season and duration of flooding: from bottomland hardwoods to herbaceous plants. Where the water has receded early in the growing season, smartweeds, wild millet, fall panicum, chufa, various amaranths and other plants (i.e. marsh elder, ragweed, and cockleburs) are likely to occur. Shallow basins that are submerged only very temporarily usually develop little or no wetland vegetation.

2.3.2 TYPE 2: WET MEADOW, FRESH WET MEADOW, WET TO WET-MESIC PRAIRIE, SEDGE MEADOW, AND CALCAREOUS FEN

Soil is usually without standing water during most of the growing season, but is waterlogged within at least a few inches of the surface. Meadows may fill shallow basins, sloughs, or farmland sags, or these meadows may border shallow marshes on the landward side. Vegetation includes grasses, sedges, rushes and various broad-leaved plants. Common representative plants are *Carex* sp. (sedges), *Juncus* sp. (rushes), redtop, reed grasses, manna grasses, prairie cordgrass, and mints. Other wetland plant community types include low prairies, sedge meadows, and calcareous fens.

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[6] Shaw and Fredine, 1959

2.3.3 TYPE 3: SHALLOW MARSH

Soil is usually waterlogged early during the growing season and may often be covered with as much as 6 inches or more of water. These marshes may nearly fill shallow lake basins or sloughs, or may border deep marshes on the landward side. These are common as seep areas on irrigated lands. Vegetation includes grasses, bulrushes, spikerushes, and various other marsh plants such as cattails, arrowhead, pickerelweed, and smartweeds. Common representatives are reed, whitetop, rice cutgrass, *Carex,* and giant burreed.

2.3.4 TYPE 4: DEEP MARSH

Soil is usually covered with 6 inches to 3 feet or more of water during the growing season. These deep marshes may completely fill shallow lake basins, potholes, limestone sinks and sloughs, or they may border open water in such depressions. Vegetation includes cattails, reeds, bulrushes, spikerushes and wild rice. In open areas, pondweeds, naiads, coontail, watermilfoils, waterweeds, duckweed, water lilies, or spatterdocks may occur.

2.3.5 TYPE 5: SHALLOW OPEN WATER

Shallow ponds and reservoirs are included in this type. Water is usually less than 10 feet deep and is fringed by a border of emergent vegetation similar to open areas of Type 4. Vegetation (mainly at water depths less than 6 feet), includes pondweeds, naiads, wild celery, coontail, watermilfoils, muskgrass, waterlilies, and spatterdocks.

2.3.6 TYPE 6: SHRUB SWAMP; SHRUB CARR, ALDER THICKET

The soil is usually waterlogged during the growing season and is often covered with as much as 6 inches of water. Shrub swamps occur mostly along sluggish streams and occasionally on flood plains. Vegetation includes alders, willows, buttonbush, and dogwoods.

Table 2.1
Wetland Communities, Classification Systems, And Common Vegetation

Wetland Plant Community Types	Classification of Wetlands and Deep Water Habitats of the United States (Cowardin et al. 1979)	Fish and Wildlife Service Circular 39 (Shaw and Fredine 1971)	Examples of Common Vegetation
Shallow, Open Water	Palustrine or lacustrine, littoral; aquatic bed; submergent, floating, and floating-leaved	Type 5: Inland open fresh water	White water lily, Yellow water lily, Northern milfoil, Largeleaf pondweed
Deep Marsh	Palustrine or lacustrine, littoral; aquatic bed; submergent, floating-leaved; and emergent; persistent and nonpersistent	Type 4: Inland deep fresh marsh	Bullrushes, Cattail, Duckweed, Water shield
Shallow Marsh	Palustrine; emergent; persistent and nonpersistent	Type 3: Inland shallow fresh marsh	Cattails, Reed canary grass, Common reed
Sedge Meadow	Palustrine; emergent; narrow leaved persistent	Type 2: Inland fresh meadow	Sedges, Canada bluejoint, Fowl bluegrass
Fresh (Wet) Meadow	Palustrine; emergent; broad and narrow-leaved persistent	Type 1: Seasonally flooded basin of flat; Type 2: Inland fresh meadow	Reed canary grass, Sawtooth sunflower, Joe-pye-weed, Giant goldenrod
Wet to Wet-Mesic Prairie	Palustrine; emergent; broad- and narrow leaved persistent	Type 1: Seasonally flooded basin of flat; Type 2: Inland fresh meadow	Cattail, gayfeather, Prairie cordgrass, Slender rush, Black bentgrass
Calcareous Fen	Palustrine; emergent; narrow-leaved persistent; and scrub	Type 2: Inland fresh meadow	Dioecious sedge, Beaked spikerush, Needle beakrush, Shrubby cinquefoil
Open Bog	Palustrine; moss/lichen; and scrub/shrub; broad-leaved evergreen	Type 8: Bog	Bog moss, Leatherleaf, Bog rosemary, Cranberry
Coniferous Bog	Palustrine; forested: needle-leaved evergreen and deciduous	Type 8: Bog	Tamarack, Black spruce, Cotton grass, Leatherleaf
Shrub-Carr	Palustrine; scrub/shrub; broad leaved deciduous	Type 6: Shrub swamp	Meadow willow, Pussy willow, Uptight Sedge, Canada blue-joint grass
Alder Thicket	Palustrine; scrub/shrub; broad-leaved deciduous	Type 6: Shrub swamp	Speckled Alder, American elder, Narrowleaf meadowsweet, Cinnamon fern
Hardwood Swamp	Palustrine; forested; broad-leaved deciduous	Type 7: Wooded swamp	Black ash, Lake sedge, Ostrich fern, Marsh marigold
Coniferous Swamp	Palustrine; forested; needle-leaved deciduous and evergreen	Type 7: Wooded swamp	Northern white cedar, Cinnamon fern, Yellow birch
Floodplain Forest	Palustrine; forested; broad-leaved deciduous	Type 1: Seasonally flooded basin or flat	Silver maple, Canada wood-nettle, Canada hornwort, Green ash
Seasonally Flooded Basin	Palustrine; flat; emergent; persistent and non-persistent	Type 1: Seasonally flooded basin or flat	Willow-weed, Pennsylvania smartweed, Barnyard grass, White goosefoot

2.3.7 *Type 7: Wooded Swamps; Hardwood Swamp, Coniferous Swamp*

The soil is waterlogged at least to within a few inches of the surface during the growing season and is often covered with as much as 1 foot of water. Wooded swamps occur mostly along sluggish streams, on old riverine oxbows, on floodplains, on flat uplands, and in very shallow lake basins. Forest vegetation includes tamarack, white cedar, black spruce, balsam fir, red maple, and black ash. Northern evergreen swamps usually have a thick ground covering of mosses. Deciduous swamps frequently support beds of duckweeds, smartweeds, and other herbs.

2.3.8 *Type 8: Bogs; Coniferous Bogs, Open Bogs*

The soil is usually waterlogged and supports a spongy covering of mosses. Bogs occur mostly in shallow lake basins, on flat uplands and along sluggish streams. Vegetation is woody or herbaceous or both. Typical plants are heath shrubs, sphagnum moss, and sedges. In the North, leatherleaf, Labrador-tea, cranberries, *Carex*, and cottongrass are often present. Scattered, often stunted, black spruce, and tamarack may occur in northern bogs.

2.4 Cowardin[7]

This methodology was used to classify wetlands for the National Wetlands Inventory maps beginning in the late 1970's and early 1980's. The hierarchical structure progresses from Systems and Subsystems at the most general levels to Classes, Subclasses, and Dominance Types at the most specific levels. A comparison of Circular 39 and Cowardin wetland classifications along with the typical Cowardin classification symbols are provided in Table 2.2.

2.4.1 *System*

The term System refers to a complex of wetlands and deepwater habitats that share the influence of similar hydrologic, geomorphologic, chemical, or biological factors. The primary systems found in the Minnesota are Palustrine, Lacustrine, and Riverine.

L: Lacustrine (lakes and deep ponds) - Lacustrine Systems include wetlands and deepwater habitats with all of the following three characteristics:

1. Situated in a topographic depression or a dammed river channel;
2. Lacking trees, shrubs, persistent emergents, emergent mosses or lichens with greater than 30 percent areal coverage;
3. Total area exceeds 8 hectares (20 acres).

Basins or catchments less than 8 hectares in size are included if they have at least one of the following characteristics:

1. A wave-formed or bedrock feature forms all or part of the shoreline boundary; or
2. The catchment has, at low water, a depth greater than two meters (6.6 feet) in the deepest part of the basin.

[7] Cowardin et al,. 1979.

P: Palustrine (shallow ponds, marshes, swamps and sloughs) - Palustrine Systems include all nontidal wetlands dominated by trees, shrubs, persistent emergents, emergent mosses or lichens.

R: Riverine (rivers, creeks and streams) - Riverine Systems are contained in natural or artificial channels periodically or continuously containing flowing water. Upland islands or Palustrine wetlands may occur in the channel, but they are not part of the Riverine System.

2.4.2 SUBSYSTEM

The term Subsystem refers to a further subdivision of Systems into more specific categories. The Palustrine System has no subsystems associated with it while Lacustrine Systems have two Subsystems and Riverine Systems have four). Each Subsystem is unique for the System to which it applies.

L1: Limnetic - Extends outward from Littoral boundary and includes deepwater habitats within the Lacustrine System.

L2: Littoral - Extends from shoreward boundary to 2 meters (6 feet) below annual low water or to the maximum extent of non-persistent emergents, if these grow at greater than 2 meters.

R2: Lower Perennial

R3: Upper Perennial

R4: Intermittent

2.4.3 CLASS, SUBCLASS

The wetland Class is the highest taxonomic unit below the Subsystem level. The Class code describes the general appearance of the habitat in terms of either the dominant life form of the vegetation or the physiography and composition of the substrate. Life forms (e.g. trees, shrubs, emergents) are used to define classes because they are easily recognizable, do not change distribution rapidly, and have traditionally been used to classify wetlands. Finer differences in life forms are recognized at the Subclass level.

Mixed classes are used as sparingly as possible, under two main conditions: (1) The wetland contains two or more distinct cover types each encompassing at least 30 percent areal coverage of the highest life form, but is too small in size to allow separate delineation of each cover type; and (2) The wetland contains 2 or more classes or subclasses each comprising at least 30 percent areal coverage so evenly interspersed that separate delineation is not possible at the scale used for classification. Mixed subclasses are also allowed and follow the same rules for mixed classes[8].

AB: Aquatic Bed - Includes wetlands and deepwater habitats dominated by plants that grow principally on or below the surface of the water for most of the growing season in most years.
Subclasses include: AB1 = Algal, AB2 = Aquatic Moss, AB3 = Rooted Vascular, AB4 = Floating Vascular, AB5 = Unknown Submergent, and AB6 = Unknown Surface.

EM: Emergent - Characterized by erect, rooted, herbaceous hydrophytes, excluding mosses and lichens. This vegetation is present for most of the growing season in most years.

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[8] Cowardin et al., 1979

Subclasses include: EM1 = Persistent (plants that normally remain standing at least until the beginning of the next growing season), and EM2 = Nonpersistent (plants which fall to the surface of the substrate or below the surface of the water at the end of the growing season).

FO: Forested - Woody vegetation greater than 6 meters (20 feet) tall.

Subclass determination is based on which type represents more than 50 percent of the areal canopy coverage during the leaf-on period and Subclasses include: FO1 = Broad-leaved Deciduous, FO2 = Needle-leaved Deciduous, FO3 = Broad-leaved Evergreen, FO4 = Needle-leaved Evergreen, FO5 = Dead, FO6 = Deciduous, and FO7 = Evergreen.

SS: Scrub/Shrub - Woody vegetation less than 6 meters (20 feet) tall. The species include true shrubs, young trees (saplings) or trees that are small or stunted because of environmental conditions.

Subclass determination is based on which type represents more than 50 percent of the areal canopy coverage during the leaf-on period and include: SS1 = Broad-leaved Deciduous, SS2 = Needle-leaved Deciduous, SS3 = Broad-leaved Evergreen, SS4 = Needle-leaved Evergreen, SS5 = Dead, SS6 = Deciduous (used if deciduous woody vegetation cannot be identified on aerial photography as either Broad-leaved or Needle-leaved), and SS7 = Evergreen (used if evergreen woody vegetation cannot be identified on aerial photography as either Broad-leaved or Needle-leaved).

UB: Unconsolidated Bottom - Includes all wetlands and deepwater habitats with at least 25 percent cover of particles smaller than stones (less than 6-7 cm.), and a vegetative cover less than 30 percent.

2.4.4 WATER REGIME

Precise description of hydrologic characteristics requires detailed knowledge of the duration and timing of surface inundation, both yearly and long-term, as well as an understanding of groundwater fluctuations. Because such information is seldom available, the water regimes that, in part, determine characteristic wetland and deepwater plant and animal communities are described here in only general terms[9]. Water regimes are grouped under two major categories, Tidal and Nontidal. The Tidal Water Regime does not occur in Minnesota so is not described here.

A: Temporarily Flooded - Surface water present for brief periods during the growing season, but the water table usually lies well below the soil surface. Plants that grow both in uplands and wetlands are characteristic of this water regime. The temporarily flooded regime also includes wetlands where water is present for variable periods without detectable seasonal periodicity. Weeks, months, or even years may intervene between periods of inundation. The dominant plant communities under this regime may change as soil moisture conditions change.

B: Saturated - The substrate is saturated to the surface for extended periods during the growing season, but surface water is seldom present.

C: Seasonally Flooded - Surface water is present for extended periods especially early in the growing season, but is absent by the end of the growing season in most years. When surface water is absent, the water table is often near the land surface. The water table after

[9] Cowardin, et al., 1979

flooding ceases is highly variable, extending from saturated to a water table well below the ground surface.

F: Semipermanently Flooded - Surface water persists throughout the growing season in most years. When surface water is absent, the water table is usually at or very near the land surface.

G: Intermittently Exposed - Surface water is present throughout the year except in years of extreme drought.

H: Permanently Flooded - Water covers the land surface throughout the year in all years. Vegetation is composed of obligate hydrophytes.

2.4.5 SPECIAL MODIFIERS

Many wetlands and deepwater habitats are human-made and natural ones have been modified to some degree by the activities of humans or beavers. Since the nature of these modifications often greatly influences the character of such habitats, special modifying terms have been included here to emphasize their importance[10].

b: Beaver – Created or modified by a beaver dam.

d: Partly Drained – The water level has been artificially lowered, but he area is still classified as wetland because soil moisture is sufficient to support hydrophytes. Drained areas are not considered wetland if they can no longer support hydrophytes.

f: Farmed – The soil surface has been mechanically or physically altered for production of crops, but hydrophytes will become reestablished if farming is discontinued.

h: Diked/Impounded – Created or modified by a barrier or dam which purposefully or unintentionally obstructs the outflow of water. Both humans-made and beaver dams are included.

r: Artificial – Refers to substrates classified as Rock Bottom, Unconsolidated Bottom, Rocky Shore, and Unconsolidated Shore that were emplaced by humans, using either natural materials such as dredge spoil or synthetic materials such as discarded automobiles, tires, or concrete.

s: Spoil – Refers to the placement of spoil materials which have resulted in the establishment of wetland.

x: Excavated – Lies within a basin or channel excavated by humans.

[10] Cowardin, et al., 1979

Table 2.2
Circular 39 and Cowardin Wetland Classification Systems
Minnesota Routine Assessment Method for Evaluating Wetland Functions, Version 3.1

Circular 39 Type	SYSTEM SUBSYSTEM CLASS SUBCLASS	Common Water Regimes	Typical NWI Symbols (Cowardin System)
Type 1	PALUSTRINE (P) Emergent (EM) Persistent (1) Forested (FO) Broad-Leaf Deciduous (1)	Temporarily Flooded (A) Intermittently Flooded (J)	PEM1A PEM1J PFO1A PFO1J
Type 2	PALUSTRINE (P) Emergent (EM) Persistent (1)	Saturated (B)	PEM1B
Type 3	PALUSTRINE (P) Emergent (EM) Persistent (1)	Seasonally Flooded (C) Semipermanently Flooded (F)	PEM1C PEM1F
Type 4	PALUSTRINE (P) OR LACUSTRINE (L) Littoral (2) Emergent (EM) Aquatic Bed (AB) Unconsolidated Bottom (UB)	Semipermanently Flooded (F) Intermittently Exposed (G) Permanently Flooded (H)	PEMF L2EM2F PEMG L2EM2G PABF L2EM2H PABG L2ABF PUBF L2ABG PUBG L2ABH
Type 5	PALUSTRINE (P) OR LACUSTRINE (L) Limnetic (1) Littoral (2) Aquatic Bed (AB) Unconsolidated Bottom (UB)	Intermittently Exposed (G) Permanently Flooded (H)	PABG L2ABG PABH L2ABH PUBG L2UBG PUBH L2UBH L1UBH
Type 6	PALUSTRINE (P) Scrub-Shrub (SS) Broad/Needleleaf Deciduous (1,2) Broad/Needleleaf Evergreen (3,4) Dead (5)	All nontidal regimes except Permanently Flooded (A,B,C,F,J,G)	PSS1,2,3,4, or 5A PSS1,2,3,4, or 5B PSS1,2,3,4, or 5C PSS1,2,3,4, or 5F PSS1,2,3,4, or 5J PSS1,2,3,4, or 5G
Type 7	PALUSTRINE (P) Forested (FO)	All nontidal regimes except Intermittently Flooded and Permanently Flooded (A,B,C,F,J)	PFO1,2,4, or 5A PFO1,2,4, or 5B PFO1,2,4, or 5C PFO1,2,4, or 5F PFO1,2,4, or 5J
Type 8	PALUSTRINE (P) Scrub-Shrub (SS) Broad + Needleleaf Deciduous (1,2) Broad + Needleleaf Evergreen (3,4) Dead (5) Forested (FO) Broad + Needleleaf Deciduous (1,2) Broad + Needleleaf Evergreen (3,4) Dead (5) Moss-Lichen (ML) Emergent (EM)	Saturated (B)	PSS1,2,3,4, or 5B PFO1,2,3,4, or 5B PMLB PEMB
	RIVERINE (R) Lower Perennial (LP) Upper Perennial (UP) Intermittent (IN) Unconsolidated Bottom (UB)	Intermittently Exposed (G) Permanently Flooded (H)	RUBG RUGH

2.5 Critical Wetland Resource Designations

Wetlands in the assessment area should be evaluated for designation as critical resources based on several features defined in Minnesota Statutes. These critical wetland resources should be classified into the Preserve management class due to their special functions. Criteria for designating wetlands as critical resources are as follows:

- Outstanding Resource Value Waters (Minn. Rules 7050.0180)
- Designated Scientific and Natural Areas (Minn. Rules 86A.05)
- Wetlands with known occurrences of Threatened or Endangered Species (Minn. Stat. 84.0895)
- State Wildlife Management Areas (Minn. Stat. 86A.05, subpart 8)
- State Aquatic Management Areas (Minn. Stat. 86A.05, subpart 14).
- Wellhead Protection Areas (Minn. Stat. 103I.101, MN Rules Chapter 4720).
- Sensitive Ground Water Areas (MN Rules 8420.0548, Subp. 6).
- Designated trout streams or trout lakes (MN Rules 6264.0050).
- Calcareous fens (MN Rules 8420.1010 through 8420.1060).
- High priority areas for wetland preservation, enhancement, restoration and establishment (MN Rules 8420.0350, subpart 2).
- Designated Historic or Archaeological Sites
- State or federal designated wild and scenic rivers (MN Rule Chapter 7050)
- Mn Pollution Control Agency “special waters search” mapping utility: www.pca.state.mn.us/water/stormwater/specialwaters

2.6.1 OUTSTANDING RESOURCE VALUE WATERS

"Outstanding resource value waters" are defined in MN Rules 7050.0180 as waters within the Boundary Waters Canoe Area Wilderness; Voyageur's National Park; and Department of Natural Resources designated scientific and natural areas; wild, scenic, and recreational river segments; Lake Superior; those portions of the Mississippi River from Lake Itasca to the southerly boundary of Morrison County that are included in the Mississippi Headwaters Board comprehensive plan dated February 12, 1981; and other waters of the state with high water quality, wilderness characteristics, unique scientific or ecological significance, exceptional recreational value, or other special qualities which warrant stringent protection from pollution.

2.6.2 CALCAREOUS FENS

Calcareous fens are defined in MN Rules 8420.1020 as peat-accumulating wetlands dominated by distinct groundwater inflows having specific chemical characteristics. The water is characterized as circumneutral to alkaline, with high concentrations of calcium and low dissolved oxygen content. The chemistry provides an environment for specific and often rare hydrophytic plants[11]. Minnesota Rules 8420.1010-1070 sets out minimum standards and criteria for the identification, protection, and management of calcareous fens as authorized by Minnesota Statutes, section 103G.223. The MnDNR is charged with identifying and maintaining a list of calcareous fens in the state and maintains a database of them. Calcareous fens are also listed in the Classifications for Waters in Major Surface Water Drainage Basins[12]. Finally, the rules for

[11] MN Rules 8420.1020

[12] MN Rules 7050.0470

Nondegradation of Outstanding Resource Value Waters[13] also lists identified calcareous fens in the state.

2.6.3 SCIENTIFIC AND NATURAL AREAS

State scientific and natural areas (SNA) are established to protect and perpetuate, in an undisturbed natural state, those natural features which possess exceptional scientific or educational value (MN Statutes 86A.05). This may include but is not limited to any of the following features: geological processes; significant fossil evidence, an undisturbed plant community, an ecological community significantly illustrating the process of succession and restoration to natural condition following disruptive change; a habitat supporting a vanishing, rare, endangered, or restricted species of plant or animal; a relict flora or fauna persisting from an earlier period; or a seasonal haven for concentrations of birds and animals, or a vantage point for observing concentrated populations, such as a constricted migration route. The area should embrace an area large enough to permit effective research or educational functions and to preserve the inherent natural values of the area.

2.6.4 HABITAT FOR DESIGNATED ENDANGERED, THREATENED, OR SPECIAL CONCERN SPECIES

Endangered and threatened plant and animal species are protected in Minnesota as specified in MN Statutes 84.0895. In MN Statutes, Subp. 3, species of wild animal or plant are designated as:

1. **Endangered**, if the species is threatened with extinction throughout all or a significant portion of its range; or
2. **Threatened**, if the species is likely to become endangered within the foreseeable future throughout all or a significant portion of its range; or
3. **Species of special concern**, if although the species is not endangered or threatened, it is extremely uncommon in this state, or has unique or highly specific habitat requirements and deserves careful monitoring of its status.

In 1987, the Minnesota County Biological Survey (MCBS) began a systematic survey of rare biological features. The goal of the MCBS is to identify significant natural areas and to collect and interpret data on the distribution and ecology of rare plants, rare animals, and native plant communities. The MCBS data for the assessment area (if available) should be examined for sites with moderate, high and outstanding biologic diversity significance.

The MnDNR Natural Heritage and Nongame Research Program (Natural Heritage Program) collects, manages, and interprets information about nongame animals, native plants, and plant communities to promote the wise stewardship of these resources. The Natural Heritage Program has developed a ranking system that is intended to reflect the extent and condition of natural communities and species in Minnesota.[14] These ‘state ranks’ have no legal ramifications, they are used by the Natural Heritage Program to set priorities for research and for conservation planning. They are grouped as follows:

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[13] MN Rules 7050.0180, Subp. 6

[14] Aaseng et al., 1993.

State Element Rank:

S1: Critically imperiled in the state because of extreme rarity (5 or fewer occurrences or very few remaining individuals or acres) or because of some factor(s) making it especially vulnerable to extirpation from the state.

S2: Imperiled in state because of rarity (6 to 20 occurrences or few remaining individuals or acres) or because of some factor(s) making it very vulnerable to extirpation from the state.

S3: Rare or uncommon in state (on the order of 21 to 100 occurrences).
S4: Apparently secure in state with many occurrences.
S5: Demonstrably secure in state and essentially ineradicable under present conditions.
SH: Of historical occurrence in the state, perhaps having not been verified in the past 20 years, and suspected to be still extant.

SN: Regularly occurring, usually migratory and typically nonbreeding species for which no significant or effective habitat conservation measures can be taken in the state.

SR: Reported from the state, but without persuasive documentation which would provide a basis for either accepting or rejecting the report.

SRF: Reported falsely.

SU: Undetermined. Possibly in peril in the state but status uncertain; need more information.

SX: Extirpated within the state.

The Natural Heritage Program information database should be searched to determine if any endangered, threatened, or special concern species have been sighted within 500 feet of the assessment area. The list of species, the subwatershed location, legal protection status, state element rank and county should be compiled.

2.6.5 State Wildlife Management Areas

State wildlife management areas are established to protect those lands and waters which have a high potential for wildlife production and to develop and manage these lands and waters for the production of wildlife, for public hunting, fishing, and trapping, and for other compatible outdoor recreational uses[15]. State wildlife management areas satisfy the following criteria:

1. Includes appropriate wildlife lands and habitat, including but not limited to marsh or wetlands and the margins thereof, ponds, lakes, stream bottomlands, and uplands, which permit the propagation and management of a substantial population of the desired wildlife species; and
2. Includes an area large enough to ensure adequate wildlife management and regulation of the permitted recreational uses.

A map of all MnDNR Wildlife Management Areas can be found at: www.dnr.state.mn.us/maps/compass.html.

2.6.6 Designated Trout Streams and Lakes

Designated trout streams and lakes in the state of Minnesota are inhabited by trout other than lake trout. Fishing and other restrictions have been placed on these waterbodies to protect and

[15] MN Statute 86A.05, subpart 8

foster the propagation of trout. Wetlands associated with these lakes are an integral part of the whole ecosystem that functions to maintain the characteristics necessary to support the fishery.[16]

2.6.7 AQUATIC MANAGEMENT AREAS

Minnesota Statutes 86A.05, Subpart 14, allows for the establishment of aquatic management areas to protect, develop, and manage lakes, rivers, streams, and adjacent wetlands and lands that are critical for fish and other aquatic life, for water quality, and for their intrinsic biological value, public fishing, or other compatible outdoor recreational uses. Aquatic management areas may be established to protect wetland areas under ten acres that are donated to the department of natural resources. Aquatic management areas must meet one or more of the following criteria:

1. Provides angler or management access;
2. Protects fish spawning, rearing, or other unique habitat;
3. Protects aquatic wildlife feeding and nesting areas;
4. Protects critical shoreline habitat; or
5. Provides a site for research on natural history.

2.6.8 WELLHEAD PROTECTION AREAS

Wellhead protection is defined as a method of preventing well contamination by effectively managing potential contaminant sources in all or a portion of the well's recharge area. The statutory authority for wellhead protection comes from Minnesota Statutes 103I.101. The rules for establishment of Wellhead Protection Plans are found in Minnesota Rules Chapter 4720, which are administered by the Minnesota Department of Health. Wetlands present within wellhead protection areas are likely to be predominantly recharge wetlands. Since wetlands typically collect surface water runoff from a larger upland area, recharge wetlands within wellhead protection areas have a greater probability of transmitting pollutants to a public groundwater supply than other wetlands. Wellhead protection plans are developed and implemented by the public water supplier, which is typically a city or the Minnesota Department of Health. The state rules governing wellhead protection can be accessed on the web at: www.revisor.leg.state.mn.us/arule/4720/.

2.6.9 SENSITIVE GROUNDWATER AREAS

The Wetland Conservation Act requires that projects proposing to impact wetlands must evaluate whether the impacts would have an adverse impact on groundwater quality[17]. If it is determined that a proposed replacement plan would have a significant adverse impact on groundwater quality, the replacement plan must be denied. Wetlands determined to be primarily recharge wetlands as a result of a functional assessment using *MNRAM Version 3.1* should be evaluated for the potential to affect groundwater resources[18].

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[16] A list of all state trout streams and lakes can be found at: www.revisor.leg.state.mn.us/arule/6264/

[17] Minnesota Rules 8420.0548, Subpart 6

[18] Evaluate according to the guidelines in: *Criteria and Guidelines for Assessing Geologic Sensitivity of Ground Water Resources in Minnesota*, Minnesota Department of Natural Resources, 1991.

2.6.10 High-Priority Areas for Wetland Preservation, Enhancement, & Restoration

Water management plans prepared by water management organizations in the metropolitan areas under Minnesota Statutes, section 103B.231 must identify those areas that qualify as high priority areas for wetland preservation, enhancement, restoration, and establishment[19]. These priority areas shall be included in the next scheduled water management plan update. Plans should give strong consideration to identifying as high priority areas, minor watersheds having less than 50 percent of their original wetland acreages, and intact wetlands, diminished wetlands, and the areas once occupied by wetlands that have been diminished or eliminated and could feasibly be restored taking into account the present hydrology and use of the area. Plans should give strong consideration to identifying as high priority areas all type 1 or 2 wetlands, and other wetlands at risk of being lost by permanent conversion to other uses. When individual wetlands are identified as high priority for preservation and restoration, the high priority area shall include the wetland and an adjacent buffer strip not less than 16.5 feet wide around the perimeter of the wetland and may include up to four acres of upland for each wetland acre.

Plans may identify additional high priority areas where preservation, enhancement, restoration, and establishment of wetlands would have high public value by providing benefits for water quality, flood water retention, public recreation, commercial use, and other public uses. High priority areas should be delineated by minor or major watershed.

2.6.11 State and Federal Designated Scenic and Wild Rivers

The rules for the protection of state designated scenic and wild rivers is set forth in Minnesota Rules Chapter 6105[20] as administered by the MnDNR. Wild rivers are defined as those that exist in a free-flowing state with excellent water quality and with adjacent lands that are essentially primitive and scenic rivers are defined as those that exist in a free-flowing state with adjacent lands that are essentially primitive. Management plans must be developed before a river can be included in the wild and scenic river system. The plans must give emphasis to the preservation and protection of the area's scenic, recreational, natural, historic, and similar values while placing no unreasonable restrictions upon compatible, preexisting, economic uses of particular tracts of land.

[19] Minnesota Rules 8420.0350, Subp. 2

[20] The state rules can be accessed at: www.revisor.leg.state.mn.us/arule/6105/.

3.0 Field Assessment and Data Analysis Procedures (sample)

In any inventory project, the data collected should include: wetland location and extent, digital photographs of each wetland, wetland classification, dominant vegetation, wetland functions, hydrologic regime, and identification of potential restoration sites within larger assessment areas.

In general, begin by specifically defining the assessment area. Create baseline wetland inventory and assessment maps utilizing available information including: Minnesota Department of Natural Resources Public Waters Inventory maps, National Wetlands Inventory maps, soil survey data, parcel data, topography, and digital orthoquad aerial photographs to help identify wetland areas. The presence of each wetland should be verified in the field. Dominant wetland types may be classified using any one of the classification systems described in Section 2.0[21], in addition to, at the very least, the U.S. Fish and Wildlife Service Cowardin System[22].

The following sample procedure is excerpted from documentation of a Minnehaha Creek wetland inventory project.

3.1 Field Assessment Maps/Data

The total watershed area within which the Functional Assessment of Wetlands (FAW) was conducted covers about 181 square miles. Maps were created for field use to locate sites, to assist in completing the wetland assessments, and to act as a field notebook for recording necessary data. Each field map covered one full section of land (one square mile).

3.2 Wetland Base Data: Hennepin Conservation District Wetland Inventory

The Hennepin Conservation District (HCD) had conducted a remote sensing wetland inventory (HCWI) within the District prior to the beginning of this project. The wetlands that had been identified in the inventory were used as a base layer for the FAW field maps to show where existing and potential wetlands are located. In conducting the wetland inventory, HCD followed a stepped procedure, described below.

First, potentially drained wetlands were identified based on depressional areas with hydric soils or transitional soils, or poorly drained depressions identified on the soil survey without clear evidence of wetland hydrology. Areas identified on the NWI were included. Areas appearing on the Metropolitan Mosquito Control maps were also highlighted, as these are known to pond water periodically.

Next, areas that appeared to have wetland hydrology on infrared (IR) stereo photos, as identified by tone, texture, and presence of a depression, were identified. Then, aerial photography from the past 15 years was evaluated in combination with data of yearly precipitation (wet, normal, dry) to evaluate wetlands that were identified during the IR and soil/topography review. During the aerial photography review each high lighted site was defined as either: (1) dry cropped, (2) dry and no crop, (3) wet and crop stress, (4) wet and no crop, (5) wet and drowned out, or (6) ponded.

[21] Classify wetlands using the U.S. Fish and Wildlife Service Circular 39 System, Shaw and Fredine, 1959.
[22] Cowardin et al., 1979.

Areas that appear to have wetland hydrology every year and do not appear to be drained were classified as wetlands with unaltered hydrology (EWET and shown as green polygons on the base maps) in the GIS. The areas showing evidence of wetland hydrology in one-third or more ‘normal’ precipitation years were classified as wetlands with altered hydrology (AWET and shown as blue polygons on the base maps). Estimated restorable areas that did not appear to have wetland hydrology during at least one-third of the normal precipitation years, or could not be observed due to tree cover, were identified as potential wetlands (RWET yellow polygons on the base maps) in the GIS. The extent of these potential wetlands was determined using either: 1) the size during the wettest year, 2) the boundary of the depressional soil unit on the soil survey, and/or 3) the boundary of the NWI or Mosquito Control District mapping.

3.3 Field Assessment Base Data

Each wetland polygon or wetland complex identified in the inventory was given a unique Wetland ID number. The ID number consists of the township number, followed by the range number, followed by the section number and finally a unique three-digit number for each wetland within the section. A letter designation (D or E) is placed at the beginning of the wetland ID. A “D” indicates that the wetland is completely or partially drained and an “E” indicates that there was not clear evidence that the wetland has been hydrologically altered. Other data on the base maps included soil type and inclusions and the approximate acreage of each wetland. Color aerial photographs from 2000 were used as a base layer on the field maps for the FAW under the wetland polygons and soil data. In addition, section numbers, parcel lines, road names, and subwatershed boundaries were added to the field maps that were plotted at a scale or 1 inch equals 200 feet.

Separate topography maps were created for use in the field. The topography maps were created in ArcView 8 using 5-ft contours with a subtle hill shading and the ~160 subwatershed boundaries at a scale of approximately 1 inch equals 800 feet. The topography maps were made at a larger scale, to include complete subwatershed areas for assessing wetland location within a subwatershed and proximity to recreational water bodies.

3.4 Field Assessment Procedures

The section maps, topographic maps, digital camera and a letter explaining the project to property owners were used each day during fieldwork. All existing wetlands and all potential wetlands greater than 0.25 acre were evaluated in the field for wetland function and for restoration potential. If potential wetlands under 0.25 acres in size were found to contain rare and/or unique features, they were assessed.

Property owners were informed of the project by publishing public notices in each local newspaper and/or newsletter. To begin an assessment, the property owner was identified using the parcel lines on the maps and an attempt was made to contact the owner. If the property owner was available, the field evaluator briefly described the project and asked the owner for permission to access the wetland(s) on their property. If the property owner refused access, a note was made on the section map.

The objective of the field assessment was to answer all questions in the Access database, excluding those highlighted in red that were evaluated using existing digital data analyzed using GIS. This included an evaluation of the presence and abundance of hydrophytic and invasive vegetation to identify and appraise the plant community, seeking out surface drain tile inlets, ditches or any other drainage feature to identify hydrogeomorphology, litter and buffer of the wetland, land-use within the subwatershed, and apparent public use of the wetland. The soil and topography maps were used in the field to determine the presence of hydric soils, and the topographic position of each wetland within the subwatershed. Both the Cowardin and Circular 39 classifications were assigned to each wetland during the field assessments.

3.5 Field Map Notation

Field notes were written on the maps using a permanent marker, preferably in red. Each evaluated wetland or potential wetland was marked on the map using the following mapping symbols:

- **NW** = **Not Wetland**: Identified as a wetland or potential wetland on the inventory but observed to be dominated by upland vegetation in the field; these would typically be accompanied by an **X** through the wetland polygon.
- **A =** **Assessed Wetland:** wetlands that were assessed in the field.
- **NA** = **Not assessed**: typically wetlands below the threshold size of 0.25 acres and identified as potential wetlands in the inventory or wetlands present on inaccessible private property
- **NAW** = **Not Assessed Wetland:** wetlands that were not assessed, but were verified as a wetland, typically classified as potential wetlands and less than 0.25 acres in size with no unique or notable characteristics.
- **SW** = **Stormwater Pond:** clearly excavated out of upland and created to manage stormwater.
- **R =** **Restorable Wetland:** drained wetlands that were only assessed for restoration potential.

Wetland boundaries were revised on field maps when field evaluations indicated a significant difference in the edge of dominant hydrophytic vegetation from the inventory mapping. If a wetland boundary was changed, an "X" was written through the old boundary to indicate the creation of a new boundary.

3.6 Guidelines for Field Map Notation

New wetland IDs were assigned to new wetlands found in the field but not identified on the inventory or portions of large wetland complexes that needed to be split. The database was reviewed to find the next sequential "D" or "E" designation ID number for the section in which the majority of the wetland resides. The new Wetland ID was entered into the database and the new ID was written within or next to the wetland polygon on the map.

Wetlands separated by roads or railroads (i.e. those with only a restricted hydrologic connection and no ecological connection) were evaluated as unique wetlands. Partially drained wetlands that were determined to be restorable were evaluated as wetlands and for restoration potential. In this case, the existing wetland areas were labeled with an **A** and the drained portions were labeled separately with an **R**, but all parts of the wetland basin were identified with the same Wetland ID.

At completion of each day, or the completion of a section, the dates and persons conducting field evaluations were indicated in the upper right corner of each map, and 'COMPLETE' was written in the upper left corner when the entire section was completed. If there were wetlands crossing the section line that have not been fully assessed or mapped they were indicated in the upper left corner of the map.

3.7 Photographs

A digital photograph was taken of each evaluated wetland and drained wetland that was assessed for restoration potential. An arrow was drawn on the map with the point of the arrow at the point where the photograph was taken from, indicating the approximate direction of the photo. Photographs were tracked by writing the photo number next to the location arrow. The photo point locations were digitized in GIS within the corresponding wetland polygon, and UTM coordinates for each point were generated. A list could also be made in a field book indicating the Wetland ID and the photograph number. Each photograph was subsequently renamed using the unique Wetland ID (i.e. D1172401001).

3.8 Identifying Potential Wetland Mitigation Sites

All drained wetlands identified in the inventory and other drained wetlands identified in the field were evaluated for the potential to restore those wetlands. Wetlands with restoration potential typically met one or more of the following conditions:

- Mapped hydric soils or hydric soil inclusions
- Wetland hydrology signatures on past aerial photos
- The area was a depression in the landscape
- Wetland hydrology was currently absent within part or all of the depression
- Evidence of ditching, tiling, or other feature that has removed the hydrology should be present
- Drained wetlands within permanently altered land uses (i.e. golf courses) were determined to not be restorable in most cases.

The approximate restorable area was delineated on the map, even if it was adjacent to an existing wetland. The currently non-wetland area which has potential to be restored was marked with an **R** to indicate which Wetland ID the restored area was associated with. A photograph was taken and the photo point was indicated on the map.

3.9 Procedures for Field Work

The functions of each wetland were evaluated by completing the Microsoft Access® database using laptop computers that were carried in the field. The wetland records from all field crews were combined by exporting completed records and importing them into a master database.

The photo ID number generated by the digital camera for each wetland photo was entered into the database which also corresponded to the photo number indicated on the field maps to allow easier tracking. For each assessed wetland, the field evaluator recorded their initials and the date of the assessment within the database for future reference. The database contains *The National List of Plant Species that Occur in Wetlands*[23], which includes common and scientific names and the indicator status for each species. This list was used for entering the dominant plant species (typically those dominants according to the 50/20 rule) within each wetland along with the cover class for each species.

When there were numerous species of one type (i.e. willow, sandbar); the appropriate species was used when known, otherwise the general name was used. When wetlands with uncommon vegetation (e.g. sedges, tamarack, sphagnum moss, bog species) were evaluated, those species were recorded, even if they weren't dominant for the entire wetland. Species were

[23] Resource Management Group, 1999.

usually selected from the drop-down list to avoid misspellings and improper names. If a species was not present in the plant list, it was added to the species list.

Upon return to the office, each assessed wetland was checked to verify that there was one complete Access database record, one digital photograph, and one wetland polygon marked with an A or an R on the field maps. Also, maps were checked for initials of the field evaluator, and the dates of the fieldwork.

4.0 GIS Procedures (sample)

The following sample procedure is excerpted from documentation of a Minnehaha Creek wetland inventory project.

4.1 GIS Wetland Shapefile

The field evaluation notation for each wetland was entered into the ArcView wetland shapefile table and the wetland boundaries were revised to note any significant changes to the inventory. This included: adding new wetland boundaries, deleting incorrect boundaries, merging wetland polygons, and splitting wetland polygons. Field assessment notations were added in GIS according to those listed in the Field Evaluation Notation section above. Following are some of the general guidelines followed in updating the inventory wetland shapefile:

- Upon completion of the FAW, each Wetland ID should only have ONE wetland polygon with an **A** in the *Assessment* field.
- Wetland polygons from the HCWI were generally not deleted; if an area was determined to not be wetland, an **NW** was entered in the *Assessment* field.
- Multiple polygons identified with the same Wetland ID in the inventory were either combined, split up and given different Wetland ID numbers, or given different designations in the *Assessment* field when indicated as necessary by the field assessment notes.
- The area of each assessed wetland was computed in ArcView after all boundary revisions were made and prior to completing the GIS data analyses.
- Where only minor alterations in the boundary of a wetland were indicated on the field maps, the boundaries were not revised in GIS. If only a portion of the wetland polygon is indicated as changing significantly, just that portion of the wetland was revised. The minor wetland boundary changes indicated on the field maps could be used to refine the digital wetland boundaries in the future.
- A photo location point was digitized in ArcView within each assessed wetland polygon.

4.2 GIS Data Analyses

Seven wetland functional parameter questions were evaluated using analyses of existing digital data in GIS. The resulting evaluation data were then imported into the database where all of the functional evaluation data are managed. The following values are given for classifications that were assigned for each of the questions answered using GIS (which are the same values used throughout MnRAM):

Exceptional = 2.0	Discharge = 0.1
High = 1.0	Recharge = 0.0
Medium = 0.5	Yes = 1.0
Low = 0.1	No = 0.1

Following is a brief description of the wetland functional parameter questions analyzed using GIS and a brief description of the criteria and analyses performed in GIS.

Question #2: Are rare plant species or state or federally listed species known to be in/near wetland?

A 200-foot buffer was established around each wetland in ArcView. The wetland and buffer area were then checked for the presence of any state or federally listed species within that area. The wetland polygon with buffer area was used to intersect rare species GIS data provided by the MnDNR Natural Heritage Inventory Database. Values for responses of yes or no were returned based on the outcome of the analysis.

Question #12: Describe the predominant upland soils within the subwatershed that affect the overland flow characteristics.

A 500-foot buffer was established around each wetland polygon. The Soil Conservation Service hydrologic soil group data (i.e. A = sand, B = sandy loam, C = clays loams, and D = plastic and swelling soils) within the 500-foot buffer was evaluated to determine which soil group represents the majority of the area. These resulting values were based on the following rules:

High: Majority of soils C, D, or combinations with C or D
Medium: Majority of soils hydrologic soil group B
Low: Majority of soils hydrologic soil group A

Question #14: Describe the density of wetlands within the subwatershed.

First, an analysis was conducted to determine the proportion of each subwatershed area comprised of wetlands, lakes, or ponds. Then it was determined within which subwatershed each wetland was located. Based on the subwatershed wetland/waterbody density, a value of high, medium, or low was attributed to each wetland based on the following rules:
Classification Rules:

High: Wetlands/water making up < 10% of subwatershed area
Medium: Wetlands/water making up 10-20% of subwatershed area
Low: Wetlands/water making up > 20% of subwatershed area

Question #28: Describe the soils within the wetland.

The digital soil survey data for Hennepin and Carver Counties was evaluated to identify all "organic" wetland soils. The soil mapping underlying each assessed wetland was evaluated for the presence or absence of organic soils. A value for each wetland was determined based on whether the majority of soils were organic or mineral according to the following criteria:
Classification Rules:

Recharge: Majority of soils in the wetland are mineral.
Discharge: Majority of soils in the wetland are organic

Question #30. Indicate conditions that best fit the wetland based on wetland size and the hydrologic properties of the soils within 500 feet of the wetland.

Again, the 500-foot buffer around each wetland was used for this analysis along with the area of each wetland (previously computed in GIS). If the total wetland area is greater than or equal to 200 acres, the wetland is discharge. If the wetland is less than 200 acres in size and the surrounding upland soils within 500-feet are in the A or B hydrologic soil group, then the wetland is discharge. Otherwise the wetland was determined to be recharge for this question.

Question #34. Is the wetland known to be used recently by rare wildlife species (or state or federally listed wildlife)?

Similar to Question 12, a 500-foot buffer around each assessed wetland was checked for known rare wildlife species using GIS data provided by the MnDNR Natural Heritage Inventory database. Based on the analysis results, the field for Question 34 was populated with the numeric values:

Yes = 1.0
No = 0.1

Question #35. Is the wetland or a portion of the wetland a rare natural habitat or community as identified by the MnDNR Natural Heritage Inventory database or the County Biological Survey.

Is the wetland plant community scarce or rare within the watershed, imperiled, or critically imperiled (state rankings S1 and S2)? If this applies, then Special Features question b is answered yes and the wetland wildlife habitat function level rating is exceptional.
Each wetland was compared to the rare habitat features from the County Biological Survey (CBS). An attribute was added to the CBS table data indicating the state rank so that those communities rated S1 and S2 that intersected the wetland were answered yes and the others were answered no. Based on the analysis results, Question 35 was populated with the numeric following values:

Yes = 1.0
No = 0.1

Question #48. Is any part of the wetland in public or conservation ownership?

The property ownership of each evaluated wetland was analyzed using the Hennepin and Carver County Parcel data. The "Find Majority Area" was used with the *ExemptCode* field being the field and Watershed ID being the value summarized. If the area of "E" = 0, then there is no public ownership (Value = "LOW"). If the area of "N" = 0, then there the entire wetland is under public ownership (Value = "High"), if not, then some of wetland is under public ownership, (Value = "Medium"). If there is no summary for wetland, the wetland must fall outside of parcels in shapefile, usually this would be road ROW. If so, assume the value = "high."

4.2.1 Creating GIS Analyses Summary Table and Importing into Database

A summary table was then created for importing the results of the GIS analyses into the database. The summary table must be formatted as shown below for proper import to the database. Each Wetland ID presented in the summary table must have a valid answer for each of the questions analyzed using GIS (i.e. Questions 2, 12, 14, 28, 30, 34, 35, and 48). Running the database import routine operates such that the data for the questions described above will be overwritten for each Wetland ID presented in the summary table. Each time this data was imported the existing data in Access will be overwritten. Missing data for any question will result in that particular question being populated with a value of 0 (zero) for that Wetland ID. In

most cases, a 0 (zero) is not valid. The table must be in comma-delimited format in the EXACT question order shown below:
"Wetland_ID","Q12_val","Q14_val","Q28_val","Q30_val","Q48_val","Q02_val","Q34_val","Q35_val"
E-117-24-14-008,0.5,0.1,0.1,0.0,0.1,0.1,0.1,0.1

This summary table was then imported into the database using the "Import GIS Data" button on the *General Information* tab of the data entry form. Within the *Import Dialog* box within the "Import GIS Data" button, the *Update GIS Fields* option is chosen and the file name and extension was entered in the *Select a File to Import* box.

4.2.2 Creating Summary Table and Importing General Information Evaluated Utilizing GIS

Several other pieces of information were generated using GIS to the improve accuracy and eliminate the possibility of data entry errors. The data generated included:

1. **Municipality/Township** (both primary and secondary) within which the wetland lies.
   A GIS polygon dataset developed by the Metropolitan Council (i.e. County_CTU.shp) containing boundaries of cities, township and unorganized territory (CTU) in the Twin Cities 7-county metropolitan area was used to determine the municipal location of each assessed wetland. The linework for this dataset comes from individual counties and is assembled by the Metropolitan Council for the MetroGIS community. The data was current as of April, 2000. Up to two pieces of data were generated from this analysis indicating the city(ies) or township(s) within which the wetland is located (i.e. "InfoCityName" and "InfoCityName2" fields). The first parameter, InfoCityName is the city within which the majority of the wetland lies, and the second, InfoCityName2 is for wetlands that cross municipal boundaries and indicates the city within which the smaller portion of the wetland lies. Each assessed wetland polygon was evaluated in GIS to determine within which city the majority of the wetland lies.
2. **Subwatershed** within which the majority of the wetland lies.
   The GIS polygon dataset provided by the Minnehaha Creek Watershed District containing the boundaries of the 16 subwatersheds in the District (Figure 1.1) was used to determine within which subwatershed the majority of each wetland lies (i.e. "InfoSubwatershed" field).
3. **Wetland Area** in acres of each assessed wetland and potential wetland restoration areas.
   The area of each wetland and potential wetland restoration area was computed in GIS using the approximate, field-verified wetland boundaries that had been digitized in GIS.

4.2.2.1 City/Subwatershed Data Import

The city and subwatershed location information was then tabulated into a summary table for importing into the database. Again, a comma delimited file format was used as shown below:
"Wetland_id","InfoCityName","InfoCityName2","InfoSubwatershed"
D-028-24-26-001,Richfield,,Richfield/South Minneapolis
D-117-22-12-035,Hopkins,Minnetonka,Upper Minnehaha Creek

This summary table was then imported into the database using the "Import GIS Data" button on the *General Information* tab on the data entry form. Within the *Import Dialog* box within the "Import GIS Data" button, the *Update Gen'l Information* option is chosen and the file name and extension was entered in the *Select a File to Import* box.

4.2.2.2 Wetland Area Data Import

The wetland area information was then tabulated into a summary table for importing into the McRAM database. Again, a comma delimited file format was used as shown below:
"WETLAND_ID","INFOCURRENTSIZE"
D-118-23-16-007,0.47
D-118-23-13-026,2.28
This summary table was then imported into the database using the "Import GIS Data" button on the *General Information* tab of the data entry form. Within the *Import Dialog* box within the "Import GIS Data" button, the *Update Wetland Areas* option is chosen and the file name and extension was entered in the *Select a File to Import* box.

4.3 Data Management and Data Use in GIS

All wetland functional data and general information is maintained in the MnRAM Access® database. Only the wetland polygons and *Assessment* status for each Wetland ID are maintained in GIS. The wetland functional data and general information stored in the database can be temporarily referenced in GIS for preparing maps and conducting spatial analyses.

4.3.1 ACCESSING AND UTILIZING DATA FROM THE DATABASE

1. Create ODBC connection to Database as follows (these directions are for Windows2000):
    a. Go to the control panel and select administrative tools.
    b. Select the “Data Sources (ODBC)” icon
    c. Select the System DSN tab
    d. Push the “Add” button
    e. It will ask for a “driver”, select the Microsoft Access driver (*.mdb).
    f. Type in “Master Database” for Data Source Name. Type in a description (not required).
    g. Specify the MnRAM database location by pushing the “select” button.
    h. When done, say OK and leave the setup program.

2. If the Access table has not been loaded into the ArcView project, do the following:
    a. From the projects menu in ArcView, select “SQL Connect”, a dialog box will appear.
    b. Select “Master Database” from the dropdown list, then press “Connect”.
    c. A list of “Tables” appears. Select **tblSummaryGISDataFinalNums** (contains the computed numeric scores for all functions except groundwater and storm water sensitivity) from the list.
    d. Double click on <all columns> in the columns list
    e. Name the output table **tblSummaryGISDataFinalNums**
    f. Push the query button. This should load the Access table into ArcView as an ArcView table.

Repeat steps a through f for the following tables:

tblSummaryGISDataFinal (contains the Assessment status [*fldStatus*]along with the text ratings for each function)

tblSummaryGISDataTwoFinal (contains the Assessment Status, Circular 39 types, Hydrologic Setting, Geomorphic setting, City1, City 2, Subwatershed, Wetland Size, Cowardin type, and Community description)

Each of these tables can be joined to the Wetland shapefile in GIS using the Wetland_ID as the common field. To map wetland types in GIS based on the dominant Circular 39 wetland type, a wetland classification lookup table must also be joined to the Wetland shapefile. From the ArcView project window, add Table *wet_lkup_sens_121602b.txt*, join to the Wetland shapefile using the *Circular 39* field as the common field and the *Dom_Type* field contains the dominant wetland type for each assessed wetland. The Circular 39 wetland types shown on the Wetland Classification figures for each municipality (i.e. Figures 6.27-6.56) are either the dominant wetland type within the assessed wetland or a known subdominant Exceptionally sensitive wetland type, if present (i.e. Types 7 and 8 wetlands). This data is contained in the field *Design* in the Table *wet_lkup_sens_121602b.txt*. Virtually any of the data tables contained in the database can be joined to the GIS Wetland shapefile as described above, however, just those tables containing the most commonly utilized data are described above.

4.4 Quality Assurance and Quality Control

Several procedures were implemented to ensure the accuracy and completeness of the data generated during the course of the project. Five primary data products were generated as a result of the project:

1. Field Assessment Maps
2. Wetland GIS Shapefile
3. Database Records
4. Wetland Photographs
5. Wetland Photo Points

Each data product contains valuable information that is either explicitly presented in this report or is part of the project record that will be integral for future use. It was important to ensure that each of these five products contained data corresponding to each unique Wetland ID.

Field Assessment Maps are part of the project record and contain all of the direct field notations including approximate wetland boundary mapping, wetland assessment status, Wetland IDs, field evaluator identification, field evaluation dates, wetland photo numbers, and wetland photo location. Many of the wetland boundaries that were revised from the inventory were not incorporated into the final GIS Wetland shapefile, so the field assessment maps provide valuable wetland boundary information not included in this report. The wetland assessment status data was incorporated into the GIS Wetland shapefile and should correspond precisely. The Wetland ID represents the unique identifier for each wetland and is the most important piece of information that must be connected to all data collected for each wetland. The identification of field evaluators, dates of each wetland assessment, and photo numbers are valuable for tracking down any data entry errors that may be present.

Wetland GIS Shapefiles contains the unique spatial wetland location and extent data, which was used as the baseline data on field assessment maps from the inventory. The original inventory shapefile was updated and revised based on the field assessments conducted throughout the project. Each assessed wetland must have a unique Wetland ID to which all other data generated during the project is tied.

Database Records contain all of the wetland functional data collected in the field and analyzed using GIS which must correspond directly to the Wetland ID noted on the field maps and contained in the Wetland GIS shapefile. The database is the primary data storage program for all data generated during the project except the spatial wetland location and extent data. It is imperative that each Wetland ID in the database corresponds to the proper wetland in the Wetland shapefile.

Wetland Photographs were taken at the time each wetland was assessed in the field and provides a visual record of each wetland from that point in time. Each digital photograph was automatically assigned a number by the camera when the photo was taken. That wetland photo number then was manually tracked and renamed using the unique Wetland ID number.

Wetland Photo Points represent the approximate location from which the photograph was taken. This location data was designated on the field maps and digitized into a photo point shapefile in GIS at the approximate location from which the photo was taken and within the wetland polygon.

4.5 Automated ArcView and McRAM Database QA/QC

The first quality assurance/quality control analysis was conducted in GIS to ensure that each unique Wetland ID contained only one wetland polygon indicated with an **A** (assessed) in the *Assessment Status* field. The second QA/QC analysis was developed to initially check for a one-to-one correspondence between wetland assessment records in the database and "assessed" wetland polygons in ArcView following the completion of the field wetland assessments. From that analysis, a table is produced containing four data columns with the possible values as follows:

1. GIS Status: The shapefile indicates whether or not the wetland was indicated as assessed in the wetland shapefile.

    Assessed – Assessment field contains an "A", shown as assessed on map
    Not Assessed – Assessment field contains "NA", shown as not assessed
    N/A – indicated as no record in ArcView

2. GIS Message: If the Wetland ID exists in the shapefile, but not the Access database

    OK – there is a polygon in the shapefile and the database
    No Shapefile Record – There is no Wetland ID in the shapefile.
    More than One Shapefile – more than one polygon with the same Wetland ID and both shown as "Assessed"

3. Access Status: Indication in Access database table whether or not the wetland has a completed assessment record or restoration potential evaluation.

    Assessed – Wetland has a completed wetland database record.
    Not Assessed – The "Complete Box" in the database has not been checked
    N/A – indicated as no record/ID in Access database

4. Access Message: If the Wetland ID exists in the Access database but not in the shapefile.

    Assessed – Database record for this Wetland ID has the Complete Box checked.
    No Table Record – No data in the database for this ID.

A new table summarizing the results will be created. Those with "Assessed" in column 1 and 3, have corresponding records in GIS and Access. Those with different values in columns 1 and 3 must be analyzed in further detail as do those without an "OK" in column 1 or 3 some aspect of the database or shape file is missing. Based on these results inconsistencies were amended. The final, automated QA/QC procedure conducted involved an analysis of wetland photo points to ensure that each "assessed" wetland polygon contain one, and only one, wetland photo point digitized within the wetland polygon.

4.5.1 Manual ArcView and Database QA/QC

All spatial wetland assessment data was mapped in ArcView for each municipality within the District. The wetland functional data was presented in three sets of tables for each municipality. A manual QA/QC procedure was conducted to ensure that the spatial wetland assessment data and database wetland functional data were consistent. The municipal Wetland Classification maps and municipal Wetland Data Tables were manually checked to ensure that each unique, assessed Wetland ID contained one wetland polygon and one database record. The QA/QC procedure for ensuring that one digital photograph was present for each assessed wetland was conducted on approximately a weekly basis throughout the duration of the project. Each field evaluator created a log of wetlands assessed and original photo numbers that was then double-checked after the wetland photos were renamed.

4.6 GIS Information:

Data Standards and Practices in Metro/Minnesota

County and Minor Civil Division Coding Exchange Standards (Statewide)
The three-digit FIPS and state standard county code as adopted as a standard for state agencies has been adopted as a MetroGIS standard for data exchange.
http://www.metrogis.org/data/standards/index.shtml

Minnesota Land Cover Classification System
Developed minimum mapping units and can let you know how to cost out a project of this magnitude. They used the MetroGIS community to aid in their development of a standard product, gain statewide buy-in and then approve/adopt the standard and use for a regional dataset.

Contact Information:
Bart Richardson, DNR Metro Region, Phone: 651-772-6150

MetroGIS Contact Information:
Randy Johnson, Metropolitan Council, MetroGIS Project: 651-602-1638

More information about GIS data is available at the following websites:

National Wetlands Inventory (NWI) Polygons:
http://deli.dnr.state.mn.us/metadata/index_th.html

County Soil Surveys:
(metro Counties) www.datafinder.org/metadata/orthos2000.htm
(statewide): http://lucy.lmic.state.mn.us/metadata/doq.html

check area LGU for updated photography or other resources

Watershed Basins (minor watershed):
(statewide) http://deli.knr.state.mn.us/metadata/full/bas95ne3.html

Parcel (land ownership):
(metro only) http://www.datafinder.org/catalog.asp
statewisde contact information only): http://www.lmic.state.mn.us/cty_contacts.html

MCBS Native Plant Communities:
http://deli.dnr.state.mn.us/metadata/full/mnnpcpy2.html

Mn Scientific and Natural Areas:
http://deli.dnr.state.mn.us/metadata/full/snaxxpy3.html

MCBS Sites of Biodiversity Significance:
http://deli.dnr.state.mn.us/metadata/full/mnsbspy2.html

Color Infrared (CIR):
http://www.dnr.state.mn.us/airphotos/ordering.html

5.0 Quick Reference—how to install the program, enter data, and get reports

Using the MnRAM database

This section is meant to supplement, not replace, user training on the wetland assessment method. Training will explain the method and rational behind the questions; this section will explain how to use the program itself. It assumes a level of familiarity with data entry and computers in general and will not attempt to explain common terms or actions.

A Visual User Manual is available over the Internet as a PowerPoint™ presentation. It gives a virtual tour of the database as well as descriptions and explanations of the questions.

ALL MNRAM MATERIALS ARE AVAILABLE AT THIS WEBSITE:

www.bwsr.state.mn.us/wetlands/mnram/index.html

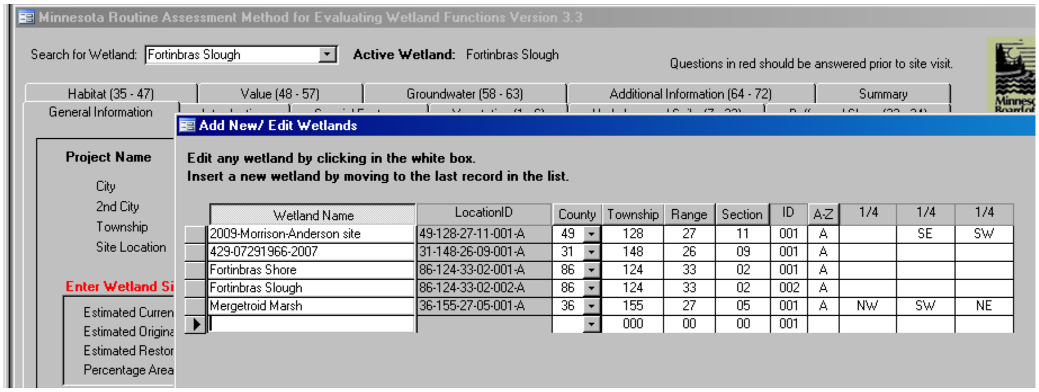
5.1 Installing the Program

Download the program to your hard drive. At the website, the text version (Microsoft Word™), field sheets (Excel™), and other materials are also available.

5.2 Opening the Database/Naming Wetland Conventions

When you open the database, Access will give several warning screens. Do not be alarmed; these are standard and cannot, at this time, be avoided. Answer <Okay> or <Run Program> as necessary and you will get to the main screen.

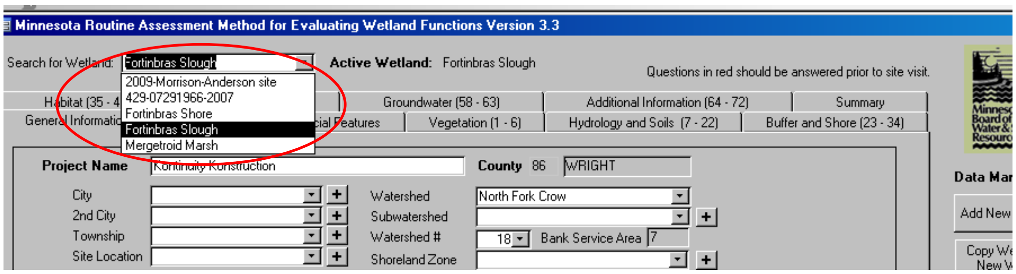
The first time you open a blank database, the main screen will appear blank with some button options to the right. Use your mouse to click the top button: "Add New Wetland." This brings up a pop-up window as shown below. The cursor should be at an open field where you first enter the site name (any mix of numbers or letters is possible). Click on the arrow near the County column to choose the County (a two-digit County Code will fill in automatically). Enter the three-digit Township number, the two-digit Range number, and the two-digit Section number. The three-digit ID is for differentiating basins among clusters of wetlands that exist in the same section. Starting with the northern-most site, number them counterclockwise (NE to NW to SW to SE) in order (001, 002, etc.).



The next field is indicates whether this is the first (A), second (B), third (C) or subsequent assessment of the wetland. Up to three ¼ section locations can be added as in the following example: SW ¼ of the SW ¼ of the SW ¼. Together, these numbers make up a unique Wetland ID.

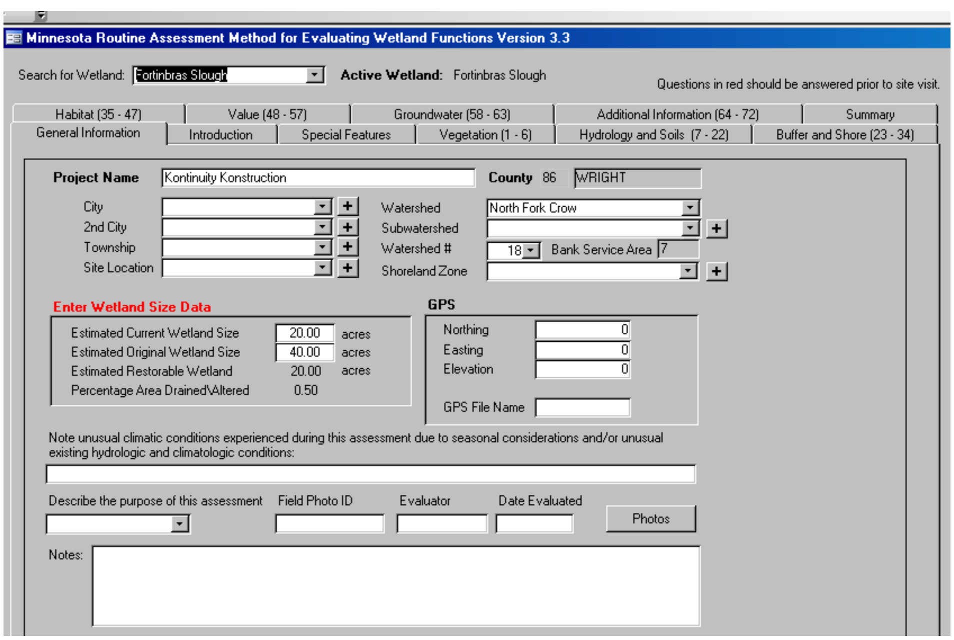
You can add several sites at once, or do one at a time. After you have entered your sites, close the Add window.

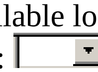
The list of wetland names you have entered will appear in the drop-down list at the "Search for Wetland" field in the upper left. Highlight one to begin entering data. The cursor can be advanced from field to field by using the "Tab" or "Enter" key. Use your mouse to switch tabs to a new set of questions.



5.3 Entering Data

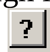
To activate a Wetland record for inclusion into reports or for export to another database, the "Complete Box" must be checked. There are several data quality checks built into the database to capture potential errors. Please take care to answer all of the questions (except for Questions 30-35 when Shoreline Protection does not apply and Questions 65-70 when Wetland Restoration potential does not apply), as all questions must be answered for the functional index calculations to perform.



Fields that have a drop-down list available look like this:  If the choice you want is not listed, you may be able to add it to the list by pressing the + button and entering the data. In some cases (such as the list of watersheds or vegetative communities), you will not be able to modify the list.

The next tab, "Introduction," gives the history and overall purpose of the wetland assessment method, as well as the ranking structure. Because of space limitations, it is a summary of the information contained in the Comprehensive Guidance.

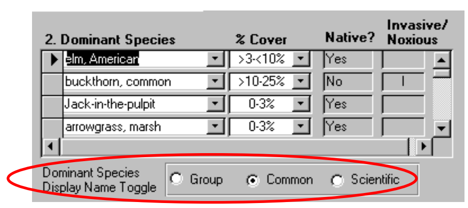
The "Special Features" tab gives a list of checkboxes, "A" through "U", which should be checked if they apply to the wetland. To check a box, either click on the box with the mouse, or, if the box is highlighted (with a dotted line around it by tabbing or entering through), then type "Shift +" to check the box.

As on all screens, use the mouse to move the scroll bar in order to see the lower portion of the page without having to tab all the way through it.
Before answering any question, click on the  to show the guidance, which points out the purpose of the question and assists in choosing the correct response.

The main questions begin on the next tab: "Vegetation (1-6)." Up to five communities may be listed under Question #1.

Question #2 Dominant Species refers to vegetative species making up 10 percent or more within the entire wetland and all non-native or invasive species. This list is for your reference only; there are no formula connections based on the Dominant Species list.

The drop-down list is set to search by group common name but you can change to search by common or scientific name using the Display Name Toggle. As you start typing in the first open field, choices will be offered. Open the drop-down list to see full list and pick the appropriate choice. If you want to enter a species that is not on the list, contact BWSR MnRAM support to request it.



An indicator for whether a species is native/non-native or invasive/noxious will fill in automatically from the list.

Question #3 Veg Index is answered in the table shown under Question #1. It is the Vegetative Index rating that you give to each distinct Wetland Plant Community.

Because of programming restrictions, the database version does not allow you to split out dominant species by Community Type, as in the Excel and paper versions. Because the species list is for reference only, this will not affect the ratings. In later versions, this discrepancy will be eliminated.

The rest of the questions on this tab are self-explanatory.

Hydrology and Soils (7-22) is the next tab. Guidance for many questions is available by clicking the question mark next to a field: . Questions shown in red need additional resources to answer and may be answered in the office ahead of time. Answers to all other questions should be recorded in the field.

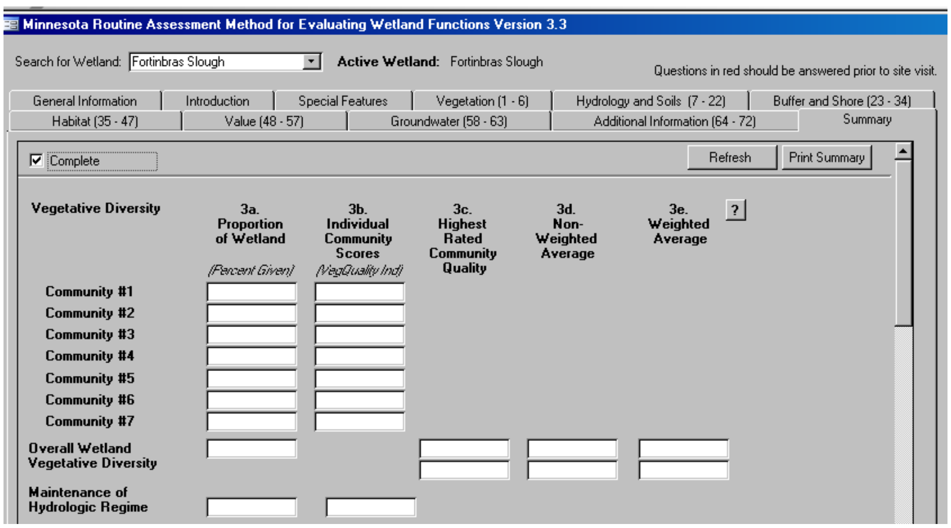
Buffer and Shore (23-34) is the next tab. Questions #24-26: remember that these refer to *all* the land surrounding the wetland out to 50 feet, whether or not it would be considered “buffer.” See the definition provided in the guidance to Question 23. The total of the three boxes for each question must add up to 100 or you will not be able to move off of that tab.

The next set of tabs, starting with Habitat (35-47) is “in back” of the first row. When you click on any of these rear tabs, the entire second row of tabs moves forward.

Questions #37 and #38: click on the box labeled “image” to see the choices.

5.4 Summary and Reports

The last tab summarizes the functional ratings using preset formulas to calculate final scores for each function. Because there are four ways to calculate and report vegetative diversity and integrity, these results are listed separately.



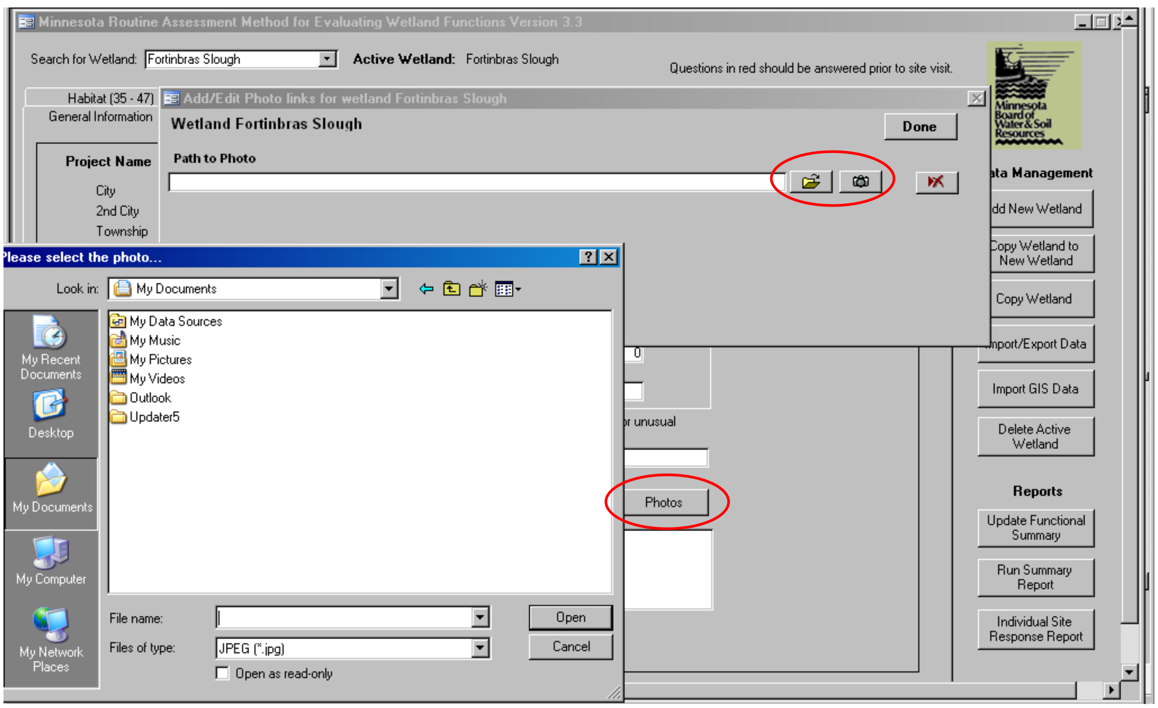
Check the Complete box and press <Refresh> to see the summary values on screen. <Print Summary> will show a one-page report of the functional ratings. That report may be printed for inclusion in reports.

To get a listing of the responses to all the questions, use the Individual Site Report. This report does not show the functional ratings, just the values you entered for each question. A description of the reports is given in Sections 5.5.5 – 5.5.7.

5.5 Extra Features

5.5.1 WETLAND PHOTO

First, load digital wetland photos into a specified drive and folder. Pressing <Photos> at the General Information tab will bring up a window for handling photo files. The "open folder" icon allows you to browse to the location where you stored the photos and link them to the site. Although not required, a standard naming convention to tracking photos is advised. One method is to name with the full Wetland ID, with the numbers given by County, Township, Range, Section, ID, and Letter. The camera icon, when clicked, will open the photograph. Double-click the photo to return to the database record. Although more than one photo may be linked to a site, be aware that photo records take up a great deal of disk space and plan accordingly.



5.5.2 IMPORT-EXPORT DATA

"Import/Export Data" is used to export assessment data from one database and import that data into another copy of the database. This feature is useful when it is desirable to compile data from multiple users into a single location or to import existing data into a newer version of the database. Only records that have had the "Complete" box checked (on the "General Information" tab) will be included in the export. Click on the import data box, type in the specific file path (including a "\" at the end of the first line and type in the folder name in the user box) where the data the data is located, select import or export and click <Import Record>.

5.5.3 IMPORT GIS DATA

Three types of GIS data can be imported using this feature. Import data must be set up in a comma-delimited file format in the exact order shown below. The dialog box describes three options: which are described below along with the data that is included in each import routine:

Option #	Description	Data included
1	Update Wetland Areas: "WETLAND_ID","INFOCURRENTSIZE"	Wetland ID, wetland size (in acres)
2	date Gen'l Information: "Wetland_id","InfoCityName","InfoCityName2","InfoSub watershed"	Wetland ID, first city, second city (leave blank if only in one city), subwatershed
3	Update GIS Fields: "Wetland_ID","Q19_val","Q21_val","Q58_val","Q60_val","Q51_val","Q04_val","Q35_val","6_val"	Wetland ID, Questions # 19, 21, 58, 60, 51, 4, 35, 36

For each Wetland ID included in an import file, the data included in each import routine will be overwritten over any existing data in the database. If a blank is provided for any of the data, a null value will be entered for that question within that Wetland ID record.

5.5.4 COPY WETLAND TO NEW WETLAND / COPY WETLAND RECORD

This time-saver feature allows all the ratings of one wetland assessment record to be copied into the record of another. This feature is most useful during inventory situations for wetlands with similar morphological characteristics, location, land uses, and hydrologic features. The receiving record must be reviewed with care to ensure that important, but subtle differences are not overlooked. It is recommended that you use this only with wetlands that are in close proximity to each other on the landscape.

If you already have Wetland Names entered for both the "to be copied" site and the duplicate wetland, use the simple <Copy Wetland> button. Otherwise, <Copy Wetland to New Wetland> allows you to create a new wetland record "on the fly".

5.5.5 UPDATE FUNCTIONAL SUMMARY

This feature is used to update added data to the report tables during a working session. Wetland subsets can be chosen here similar to the reporting feature. Update Functional Summary **must be**

run during a working session **prior to running reports**, otherwise, data entered during the working session will not appear in the reports.

5.5.6 Run Summary Report

Two reports can be generated:

1) Functional Assessment Summary (this is a two-page report).
2) Wetland Community Summary.

Because wetland vegetative community information can be extensive and is often used for different purposes, this report is separate from the functional rating report.

You can choose to view the ratings as either Numeric (i.e. 0.64, 1.0) or Text (i.e. high, medium, low). Choosing the numeric view allows you to see how close a rating may have been to the next category (a rating of 0.65, for example, will result in a Medium rating, whereas a 0.66 is High).

Each report can be run with either all data (every site will appear) or filtered by subset categories: Complete/Incomplete, Project, City, and Subwatershed.

If you want to be able to see the results from a group of sites, name all the sites with the same Project Name (i.e. "Timber Woods Development"). If you want the results of one site, choose a unique Project Name for that site (i.e. "Haldeman Driveway Project").

For a comprehensive report showing both vegetative and functional rating information together from a single site, with both numeric and text ratings, press the <Print Summary> button on the Summary tab. You can print the report that appears onscreen.

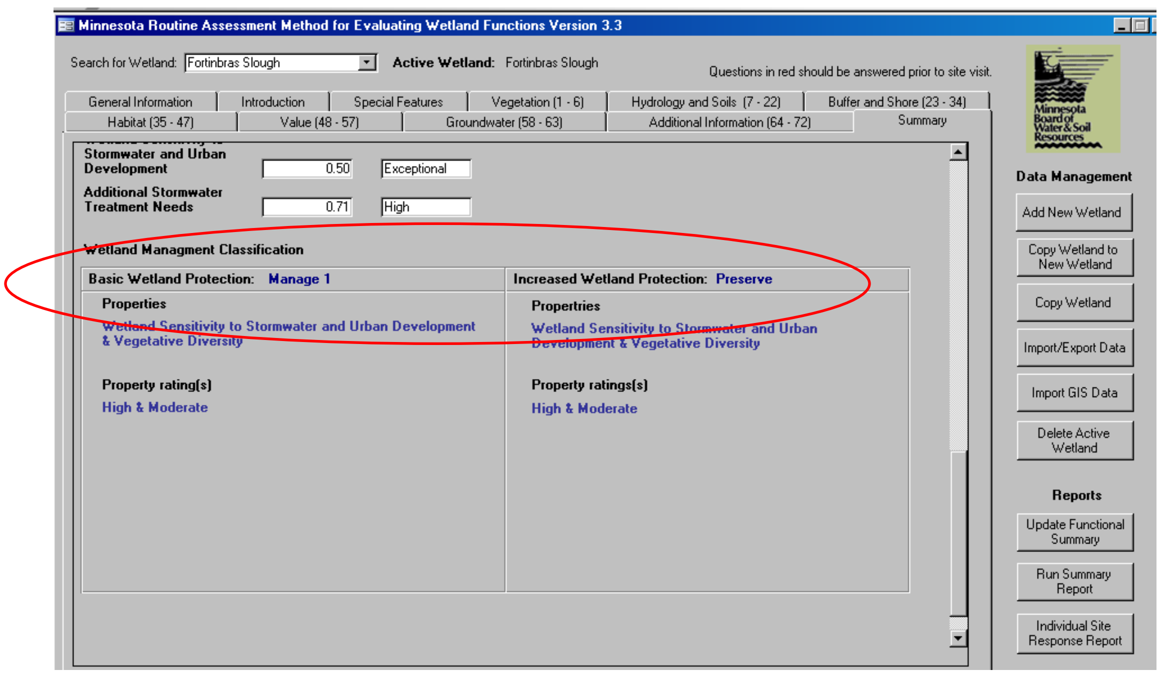
5.5.7 Individual Site Report

The last report button on the General Information tab will produce a report that shows the responses to most questions. If you need to show this in a report or want to compare input between two or more sites, this report provides a concise record of the entries. It does not provide a summary of the results, however: to get a record of the functional ratings, go the Summary tab and choose <Print Summary>.

5.6 Using the Data—Management Classification

Once wetlands have been assessed, the data stored in the MnRAM database may be used for local planning, regulatory determinations, or other general use. Wetland Management Classification is intended to give local resource managers a framework for using the wetland data to make land use and wetland management decisions. The Wetland Management Classification system provides a scientifically based approach to ranking wetland functions. A document explaining the Management Classification system is available at the BWSR website. The last two pages show the flow charts that have been programmed into the MnRAM database.

There are two prepared options for sorting wetlands, Basic and Increased Protection. The results of both sort options are given at the end of the Summary page.



Also shown are the functions and ratings that caused the wetland to fall into the management category shown. Understanding how management classification works is easiest using the visual aide of the flowcharts.

6.0 Functional Rating Formulas

GENERAL NOTE: Some questions are not applicable to particular wetlands and will be scored N/A. In these cases, rather than count N/A as zero, an alternate equation is provided that eliminates the question from the formula altogether. Because not every question has N/A as an option, formulas that do not include N/A-option questions have only one configuration.

Formulas with a "reverse rating" (marked as "R") take the actual response and "flip" its value for the calculation, so that a question response of "A" high (value of 1.0) will be calculated as low (value of 0.1). In such a formula, medium ratings stay medium.

6.1 VEGETATIVE DIVERSITY/INTEGRITY

Table 3: Vegetative Diversity/Integrity Summary

The functional rating is based primarily on the diversity of vegetation within the wetland in comparison to an undisturbed condition for that wetland type. An exceptional rating results from one of the following conditions: 1) highly diverse wetlands with virtually no non-native species, 2) rare or critically impaired wetland communities in the watershed, or 3) the presence or previous sighting of rare, threatened, or endangered plant species. A high rating indicates the presence of diverse, native wetland species and a lack of non-native or invasive species. Wetlands that rate low are primarily dominated by non-native and/or invasive species.

This table may be used when calculating Vegetative Diversity/Integrity Functional Index manually. It shows four options for calculating and presenting floristic data. If you are entering data directly into the MnRAM database, this table does not apply.

	3A Proportion of Wetland	3B Individual Community Scores	3C Highest Quality	3D Non-Weighted Average	3E Weighted Average
Community #1	**T**	**A**		**A**	**A**
Community #2	**U**	**B**		**B**	**B**
Community #3	**V**	**C**		**C**	**C**
Community #4	**W**	**D**		**D**	**D**
Community #5	**X**	**E**		**E**	**E**
Community #6	**Y**	**F**		**F**	**F**
Community #7	**Z**	**G**		**G**	**G**
Wetland Rating Value	**1.0**		**Highest Value**	**(A+B+C+D+E +F+G)/7 = Ave.**	**(A*T)+(B*U)+(C*V)+(D*W)+(E*X)+(F*Y)+(G*Z) = Wt. Ave.**

If any questions #4-6 are answered yes and/or if any of the Special Features b, d, or i have been selected, enter Exceptional for the functional index. If not, compute the contribution to vegetative diversity and integrity by each plant community by doing the following: multiply the ranking for each community

(Question #3b) by its total proportion in Question 3a (percent of total). Then, the functional index for the entire wetland can be calculated four ways (as follows) and should be utilized according to the scope of the project:

- **3b) Individual Community Scores:** maintain raw data as recorded.
- **3c) Highest Quality Community:** report the highest-functioning community.
- **3d) Non-Weighted Average Quality of all Communities:** straight average
- **3e) Weighted Average Quality Based on Percentage of Each Community:** multiply each community rating by its percentage, then add all together.

<table>
<tr><th colspan="3">Vegetative Diversity/ Integrity</th><th></th><th></th><th></th></tr>
<tr><th></th><th>3a. Proportion of Wetland</th><th>3b. Individual Community Scores</th><th>3c. Highest Rated Community Quality</th><th>3d. Non-Weighted Average</th><th>3e. Weighted Average</th></tr>
<tr><td>Community #1</td><td>T</td><td>A</td><td colspan="3" rowspan="7">If Spec. Features b, d or i are checked then rate Exceptional (2);
if either question 4, 5, or 6 are Yes, then rate Exceptional (2); else:</td></tr>
<tr><td>Community #2</td><td>U</td><td>B</td></tr>
<tr><td>Community #3</td><td>V</td><td>C</td></tr>
<tr><td>Community #4</td><td>W</td><td>D</td></tr>
<tr><td>Community #5</td><td>X</td><td>E</td></tr>
<tr><td>Community #6</td><td>Y</td><td>F</td></tr>
<tr><td>Community #7</td><td>Z</td><td>G</td></tr>
<tr><td>Overall Wetland Value Rating</td><td>1.0</td><td></td><td>: Highest Value of A-G</td><td>: (A+B+C+D+E+F+G)/7 = Ave.</td><td>:(A*T)+(B*U)+(C*V)+(D*W)+(E*X)+(F*Y)+(G*Z) = Wt. Ave.</td></tr>
</table>

6.2 *MAINTENANCE OF CHARACTERISTIC HYDROLOGIC REGIME*

A wetland's hydrologic regime or hydroperiod is the seasonal pattern of the wetland water level that is like a hydrologic signature of each wetland type. It defines the rise and fall of a wetland's surface and subsurface water. The constancy of the seasonal patterns from year to year ensures a reasonable stability for the wetland[24]. The ability of the wetland to maintain a hydrologic regime characteristic of the wetland type is evaluated based upon wetland soil and vegetation characteristics, land use within the wetland, land use within the upland watershed contributing to the wetland, and wetland outlet configuration. Maintenance of the hydrologic regime is important for maintaining a characteristic vegetative community, and is closely associated with other functions including flood attenuation, water quality and groundwater interaction.

Measures the degree of human alteration of the wetland hydrology, either by outlet control or by altering immediate watershed conditions. Each parameter is weighted equally.

MnRAM #	Excel #	Variable Description	Type of Interaction
13	E17	Outlet—natural hydrologic regime	Controlling
14	E18	Dominant upland land use	Compensatory
15	E19	Soil condition/wetland	Compensatory
20 R	F24	Stormwater runoff/pretreatment-Reversed	Compensatory

Hydrologic Regime Index = $(13+14+15+20_{reverse})/4$

6.3 *FLOOD AND STORMWATER STORAGE/ATTENUATION*

A wetland's ability to provide flood storage and/or flood wave attenuation is dependent on many characteristics of the wetland and contributing watershed. Characteristics of the subwatershed that affect the wetlands ability to provide flood storage and attenuation include: soil types, land use and resulting stormwater runoff volume, sediment delivery from the subwatershed, and the abundance of wetlands and waterbodies in the subwatershed. Wetland characteristics which affect the wetland's ability to store and or attenuate stormwater include: condition of wetland soils; presence, extent, and type of wetland vegetation; presence and connectivity of channels; and most importantly outlet configuration. Higher rated wetlands will have an unaltered or restricted outlet, undisturbed wetland soils, dense emergent vegetation without channels, a high proportion of impervious surfaces in the subwatershed, large runoff volumes, clayey upland soils, and few wetlands present within the subwatershed.

This formula is based on the Surface Water Storage Functional Capacity Index scoring concept and equation[25]. The formula was altered with the addition of three surface flow characteristics and two stormwater runoff parameters (Stormwater Runoff Quality/Quantity and Subwatershed Wetland Density) along with the removal of two parameters (Soil Porosity and Subsurface Outlet, which is already characterized in another parameter). This index is comprised of 5 primary processes, which are weighted equally; included in each major process are one to three characteristics that equally contribute to that process.

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[24] Mitsch and Gosselink, 2000
[25] Lee et al., 1997

1. **Outlet Characteristics**: Outlet characteristics
2. **Upland Watershed**: Upland land use, Upland soils,
3. **Wetland Condition/Land Use**: Wetland land use, sediment delivery
4. **Runoff Characteristics:** Stormwater runoff quality/quantity, subwatershed wetland density
5. **Surface Flow Characteristics**: Flow-through emergent vegetation density, surface flow characteristics

Flood and Stormwater Storage Index Computation:

Entire Formula: Outlet for flood retention{12} + (Dominant upland use{$14_{reversed}$}+ Upland soils{19})/2 + (Soil condition{15} + Sediment delivery{18})/2 + Stormwater runoff pretreat&det{20} + Subwatershed wetland density{21})/2 + (Percent emergent vegetative cover{16} + Flow-through emergent vegetative roughness{17} + Channels/sheet flow{22})/3)/5.

1. If 12=0, then: ((14 $_{reversed}$ +19)/2+(15+18)/2+(20+21)/2+(16+17+22)/3)/4

2. If 12>0, then: (12+(14 $_{reversed}$ +19)/2+(15+18)/2+(20+21)/2+(16+17+22)/3)/5

No changes to the formula are necessary if 16=0.

Flood and Stormwater Storage/Attenuation Variables

MnRAM #	Excel #	Variable Description	Type of Interaction
12	E16	Outlet—flood attenuation	Controlling—optional
14-R	F18	Dominant upland land use—reversed	Compensatory
19	E23	Upland soils	Compensatory
15	E19	Soil condition	Compensatory
18	E22	Sediment delivery	Compensatory
20	E24	Stormwater pretreatment &detention	Compensatory
21	E25	Subwatershed wetland density	Compensatory
16	F20	Emergent vegetation % cover	Comp.—optional
17	E21	Emergent vegetation flood resistance	Comp.—optional
22	E26	Channels/sheet flow	Compensatory

6.4 DOWNSTREAM WATER QUALITY PROTECTION

This rates the wetland's ability and opportunity to protect valuable downstream resources. Valuable downstream resources include recreational waters (i.e. lakes, streams, rivers, creeks, etc) and potable water supplies. The level of functioning is determined based on runoff characteristics, sedimentation processes, nutrient cycling, and the presence and location of significant downstream water resources. Runoff characteristics that are evaluated include: land use and soils in the upstream watershed, the stormwater delivery system to the wetland, and sediment delivery characteristics. The ability of the wetland to remove sediment from stormwater is determined by emergent vegetation and overland flow characteristics. A high nutrient removal rating indicates dense vegetation and sheet flow to maximize nutrient uptake and residence time within the wetland. The opportunity for a wetland to protect a valuable water resource diminishes with distance from the wetland so wetlands with valuable waters within 0.5 miles downstream have the greatest opportunity to provide protection, as do those that receive more (and less-treated) runoff.

Compute Functional Index for Downstream Water Quality Protection

This functional index computation was derived from a combination of Nutrient Cycling and Retention of Particulates functions in the HGM Prairie Pothole draft guidebook[54] with the downstream sensitivity concept from *The Minnesota Wetland Evaluation Methodology.* Three major processes make up equal portions of the Downstream Water Quality Protection function[26] with a measure of opportunity to protect downstream resources; each process is comprised of two to four observable parameters.

1. **Rate, Quantity, and Quality of Runoff to the Wetland**: this is characterized by the conditions in the upstream watershed; both land use and soils, that affect the sediment and nutrient loads to the wetland, and by the existing storm water delivery system to the wetland (Upland watershed conditions, storm water runoff, evidence of sediment delivery, and upland buffer each comprise 1/16 of the entire downstream water quality functional index based on their contribution to sediment removal).
2. **Sedimentation**: this is characterized by the presence of flow-through emergent vegetation density and by the overland flow characteristics within the wetland. A wetland with primarily sheet flow through the wetland and dense emergent vegetation density will allow sediment to drop out more effectively than a wetland with channel flow and no vegetation (When all parameters are applicable; emergent vegetative density and overland flow characteristics each make up 1/8 of the total downstream water quality functional index based on their contribution to sediment removal).
3. **Nutrient Uptake**: this is characterized by the outlet configuration and vegetative characteristics. A wetland with long water retention times has more capacity to remove nutrients from the water column via physical and biological processes. Vegetation slows floodwaters by creating frictional drag in proportion to stem density which allows sediment particles to settle out, thereby improving the water quality for downstream uses (Outlet characteristics and vegetative density each make up 1/8 of the total downstream water quality functional index based on their contribution to nutrient uptake).
4. **Downstream Sensitivity**: if the wetland contributes to the maintenance of water quality within one-half mile of a recreational water body or potable water supply source downstream, it operates at a higher functioning level than a similar wetland farther from or without significant

[26] Derived from a combination of Nutrient Cycling and Retention of Particulates functions in the HGM Prairie Pothole draft guidebook (Lee et al., 1997) with the downstream sensitivity concept from *The Minnesota Wetland Evaluation Methodology*.

downstream water resources (This factor accounts for ¼ of the total downstream water quality functional index).

Downstream Water Quality Functional Index Computations:

1. If 12=0, then: (14+20+18+(**23+24+26**)/3+(**16**+17)/2+27)/6

2. If 12>0, then: (14+20+18+(**23+24+26**)/3+(**16**+17)/2+27+12)/7

No changes to the formula are necessary if 16=0.

Entire Formula:
(Dominant upland land use{14} + Stormwater runoff pretreatment & detention{20} + Sediment delivery {18} + (Upland buffer width{23_{WQ}} + Upland buffer vegetative cover{24} + Upland buffer slope {26})/3 + (Flow-through %emergent vegetative cover{16} + Flow-through emergent vegetative roughness{17})/2 + Downstream sensitivity{27}+ Outlet for flood{12})/7

Downstream Water Quality Variables

MnRAM #	Excel #	Variable Description	Type of Interaction
14	E18	Dominant upland land use	Controlling
20	E24	Stormwater runoff pretreatment & detention	Controlling
18	E22	Sediment delivery	Controlling
23	G27	Upland buffer width—water quality valuation	Comp.
24	G28	Upland area management	Comp.
26	G34	Upland area slope	Comp.
16	F20	Emergent vegetation (% cover)	Comp.—optional
17	E21	Emergent vegetation (roughness coefficient)	Comp.—optional
27	E39	Downstream sensitivity	Comp.
12	E16	Outlet for flood	Controlling--optional

6.5 MAINTENANCE OF WETLAND WATER QUALITY

The sustainability of a wetland is partially driven by the quality and quantity of stormwater runoff entering the wetland. The ability of the wetland to sustain its characteristics is evaluated based on characteristics of the contributing subwatershed and indicators within the wetland. Subwatershed conditions which affect the wetland's sustainability in relation to water quality impacts include: upland land use; sediment delivery characteristics to the wetland; stormwater runoff volumes and rates; and the extent, condition, and width of upland buffer. Indicators of nutrient loading to the wetland indicate that a diverse wetland may not be sustainable. Indicators that a wetland has been affected by nutrient loading include the presence of monotypic vegetation and/or algal blooms.

This functional index was derived from a combination of sources including MNRAM, HGM, WEM, WET, and experiences of the project team. The sustainability of a wetland is partially driven by the quality and quantity of stormwater runoff entering the wetland. The ability of the wetland to sustain its characteristics is evaluated based on characteristics of the contributing subwatershed and indicators within the wetland. Subwatershed conditions which affect the wetland's sustainability in relation to water quality impacts include: upland land use; sediment delivery characteristics to the wetland; stormwater runoff volumes and rates; and the extent, condition, and width of upland buffer. Indicators of nutrient loading to the wetland indicate that a diverse wetland may not be sustainable. Indicators that a wetland has been affected by nutrient loading include the presence of monotypic vegetation and/or algal blooms.

Wetland Water Quality Functional Index Computation:

$(3e*2+14+20_{reversed} +(\mathbf{23}+\mathbf{24}+\mathbf{26})/3+18+28)/7$

Entire Formula:
(Vegetative Diversity/Integrity{3e*2} + Dominant upland land use{14} + Stormwater runoff pretreatment & detention{$20_{reversed}$} + (Upland buffer width{23_{WQ}} + Upland buffer vegetative cover {24} + Upland buffer slope {26})/3 + Sediment delivery {18})/2 + Nutrient loading {28})/7

Wetland Water Quality Variables

MnRAM #	Excel #	Variable Description	Type of Interaction
3e	D6*2	Vegetative Diversity/Integrity	Contributing
14	E18	Dominant upland land use	Contributing
20 R	F24	Stormwater runoff pretreatment and detention—RR	Contributing
23	G27	Upland buffer width—water quality valuation	Contributing
24	G28	Upland area management	Contributing
26	G34	Upland area slope	Contributing
18	E22	Sediment delivery	Contributing
28	E40	Nutrient loading	Contributing

This functional index was derived from a combination of sources including MNRAM, HGM, WEM, WET, and experiences of the project team. The sustainability of a wetland is partially driven by the quality and quantity of stormwater runoff entering the wetland. The ability of the wetland to sustain its characteristics is evaluated based on characteristics of the contributing subwatershed and indicators within the wetland. Subwatershed conditions which affect the wetland's sustainability in relation to water quality impacts include: upland land use; sediment delivery characteristics to the wetland; stormwater runoff volumes and rates; and the extent, condition, and width of upland buffer. Indicators of nutrient loading to the wetland indicate that a diverse wetland may not be sustainable. Indicators that a wetland has been affected by nutrient loading include the presence of monotypic vegetation and/or algal blooms.

6.6 SHORELINE PROTECTION

Shoreline protection is evaluated only for those wetlands adjacent to lakes, streams, or deepwater habitats. The function is rated based on the wetlands opportunity to protect the shoreline; i.e. wetlands located in areas frequently experiencing large waves and high currents have the best opportunity to protect the shore. In addition, shore areas composed of sands and loams with little vegetation or shallow-rooted vegetation will benefit the most from shoreline wetlands. The wetland width, vegetative cover, and resistance of the vegetation to erosive forces determine the wetland's ability to protect the shoreline.

Each of the five parameters contributes equally[27]: based primarily on the characteristics presented in WEM with a simple, straightforward computation of the index assuming all characteristics contribute equally.

MnRAM #	Excel #	Variable Description	Type of Interaction
29	E41	Shoreline?	Controlling
30	E42	Rooted shoreline vegetation (% cover)	Contributing
31	E43	Wetland width (average)	Contributing
32	E44	Emergent vegetation erosion resistance	Contributing
33	E45	Shoreline erosion potential	Contributing
34	E46	Bank protection ability	Contributing

Shoreline Protection Functional Index Computation:

If 29=1, then:
Shoreline Protection Index = (30+31+32+33+34)/5

Entire Formula:
(Rooted shoreline vegetation {30} + Average shoreline wetland width {31} + Emergent vegetation erosion resistance {32} + (Shoreline erosion potential {33} + Bank protection ability {34})/5

6.7 MAINTENANCE OF CHARACTERISTIC WILDLIFE HABITAT STRUCTURE

The ability of a wetland to support various wildlife species is difficult to determine due to the specific requirements of the many wildlife species that utilize wetlands. This function determines the value of a wetland for wildlife in a more general sense, and not based on any specific species. The characteristics evaluated to determine the wildlife habitat function include: vegetative quality, outlet characteristics (which control hydrologic regime), upland land use, wetland soil type and conditions, water quality of storm water runoff entering the wetland, upland buffer extent, condition, and diversity; the interspersion of wetlands in the area; barriers to wildlife movement; wetland size; vegetative and community interspersion within the wetland; and amphibian breeding potential and overwintering habitat.

Thirteen parameters are weighed equally as described below; vegetative quality is weighted double the other factors. The questions are borrowed or modified from MNRAM, WET, WEM, and HGM methodologies, combined to provide a measure of wildlife habitat in general, not focusing on any particular species.

If Rare Wildlife (35) or Rare Natural Community (36) are true, then this Index is Exceptional.

If Special Features d, g, or j are checked, then this Index is Exceptional, otherwise, follow conditions below:
If 37=0 and 38=0 and 39=0 [Vegetation (37) and Community interspersion (38) and Wetland Detritus (39) are all n/a], then:
(3e*2+40+41+(**23**+**24**+**25)**/3+13+ 20)/7

If 38=0 and 39=0 [Community interspersion (38) and Wetland Detritus (39) are n/a], then:
(3e*2+37+40+41+(**23**+**24**+**25)**/3+ 13+20)/8

[27] Based primarily on the characteristics presented in WEM.

If 37=0 and 39=0 [Vegetation (37) and Wetland Detritus (39) are n/a], then:
(3e*2+38+40+41+(**23**+**24**+**25)**/3+ 13+20)/8

If 37=0 and 38=0 [Vegetation (37) and Community interspersion (38) are n/a], then:
(3e*2+39+40+41+(**23**+**24**+**25)**/3+ 13+20)/8

If 39=0 [Wetland Detritus (39) is n/a], then:
(3e*2+37+38+40+41+(**23**+**24**+**25)**/3+13+20)/9

If 38=0 [Community interspersion (38) is n/a], then:
(3e*2+39+37+40+41+(**23**+**24**+**25)**/3+13+20)/9

If 37=0 [Vegetation interspersion (37) is n/a], then:
(3e*2+39+38+40+41+(**23**+**24**+**25)**/3+13+20)/9

If 37>0 and 38>0 and 39>0, then:
(3e*2+39+37+38+40+41+(**23+24+25**)/3+13+20)/10

Entire Equation:
(Vegetative Diversity/Integrity{3e*2} + Wetland Detritus {39} + Vegetation Interspersion {37} + Community Interspersion {38} + Wetland Interspersion {40} + Wildlife Barriers {41} + (Upland buffer width {$23_{\text{wildlife value}}$} + Upland Area Management{24} + Upland area diversity {25})/3 + Outlet natural hydrologic regime {13}+ Stormwater runoff pretreatment and detention 20_{reversed})/10

MnRAM #	Excel #	Variable Description	Type of Interaction
41	E53	Wildlife barriers	Controlling
3e	D6	Vegetative Ranking (communities' weighted average)	Compensatory
39	E51	Wetland detritus (n/a)	Contributing
23	I27	Upland buffer average width—wildlife valuation	Contributing
24	G28	Upland area management	Contributing
25	G31	Upland area diversity	Contributing
13	E17	Outlet natural hydrologic regime	Contributing
20 R	F24	Stormwater runoff pretreatment & detention—reversed	Contributing
37	F49	Vegetation interspersion (n/a)	Contributing
38	F50	Community interspersion (n/a)	Contributing
40	E52	Wetland interspersion	Contributing

6.8 MAINTENANCE OF CHARACTERISTIC FISH HABITAT

The ability of the wetland to support native fish populations is determined by structural factors within the wetland as well as water quality contributions from upland factors. Wetlands rated High are lacustrine or riverine and provide spawning/nursery habitat, or refuge for native species (included but not limited to game fish). Wetlands rated Low for fish habitat do not have a direct hydrologic connection to a waterbody with a native fishery or have poor water quality.

MnRAM #	Excel #	Variable Description	Type of Interaction
46	E58*2	Fish habitat quality	Controlling
29	D41	Fringe wetland?	Contributing
24	G28	Adjacent area management	Compensatory

18	E22	Sediment delivery	Compensatory
20 R	F24	Storm water runoff—reversed	Compensatory
28	E40	Nutrient load	Compensatory
30	E42	Percent cover	Compensatory
31	E43	Wetland shoreline width	Compensatory
33 (R)	F45	Shoreline erosion potential	Compensatory

Fish Habitat Functional Index Computation:

If Special Features a or g are checked, then Fishery Habitat Index = Exceptional.

If 46=0, then Fishery Habitat = N/A

If 29=0, Fishery Habitat Index = $[(46*2)+24+18+20_{reversed}+28]/6$

If 29>0, Fishery Habitat Index = $[(46*2)+24+18+20_{reversed}+28+\mathbf{30}+\mathbf{31}+\mathbf{33(R)}]/9$

6.9 MAINTENANCE OF CHARACT. AMPHIBIAN HABITAT FOR BREEDING/OVERWINTERING

The characteristic ability of a wetland to support various amphibian species is difficult to determine due to the specific requirements of the many amphibian species that depend on wetlands. This function determines the value of a wetland for amphibians in general, not based on specific species. An adequate wetland hydroperiod and the presence or absence of predatory fish are considered to be limiting variables for this function. In general, wetlands must remain inundated until early to mid-June to allow the larval stages to metamorphose into adults. Because many amphibians are partly terrestrial, the characteristics evaluated to determine the amphibian habitat function include numerous hydrology and terrestrial measures. The characteristics evaluated include: upland land use, upland buffer width, water quality of storm water runoff entering the wetland, barriers to wildlife movement, and amphibian breeding potential and overwintering habitat.

An adequate wetland hydroperiod (Question 42) is considered to be the primary limiting variable for this functional index. If the hydroperiod is insufficient for breeding, the wetland rating for amphibian use will be Not Sufficient. The status of predatory fish in the wetland (Q.43) is a secondary limiting factor to the final rating; the lowest rating for this variable, however, is 0.1 (Low), rather than zero (Not Sufficient).

Amphibians' ability to use a particular wetland for over wintering is a contributing factor in rating the wetland's functional index (Q.44). Because most amphibians are partly terrestrial, the extent of upland buffer habitat surrounding the wetland (Q.23) is an important habitat component[28] and is weighted by a factor of two. Question 14 (Upland Land Use) is also included as an indicator of the quality of the surrounding upland habitat[56]. Unnatural fluctuations in water depth in wetlands from conducted storm water runoff can impair reproductive success in amphibians, which often attach their eggs to stems of wetland vegetation, e.g., salamanders, tree frogs, green frogs, and wood frogs[29]. Extreme water level fluctuations during winter may also cause mortality in overwintering reptiles and amphibians[30]. Thus,

[28] Knutson et al., 2000
[29] Richter and Azous, 1995
[30] Hall and Cuthbert, 2000

Question 20 is included in the formula, with a reverse rating. Question 41 (Barriers) is included because access to and from the wetland by amphibians is an important factor in habitat quality[31].

Amphibian Habitat Functional Index Computation:

If 42=0, then N/A

Otherwise: Amphibian Habitat Index = (43) * [(44 + 2*$23_{wildlife}$ + 14 + 41 + $20_{reversed}$)/6]

Entire Formula:

If Amphibian Breeding Potential-Hydroperiod {42} is applicable, then: (Amphibian Breeding Potential-Predator Fish {43}) * {[(Amphibian Overwintering Habitat {44}+ 2*Upland Buffer Width $(23)_{Wildlife}$ + Dominant Upland Land Use {14} + Barriers {41} + Stormwater Input {$20_{reverse}$}]/6}

Amphibian Habitat Variables

MnRAM #	**Excel #**	Variable Description	Type of Interaction
42	D54	Amphibian breeding potential—hydroperiod	Controlling
43	D55	Amphibian breeding potential—fish presence	Controlling
44	E56	Amphibian overwintering habitat	Compensatory
23	I27	Upland buffer width	Compensatory
41	E53	Wildlife barriers	Compensatory
14	E18	Dominant upland land use	Compensatory
20	F24	Stormwater runoff pretreatment & detention—RR	Compensatory

6.10 AESTHETICS/RECREATION/EDUCATION/CULTURAL/SCIENCE

The aesthetics/recreation/education/cultural and science function and value of each wetland is evaluated based on the wetland’s visibility, accessibility, evidence of recreational uses, evidence of human influences (e.g. noise and air pollution) and any known educational or cultural purposes. Accessibility of the wetland is key to its aesthetic or educational appreciation. While dependent on accessibility, a wetland's functional level could be evaluated by the view it provides observers. Distinct contrast between the wetland and surrounding upland may increase its perceived importance. Also, diversity of wetland types or vegetation communities may increase its functional level as compared to monotypic open water or vegetation. Excess negative human influence on the wetland is counted double in the formula.

All questions contribute equally to the overall index.

MnRAM #	Excel #	Variable Description	Type of Interaction
48	E60	Rare educational opportunity	Controlling
49	E61	Wetland visibility	Compensatory
50	E62	Proximity to population	Compensatory
51	E63	Public ownership	Compensatory
52	E64	Public access	Compensatory
53	E65	Human influence—wetland	Compensatory

[31] Knutson, et al., 1999; Findlay and Bourdages, 2000; Semlitsch, 2000.

54	E66	Human influence—viewshed	Compensatory
55	E67	Spatial buffer	Compensatory
56	E68	Recreational activities in wetland	Compensatory

Aesthetics/Recreation/Education/Cultural/Science Functional Index Computations:

If Special Features c, h, or u is checked[32], or

If 48=1, then Index = Exceptional;

If 53=0.1 (Low), then = (50+51+52+2*53+54+55+56)/8

If 53>0.1, then = (49+50+51+52+53+54+55+56)/8

Entire Formula

(Wetland Visibility {49} + Proximity to Population {50} + Public Ownership {51} + Public Access {52} + Human Influence - Wetland {53} + Human Influence - Viewshed {54} + Spatial Buffer {55} + Recreational Activities in Wetland {56})/8

6.11 COMMERCIAL USES

This question considers the nature of any commercially-valuable use of the wetland and requires the assessor to consider how such use may be a detriment to the sustainability of the wetland. Some row crops can be planted in Type 1 wetlands after spring flooding has ceased and still have adequate time to grow to maturity. This non-wetland-dependent agricultural use of wetlands may include hay, pasture/grazing, or row crops such as soybeans or corn. Wetland-dependent crops include wild rice and cranberries, which rely on the wetland hydrology for part of their life cycle.

Sustainable uses of the wetland would not require modifying a natural wetland. Products in this category would include collection of botanical products, wet native grass seed, floral decorations, wild rice, black spruce, white cedar, and tamarack. Sustainable uses may require modification of the natural hydrology, such as for wetland-dependent crops (rice, cranberries). Haying and grazing can be less intrusive agricultural activities utilized more or less casually when hydrologic conditions permit; light pasture and occasional haying would be considered more or less sustainable. Like peat-mining, cropping is an unsustainable use of the wetland as it is results in severe alterations of wetland characteristics (soil, vegetation, hydrology).

MnRAM #	**Excel #**	Variable Description	Type of Interaction
57	**E69**	Commercial crop—hydrologic impact	Controlling

[32] c = Designated scientific and natural area; h = Archeologic or historic site designated by the State Historic Preservation Office; u = State or Federal designated wilderness area.

Commercial Uses Functional Index = 57

6.12 GROUND-WATER INTERACTION

The ground water interaction function is the most difficult to assess. Here the most likely type of ground water interaction is determined, i.e. recharge or discharge, or a combination. In many cases, a wetland will exhibit both recharge and discharge characteristics, however one is usually more dominant. Several wetland and watershed characteristics are evaluated to determine the likely interaction including: wetland soil type, upland land use, upland soil types and wetland size, wetland hydroperiod, wetland outlet characteristics, and topographic relief.

The purpose of this function is strictly to determine the likelihood of the appropriate ground-water interaction based on observable characteristics of the wetland and watershed. The significance of ground water as a component of the wetland water budget is the most difficult functional characteristic to determine without large quantities of detailed hydrologic and geologic information. The following methodology takes the most easily observable and distinct measures of recharge/discharge relationships from the *Wetland Evaluation Technique*[33] and the *Hydrogeomorphic Assessment Methodology*[34]. In many wetlands, surface water and ground water both make significant contributions to the water budget, but occasionally recharge or discharge is dominant. The goal here is to identify the dominant ground-water interaction (if there is one) to help guide future management and provide an indication when additional information may be warranted.

- If 5 or 6 of questions 58-63 are answered the same, this indicates a strong likelihood that the most frequently stated interaction exerts the primary influence on the wetland.
- If 3-4 questions are answered the same, then the wetland is likely influenced by a combination of both recharge and discharge interactions (i.e. both types of ground water interaction are likely to be present at some point during most years).

58. Wetland Soils – from HGM system functional assessments and Novitzki
59. Subwatershed Land Use/Imperviousness – taken from WET Volume I
60. Wetland Size and Upland Soils – taken from WET Volume I and HGM
61. Wetland Hydrologic Regime– taken from WET Volume I and HGM
62. Inlet/Outlet Configuration – taken from WET Volume I and HGM
63. Upland Topographic Relief – taken from WET Volume I

Special Concerns for Recharge Wetlands

Wherever ground water recharge is indicated as the **primary** interaction and the wetland lies within a sensitive ground water area (**Special Feature Question q**), a contribution area to a public water supply, or a wellhead protection area (**Special Feature Question r**), it should be recorded as Exceptional for the ground water/wetland function.

[33] Adamus, et al., 1987
[34] Magee and Hollands, 1998

6.13 *WETLAND RESTORATION POTENTIAL*

The potential for wetland restoration is determined based on the ease with which the wetland could be restored, the number of landowners within the historic wetland basin, the size of the potential restoration area, the potential for establishing buffer areas or water quality ponding, and the extent and type of hydrologic alteration. Each variable uses the High, Medium, Low rating rather than raw numbers—see MnRAM for individual ranges.

MnRAM #	Excel #	Variable Description	Type of Interaction
64	**D79**	Wetland Restoration Potential	Controlling
65	F80	Number of Landowners Affected	Contributing
21	E25	Subwatershed Wetland Density	Contributing
66b	F82	Total Wetland Restored Size (Potential)	Contributing
66c	F83	Calculated potential new wetland area	Contributing
67	F84	Potential Buffer Width	Contributing
68	F85	Likelihood of Restoration Success	Contributing

If 64="Yes", then Wetland Restoration Potential = (65+21+66b+66c+67+68)/6,

Otherwise, if 64="No" then "N/A"

Entire Formula
(Landowners Affected by Restoration (65)+Subwatershed Wetland Density (21)+ Wetland Restoration Size (66b)+Proportion of Wetland Drained (66c)+Potential Buffer Width (67)+Likelihood of Restoration Success (68))/6

6.14 *WETLAND SENSITIVITY TO STORMWATER INPUT AND URBAN DEVELOPMENT*

The sensitivity of the wetland to stormwater and urban development is determined based on guidance within the *Storm-Water and Wetlands: Planning and Evaluation Guidelines for Addressing Potential Impacts of Urban Storm-Water and Snow-Melt Runoff on Wetlands*, State of Minnesota Storm-Water Advisory Group, June 1997. The database pulls this rating directly from the Plant Community entry. If any of the following plant communities are present, this value will always be Exceptional: 3B, 4A, 4B, 7A,7B, 10A,13A,14A, 16B.

Use habitat proportions from Vegetative Integrity section and enter into a formula to compute answer according to the following criteria[35].

Exceptional = Sedge meadows, open and coniferous bogs, calcareous fens, low prairies, wet to wet-mesic prairies, coniferous swamps, lowland hardwood swamps, or seasonally flooded basins.

A = Shrub-carrs, alder thickets, diverse fresh wet meadows dominated by native species, diverse shallow and deep marshes, and diverse shallow, open water communities.

B = Floodplain forests, fresh wet meadows dominated by reed canary grass, shallow and deep marshes dominated by cattail, reed canary grass, giant reed or purple loosestrife, and shallow, open water communities with low to moderate vegetative diversity.

C = Gravel pits, cultivated hydric soils, or dredge/fill disposal sites.

[35] Taken directly from State of Minnesota Storm-Water Advisory Group, 1997.

6.15 ADDITIONAL STORMWATER TREATMENT NEEDS

This rates the sustainability of the wetland with regard to stormwater discharges to the wetland. The need for additional stormwater treatment prior to discharge to the wetland is rated based on the overall rating for Maintenance of Wetland Water Quality. If a wetland is severely degraded by stormwater inputs, the rating will be low, since a diverse, high quality wetland will not be sustainable.

Use functional rating for Maintenance of Wetland Water Quality (MWWQ) as follows (this index is rated strictly from the measure of the water quality in the wetland and the sustainability, i.e. if the water quality in the wetland is low, additional stormwater treatment is needed to protect the wetland and the rating is low):

Use Value for Maintenance of Wetland Water Quality Index (D76, Excel spreadsheet) and apply to criteria below.

A = Maintenance of Wetland Water Quality Index >0.66 (no additional treatment needed)
B = 0.33 < Maintenance of Wetland Water Quality Index # < 0.66 (sediment removal needed)
C = Maintenance of Wetland Water Quality Index < 0.33 (sediment and nutrient removal needed)

7.0 References

Most reference material will be available at the Board of Water & Soil Resources library. Please report errors or omissions to the BWSR MnRAM contact person.

Adamus, P.R., L.T. Stockwell, E.J. Clairain, Jr., M. E. Morrow, L.P. Rozas, R.D. Smith, 1991. *Wetland Evaluation Technique: Volume I , Literature Review and Evaluation Rationale*. US Army Corps of Engineers Waterways Experiment Station.

Adamus, P.R., ARA, Inc, E.J. Clairain, Jr., R.D. Smith, and R.E. Young, 1987. *Wetland Evaluation Technique (WET) Volume II , Methodology, Operational Draft*. Department of the Army, Vicksburg, MS.

Ammann, A. P. and A. Lindley Stone, 1991. *Method for the Comparative Evaluation of Nontidal Wetlands in New Hampshire*. Published by the New Hampshire Department of Environmental Services. NHDES-WRD-1991-3.

Aaseng, N.E., J.C. Almendinger, R.P. Dana, B.C. Delaney, H.L. Dunevitz, K.A. Rusterholz, N.P. Sather, and D.S. Wovcha. 1993. *Minnesota's Native Vegetation: A Key to Natural Communities, Version 1.5.* Minnesota Department of Natural Resources Biological Report No. 20. Natural Heritage Program.

Chow, V.T., D.R. Maidment, and L.W. Mays, 1988. *Applied Hydrology.* McGraw-Hill, Inc. New York. 572 pp.

Cowardin, L.M., V. Carter, F.C. Golet, R.T. LaRoe. 1979. *Classification of Wetlands and Deepwater Habitats of the United States.* U.S. Fish and Wildlife Service, FWS/OBS079/31, 103 pp.

Eggers, S.D. & D.M. Reed. 1997. Wetland Plants and Plant Communities of Minnesota & Wisconsin. 2nd edition. US Army Corps of Engineers, St. Paul.

Fetter, C.W. 1980. *Applied Hydrogeology.* MacMillan Publishing Company, New York, NY. 592 pp.

Findlay, C.S. and J. Bourdages. 2000. *Response time of wetland biodiversity to road construction on adjacent lands.* Conservation Biology 14:86-94.

Federal Interagency Committee for Wetland Delineation. 1989. "Federal Manual for Identifying and Delineating Jurisdictional Wetlands." USEPA, USFWS, US Army Corps of Engineers and US Soil Conservation Service, Washington, D.C. 76 pp. plus appendices.

Flores, A.C., P.B. Bedient and L.W. Mays, 1981. *Method for Optimizing Size and Location of Urban Detention Storage.* Proc. Of the Internatl. Symp. On Urban Hydrology, Hydraulics and Sediment Control, ASCE, New York, pp 357-365.

Golet, F.C. 1976. *Wildlife wetland evaluation model.* Pages 13-34 in J.S. Larson, ed., Models for assessment of freshwater wetlands. University of Massachusetts Water Resources Research Cent. Publ. No., 32, Amherst. 91 pp.

Hall, C.D. and F.J. Cuthbert. 2000. *Impact of a controlled wetland drawdown on Blanding's turtles in Minnesota.* Chelonian Conservation & Biology 4:643-657.

Hennepin County Well Index, 2001. Surficial Aquifer Data.

Knutson, M.G., J.R. Sauer, D.A. Olsen, M.J. Mossman, L.M. Hemesath and M.J. Lannoo. 1999. *Effects of landscape composition and wetland fragmentation on frog and toad abundance and species richness in Iowa and Wisconsin, U.S.A.* Conservation Biology 13:1437-1446.

Knutson, M.G., J.R. Sauer, D.A. Olsen, M.J. Mossman, L.M. Hemesath and M.J. Lannoo. 2000. *Landscape associations of frog and toad species in Iowa and Wisconsin, U.S.A.* Jour. Iowa Acad. Sci. 107(3):134-145.

Knutson, P. L., J. C. Ford, and M. R. Inskeep. 1981. *National Survey of Planted Salt Marshes (vegetative stabilization and wave stress).* Wetlands 3:129-153.

Kuchler, A.W. 1967. Vegetation Mapping. The Ronald Press, New York, New York.

Lannoo, M.J. 1998. *Amphibian conservation and wetland management in the upper midwest: a catch 22 for the cricket frog. In* Status and Conservation of Midwestern amphibians. M.J. Lanoo, ed. University of Iowa Press, Iowa City, Iowa. Pages 331-339.

Lee, L.C. and Mark M. Brinson, William J. Kleindl, P. Michael Whited, Michael Gilbert, Wade L. Nutter, Dennis F. Whigham, Dave DeWald. 1997. *Revised Operational Draft Guidebook for the Hydrogeomorphic Assessment of Temporary and Seasonal Prairie Pothole Wetlands*. Seattle, WA. pp. 116+app.

Lehtinen, R.M., S.M. Galatowitsch and J.R. Tester. 1999. *Consequences of habitat loss and fragmentation for wetland amphibian assemblages.* Wetlands 19:1-12.

Magee, D.W. and Garrett G. Hollands. 1998. *A Rapid Procedure for Assessing Wetland Functional Capacity.* Association of State Wetland Managers. 190 pp.

Michigan DNR. 1981. *Manual for Wetland Evaluation Techniques.* Michigan Department of Natural Resources, Lansing, MI.

Mitch & Gosselink 2000. Wetlands 3rd Edition.

Ogawa, H. and J. W. Male. 1983. *The Flood Mitigation Potential of Inland Wetlands*. Water Resources Research Center. University of Massachusetts.

Oldfield, B. and J.J. Moriarty. 1994. *Amphibians and reptiles native to Minnesota.* University of Minnesota Press, Minneapolis, Minnesota.

Reed, P.B. 1988 (and 1993 supplement). National List of Plant Species that Occur in Wetlands, U. S. Fish and Wildlife Service National Wetland Inventory, St. Petersburg, FL.

Rheinhardt, R., Mark M. Brinson, N. Eric Fleming, J. Glenn Sandifer, Jr., 1997. *Deciduous Wetland Flats Interim HGM Model*. 50 pp.

Richter, Klaus O. and Amanda L. Azous. 1995. Amphibian occurrence and wetland characteristics in the Puget Sound Basin. Wetlands 15:305-312.

Seaberg, J.K. and Douglas D. Hansen. 2000. *Metropolitan Area Groundwater Model Project Summary: Northwest Province, Layers 1, 2, and 3 Model, Version 1.00*. Minnesota Pollution Control Agency.

Semlitsch, R.D. 2000. Principles for management of aquatic-breeding amphibians. J. Wildlife Mgmt. 64:615-631.

Shaw, S. and C.G. Fredine. 1956. *Wetlands of the United States Circular 39.* U.S. Fish and Wildlife Service. U.S. Government Printing Office, Washington, D.C.

Smith, S.G. 1986. *The cattails (Typha): Interspecific ecological differences and problems of identification.* Proceedings of the 5th Annual Conference of the NALMS. Geneva, Illinois, 357-362.

Snodgrass, J.W., M.J. Komoroski, A.L.Bryan, Jr., and J. Burger, Jr. 2000. *Relationships among isolated wetland size, hydroperiod, and amphibian species richness: implications for wetland regulations.* Conservation Biology 14:414-419.

State of Minnesota Storm-Water Advisory Group. 1997. *Storm-Water and Wetlands: Planning and Evaluation Guidelines for Addressing Potential Impacts of Urban Storm-Water and Snow-Melt Runoff on Wetlands.*

Thill, D., and M. Jacobson. 2000. *The Minnehaha Creek Routine Assessment Method*, in conjunction with the Minnehaha Creek Watershed District.

Environmental Laboratory. 1987. Corps of Engineers Wetlands Delineation Manual. Technical Report Y-87-1, Final Report.

Verry, E.S. 1988. *The Hydrology of Wetlands and Man's Influence on it.* International Symposium on the Hydrology of Wetlands in Temperate and Cold Regions. Joensuu, Finland.

Wells, J. Mike Mueller, John Parker, Bruce Gerbig, S. Jatnieks-Straumanis, Bruce Wilson, John Kittelson, Paul Richert, Teri Sardinas, Scott LaChance, and Larry Smith, 1988. *The Minnesota Wetland Evaluation Methodology for the North Central United States*. Corps of Engineers in conjunction with the Minnesota Environmental Quality Board Wetland Evaluation Methodology Task Force, John R. Wells, Chairman.

Whited, D., Galatowitsch, S., Tester, J.R., Schik, K., Lehtinen, R., Husveth, J. 2000. Landscape and Urban Planning, 49 (1-2): 49-65.

Williams, R.E. 1968. *Flow of groundwater adjacent to a small, closed basin in glacial till.* Water Resources Research 4:777-783.

BMP References:

Board of Water and Soil Resources, Association of Metropolitan Soil and Water Conservation Districts. 1989. Minnesota Construction Site Erosion and Sediment Control Planning Handbook. St. Paul.

Minnesota Pollution Control Agency. 2000. Protecting Water Quality in Urban Areas: Best Management Practices for Dealing with Storm Water Runoff from Urban, Suburban and Developing Areas of Minnesota. Minneapolis, March, 2000.

Barr Engineering Company. 2001. Minnesota Urban Small Sites BMP Manual: Stormwater Best Management Practices for Cold Climates. Metropolitan Council Environmental Services, St. Paul, MN.

8.0 Appendices

Appendix 1: Possible Best Management Practices, Detailed Listing

Type of Practice	Area of Benefit	Storm Protection Benefit	Pollutants Controlled	Construction Requirements
Institutional Source Controls				
Public Education (Billing inserts, news releases, radio public service announcements, school programs, and pamphlets)	Not applicable.	Reduced pollutant load to storm drain system.	Can reduce improper disposal of paints, varnishes, thinners, pesticides, fertilizers, and household cleansers, and chemicals, etc.	None.
Litter Control	Site dependent.	Reduced potential for clogging and discharge.	Household and restaurant paper, plastics, and glass.	Increase number of trash receptacles and regulary service.
Recycling Programs	Site dependent.	Reduction in potential for clogging and harmful discharge.	Household paper, glass, aluminum, and plastics. Oil and grease from auto maintenance.	Collection and sorting stations.
"No Littering" Ordinance	Storm drain system and receiving water.	Prohibits littering and prevents litter from entering storm drains.	Paper, plastics, glass, food wrappers, and containers.	None.
"Pooper Scooper" Ordinance	Storm drain system and receiving water.	Requires animal owners to clean up and properly dispose of animal wastes.	Coliform bacteria and nitrogen/urea.	None.
Develop and Enact Spill Response Plan	Site dependent.	Prevent pollutants from entering storm drain.	Hazardous chemical, harmful chemicals, oil, and grease.	None.
Clean Up Vacant Lots	Site dependent.	Prevent debris from accumulating on lot. Prevent site from appearing as a "dump" for others to use for disposal. Eliminate sources of hazardous waste.	Hazardous and/or harmful chemicals, wind blown for water borne debris.	None.
Prohibit Illegal and Illicit Connections and Dumping into Storm Drain System	Storm drain system and receiving water.	Reduces pollutant load entering storm drains.	Coliform bacteria, nitrogen, contaminants, and toxic or harmful chemicals.	None.

Type of Practice	Area of Benefit	Storm Protection Benefit	Pollutants Controlled	Construction Requirements
Identify, Locate, and Prohibit Illegal or Illicit Discharge to Storm Drain System	Area-wide.	Halt hazardous and harmful discharges, whether intentional or negligent.	Sewage from cross connections, oil, grease, direct disposal of pesticides and fertilizers, contaminated water, paint, varnish, solvents, water from site dewatering, swimming pool and spa water, flushing water from radiators and cooling systems, and hazardous or harmful chemicals.	Monitor storm drain system for flows and water quality.
Require Proper Storage, use, and Disposal of Fertilizers, Pesticides, Solvents, Paints and Varnishes, and Other Household Chemicals (oil, grease, and antifreeze, etc.)	Site dependent (City, State, or County-wide).	Reduce pollutant load to storm system.	Household hazardous materials.	None.
Restrict Paving and Use of Nonporous Cover Materials in Recharge Areas	Recharge area site.	Promotes infiltration to groundwater and reduces runoff volume and velocity. Filters pollutants.		Establishment of vegetation or use of recharge/infiltration materials.
Nonstructural Source Controls				
Street Sweeping	Street right-of-way.	Reduction in potential for clogging storm drains with debris. Some oil and grease control possible.	Paper and plastics, leaves and twigs, dust, and oil and grease.	Acquire street sweeping equipment.
Sidewalk Cleaning	Sidewalk right-of-way in areas of heavy foot traffic.	Reduction in pollutants entering storm drain.	Oil and dirt.	None.
Clean and Maintain Storm Drain Channels Annually	Channel capacity and receiving water. Upstream flood control benefits. Includes benefits to channel wildlife habitat and vegetation.	Prevent erosion in channel. Improve capacity by removing silt and sedimentation. Remove debris that is habitat destroying or toxic to wildlife.	Silt and sediment and the contaminants contained therein. Plastic, glass, paper, and metal thrown or washed in channel.	None.
Clean and Inspect Storm Inlets and Catch Basins Annually	Site dependent flood control benefits.	Allows proper drainage to prevent flooding and continued proper operation of facilities.	Silt and sediment and the contaminants contained therein. Plastic, glass, paper, and metal thrown or washed into facilities.	None.
Clean and Inspect Debris Basins Annually	Site dependent flood control benefits.	Allows proper drainage to prevent flooding and continued proper operation of facilities.	Silt and sediment and the contaminants contained therein. Plastic, glass, paper, and metal thrown or washed into facilities.	None.

Type of Practice	Area of Benefit	Storm Protection Benefit	Pollutants Controlled	Construction Requirements
Storm Drains Cleaned and Maintained Every 3 to 6 Years	Flood control and water quality benefits.	Allows proper drainage to prevent flooding and continued proper operation of facilities.	Silt and sediment and the contaminants contained therein. Plastic, glass, paper, and metal thrown or washed into facilities.	None.
Storm System Pump Stations Cleaned and Maintained Annually	Site dependent flood control and water quality benefits.	Prevents flooding and allows continued proper operation of facilities.	Silt and sediment and the contaminants contained therein. Plastic, glass, paper, and metal thrown or washed into facilities.	None.
Inspect and Maintain Sewer System	Storm drain system and receiving water.	Prevents and eliminates sewer system surcharges.	Contaminants, toxics, and coliform bacteria.	None.
Minor Structural Source Controls				
Storm Drain Inlet Protection	Storm drain drainage area.	Prevent debris from entering storm drain.	Dirt, leaves, twigs, paper, plastic, and other incidentals.	Not available.
Outlet Protection	Storm drain receiving water.	Prevent erosion at the outlet of pipes or paved channels and protect downstream water quality.	Turbidity and sediment.	Structural apron lining at the outlet location. Made of riprap, grouted riprap, concrete, or other structural materials.
Slope Stabilization and Erosion Control Measures	Site and topography dependent.	Reduce silt and sediment load to storm drains.	Silt and sediment and the contaminants therein.	None.
Interceptor Swale	Dependent on flow velocity. Max. velocity for earth channel is 6 fps. Max. velocity for vegetated or riprap channel is 8 fps.	Shorten length of exposed slopes and intercept and divert storm runoff from erodible areas.	Sediment and silt and the contaminants contained therein.	Excavation drainageway across disturbed areas or rights-of-way.
Improve and Maintain Natural Channels	Channel capacity and receiving water. Upstream flood control benefits. Includes benefits to channel wildlife habitat and vegetation.	Prevent erosion in channel. Improve capacity by removing silt and sedimentation. Remove debris that is habitat destroying or toxic to wildlife.	Silt and sediment and the contaminants contained therein. Plastic, glass, paper, and metal thrown or washed in channel.	None.
Diversion Channel	Dependent of flow velocity. Maximum velocities: 5 fps for vegetated channel and 8 fps for riprap channel. Not for use on slopes greater than 15%. Drainage area should be 5 acres or less.	Intercept and convey runoff to outlets at nonerosive velocity.	Sediment and erosion controls.	Lined drainageway of trapezoidal cross section.
Grass-Lined Channel	Site dependent but of larger capacity than interceptor or perimeter swales.	Intercept runoff and convey runoff from site.	Sediment and silt and the contaminants contained therein.	Excavation of channel or improvements to natural channel. Stabilization with vegetation.

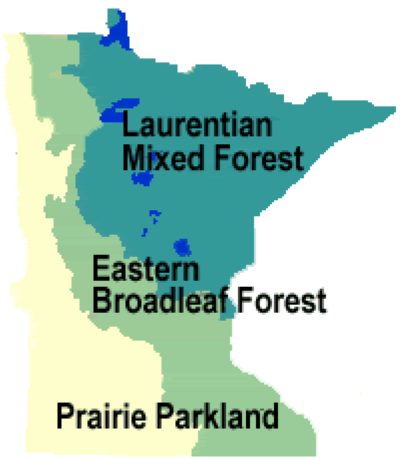
Type of Practice	Area of Benefit	Storm Protection Benefit	Pollutants Controlled	Construction Requirements
Storm Drain Drop Inlet Protection	Areas less than 1 to 2 acres.	Filters sediment from runoff before it enters inlet. Provides relatively good protection.	Sediment and the contaminants contained therein.	Barrier around storm drain inlet. Useful for areas where storm drain is operational before area runoff area is stabilized.
Riprap	Site dependent	Provides stabilization and erosion control for stream banks and channels, outlet, and slopes.	Erosion and sediment.	Placement of rock on area to be stabilized. May also require use of filter fabric liner.
Gabions	Site dependent	Provides stabilization and erosion control for stream banks, outlet, and slopes.	Erosion and sediment.	Placement of wire cage will with rocks over area to be stabilized. May also require use of filter fabric liner.
Vegetative Control	Applicable and effective for most sites.	Provides stabilization and erosion control for streambanks, swales, channels, outlets, slopes, open disturbed areas. Can be up to 99% effective with established cover. Temporary seeding can be up to 90% effective.	Erosion and sediment.	Site preparation (can include land leveling and installation of irrigation system), seeding or planting, and netting or mulching to establish seed. Can also include other sodding, ground cover, shrubs, trees, and native plants.
Filter Strips	Site dependent.	Receives overland flow slowing runoff and trapping particulates. Can be 30 to 50% effective for sediment control.	Silt, sediment, trash, organic matter, and to an extent, soluble pollutants through infiltration.	Grading and vegetative establishment. Should have a minimum width of 15 to 20 feet. Good performance is achieved with a 50 to 75 foot width.
Fence Open Channels	Site dependent.	Prevent windblown trash from entering channel. Prevents illegal dumping in channel.	Trash and pollutants.	Construction of fences.
Discharge Elimination Methods				
French Drains and Subsurface Drains	Dependent on site topography and soil permeability.	Provides drainage of “wet” soils to allow establishment of vegetation. Can reduce runoff.	Sediment.	Underground perforated pipe leading to a surface water outlet. Pipe size, bedding and depth is dependent on site conditions.
Infiltration Trench and Dry Well	Small drainage areas. Runoff from rooftops, parking lots, residential, etc.	Provides temporary storage of runoff and infiltration to soil. Not for use in areas where groundwater could become contaminated.	Prevents 100% of pollutants from entering surface water. Oil, grease, floating organic matter, and settleable solids should be removed before water enters trench.	Excavation of a shallow trench 2’ to 10’ deep. Backfilled with coarse stone aggregate.

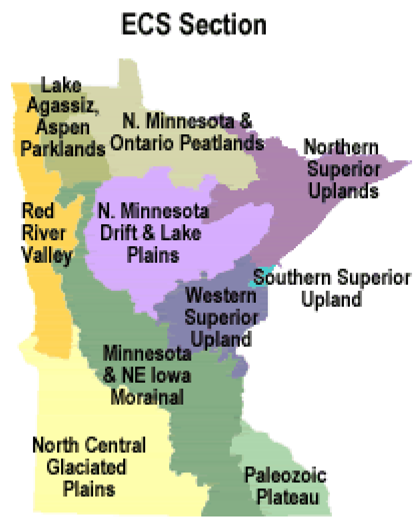
Type of Practice	Area of Benefit	Storm Protection Benefit	Pollutants Controlled	Construction Requirements
Exfiltration Trench	Site dependent.	Prevent silting on underlying filter gravel or rock bed. Retain first flush, reduce runoff volume and peak discharge rate and promote water quality improvement.	Prevents pollutants from entering surface water. Oil, grease, floating organic matter, and settleable solids should be removed before water enters trench.	Uses perforated pipe with suitable membrane filter material. Installed before receiving water outlet or in groundwater recharge area.
Porous Pavement	Site dependent. Requires relatively flat surface.	Allow infiltration of surface runoff. Reduce runoff volume and pollutant loadings from low volume traffic areas.	Oil and grease.	Install porous pavement. May require twice as much paving material as standard asphalt to achieve same strength.
Retention Basin	Best for sites of 5 to 50 acres.	Promotes infiltration to groundwater and reduces runoff volume and velocity. Filters pollutants.	Sediment, trace metals, nutrients, and oxygen-demanding substances.	Excavation of a basin over permeable soils. Size is site dependent. Depth is 3 to 12 feet.
Floatables and Oil Removal				
Clarifiers and Oil and Water Separators on Parking Structures	Parking lot structure and receiving water.	Collect debris before it can enter storm drain.	Oil, grease, and antifreeze from vehicles and foods and food wrappers.	Install grit and separators.
Oil and Grit Separators	Site dependent. For heavy traffic areas or areas with high potential for oil spills.	Remove pollutants.	Sediments and hydrocarbons.	Install oil and grit separators on storm drains.
Sediment/Grease Trap	Installed on storm drain inlets.	Intercept and trap sediment and grease from runoff.	Sediment, oil, and grease.	Install sediment and grease traps.
Solids Removal				
Detention Basin	Four acres of drainage area for each acre/foot of storage provided to retain a permanent pool of water.	Temporary storage of storm runoff until release. Can also improve water quality.	Sediment, trace metals, hydrocarbons, nutrients, and pesticides.	Excavation of a basin over soils which will cause excessive seepage. May require a liner. Can be used aesthetically as a small pond in landscaping.
Extended Detention Basin	Size for a minimum detention time of 24 hours.	Temporary storage of runoff for an extended period of time. Can improve water quality.	Sediment, trace metals, hydrocarbons, nutrients, and pesticides.	Excavation of a basin over soils which will cause excessive seepage. May require a liner. Can be used aesthetically as a small pond in landscaping.
Bar Screens	Site dependent.	Restrict passage of objects which may obstruct pump station suction bays.	Large debris.	Install bar screens before pump station suction bays.

Appendix 2: Ecological Classification System

The Ecological Classification System (ECS) is part of a nationwide mapping initiative developed to improve our ability to manage all natural resources on a sustainable basis. This is done by integrating climatic, geologic, hydrologic and topographic, soil and vegetation data.

Three of North America's ecological regions, or biomes, representing the major climate zones converge in Minnesota: prairie parkland, deciduous (Eastern broadleaf) forest and coniferous (Laurentian mixed) forest. The presence of three biomes in one non-mountainous state is unusual, and accounts for the diversity of ecological communities in Minnesota.





Appendix 3: Glossary

Aquatic Bed (AB) – A class within the Cowardin Wetland Classification system. Includes wetlands and deepwater habitats dominated by plants that grow principally on or below the surface of the water for most of the growing season in most years.

Best Management Practices: Land management actions that can be implemented to protect wetlands from various nonpoint source pollutants. In general, they must be designed and often implemented to meet site-specific needs. Typically, BMPs are chosen and implemented for their ability to treat or reduce sediment, nutrient removal and to reduce excess surface water from entering the wetland.

Buffer: A buffer is an unmanicured upland area dominated by permanent native and noninvasive vegetation immediately adjacent to the wetland boundary.

Discharge: Wetland systems in which water preferentially discharges from groundwater into the wetland.

Emergent shoreline vegetation: These plants grow along edges of lakes and ponds, or on wet ground away from open water. Examples of such vegetation include: cattail, bulrush, loosestrife, and reed canary grass.

Exotic Plant: A plant not originally from this area or location.

Facultative Plants: Plants with a similar likelihood of occurring in both wetlands and nonwetlands (estimated probability 33% to 67%).

Facultative Upland Plants: Plants that sometimes occur in wetlands (estimated probability 1% to 33%), but occur more often in nonwetlands (estimated probability >67% to 99%).

Facultative Wetland Plants: Plants that usually occur in wetlands (estimated probability 67% to 99%), but also occur in nonwetlands (estimated probability 1% to 33%).

Flood Attenuation: The slowing of a flood wave by spreading water flow laterally over the ground surface or by the increased resistance of water flow through emergent vegetation.

Genera: Genera or genus is a level of taxonomy and is typically the first part of a scientific name that is utilized to identify a plant or animal. The scientific name for purple loosestrife is *Lythrum salicaria* (*Lythrum* is the genus name, while *salicaria* is the specices name).

Geographic Information System (GIS): A system designed to work with data referenced by spatial or geographic coordinates.

Hydric Soils: Soils that are saturated, flooded, or ponded long enough during the growing season to develop anaerobic conditions in the upper part.

Hydrologic Regime (Hydroperiod): The seasonal pattern of wetland water level that is like a hydrologic signature of each wetland type. It defines the rise and fall of a wetland's surface and subsurface water. Constancy of seasonal patterns from year to year ensures a reasonable stability for the wetland.

Hydrophytic Vegetation: Macrophytic plant life growing in water, soil, or on a substrate that is at least periodically deficient in oxygen as a result of excessive water content.

Inundation: Covering or flooding of the land surface with water.

Invasive Plant: A non-native plant that escapes from where it was planted and invades native plant communities.

Macrophyte: A plant that is physiologically adapted to live in sediment, which is saturated or inundated for an extended duration or permanently.

Monotypic Vegetation: Vegetative communities dominated by a single plant species.

National Wetland Inventory (NWI): An inventory of the Nation's wetland resources and deepwater habitats conducted by the U.S. Fish and Wildlife Service containing information on the extent and characteristics of wetlands identified primarily from aerial photographs.

Native Vegetation: Plant species that are indigenous to Minnesota or that expand their range into Minnesota without being intentionally or unintentionally introduced by human activity and are classified as native in the Minnesota Plant Database.

Non-invasive Vegetation: Plant species that do not typically invade or rapidly colonize existing, stable plant communities.

Non-native Plant: A plant introduced by human activities to areas where they do not naturally occur.

Nutrient Loading: The import of nutrients (phosphorus and nitrogen) carried in runoff water.

Obligate Upland Plants: Plants that rarely occur in wetlands (estimated <1%), but almost always occur in nonwetlands (estimated probability >99%) under natural conditions.

Obligate Wetland Plants: Plants that occur almost always (estimated probability >99%) in wetlands under natural conditions, but which may also occur rarely (estimated probability <1%) in nonwetlands.

Pretreatment: Removal of nutrients or sediment from stormwater runoff prior to discharging into a wetland.

Recharge: Wetland systems in which water preferentially seeps into groundwater.

Reference Standard Wetland: Reference Standard Wetlands are the least disturbed/altered wetlands within the Wetland Comparison Domain.

Submergent Aquatic Vegetation: The entire plant is usually underwater, but the flowers and fruits may rise above the water surface. Submergent species are rooted in the sediment and have underwater leaves. They can grow from shallow water to depths greater than 20 feet.

Subwatershed: Major watersheds are split up into subwatersheds, each of which defines the land area in which all water drains to a defined point.

Terrestrial Exotic Plant: A plant not originally from this area that is best adapted to life on ground that is not saturated or inundated for extended periods of time.

Watershed: The land area in which all water drains to a defined point.

Wetland: Lands transitional between terrestrial and aquatic systems where the water table is usually at or near the surface or the land is covered by shallow water. Wetlands must:

(1) have a predominance of hydric soils;
(2) be inundated or saturated by surface water or groundwater at a frequency and duration sufficient to support a prevalence of hydrophytic vegetation typically adapted for life in saturated soil conditions; and
(3) under normal circumstances, support a prevalence of hydrophytic vegetation.

Wetland Community: A characteristic assemblage of various vegetation species typically found in specific wetland conditions.

Wetland Comparison Domain: A Wetland Comparison Domain is defined in the MnRAM 2.0as the geographic area, generally of a size so as to include some relatively undisturbed Reference Standard Wetlands (e.g., the political boundary, major or local watershed boundary or ecoregion subsection), used for functional comparison.

Wetland Conservation Act (WCA): The Wetland Conservation Act became effective on January 1, 1992. WCA rules are administered by Local Government Units (LGU) with oversight provided by the Board of Water and Soil Resources and technical assistance from the Soil and Water Conservation Districts. The Department of Natural Resources conservation officers and other peace officers provide enforcement of the WCA. The primary goals of the WCA are to:

1. Achieve no net loss in the quantity, quality, and biological diversity of Minnesota's existing wetlands.
2. Increase the quantity, quality, and biological diversity of Minnesota's wetlands by restoring or enhancing diminished or drained wetlands.
3. Avoid direct and indirect impacts to wetlands from activities that destroy or diminish the quantity, quality, and biological diversity of wetlands.
4. Replace wetland values where avoidance of activity is not feasible or prudent.

Wetland Functions: Physical, chemical, or biological processes or attributes of a wetland -- simply something a wetland does. For example, the process of retaining surface water is a commonly cited wetland function.

Wetland Creation: The conversion of a persistent upland into a wetland by human activity.

Wetland Restoration: Reestablishment of a historical wetland in an area in which wetland hydrology has been removed.

Wetland Value: A wetland value is the extent to which a wetland function is perceived as beneficial to an individual or society. Reduced flood damage to downstream properties is a value generally associated with the function of surface water retention.

(Issued 9/15/10)

MnRAM 3.4

FOR EVALUATING WETLAND FUNCTIONS

MnRAM 3.4 is designed to help assess functions and values associated with Minnesota wetlands. The Comprehensive Guidance document (available at www.bwsr.state.mn.us) contains explanations, references, definitions, and a ranking formula for each function. After using this tool, the Management Classification Reference will help to organize the results for managing local wetland resources.

GENERAL INFORMATION:

Project Number or Name:		Wetland Number:	
Location: County;	Section; ,	Township	Range
Major Watershed:	Subwatershed:		City:
Evaluator(s):			Date of Site Visit:

SCOPE AND LIMITATIONS:

1. Note unusual climatic conditions experienced during this assessment due to seasonal considerations and/or unusual existing hydrologic and climatologic conditions:
2. Describe the **purpose** of this assessment: inventory/planning/monitoring/regulatory/classification____________________

SUMMARY TABLE

ACTUAL CONDITIONS	FUNCTIONAL INDEX*		
FUNCTIONS (and Related Values)	N/A	Functional Index Score	Comments
Vegetative Diversity/Integrity** Plant Comm. #1			
Plant Comm. #2			
Plant Comm. #3			
Maintenance of Characteristic Hydrologic Regime			
Flood/Stormwater/Attenuation			
Downstream Water Quality			
Maintenance of Wetland Water Quality			
Shoreline Protection			
Maintenance of Characteristic Wildlife Habitat Structure			
Maintenance of Characteristic Fish Habitat			
Maintenance of Characteristic Amphibian Habitat			
Aesthetics/Recreation/Education/Cultural			
Commercial Uses			
Groundwater Interaction			
Additional Information			
Wetland Restoration Potential			
Sensitivity to Stormwater and Urban Development			
Additional Stormwater Treatment Needs			

*The functional index may be calculated manually using formulas in the Comprehensive Guidance.

**If more than 3 plant communities are present, use an additional summary table.

FUNCTIONAL ASSESSMENT - **Special Features**

Is the wetland part of, or directly adjacent to, an area of special natural resource interest?
Check those that apply:

a. ____ Designated trout streams or trout lakes (For Minnesota, see MnDNR Commissioners Order 2450 Part 6262.0400 subparts 3 and 5) (*if yes, Fish Habitat Rating is Exceptional*).

b. ____ Calcareous fen (Special Status— For Minnesota, see MN Rule Chapter 7050) *(if yes, Vegetative Diversity/Integrity functional rating is Exceptional). Consult DNR for regulatory purposes.*

c. ____ DNR designated scientific and natural area (*if yes, then Aesthetics/Recreation/Education/ Cultural functional rating is Exceptional).*

d. ____ Rare natural community. Defined as: a wetland native plant community having a state element rank of S1, S2, or S3[1] that is mapped or determined to be eligible for mapping in the Natural Heritage Information System (NHIS) maintained by the Minnesota Department of Natural Resources OR a wetland native plant community contained within an area mapped or determined to be eligible for mapping in the NHIS as a Site of Outstanding or High Biological Diversity.[2] *If present, then the ratings for Vegetative Diversity/Integrity and Wildlife Habitat are Exceptional (see MnRAM question 5). For Minnesota, refer to Minn. Rule Ch. 8420.0548, Subp. 3. This answer automatically makes the answer to #5 = "Yes."*

e. ____ High priority wetland, environmentally sensitive area or environmental corridor identified in a local water management plan.

f. ____ Public park, forest, trail or recreation area.

g. ____ State or Federal fish and wildlife refuges and fish and wildlife management areas, and water fowl protection areas *(if yes, then Wildlife and/or Fish Habitat functional rating is Exceptional).*

h. ____ Archeological or historic site as designated by the State Historic Preservation Office *(if yes, then Aesthetics/Recreation/Education/Cultural functional rating is Exceptional).*

i. Plant species: naturally occurring, persistent populations that are[3]:
Federally listed: ____ Endangered ____ Threatened
State listed: ____ Endangered ____ Threatened (In Minnesota, see Minn. Rule Ch. 8420.0548, Subp. 2)
Species of special concern: _____
List the species: _________________________ .

If yes, then question 35 is yes, then the Vegetative Diversity/Integrity functional rating is Exceptional. This answer automatically makes the answer to #4 = "Yes."

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[1] State element ranks are assigned to all native plant communities in the state based on their extent and status as follows: S1 = critically imperiled in the state due to extreme rarity; S2 = imperiled in the state due to rarity; S3 = rare or uncommon in the state; S4 = apparently secure in the state; S5 = demonstrably secure in the state. For information on state element ranks for specific native plant communities, contact the DNR at 651-259-5125 or 651-259-5109 or email Ecoservices@dnr.state.mn.us and put "Wetlands/NHIS" in the subject line.

[2] Information on the NHIS and how to obtain NHIS reports for a specific location is available at: http://www.dnr.state.mn.us/ecological_services/nhnrp/nhis.html .

[3] Information on known occurrences of listed plant species is available from the NHIS. See footnote 2.

j. **Wildlife species** in or using the wetland that are[4]:
Federally listed:____ Endangered ____ Threatened
State listed: ____ Endangered ____ Threatened (In Minnesota, see Minn. Rule Ch. 8420.0548, Subp. 2)
Species of special concern: _____
List the species: _________________________ .

If present, then the Wildlife Habitat functional rating is Exceptional.

k. ____ Local Shoreland Management Plan area.
l. ____ State Coastal Zone or Shoreland Management Plan area.
m. ____ Shoreland area identified in a zoning ordinance (generally within 1000 feet from a water basin and 300 feet from a watercourse).
n. ____ Floodplain area identified in a zoning ordinance or map.
o. ____ Wetland restored or preserved under a conservation easement.
p. ____ Wetland restored or created for mitigation purposes.
q. ____ Designated Wellhead or Sourcewater Protection Area *(if yes and Ground Water Interaction is Recharge, then Ground Water functional index is Exceptional).*
r. ____ Sensitive ground-water area *(if yes and Ground Water Interaction is Recharge, then Ground Water functional index is Exceptional).*
s. ____ State or Federal designated wild and scenic river (In Minnesota, see MN Rule Chapter 7050).
t. ____ Federally identified special area management plan, special wetland inventory study, or an advanced delineation and identification study.
u. ____ State or Federal designated wilderness area (*if yes, then Aesthetics/Recreation/Education/ Cultural functional rating is Exceptional).*

[4] Information on known occurrences of listed animal species is available from the NHIS. See footnote 2

Vegetative Diversity and Integrity

1. **Go to upper canopy to key out wetland plant community(-ities) within the evaluation area using the following key[5].** Evaluate only each contiguous type that comprises at least 10% of the vegetated wetland area; the exception is a shallow, open water community in which any fringe emergent communities must be evaluated. Be sure to sample shallow, open water areas for submergent vegetation. Enter in page one of field data form, MnRAM database second tab, or the manual-use summary table located in the Guidance.

Wetland Community Classification Key

1A. Mature trees (dbh of 6 inches or more) are present and form closed stands (more than 17 trees per acre; more than a 50 percent canopy cover) on wet, lowland soils (usually floodplains and ancient lake basins).

2A. Hardwood trees are dominant (>50% areal coverage or basal area of the tree stratum); usually alluvial, peaty/mucky, or poorly drained mineral soils.

3A. Silver maple, American elm, river birch, green ash, black willow, box elder and/or eastern cottonwood are dominant; growing on alluvial soils associated with riverine systems…………………..……………………………………………… **FLOODPLAIN FOREST**
(Type 1); (PFO; 1,6; A)

3B. Black ash, green ash, American elm, eastern cottonwood, black willow, box elder, yellow birch, silver maple, quaking aspen and/or red maple are dominant; northern white cedar may be subdominant; growing on poorly-drained mineral or peat/muck soils, often associated with ancient lake basins………………………….. **HARDWOOD SWAMP**
(Type 7); (PFO;1, 6; A, B, C)

2B. Coniferous trees are dominant (>50% areal coverage or basal area of the tree stratum); soils usually peaty.

4A. Tamarack and/or black spruce are dominant; growing on a continuous sphagnum moss mat and acid, peat soils…………………………………………………...**CONIFEROUS BOG**
(Type 8); (PFO; 2, 4, 6, 7; B)

4B. Northern white cedar and/or tamarack are dominant; continuous sphagnum moss mat absent; usually growing on neutral to alkaline peat/muck soils.…….**CONIFEROUS SWAMP**
(Type 7); (PFO;2, 4, 6, 7; B, C)

1B. Mature trees are absent or, if present, form open, sparse stands; other woody plants, if present, are shrubs or saplings and pole-size trees (dbh less than 6 inches) less than 20 feet high and growing on wet, lowland, or poorly-drained soils, or in ground-water seepage areas.

5A. Community dominated (>50% areal coverage) by woody shrubs.

[5] Refer to Pages 19 - 22 of *"Wetland Plants and Plant Communities of MN and WI";* (USACOE - St. Paul District; Eggers and Reed).

6A. Low, woody shrubs usually less than 3 feet high; sphagnum moss mat layer may or may not be present.

7A. Shrubs are ericaceous and evergreen growing on a sphagnum moss mat layer; peat soils are acidic.…………………………………………………………………..**OPEN BOG**
(Type 8); (PSS;2, 3, 4, 7; B)

7B. Shrubs are deciduous, mostly shrubby cinquefoil, often growing on sloping sites with a spring-fed supply of internally flowing, calcareous waters; other calciphiles are also dominant; sphagnum moss mat layer absent; muck/poorly-drained mineral soils are alkaline……………………….**CALCAREOUS FEN**
(Type 2/6), (PEM/PSS;1; B)

6B. Tall, woody deciduous shrubs usually greater than 3 feet high; sphagnum moss mat layer absent: SHRUB SWAMPS**.**

8A. Speckled alder is dominant; usually on acidic soils in and north of the vegetation tension zone (a map of the tension zone is on page 9 of Eggers and Reed [1997]). ……………………………………………………………**ALDER THICKET**
(Type 6); (PSS;1, 6; B, C)

8B. Willows, red-osier dogwood, silky dogwood, meadowsweet and/or steeplebush are dominant on neutral to alkaline poorly drained muck/mineral soils; found north and south of the vegetation tension zone. NOTE: Non-native buckthorns (*Rhamnus cathartica* and *R. frangula*) may occur as dominant shrubs or small trees in disturbed shrub-carrs. …………………………………………………**SHRUB-CARR**
(Type 6); (PSS;1, 6; B, C)

5B. Community dominated (>50% areal coverage) by herbaceous plants.

9A. Essentially closed communities, usually with more than 50 percent cover.

10A. Sphagnum moss mat on acid peat soils; leatherleaf, pitcher plants, certain sedges, and other herbaceous species tolerant of low nutrient conditions may be present. …………………………………………………………………………..**OPEN BOG**
(Type 8); (PSS; 2, 3, 4, 7; B; and PML; 1; B)

10B. Sphagnum moss mat absent; dominant vegetation consists of sedges (Cyperaceae), grasses (Gramineae), cattails, giant bur-reed, arrowheads, forbs and/or calciphiles. Soils are usually neutral to alkaline, poorly-drained mineral soils and mucks.

11A. Over 50 percent of the cover dominance contributed by the sedge family, cattails, giant bur-reed, arrowheads, wild rice, and/or giant reed grass (*Phragmites*).

12A. Herbaceous emergent plants growing on saturated soils to areas covered by standing water up to 6 inches in depth throughout most of the growing season.

13A. Major cover dominance by the sedges (primarily genus *Carex*) typically on saturated soils with, at most, short periods of inundation. Canada blue-joint grass may be a subdominant. Lake sedges (*Carex lacustris*, *C. utriculata*) and slough sedge (*Carex atherodes*) can also be dominants in shallow marshes – see 13B. below………………...……**SEDGE MEADOW**
(Type 2), (PEM; 1; B)

13B. Major cover dominance by cattails, bulrushes, water plantain, *Phragmites*, arrowheads, slough sedge and/or lake sedges typically on soils that are inundated by up to 6 inches of water depth for a significant portion of most growing seasons……….
…………………………………………….………….**SHALLOW MARSH**
(Type 3); (PEM; 1, 2; C)

12B. Herbaceous submergent, floating-leaved, floating and emergent plants growing in areas covered by standing water greater than 6 inches in depth throughout most of the growing season.…………….**DEEP MARSH**
(Type 4); (PEM; 1, 2; F, G, H; and PAB; 2, 4, 5; F, G; and PUB; F, G; and L2EM2; F, G; and L2AB; 2, 4, 5; F, G)

11B. Over 50 percent of the cover dominance contributed by grasses (except wild rice and *Phragmites*), forbs and/or calciphiles.

14A. Spring-fed supply of internally flowing, calcareous waters, often sloping sites; calciphiles such as sterile sedge, wild timothy, Grass-of-Parnassus and lesser fringed gentian are dominant.…**CALCAREOUS FEN**
(Type 2); (PEM; 1; B)

14B. Water source(s) variable; calciphiles not dominant.

15A. Dominated by native prairie grasses (e.g., big bluestem, prairie cordgrass, Canada blue-joint grass) usually with characteristic wet prairie forbs (e.g., Riddell's goldenrod, gayfeather, mountain mint)…
……...……….……….………..……….……**WET TO WET- MESIC PRAIRIE**
(Type 2); (PEM; 1; A, B)

15B. Dominated by other grass species (e.g., reed canary grass, redtop) and/or generalist forbs (e.g., giant goldenrod, giant sunflower, swamp aster, marsh aster, wild mint)…………...
…………………………..……………………...**FRESH (WET) MEADOW**
(Type 2); (PEM; 1; B)

9B. Essentially open communities, either flats or basins usually with less than 50 percent vegetative cover during the early portion of the growing season, or shallow open water with submergent, floating and/or floating-leaved aquatic vegetation.

16A. Areas of shallow, open water (< 6.6 feet in depth) dominated by submergent, floating and/or floating-leaved aquatic vegetation ……………………………. ……………………………. …………**SHALLOW, OPEN WATER COMMUNITIES** (Type 5); (PAB; 2, 4, 5; G, H; and PUB; G, H; and L2EM; 2; G, H; and L2AB; 2, 4, 5; G, H)

16B. Shallow depressions or flats including vernal pools; standing water may be present for a few weeks each year, but are dry for much of the growing season; often cultivated or dominated by annuals such as smartweeds and wild millet; when not cultivated, perennial vegetation may be present (see Table 4 on page 15)………………..……………**SEASONALLY FLOODED BASIN** (Type 1); (PEM; A)

2. **Utilizing the "50/20 Rule" identify the dominant species within each plant community and which ones are non-native or invasive and the cover class of each species present.** Use species list found on the MnDNR website[6] that includes non-native status and use the following six cover classes[7]: *Note: Cover Class 1 and 2 are for use with invasive species only.*

Cover Class	Class Range
1	0 – 3%
2	>3 – <10%
3	>10 –25%
4	>25 –50%
5	>50 –75%
6	>75 – 100%

Table 1: Partial List of Invasive Species[8]

Scientific Name	Common Name	Scientific Name	Common Name
Acer negundo	Box elder	*Myriophyllum spicatum*	Eurasian water milfoil
Alliaria petiolata	Garlic mustard	*Pastinaca sativa*	Wild parsnip
Berteroa incana	Hoary alyssum	*Phalaris arundinacea*	Reed canary grass
Bromus inermis	Smooth brome grass	*Phragmites australis*	Common reed grass
Butomus umbellatus	Flowering rush	*Potamogeton crispus*	Curly leaf pondweed
Cirsium arvense	Canada thistle	*Rhamnus cathartica*	Common buckthorn
Cirsium vulgare	Bull thistle	*Rhamnus frangula*	Glossy buckthorn
Euphorbia esula	Leafy spurge	*Sonchus arvensis*	Sow thistle
Glechoma hederacea	Creeping charlie, ground ivy	*Trapa natans*	Water chestnut

[6] www.dnr.state.mn.us
[7] Adapted from Kuchler, A.W.
[8] See MnRAM **3.1** database for a list of invasive/non-native plant species referenced from the MnDNR.

Hydrilla verticillata	Hydrilla	*Typha angustifolia*	Narrow leaved cattail
Hydrocharis morsus-ranae	European frog-bit	*Ulmus pumila*	Siberian elm
Iris pseudacorus	Yellow iris	*Urtica dioica*	Stinging nettle
Lonicera x *bella*	Honeysuckle	*Vicia cracca*	Cow vetch
Lotus corniculatus	Birdsfoot trefoil	*Vicia villosa*	Hairy vetch
**Typha x glauca*	Blue (hybrid) cattail	*Setaria glauca*	Yellow foxtail
Lythrum salicaria	Purple loosestrife	*Echinochloa crusgalli*	Barnyard grass
Salix fragilis	Crack willow	*Elytrigia repens*	Quack grass
Salix alba	White willow	*Sonchus arvensis*	Perennial sowthistle
Salix babylonica	Weeping willow	*Cirsium vulgare*	Bull thistle
Ambrosia artemisiifolia	Common ragweed	*Alliaria petiolata*	Garlic mustard

Cattail Key (Adapted from Smith, 1986)

Two species of cattail (*Typha* sp.) occur in Minnesota and they readily hybridize producing a highly variable hybrid known by the common name of White (or Blue or hybrid) cattail *Typha* x *glauca* (ITIS 2002) as referred to in the 'National List of Plant Species That Occur In Wetlands Region 3 – North Central, second printing 1988. Broad-leaved cattail (*Typha latifolia*) is native throughout Minnesota. Narrow-leaved cattail (*Typha angustifolia*) is believed to be native to the eastern region of the U.S. and made its way to the Upper Midwest where it began to hybridize with *T. latifolia.* Both *Typha angustifolia* and *Typha* x *glauca* are more tolerant to a wide range of human influences including hydrologic changes, nutrient inputs, loading of certain toxic compounds such as chloride and heavy metals such as cadmium, copper and zinc and are therefore more invasive. Older, more extensive stands may have both *Typha* species present; various generations of the hybrid make reliable species cover estimates difficult. The following condensed key may be used to help determine what species of cattail is encountered in the field. See the database for a more detailed key.

Table 2: Diagnostic characteristics of cattails

Characteristic	***Typha latifolia* (Broad-leaved cattail)**	***Typha angustifolia* (Narrow-leaved cattail)**	***Typha x glauca* (White/Blue or hybrid cattail)**
Mature Leaf width	14 – 23 mm	4 – 10 mm	10 – 14 mm
Leaf Cross-section shape	Flat, scarcely concave below mid.	Convex below middle	Flat to convex below middle
Spike width	25 – 34 mm	15 –22 mm	19 – 25 mm
Pistillate length	$\leq$15 cm	$\leq$15 cm	>15 cm
Spike separation	Frequently contiguous but not more than 2 cm apart	Separated by at least 2 cm and usually >3 cm	Occasionally contiguous, more commonly up to 4 cm
Spike color	Dark brown to black	Brown	Brown to bright brown
Colony density	Sparse, often large gaps between shoots	Frequently very dense	Density intermediate

3. Characterize the current vegetative quality of each wetland community comprising at least 10% of the wetland using the following key and enter the community proportion of the whole wetland (**3a**), and the vegetative quality rating for each community in the table below. **Compute the index for vegetative diversity and integrity for each plant community by doing the following:** If any of questions #**4-6** are answered yes and/or if any of the Special Features **b, d, or i** have been selected, enter **Exceptional** for the functional index; if not, use the answer in the Vegetative Quality Index from the table for each community (Question 3). The overall vegetative diversity index for the wetland may be calculated one of four ways. The method should be based on the purpose of the assessment:

3b) Maintain Individual Community Scores: preserves data to the highest level by maintaining the quality ratings of each community within the wetland. While it may be cumbersome to maintain this data for a large number of wetlands, this data should always be maintained and reported when the MnRAM is utilized for inventory or regulatory purposes.

3c) Highest Quality Community: This method of presenting the Vegetative Diversity/Integrity can be utilized for determining sensitivity to impacts such as stormwater/hydrologic alterations. Typically, communities with the highest quality are also those that are most sensitive to alteration. *(This method would be preferable in regulatory situations in which a wetland basin may be impacted).*

3d) Non-Weighted Average Quality of all Communities: This method of data presentation results in the greatest dilution of the individual community data. However, it may be the only reasonable method for comparing large numbers of wetlands such as for an inventory and/or planning project. In some instances, it may not be possible, given budget and scope constraints, to collect community dominance data. In that case, one way to get a single measure of overall wetland vegetative diversity/integrity quality is to utilize the non-weighted average. It is important to maintain and report the individual community quality data, even if it cannot be readily used to develop management classifications. *(This method is not recommended for regulatory purposes)*.

3e) Weighted Average Quality Based on Percentage of Each Community: This data presentation method provides the best average Vegetative Diversity/Integrity measure for the entire wetland. Here the quality rating is computed by summing the product of each community rating and the proportion of the wetland that community comprises. Whenever possible, the community proportion data should be collected to preserve the highest possible value for a single Vegetative Diversity/Integrity rating. Again, the individual community ratings should be preserved and reported to provide a complete data set. *(This method is not recommended for regulatory purposes).*

Guidance: The plant community rating incorporates two principal components: integrity and diversity. **Diversity** refers to species richness, e.g., number of plant species. Generally, the more floristically diverse a community is, the higher the rating. **Integrity** refers to the condition of the plant community in comparison to the reference standard for that community. The highest rating is given to those communities that represent the characteristic condition of that particular community. The degree (e.g., minor versus substantial) and type of disturbance typically play an important role in the diversity/integrity of plant communities. Some native plant communities are maintained by periodic, natural disturbances (e.g., fire, annual floods). For purposes of this functional assessment, disturbances are more in reference to man-induced alterations (e.g., filling, dredging, drainage) that are typically detrimental to vegetative diversity/integrity.

It is important to note that some native wetland plants naturally form large colonies or clones creating communities that are low in diversity, but high in integrity. Examples are stands of wild rice, arrowhead, lake sedges, river bulrush, hardstem bulrush, American lotus, wild celery, pickerelweed, wire-grass sedge and tussock sedge. Plant communities with low diversity but high integrity can have a high vegetative diversity/integrity ranking if they represent the characteristic condition of that plant community (i.e., compared to the reference standard community).

Size of the area sampled for the rating can also be a factor. If the area sampled is small, the evaluator must be aware that it may not naturally support the diversity of species a larger area of the same plant community supports.

User Notes: Each community is outlined below with descriptions for high, medium, and low quality. Many sites have more than one community; consult the descriptions individually to decide the appropriate rating for each community, *except* the following description of "exceptional" quality is applicable to all communities:

Exceptional Quality: Plant community is undisturbed, or sufficiently recovered from past disturbances, such that it represents pre-European settlement conditions. Non-native plant species are absent or, if present, constitute a minor percent cover of the community. Unique features (e.g., old growth forest, never-plowed wet prairie, T/E species) may also be present.

NOTE: For purposes here, "dominant" or "dominated by" refers to the dominant species determined by the "50/20 Rule" or other appropriate method for determining which species are dominants. "Subdominant" refers to species that may not meet the "50/20 Rule" for dominance, but have at least 10 percent areal cover (or other dominance measure)[9].

16A. SHALLOW, OPEN WATER COMMUNITIES[10]

High Quality: Aquatic bed communities with greater than 10 percent coverage of the open water area and dominated by 3 or more species of native aquatic plants such as pondweeds, water lilies, bladderworts, wild celery, duckweed, water crowfoots, native milfoils, etc.; or communities with low diversity but high integrity as given in additional guidance (e.g., beds of wild celery). Eurasian water milfoil and/or curly leaf pondweed, if present, cumulatively comprise less than 20 percent cover of the aquatic bed community.

Medium Quality: Aquatic bed communities with greater than 10 percent coverage of the open water area and dominated by 1 or 2 species of native aquatic plants; and/or Eurasian water milfoil and/or curly leaf pondweed cumulatively comprise 20 to 50 percent cover of the aquatic bed community.

Low Quality: Aquatic vegetation absent or coverage is less than 10 percent of the open water area; or, Eurasian water milfoil and/or curly leaf pondweed cumulatively comprise greater than 50 percent cover of the aquatic bed community.

13B. SHALLOW MARSHES[11]

High Quality: Three or more native aquatic plants (e.g., bur-reeds, bulrushes, arrowheads, duckweeds, cattails, sweet flag, pondweeds) are dominants; or, communities with low diversity but high integrity as described in guidance (e.g., stands of arrowhead, lake sedges). Cattails, if present, comprise less than 40 percent cover. Purple loosestrife absent or comprises less than 20 percent cover.

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[9] The "50/20 Rule" is explained in the *Corps of Engineers Wetlands Delineation Manual* (1987).
[10] I., page 28, Eggers and Reed.
[11] II.B., pages 51-53, Eggers and Reed.

Medium Quality: At least 2 species of native aquatic plants are dominants; and/or purple loosestrife comprises 20 to 50 percent cover; and/or cattails comprise 40 to 85 percent cover.

Low Quality: Dominated by 1 native aquatic species; and/or purple loosestrife comprise more than 50 percent cover; and/or cattail comprises more than 85 percent cover.

12B. DEEP MARSHES[12]

High Quality: Three or more species of native aquatic plants (e.g., bur-reeds, bulrushes, arrowheads, duckweeds, cattails, sweet flag, pondweeds) are dominants; or communities with low diversity but high integrity as described in guidance (e.g., stands of bulrushes, wild rice, lotus, arrowheads). Cattails, if present, comprise less than 40 percent cover. Purple loosestrife and/or Eurasian water milfoil absent or cumulatively comprise less than 20 percent cover.

Medium Quality: Dominated by 2 species of native aquatic plants; and/or purple loosestrife and/or Eurasian water milfoil, cumulatively comprise 20 to 50 percent cover; and/or cattail comprises 40 to 85 percent cover.

Low Quality: Dominated by 1 native aquatic species; and/or purple loosestrife and/or Eurasian water milfoil cumulatively comprise more than 50 percent cover; and/or cattail comprises more than 85 percent cover.

13A. SEDGE MEADOWS[13]

High Quality: Stands dominated solely by sedges (e.g., wiregrass sedge, hummock sedge, lake sedge, woolgrass [*Carex lasiocarpa, C. stricta, C. lacustris, Scirpus cyperinus*, respectively]) including nearly monotypic stands; or stands with a mixture of sedge dominants and dominant or subdominant native forbs/ferns/grasses/rushes (e.g., Canada blue-joint grass, joe-pye weed, giant sunflower). Reed canary grass, purple loosestrife, stinging nettle and/or other invasive species (Table 1) are absent or cumulatively comprise less than 20 percent cover in the herbaceous stratum. Non-native buckthorns, if present, comprise less than 10 percent cover within the sedge meadow community.

Medium Quality: Stands of sedges where the invasive species listed above cumulatively comprise 20 to 40 percent cover in the herbaceous stratum; and/or non-native buckthorns comprise 10 to 30 percent cover within the sedge meadow community.

Low Quality: Invasive herbaceous species listed above cumulatively comprise 40 to 50 percent cover; and/or non-native buckthorns comprise 30 to 50 percent cover within the sedge meadow community.

[Note: Stands with less than 50 percent cover by sedges key out to wet meadows, 15B. Stands with greater than 50 percent cover by buckthorn shrubs key out to shrub-carrs, 8B.]

15B. WET MEADOWS[14]

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[12] II.A., pages 51-53, Eggers and Reed.
[13] III.A., page 86, Eggers and Reed.
[14] III.B., page 105, Eggers and Reed.

High Quality: Composed of 10 or more species of native/non-invasive grasses, sedges, ferns, rushes and/or forbs. Reed canary grass, purple loosestrife, stinging nettle and/or other invasive species (Table 1), if present, cumulatively comprise less than 20 percent cover. Non-native buckthorns absent or comprise less than 10 percent cover within the wet meadow community.

Medium Quality: Community composed of 5 to 9 species of native grasses, sedges, rushes, ferns and/or forbs; and/or invasive herbaceous species listed above cumulatively comprise 20 to 50 percent cover; and/or non-native buckthorns, comprise 10 to 30 percent cover within the wet meadow community.

Low Quality: Composed of 4 or fewer species of native grasses, sedges, rushes, ferns and/or forbs; and/or invasive herbaceous species listed above cumulatively comprise more than 50 percent cover; and/or non-native buckthorns comprise 30 to 50 percent cover within the wet meadow community. For example, this rating includes the nearly monotypic stands of reed canary grass that are commonly encountered.

[Note: Greater than 50 percent cover by buckthorn shrubs key out to shrub-carrs, 8B.]

15A. WET to WET-MESIC PRAIRIES[15]

High Quality: Community composed of native grasses (e.g., prairie cord-grass, switchgrass, Canada blue-joint grass), sedges, and forbs characteristic of wet to wet-mesic prairies. Reed canary grass, purple loosestrife, quack grass, Canada thistle and/or other invasive species (Table 1) are absent or cumulatively comprise less than 20 percent cover. Non-native buckthorns absent or comprise less than 10 percent cover within in the prairie community.

Medium Quality: Invasive species listed above cumulatively comprise 20 to 50 percent cover in the herbaceous stratum; and/or non-native buckthorns comprise 10 to 30 percent cover within the prairie community.

Low Quality: Invasive species listed above cumulatively comprise more than 50 percent cover in the herbaceous stratum; and/or non-native buckthorns comprise 30 to 50 percent cover within the prairie community.

7B. & 14A. CALCAREOUS FENS[16]

Due to their uniqueness, rarity, and disproportionate number of threatened and special concern plant species, calcareous fen communities are rated as “exceptional” for vegetative diversity/integrity (see Special Features, item b.).

7A. & 10A. OPEN BOGS[17]

High Quality: Composed of the characteristic assemblage of sphagnum mosses, sedges and heath family

[15] III.C., page 125, Eggers and Reed.
[16] III.D., page 141, Eggers and Reed.
[17] IV.A., page 161, Eggers and Reed.

shrubs, often with carnivorous plants and various orchid species. Cattails, quaking aspen, non-native buckthorns, reed canary grass, stinging nettle and/or other invasive species (Table 1) are absent or comprise less than 20 percent cover in each stratum (e.g., bryophyte, herbaceous, shrub).

Medium Quality: Invasive species listed above comprise 20 to 50 percent cover in one or more strata.

Low Quality: Invasive species listed above comprise greater than 50 percent cover in one or more strata. Dieback of sphagnum mosses due to flooding, nutrient loading, salt spray, sediment input, etc., can be an indicator.

4A. CONIFEROUS BOGS[18]

High Quality: Stands of tamarack and/or black spruce with the characteristic assemblage of sphagnum mosses, sedges and heath family shrubs. Cattails, quaking aspen, non-native buckthorns, stinging nettle, reed canary grass, and/or other invasive species (Table1) comprise less than 20 percent cover in any stratum (e.g., bryophyte, herbaceous, shrub, tree).

Medium Quality: Stands of tamarack and/or black spruce invaded by cattail, quaking aspen, non-native buckthorns, stinging nettle and other invasive species (Table 1) that comprise 20 to 50 percent cover in one or more strata.

Low Quality: Non-native buckthorns, quaking aspen, stinging nettle, cattail and/or other invasive species (Table 1) cumulatively comprise more than 50 percent cover in one or more strata. Also includes stands where greater than 50 percent of the black spruce and tamarack are dead (due to impoundment, drainage, salt spray, etc.).

8B. SHRUB-CARRS[19]

High Quality: Dominated by native shrubs (e.g., dogwoods, willows) with a herbaceous stratum composed of five or more species of native grasses, sedges, rushes, ferns and/or forbs. Non-native buckthorns, non-native honeysuckles, box elder and/or other invasive woody species (Table 1), cumulatively comprise less than 20 percent cover of the shrub stratum. Reed canary grass and other invasive herbaceous species comprise less than 20 percent cover of the herbaceous stratum.

Medium Quality: Invasive species listed above comprise 20 to 50 percent cover in any one stratum (shrub or herbaceous or both); and/or the herbaceous stratum has 4 or fewer species of native grasses, sedges, rushes, ferns or forbs.

Low Quality: Invasive species listed above comprise more than 50 percent cover in any one stratum (shrub or herbaceous or both).

8A. ALDER THICKETS[20]

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[18] IV.B., page 175, Eggers and Reed.
[19] V.A., page 180, Eggers and Reed.
[20] V.B., page 192, Eggers and Reed.

High Quality: Stands of speckled alder with less than 20 percent cumulative cover by non-native buckthorns, non-native honeysuckles, box elder and/or other invasive woody species (Table 1). Herbaceous stratum composed of 5 or more species of native grasses, sedges, rushes, ferns and forbs. Reed canary grass, if present, comprises less than 20 percent cover.

Medium Quality: Invasive species listed above cumulatively comprise 20 to 40 percent cover of the shrub stratum; and/or the herbaceous stratum has 4 or fewer native herbaceous species; and/or herbaceous stratum has 20 to 50 percent cover of reed canary grass or other invasive species.

Low Quality: Forty to 50 percent cover of the shrub stratum consists of invasive woody species listed above (Table 1); and/or reed canary grass comprises more than 50 percent cover of the herbaceous stratum.

[Note: Stands with more than 50 percent cover by buckthorns, key out to shrub-carrs, 8B.]

3B. HARDWOOD SWAMPS and 4B. CONIFEROUS SWAMPS[21]

High Quality: Tree/sapling/shrub strata each have less than 20 percent cover of box elder, non-native buckthorns, non-native honeysuckles, eastern cottonwood, quaking aspen (see note below regarding aspen) and/or other invasive species (Table1). Herbaceous stratum composed of 5 or more species of native grasses, sedges, rushes, ferns and/or forbs, and reed canary grass comprises less than 20 percent cover. Another factor is the common presence of seedlings/saplings of the characteristic tree species, which indicates regeneration of the stand, as opposed to observing abundant seedlings/saplings of invasive woody species. NOTE: aspen parkland in northern Minnesota is a special case. Stands of quaking aspen with a ground layer of native prairie species should be rated by a separate method specific to aspen parklands.

Medium Quality: Invasive species listed above comprise 20 to 50 percent cover in one or more strata, and/or the herbaceous stratum has 4 or fewer species of native grasses, sedges, rushes, ferns and forbs. This rating also includes early successional forests of quaking aspen with an under story of characteristic tree species of swamps (e.g., green ash, black ash, red maple, balsam poplar, northern white cedar.).

Low Quality: Invasive species listed above comprise more than 50 percent cover in one or more strata (e.g., tree, sapling, shrub, herbaceous). Typically, few to no indications of regeneration of the characteristic tree species are present.

3A. FLOODPLAIN FORESTS[22]

High Quality: Tree stratum with less than 20 percent cumulative cover by box elder, crack willow, weeping willow or white willow. Herbaceous stratum, if present, composed of native forbs, ferns, sedges and grasses characteristic of floodplain forests (e.g., wood nettle, jewelweed, Virginia rye, cut-leaf coneflower) with less than 20 percent cover by reed canary grass.

Medium Quality: Invasive species listed above comprise 20 to 50 percent cover in one or more strata.

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[21] VI.A and VI.B., pages 197 to 213, Eggers and Reed.
[22] VII., page 214, Eggers and Reed

Low Quality: Invasive species listed above comprise greater than 50 percent cover in one or more strata. Also include stands where greater than 50 percent of the trees are dead.

16B. SEASONALLY FLOODED BASINS[23]

High Quality: Dominated by native/non-invasive species (examples in Table 4) with less than 20 percent cover in any one stratum by non-native and/or invasive species (e.g., common buckthorn, reed canary grass, Canada thistle, yellow foxtail, barnyard grass, common ragweed, stinging nettle, quack grass – see Table 1). Typically located within an area of permanent vegetative cover (e.g., forest, prairie, non-agricultural settings) undisturbed or minimally disturbed by artificial drainage, haying, grazing, plowing, stormwater input, or other disturbances.

Medium Quality: Invasive species listed above comprise 20-50 percent cover in one or more strata. Typically located in areas that are partially drained, infrequently cropped, lightly grazed, subject to some stormwater input, etc.

Low Quality: Invasive species listed above comprise greater than 50 percent cover in one or more strata. Typically located in frequently cropped agricultural fields, heavily grazed, or subjected to substantial inputs of stormwater, or other adverse disturbances.

Table 4: Examples of Native/Non-Invasive Species of Seasonally Flooded Basins Including Vernal Pools

Scientific Name	Common Name	Scientific Name	Common Name
Onoclea sensibilis	Sensitive fern	*Geum canadense*	White avens
Athyrium filix-femina	Lady fern	*Impatiens capensis*	Jewelweed
Ribes americanum	Wild black currant	*Juncus canadensis*	Canada rush
Sambucus canadensis	Common elderberry	*Juncus tenuis*	Slender rush
Vitis riparia	Riverbank grape	*Juncus torreyi*	Torrey's rush
Boehmeria cylindrica	False nettle	*Leersia virginica*	Whitegrass
Carex grayi	Gray's sedge	*Leersia oryzoides*	Rice cut-grass
Carex lupulina	Hop sedge	*Rudbeckia laciniata*	Cut-leaf coneflower
Carex muskingumensis	Muskingum sedge	*Sium suave*	Water parsnip
Carex stipata	Stalk-grain sedge	*Polygonum pensylvanicum*	Penn. smartweed
Carex typhina	Cattail sedge	*Polygonum lapathifolium*	Nodding smartweed
Cyperus strigosus	Straw-color flatsedge	*Ranunculus septentrionalis*	Buttercup
Eleocharis obtusa	Blunt spikerush	*Elymus virginicus*	Virginia wild-rye
Aster lateriflorus	Calico aster	*Bidens cernua*	Nodding beggartick

[23] VIII., page 227, Eggers and Reed.

4. **Y N Are state or federally listed plant species, rare, threatened or of special concern, found or known to be found in the wetland recently?** If Special Features questions d or i [rare natural community, rare plant species] are answered yes, then this question is yes and Vegetative Diversity function is Exceptional.

5. **Y N Is the wetland or a portion of the wetland a rare natural community or habitat based on the Minnesota Natural Heritage Database or the County Biological Survey[24]?** If yes, wildlife habitat functional level rating = exceptional. (If Special Features question d is answered yes, this question will also be affirmative.)

Guidance: Rare Natural Communities. The Minnesota Department of Natural Resources Natural Heritage and Nongame Research Program and the County Biological Survey collects, manages, and interprets information about nongame animals, native plants, and plant communities to promote the wise stewardship of these resources. A ranking system is intended to reflect the extent and condition of natural communities and species in Minnesota. These ‘state ranks’ have no legal ramifications; they are used by the Natural Heritage Program to set priorities for research and for conservation planning. They are grouped as follows:

State Element Rank:

S1: Critically imperiled in the state because of extreme rarity.
S2: Imperiled in state because of rarity.
S3: Rare or uncommon in state.
S4: Apparently secure in state.
S5: Demonstrably secure in state.

For this question, a rare natural community is defined as a wetland native plant community having a state element rank of S1, S2, or S3 that is mapped or *determined to be eligible for mapping* in the Natural Heritage Information System OR a wetland native plant community contained within an area mapped or determined to be eligible for mapping in the NHIS as a Site of Outstanding or High Biological Diversity.
If a special case is suspected, consider using a specific assessment tool in addition to MnRAM.

6. **Y N Does the wetland represent pre-European-settlement conditions? (e.g., MnDNR Native Plant Communities publication)** If yes, then Vegetation function is Exceptional (continue to answer subsequent questions). Created wetlands would not qualify, regardless of quality.

[24] These references are available at local Soil & Water Conservation District offices; some counties are online at the Minnesota Department of Natural Resources/Ecological Services website.

General information about the wetland site:

7. Describe the hydrogeomorphology of the wetland and associated topography (check those that apply):

___ Depressional/Isolated (no discernable inlets or outlets)
___ Depressional/Flow-through (apparent inlet and outlet)
___ Depressional/Tributary (outlet but no perennial inlet or drainage entering from upstream subwatershed)
___ Riverine (within the river/stream banks)
___ Lacustrine Fringe (edge of deepwater areas)/Shoreland
___ Extensive Peatland/Organic Flat
___ Slope
___ Floodplain (outside waterbody banks)
___ Other ___________________________________

8. Approximate maximum depth of standing water in the wetland (inches): ______

Percent of wetland area inundated: ______%

~ **9. What is the estimated area of the wetland's immediate drainage area in acres?_____**

~ **10. Estimated size of existing wetland in acres:_________**

10. Guidance: Determining wetland size. The estimated size of existing wetlands can be calculated off aerial photos, preferably infrared, and/or in some cases calculating the size of the depressional hydric soil polygon. If available on a GIS system, these polygon areas can automatically be calculated.

~ **11. General description of soil(s)** from Soil Survey and on site:

	Adjacent UPLAND Area (within 500 feet)	**WETLAND Area**
Soil Survey Classification(s):		

12. For depressional wetlands, describe the wetland surface and subsurface outlet characteristics as it relates to the wetland's ability to detain runoff and/or store floodwater.

A = No surface or subsurface outlet, or a restricted outlet at or greater than 2 feet higher than the wetland boundary

B = Swale, channel, weir, or other large, surface outlet (>18 inch pipe) with outflow elevation 0-2 feet above the wetland boundary, subsurface tile with no surface inlet.

C = Wetland outflow elevation below the wetland boundary with either a high capacity surface outlet (swale, channel, weir, pipe >18 inch diameter, etc…) or a subsurface outlet (drain tile) with a surface inlet.

N/A = Not applicable for floodplain, slope, lacustrine, riverine, and extensive peatland/flat wetlands.

13. Describe the wetland surface and subsurface outlet characteristics as it relates to the wetland hydrologic regime[25]:

A = No outlet, natural outlet condition, or a constructed outlet at the historic outflow elevation; no evidence of subsurface drainage (drain tile).

B = Constructed, reduced capacity outlet below the top of the temporary wet meadow zone; moderate indications of subsurface drainage; outlet raised but managed to mimic natural conditions; watercourse has been recently ditched/channelized.

C = Excavated or enlarged outlet constructed below the bottom of the wet meadow zone; strong indications of subsurface drainage; outlet removes most/all long-term and temporary storage; or outlet changes hydrologic regime drastically.

12/13. Guidance: Outlet Characteristics. The ability of a wetland to maintain a hydrologic regime characteristic of the wetland type is somewhat dependent upon whether a natural outlet is present, or whether an outlet has been constructed or modified by humans. Constructed outlets can significantly diminish the ability of a wetland to provide temporary and long-term water retention, and thus its ability to maintain its characteristic hydrologic regime. Wetlands with natural outlets are functioning at the highest level possible for the type within the wetland comparison domain, and should be rated A [high]. Constructed outlets above the temporary wetland (wet meadow) zone are rated B [medium] if managed to mimic natural conditions. Constructed outlets, either surface or subsurface, below the top of the temporary wet meadow zone reduce the ability of the wetland to provide temporary and long-term water retention; if a constructed outlet is present below the top of the temporary wetland zone, but is such that the wetland is able to provide some temporary and long-term water retention (i.e. the wetland is only partially drained), the rating should be B [medium]. Constructed outlets, either surface or subsurface, which remove most or all temporary and long-term retention capabilities, significantly reduce the ability of the wetland to maintain its characteristic hydrologic regime; the rating should be C [low]. Constructed outlets that keep open water wetlands open water or keep saturated wetlands saturated are rated B [medium]. If the constructed outlet changes the wetland to non-wetland or to deepwater habitat or from saturated conditions to open water or from open water to saturated then it is rated C [low].

[25] Lee et al., 1997.

~ **14. Describe the dominant land use and condition of the immediate upland drainage area of wetland.[26] If the immediate upland drainage is not evident, then within 500 feet.**

A = Watershed conditions essentially unaltered; < 10% impervious (i.e. low density residential, >1 acre lots); land use development minimal, idle lands, lands in hay or forests or low intensity grazing.

B = Watershed conditions somewhat modified; e.g., 10–30 % impervious (i.e. medium density residential, 1/3 to 1 acre lots); moderate intensity grazing or haying with some bare ground; conventional till with residue management on moderate slopes, no-till on steep slopes.

C = Watershed conditions highly modified; e.g., >30 % impervious surfaces (i.e. high density residential, lots smaller than 1/3 acre, industrial, commercial, high impervious institutional) maximizing overland flow to the wetland; intensive agriculture or grazing with a high amount of bare ground, no residue management on moderate or steep slopes, intensive mining activities.

14. Guidance: Dominant upland land use[27]. Overland flow affects wetland flood storage capabilities and overland flow is affected by changes in upstream vegetative communities. Upland land use within the watershed contributing to the wetland (as defined in Question #9) and the watershed size have a significant influence on the flow of runoff and sediments to the wetland, and thus the ability of the wetland to desynchronize flood flows and maintain its characteristic hydrologic regime. The more developed and intensively the watershed is used, the greater the delivery of runoff and sediments to the wetland is likely to be and the more likely the wetland will have the opportunity to minimize flooding downstream. With increased runoff and sediment delivery, the wetland will be less likely to maintain its characteristic hydrologic regime. As the proportion of the impervious watershed area increases, runoff volume and rate increases along with sediment concentrations.

15. Describe the conditions of the wetland soils:

A = There are no signs or only minor evidence of recent disturbance or alteration to the wetland soils; temporary wetland wet meadow zone intact; idle land, hayed or lightly to moderately grazed or logged. Minimal compaction, rutting, trampling, or excavation damage to wetland.

B = Moderate evidence of disturbance or alteration to the wetland soils. Temporary wet meadow zone tilled or heavily grazed most years. Zones wetter than temporary receive tillage occasionally. Some compaction, rutting, trampling, or excavation in wetland is evident.

C = Evidence of significant disturbance or alteration to the wetland soils. Wetland receives conventional tillage most (>75%) years; or otherwise significantly impacted (e.g., fill, sediment deposits, cleared, excavated). Severe compaction, rutting, trampling, or excavation damage to wetland.

15. Guidance: Condition of Wetland Soils. The condition of the soils in the wetland affects the vegetation within the wetland, and thus the relationships affecting ground-water discharge, recharge, and evapotranspiration. The more developed and intensively the wetland is used (i.e. tillage, excavation, vehicle traffic, pedestrian or livestock usage), the more likely these relationships are to be impacted, and the more likely the ability of the wetland to maintain its characteristic hydrologic regime will be reduced.

16. Enter the percentage of the wetland that is vegetated with woody, emergent, submergent, or

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[26] Lee et al., 1997.

[27] The range of impervious proportions for various land uses is borrowed from Chow, Maidment, and Mays (1988)

floating-leaved vegetation.

______%

16. Guidance: Wetland Vegetation is assessed here for two related properties:

1) Water/Vegetation Proportions and Interspersion. Rooted vegetation in flow-through wetlands slows floodwaters by creating frictional drag in proportion to stem density, more or less according to vegetation cover type and interspersion. Flow-through wetlands with relatively low proportions of open water to rooted vegetation and low interspersion of water and rooted vegetation are more capable of altering flood flows. Dense stands of rooted vegetation, including trees, shrubs, and herbaceous emergent are more capable of slowing floodwater than open water alone. Ratings follow these categories: High (dense vegetative cover) >75%; Medium (combination some unvegetated open water and vegetative cover) = 25 - 75%; Low (primarily unvegetated open water) = <25%. Isolated wetlands, which are perfect containers of floodwaters, should be rated 100%.

2) Nutrient Uptake/Cycling. A wetland's ability to uptake, metabolize, sequester and/or remove nutrients and imported elements from the water is primarily dependent on wetland vegetative conditions. Microbial processing and bioaccumulation are associated with plant cover including floating, emergent or submergent vegetation.[28] Vegetative density can serve as an index of primary production, which is an indicator of nutrient assimilation. Forested wetlands retain ammonia during seasonal flooding and wetland environments are effective at denitrification. Wetlands take up metals both by adsorption in the soils and by plant uptake via the roots. They allow metabolism of oxygen-demanding materials and can reduce fecal coliform populations. These pollutants are often buried by deposition of newer plant material, isolating them in the sediments.

17. Describe the roughness coefficient of the potential surface floodwater flowpath in relation to wetland vegetation biomass, numeric density and plant morphology[29]:

A = Dense bushy willow, heavy stand of timber with or without downed trees, or mature field crops with flow at half or less of crop height.

B = Dense grass with rigid stems, weeds, tree seedlings, or brushy vegetation where flows can be two to three times the height of the vegetation.

C = Primarily flexible turf grass or other supple vegetative cover or unvegetated.

N/A = Not applicable if wetland is isolated.

17. Guidance: Floodwater resistance. Forest cover and other woody stems increase surface roughness resulting in an increased detention of high flows. The cumulative effect is reduced peak flows downstream. A forest (i.e. ash, boxelder, red maple, conifers) with a dense understory is best for detaining high flows. Without a forest present, woody shrubs (i.e. alder, willow, red osier dogwood) can be extremely effective but lose effectiveness once high flows approach and exceed the woody shrub height. Dense, non-woody vegetation (i.e. cattails, reed canarygrass) are effective at detaining minor flood flows but lay down to higher flows and the surface roughness greatly diminishes. Turf grass and other supple vegetation has minimal effects on flood flows. Open water wetlands with submergent and scattered emergent vegetation are part of the channel characteristics and have minimal effect on detaining flood flows. The Manning's roughness coefficient decreases as water depth increases above the macrophytes and other surface roughness characteristics**.** Dense, robust, tall vegetation is best for

[28] Magee and Hollands, 1998; Lee et al., 1997.
[29] Adamus et al., 1991.

floodplains.

18. Describe the extent of observable/historical sediment delivery to the wetland from anthropogenic sources including agriculture:

A = No evidence of sediment delivery to wetland.

B = Minor evidence of accelerated sediment delivery in the form of stabilized deltas, sediment fans.

C = Major sediment delivery evidenced by buried detritus and/or vegetation along outer edge of temporary wetland (wet meadow) zone. Recent deltas, sediment plumes, etc. in areas of concentrated flow or sedimentation raising bottom elevation of wetland.

18. Guidance: Sediment Delivery. Wetlands filled by sediment from anthropogenic sources will have reduced capacity to store stormwater. Land use, ground slope, and erodibility characteristics of the soils affect the potential for sediment delivery to the wetland.

~ **19. Describe the predominant upland soils within the wetland's immediate drainage area that affect the overland flow characteristics to the wetland[30]:**

A = Sands (Hydrologic soil group A)

B = Silts or loams (Hydrologic soil group B)

C = Clays or shallow to bedrock (Hydrologic soil groups C, D, A/D, B/D, C/D)

19. Guidance: Watershed Soils. Use hydrologic grouping if available, otherwise, use soil texture from the soil survey [see chart in Guidance for Question #60]. Greater runoff and higher flood peaks occur in watersheds having primarily impermeable soils. These types of soils impede water infiltration and so produce increased runoff. Wetlands located downslope of more impermeable soils are more likely to provide flood attenuation.

20. Describe the characteristics of stormwater, wastewater, or concentrated agricultural runoff detention/water quality treatment prior to discharging into the wetland:

A = Receives significant volumes of untreated/undetained stormwater runoff, wastewater, or concentrated agricultural runoff directly, in relation to the wetland size.

B = Receives moderate volumes of directed stormwater runoff, wastewater, or concentrated agricultural runoff in relation to wetland size, which has received some treatment (sediment removal) and runoff detention.

C = Does not receive directed stormwater runoff, wastewater, or concentrated agricultural runoff; receives small volumes of one or more of these sources in relation to wetland size; or stormwater is treated to approximately the standards of the National Urban Runoff Program (NURP); and runoff rates controlled to nearly predevelopment conditions.

20. Guidance: Stormwater Runoff Pretreatment and Detention. These ratings apply to both Flood/Stormwater Storage and Attenuation *and* Downstream and Wetland Water Quality Protection. When used for determining water quality characteristics, the ratings are reversed (i.e. A=High shown

[30] See the Soil Data Mart on the NRCS/USDA website for help with soil characterization.

above will be counted as C=Low). Wetlands receiving undetained, directed stormwater from developed areas generally provide a higher functional level for flood/stormwater storage than do similar wetlands receiving stormwater at rates of, and with water quality equivalent to, that prior to development.

A NURP pond is most easily identified by having a 10-foot wide, nearly flat shelf just below the normal water level and will be 4 to 10 feet deep. Typically, these ponds will have a wet surface area (at the normal level) approximately equal to 1% of the watershed area (when the impervious percentage is less than 50), or 2% of the watershed impervious area (when the impervious percentage is >50). For example, a 0.5 acre pond will serve 50 acres of drainage area with 15% impervious surfaces or a 35 acre watershed containing 25 acres of impervious surfaces). Ponds that remove sediment only are typically smaller with a depth of 4 feet or less. The high rating equates with direct pipe discharge into the wetland and runoff rates, which will likely increase the water level in the wetland significantly (i.e. a pipe discharge from a short length of road or from several residential back yards to a 100 acre wetland complex does not constitute a significant impact).

~ **21. Describe the proportion of wetlands within the DNR minor watershed** (5,600 DNR minor watersheds are defined in Minnesota by Minnesota Rules 8420.0110, Subp. 31—the definition of "minor watershed" may vary by state) **and the opportunity for contributing to floodwater detention[31]:**

A = Wetlands make up less than 10% of the minor watershed area.
B = Wetlands make up 10-20% of the minor watershed.
C = Wetlands make up more than 20% of the minor watershed.

21. Guidance: Subwatershed Wetland Density. The density of wetlands in the minor watershed will determine the benefit each provides downstream. Wetlands reduce flood peaks up to 75 percent compared to rolling topography when they occupy only 20 percent of the total basin.[23] When wetland densities in the minor watershed exceed 20% total cover, the flood storage benefits of additional wetlands rapidly decrease.

22. Describe the functional level of the wetland in retarding or altering flows based on the surface flow characteristics through the wetland:

A = No channels present.
B = Channels present, but not connected, or meandering channels.
C = Channels connecting inlet to outlet.

22. Guidance: Channels/Sheet Flow. Channels are formed in the underlying substrate, not just as paths through emergent vegetation. Sheet flow, rather than channel flow, offers greater frictional resistance. The potential for floodflow desynchronization is greater when water flows through the wetland as sheet flow. Connecting channels will carry water directly from the inlet to the outlet preferentially in the channel. Channels not connected indicate that some channelized flow may occur within the wetland but not all the way through the wetland via a single channel; some sheet flow will occur. No channels present represents wetlands in which water from the inlet will spread out over the wetland to the outlet (e.g., unchannelized meadows, shallow marshes, deep marshes, ponds, typical floodplains without meander channels, etc.).

[31] Verry, 1988; Wells et al., 1988; Flores et al., 1981; and Ogawa and Male 1983/MA:P.

23. Adjacent Buffer width: Average width of the naturalized buffer:_____feet [Within 500']

23. Guidance: Upland Buffer. Vegetated buffers around wetlands provide multiple benefits including wildlife habitat, erosion protection, and a reduction in surface water runoff. A buffer is an unmanicured area immediately adjacent to the wetland boundary. For this question, do not include lawn areas. If the buffer varies from one side to another, take the average width over the entire perimeter.

Widths for Water Quality	Widths for Wildlife Habitat
High = >50 feet	High = >300 feet
Medium = 25 – 50 feet	Medium = 50 – 300 feet
Low = <25 feet	Low = <50 feet

To score the next three questions, consider a 50-foot ring around the wetland or assessment area. Describe the condition (minimum 10%) of each category. Total must equal 100%.

24. Adjacent Area Management: average condition of vegetative cover for water quality.

____% Full vegetative cover

____% Manicured, primarily vegetated (i.e. short-grass lawn, clippings left in place)

____% Lacking vegetation: bare soil or cropped, unfenced pasture, rip-rap, impervious/pavement.

24. Guidance: Adjacent Area Management. This question refers to the 50 feet surrounding the wetland assessment area (unlike the shoreland wetland vegetation question, which refers to the vegetation within the wetland itself). Maintenance may include mowing, haying, spraying or burning.

25. Adjacent Area Diversity & Structure (composition of characteristics for habitat)

____% Full coverage of native non-invasive vegetation

____% Mixed native/non-native vegetation, moderate density coverage, OR dense non-native cover.

____% Sparse vegetation and/or impervious surfaces.

25. Guidance: Adjacent Area Diversity and Structure. Many wetland-associated wildlife utilize upland areas for breeding, nesting, and foraging activities. Quality of the upland will affect the diversity and stability of the wetland wildlife community. This question combines estimates of both diversity and density—most wetlands will fall in the middle.

26. Adjacent Upland Slope

____% gentle slopes, 0-6%

____% moderate slopes, >6-12%

____% steep slopes, >12%

26. Guidance: Adjacent Upland Slope. Gentle slopes are associated with greater use by wildlife and also are less likely to erode. This measurement is best estimated on site.

~ **27. Describe the proximity of the first recreational lake, recreational watercourse, spawning area or significant fishery, or water supply source down-gradient of the wetland[32]:**

A = Isolated wetlands *or* wetland with one or more resource within 0.5 mile downstream via any form of channel, pipe.
B = One or more resource within 0.5 to 2 miles downstream.
C = No significant resources are located within 2 miles downstream.

27. Guidance: Downstream Sensitivity. The water quality function wetlands provide help disperse the physical, chemical, and biological impacts of pollution in downstream waters. Sensitive water resources located within 0.5 miles downstream of the wetland will realize the greatest benefit to water quality from the wetland. As discharges from the wetland move farther downstream, the benefits to water quality provided by the wetland will continue to diminish.

28. Does the wetland water quality and/or plant community exhibit signs of excess nutrient loading:

A = No evidence of excess nutrient loading or nutrient sources (e.g. evidence of diverse, native vegetative community, no pipes, etc.).

B = Some evidence of excess nutrient loading source and evidence in the plant communities such as dense stands of reed canary grass or narrowleaf, and/or blue (hybrid) cattail.

C = Strong evidence of excess nutrient loading by evident nutrient sources or evidence in the plant community such as algal mats present or evidence of excessive emergent, submergent and/or floating macrophyte growth.

28. Guidance: Nutrient Loading. Excessive nutrient loading to a wetland can cause nuisance algal blooms and the production of monotypic stands of invasive or weed species. Observed point source or nonpoint source of nutrients may include but is not limited to: fertilized lawns, agricultural runoff, manure storage or spreading, concentrated stormwater runoff, or pet waste inputs.

29. Y N Is the wetland fringing deepwater habitat, a lake, or within a watercourse? If NO, enter "not applicable" for this function in the Summary Table and skip to Question 35 [remove from computation of Shoreline Protection function.] If YES, answer the following questions.

29. Guidance: Shoreline Wetlands. The Shoreline Protection function only applies to wetlands that lie at the fringe of lakes, deepwater habitats, and within creeks, streams, rivers, and other watercourses. Typically, these include lacustrine wetlands i.e. fringing lakes which are defined as being situated in a topographic depression; lacking trees, shrubs, persistent emergents, emergent mosses or lichens with greater than 30 percent areal coverage; and greater than 20 acres in size or fringing deepwater habitats which are defined as less than 20 acres in size, but either greater than 6.6 feet deep at the deepest, or has a wave-formed shoreline[33]. The wetland portion is typically the area that is less than 6.6 feet deep. Also included as shoreline wetlands are floodplain/riverine systems (i.e. wetlands present between the active river channel and river banks that may experience frequent water level fluctuations and/or erosive forces).

[32] Wells et al., 1988.
[33] Cowardin, 1979

30. Enter the percent cover of rooted shoreline wetland vegetation[34].

______%

30. Guidance: Rooted Shoreline Vegetation. The erosive strength of waves and currents can be greatly dissipated by a dense vegetation cover including submerged macrophytes. The greater the vegetation density, the greater the shoreline protection. (High = Macrophyte cover in the wetland >50%; Medium = Macrophyte cover in the wetland is 10% - 50%; Low = Macrophyte cover in the wetland <10%.)

31. Enter the average wetland width in feet between the shoreline/streambank and deep water/stream[35]:

_____ feet

31. Guidance: Wetland Width. Wetlands with wide stands of vegetation are more likely to stabilize sediments than those with narrow stands. Knutson et al. (1981) found that wetlands wider than 30 feet reduced wave energy by 88% while emergent wetlands less than 6 feet wide were relatively ineffective in wave buffering. Measure width starting from the deepwater edge up to the normal water's edge, not to include the shore area up out of the water itself (the shore-area wetland is considered in Question #34). (High = Wetland width >30 feet; Medium = Wetland width 10-30 feet; Low = Wetland width <10 feet).

32. Describe the emergent vegetation type and resistance within the shoreline wetland[36]:

A = Dominance of emergent species with strong stems present all year and/or dense root mats in the wash zone (e.g., cattails, shrubs) that are resistant to erosive forces.

B = Presence of some emergent species with strong stems or dominance of weak-stemmed emergent species persisting most of the year and/or moderately dense root mats in the wash zone (e.g., bulrushes, grasses) that are resistant to erosive forces.

C = Presence of some weak-stemmed emergent species and/or no dense root mats in the wash zone (e.g., rushes).

32. Guidance: Emergent Vegetation. The erosive strength of waves and currents can be greatly dissipated by a dense, emergent vegetation cover. In addition, species with stronger stems will provide greater protection than weak-stemmed species. The greater the vegetation density, the greater the shoreline protection. Some of the more common species with potentially high value for shoreline anchoring include: sweetflag (*Acorus calamus*), speckled alder (*Alnus incana* ssp. *rugosa*), blue joint grass (*Calamagrostis canadensis*), sedges (*Carex* spp.), red-osier dogwood (*Cornus stolonifera*), spike rush (*Eleocharis palustris*), scouring rush (*Equisetum fluviatile*), rice cutgrass (*Leersia oryzoides*), switchgrass (*Panicum virgatum*), reed canary grass (*Phalaris arundinacea*), common reed (*Phragmites australis*), smartweeds (*Polygonum* spp.), pickerelweed (*Pontederia cordata*), cottonwood (*Populus deltoides*), arrowhead (*Sagittaria* spp.), willows (*Salix* spp.), bulrushes (*Scirpus* spp.), cordgrass (*Spartina pectinata*), and cattails (*Typha* spp.).

[34] Wells et al., 1988.
[35] Adamus et al., 1991.
[36] Wells, et al., 1988.

33. Describe the shoreline erosion potential at the site[37]:

A = Strong wave action or water current (greatest wind fetch on a lake or outside river bend); frequent boat traffic and restrictions that funnel boats into narrow passages; sandy soils or evidence of erosion or slope failure.

B = Moderate wave action or water current (small lakes or large ponds); moderate boat traffic with some evidence or potential for erosion or slope failure.

C = Negligible erosive forces (little open water or wave action or slow-moving, straight river); minimal to no boat traffic or no-wake zone; no evidence of past erosion or slope failure.

33. Guidance: Shoreline Erosion Potential. Wetlands located in areas with strong currents and wave action have the greatest potential for protecting shoreline. Shorelines composed of sandy or erodible soils will benefit the most from shoreline wetland protection.

34. Describe the shoreline/streambank vegetation conditions up slope from the water level in relation to the ability to protect the bank from erosion or slope failure:

A = Lack of vegetation; regularly manicured, short-grass lawn.

B = Full vegetative cover composed of shrubs receiving only moderate maintenance or grasses/understory vegetation that is not manicured.

C = Deep-rooted vegetation not actively manicured (e.g., trees, shrubs and grasses), or rip-rap.

34. Guidance: Bank Protection Ability. The potential for erosion and/or slope failure of shoreline or streambank areas is also dependent on the land use and condition on the slope above the water level and on top of the bank. Bare soils or those with shallow rooted grasses that are manicured on a regular basis provide less protection than deep-rooted grasses allowed to grow naturally. For this question, consider that part of the wetland starting at the water's edge up to the upland edge, to encompass the shore area up out of the water itself (the water-level wetland is considered in Question #31).

~ **35. Y N Is the wetland known to be used recently by rare wildlife species or wildlife species that are state or federally listed?** If yes, wildlife habitat functional level rating = exceptional. (If Special Features, question J is answered, the functional level will also be exceptional)

35. Guidance: Rare Wildlife. Rare wildlife species include any of those listed in the or are federally listed. This question is meant to address local conditions rather than statewide priorities. Although consulting the Minnesota Natural Heritage Database or County Biological Survey (see Question #5) will be helpful to guide the assessment, local considerations of scarcity or abundance must be applied.

~ **36. Y N Is the wetland plant community scarce or rare within the watershed?** If the wetland community has a High quality rating from Question #2 and this question is yes, then Vegetation function is Exceptional.

36. Guidance: Rare Community. This question is meant to address local conditions rather than statewide priorities. Although consulting the Natural Heritage Database and County Biological Survey

[37] Wells et al., 1988.

(see Question #5) will be helpful to guide the assessment, local considerations of scarcity or abundance must be applied here.

37. For deep and shallow marshes or shallow open water wetland types (types 3, 4, and 5) select the cover category that best illustrates the interspersion of open water and emergent, submergent, or floating-leaved vegetation within the wetland (See Interspersion Diagram Figure 1[38], Appendix Fig. 1 or the database *image*).

Enter the cover category based on the diagram: ____

N/A = Not applicable for wetland types 1, 2, 6, 7, 8.

37. Guidance: Vegetation Interspersion[39]. Wetlands that contain vegetation interspersed with open water are more likely to support notably greater on site diversity and/or abundance of fish and wildlife species. Those with very dense vegetation and no channels or open water areas are less likely to support this function. Vegetation interspersion is a measure of the amount of edge between vegetation and open water, which is valuable to wildlife. Cover categories 5 and 7 rate High; 3, 4, and 6 rate Medium; 1, 2, and 8 rate Low.

38. For wetlands having more than one vegetative community (see Question 1), indicate the interspersion category that best fits the wetland (see Appendix Fig. 2 or database version *Image*).

Category =____. (Category 3=High, 2=Medium, 1=Low)

N/A = Only one vegetative community is present.

38. Guidance: Vegetative Interspersion. For wetlands that are characterized by multiple vegetative communities, the increased structural diversity and amount of edge associated with greater interspersion is generally positively correlated with wildlife habitat quality. Interspersion is a modification based on the Wells et al., 1988, Page 67, Interspersion Diagram, Golet et al., 1976. The figures shown in the appendix are examples of complexity, not meant to be exact representations of any individual site. Choose the one that most closely approximates the degree of interspersion at your site, regardless of structural differences. "Site," in some instances, may mean a portion of a larger basin, if that is how the assessment area has been defined from the start.

39. A healthy wetland will have detritus (vegetative litter) in several stages of decomposition. Describe the wetland condition[40]:

A = The presence of litter layer in various stages of decomposition.

B = Some litter with apparent bare spots, or dense litter mat (e.g., reed canary grass mat).

C = No litter layer.

N/A = Deep marshes, shallow open water and bog communities.

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[38] Wells et al., 1988; Adamus et al., 1991.

[39] Interspersion is based on Wells et al., 1988, Page 180 Interspersion Diagram

[40] Lee et al., 1997

39. Guidance: Wetland Detritus. Detritus or vegetative litter in various stages of decomposition is a sign of a healthy wetland. Detrital biomass impacts nutrient cycling processes and disturbance regime and thereby influences plant assemblages. Detritus maintains thermal regulation of rhizomes and propagules, and is essential to nutrient cycling. The integrity of the system's vegetation components supplies the bulk of the faunal habitat requirements. When assessing a site, consider that the amount of detritus will vary with the time of year; floodplain forests may show no litter after spring flood events, for example.

~ **40. Describe the relative interspersion of various wetlands in the vicinity of the assessment wetland[41]:**

A = The wetland occurs in a complex of wetlands of various types (general guideline: at least 3 wetlands within 0.5 miles of assessment wetland, at least one of which has a different dominant plant community than the assessment wetland); or the assessment wetland is the only wetland within a 2 mile radius.

B = Other wetlands of the same plant community as the assessment wetland are present within 0.5 miles.

C = No other wetlands are present within 0.5 miles of the assessment wetland but are present within 2 miles.

40. Guidance: Wetland Interspersion. This question is best determined using GIS (except in forested areas where wetlands smaller than one to three acres may not appear). This question uses a 0.5-mile radius and rates wetlands higher for having more wetland neighbors. However, research indicates that the critical radius varies by species[42]. Wetlands that are isolated in the landscape may provide the last refuge for wetland dependent plant and animal species in an otherwise upland or developed area.

41. Habitat value diminishes when fragmented by barriers, which restrict wildlife migration and movement. Describe barriers present between the wetland and other habitats[43]:

A = No barriers or minimal barriers present; i.e. low traffic; uncurbed roads, low density housing (> 1 acre lots), golf courses, utility easements, or railroads.

B = Moderate barriers present; i.e. moderately traveled; curbed roads, moderate density housing (1/3 to 1 acre lots), residential golf courses, low dikes, row crops.

C = Large barriers present; i.e. 4-lane or wider, paved roads, parking lots, high-density residential (<1/3 acres), industrial and commercial development.

41. Guidance: Wildlife Barriers. This variable is defined as a measure of habitat fragmentation of the wetland relative to other wetlands and native plant communities to indicate the ecosystem connectivity. It identifies barriers to wildlife migration ranging from very small barriers such as unpaved roads and low-density housing to large hydrologic barriers such as regional canals and levied roads. Reference area will affect this rating: "other habitats" includes upland areas usable as wildlife resting or reproductive habitat. Because agricultural use can vary in intensity, use Best Professional Judgment to determine if cropland could be considered "habitat."

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41 Wells et al., 1988; Adamus et al., 1991
42 Whited et al., 2000
43 Rheinhardt et al., 1997

42. Amphibian breeding potential – hydroperiod (check one)

___ Adequate—the wetland is inundated long enough in most years to allow amphibians to successfully breed (Cowardin et al. water regimes A, C, F, H, G) (Score = 1.0)

___ Inadequate—the wetland is not inundated long enough in most years to allow amphibians to successfully breed (Cowardin et al. water regimes B, D, E, J) (Score = 0)

42. Guidance: Amphibian Breeding/Hydroperiod. Frogs, toads and salamanders reproduce at different times from late March to June, depending on the species[44]. Early breeders (such as spring peepers, wood frogs, chorus frogs, salamanders) typically reproduce in shallow, seasonal wetlands. Green frogs and mink frogs reproduce in larger more permanent wetlands. For breeding to be successful, the wetland must remain inundated long enough for the larval stages to metamorphose into adults. This period varies depending on the species, but a rough guide is that the wetland should remain inundated at least through June 1 for the portion of the state south of I-94 and at least through June 15 north of I-94. This period of inundation will not accommodate all species, but is reasonably likely to ensure that the wetland is suitable for breeding by some amphibians.

The Cowardin et al. water regimes listed above are approximate indicators—more direct evidence of hydroperiod should be used when possible. Direct evidence of amphibian breeding **may** be an indication of a sufficient hydroperiod. Such evidence would include observations of frogs calling, egg masses in the water, presence of tadpoles or presence of young, newly metamorphosed frogs, toads or salamanders at the wetland. Note however, that some species are opportunistic and will lay eggs in temporary pools that will not remain inundated long enough for successful reproduction. Exercise caution when using this indicator.

43. Amphibian breeding potential – fish presence

A = The wetland is isolated so that predatory fish (e.g., bass, northern pike, walleye, bluegill, perch, etc…) are never present.

B = The wetland may occasionally be connected to other waters so that predatory fish may be present in some years.

C = The wetland is connected with a lake or river so that predatory fish are always present or the wetland is used for rearing of game fish.

43. Guidance: Amphibian Breeding/Predators. Optimal amphibian breeding habitat is characterized by a lack of predatory fish[45]. These habitats are wetlands that winterkill, dry periodically, are periodically anoxic, and are not connected to waters bearing predatory fish. The wetland should not be used to rear bait or game fish. This question utilizes observable characteristics of the wetland to infer about the status of fish. Direct observation or knowledge about fish presence should be substituted where possible.

44. Amphibian and reptile overwintering habitat

A = The wetland is normally more than 1.5 meters deep (never or rarely winterkills).

B = The wetland is normally around 1 meter deep (may occasionally winterkill).

C = The wetland is normally less than 1 meter deep and often freezes to the bottom.

N/A = The wetland never or rarely contains standing water or is nearly always dry in winter.

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[44] Oldfield and Moriarty, 1994

[45] Lannoo, 1998

44. Guidance: Amphibian Habitat. Wetlands that are deep and well oxygenated provide over-wintering habitat for leopard, green and mink frogs, as well as turtles[46]. Evidence of over-wintering would be observations of migrations of frogs to the wetland in fall and away from the wetland in spring and basking turtles in the spring. Recent evidence of Blandings turtles overwintering in Type 6 wetlands may alter this assessment.

45. List any noteworthy wildlife species observed or in evidence (e.g., tracks, scat, nest/burrow, calls, viewer reports), including birds, mammals, reptiles, and amphibians. *(Note: This list is for documentation only and is not necessarily an indication of habitat quality.)*

46. Is the wetland contiguous or intermittently contiguous with a permanent waterbody or watercourse such that it may provide spawning/nursery habitat for native fish species? Choose the condition from the following list that best describes the wetland in relation to fish habitat:

Exceptional = The wetland is a known spawning habitat for native fish of high importance/interest or the wetland is part of or adjacent to a trout fishery as identified by the DNR.

A = The wetland is lacustrine/riverine or is contiguous with a permanent water body or watercourse and may provide spawning/nursery habitat, refuge for native fish species in adjacent lakes, rivers or streams, or provides shade to maintain water temperature in adjacent lakes, rivers or streams.

B = The wetland is intermittently connected to a permanent water body or watercourse that may support native fish populations as a result of colonization during flood events, or the wetland is isolated and supports native, non-game fish species.

C = The wetland is isolated from a permanent water body or watercourse or has exclusive, high carp populations, which cause degradation to the wetland.

N/A = None of the above. The wetland does not have standing water during most of the growing season. The site is not capable of supporting fish.

46. Guidance: Fish Habitat Quality. Generally, the value of a wetland for fish habitat is related to its connection with deepwater habitats. In the north central region, spawning habitat for warm water species can be an important function of a wetland, and northern pike are among the most valuable warm water species spawning in wetlands[47]. Cold-water species are relatively rare and wetlands (according to traditional definition) do not provide habitat for spawning trout, but have an indirect effect through improving water quality[48].

Northern pike wetland spawning habitat will have several characteristics including: 1) A semi-permanent or permanent connection to a lake or stream that has a population of northern pike; 2) The wetland is vegetated primarily with reeds, grasses, or sedges; or secondarily with cattails, rushes, arrowhead, water lilies, submerged plants, and shrubs or lowland hardwoods with grass and low emergents; 3) The wetland is flooded during the early spring at least once every 3 years for at least 20 days and remains connected to the lake or stream during that time; 4) Lacustrine areas should have 4 to 8 acres of actual spawning area for each 100 littoral acres of lake[49]; and 5) Shallow or deep marsh wetland spawning areas are typically located on the upstream side of the lake or stream[50].

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[46] Oldfield and Moriarty, 1994
[47] Adamus et al., 1991.
[48] Adamus et al., 1991.
[49] MIDNR, 1981; Adamus et al., 1991.
[50] Personal communication, D. Ellison, MnDNR.

A wetland should be rated as having high value for fish if it provides spawning/nursery habitat, or refuge for *native* fish species in adjacent lakes, rivers or streams. Some isolated deep marshes may intermittently support populations of sunfish and northern pike as a result of colonization during flood events. Permanently flooded isolated wetlands that support native populations of minnows provide moderate value. Wetlands with exclusive, high carp populations provide low value for fish habitat because carp cause extreme degradation of the wetland. Isolated wetlands that are not permanently flooded do not generally support fish populations.

47. List any fish species observed or evidenced. *Note: This list is for documentation only and is not necessarily an indication of habitat quality* (database drop-down list: northern pike, perch, sunfish, bass, minnows, carp).

48. Y N Does the wetland provide a unique or rare educational, cultural, or recreational opportunity (e.g., located in an outdoor learning park focused on wetland study)? (If yes this function rates exceptional)

48. Guidance: Unique Opportunity.
The wetland must provide a rare or unique opportunity within the ecoregion, wetland comparison domain, or study area, such as a wetland associated with a school environmental program or public education institution (University of Minnesota's Cedar Creek, Landscape Arboretum's Spring Peeper Wetland), cultural experience (wild rice areas), or a pristine-reference site for another assessment tool[51].

49. Is the wetland visible from vantage points such as: roads, waterways, trails, houses, and/or businesses?

A = The wetland is highly visible and can be seen from several public vantage points.
B = The wetland is somewhat visible and can be seen from a few vantage points.
C = Very limited visibility.

49. Guidance: Visibility. While dependent on accessibility, a wetland's functional level could be evaluated by the view it provides observers. Distinct contrast between the wetland and surrounding upland may increase its perceived importance. Multiple vantage points increase the likelihood and number of people that may view the wetland.

50. Y N Is the wetland in/near a city, town, or village so as to generate aesthetic/recreation/ educational/cultural use?

50. Guidance: Population Centers. Accessibility of the wetland is key to its aesthetic or educational appreciation. Thus, proximity to population centers may increase its perceived importance. However, proximity to population centers and locations in public areas may have associated noise and/or pollution factors that could degrade the aesthetic and educational functional level.

~ **51. Is any part of the wetland in public or conservation ownership?**

A = Completely contained within publicly owned land or entirely within a conservation easement.

B = Partially within publicly owned land or partially within a conservation easement.

C = Privately owned or not within a conservation easement.

[51] Minnesota's Index of Biologic Integrity uses several wetlands as reference-standard sites for both high- and low-functioning sites.

51. Guidance: Public Ownership. Wetlands located on lands in public ownership inherently will provide open accessibility. Wetlands being on lands within a conservation easement provides some certainty that the wetlands will not be subject to impact pressures.

52. Does the public have access to the wetland from public roads or waterways?

A = Direct access through a public facility with an established parking area or boat access.

B = Cumbersome access from a public facility (i.e. no established trails to or near wetland) or no public parking or boat access available.

C = No public access available.

52. Guidance: Public Access. Accessibility of the wetland is key to its aesthetic or educational appreciation. Wetlands located on private lands are not likely to provide aesthetic or educational opportunities to the general public.

53. What are the obvious human influences on the wetland itself, such as:

A = No structures, pollution, trash, or other alteration present in the wetland.

B = Wetland only moderately disturbed by structures, pollution, trash, or alteration.

C = Wetland has signs of extensive pollution/trash, severe vegetative alteration, or multiple structures.

53. Guidance: Human Disturbances in Wetland. Wetlands subject to direct human disturbances/impacts are not likely to provide aesthetically pleasing natural environments.

54. What are the obvious human influences on the viewshed of the wetland, such as:

A = No or minimal buildings, roads, or altered land uses surrounding the wetland.

B = Surrounding area composed of mostly open space with a few buildings or roads, low intensity agriculture.

C = Wetland surrounded by residential, other intensively developed land uses, or intensive agriculture.

54. Guidance: Wetland Viewshed. This question requires a judgment as to the dominant land use visible at the primary viewing locations within the wetland. This method assumes that the most appealing views of wetlands are from other areas of natural beauty such as an upland forest[52]. Wetlands occurring in densely developed urban areas equate with lower ratings. Excessive noise from nearby highway or factories could be considered an intrusive human influence.

55. Does the wetland and buffer area provide a spatial buffer between developed areas?

A = Spatial buffer more than 500 feet wide.
B = Spatial buffer between developed areas less than 500 feet wide.
C = Does not provide a spatial buffer—no developed land near the wetland.

55. Guidance: Spatial Buffer. Views of open water and open space in general are considered to be

[52] Ammann and Stone, 1991.

aesthetically appealing[53]. Distinct contrast between the wetland and surrounding upland may increase its perceived importance. Expansive wetlands and associated buffer areas provide open space and a feeling of a natural environment while reducing the visibility of adjacent human development. If the wetland is surrounded by undeveloped land within its immediate viewshed, the wetland has little value as a spatial buffer. Developed lands across any portion of the wetland will benefit from the spatial buffering of the wetland. Spatial buffer is measured from the edge of the developed area, across the wetland, to the edge of the next developed area. The edge may be considered the end of manicured lawn or golf course, sidewalk or paved area, or up to a wall or fence.

56. Is the wetland and immediately adjacent area assumed to be currently used for (or does it have the potential to be used for) recreational activities such as the following: education, cultural, scientific study, hiking, biking, skiing, hunting, fishing, trapping, boating, canoeing, wildlife observation, exploration, play, photography, or food harvest.

A = Evidence or a high probability for multiple recreational uses.
B = Evidence of or a high probability for a few recreational uses.
C = Low probability or potential for recreational use

56. Guidance: Activities. Wetlands can provide recreational and educational opportunities that enhance their value. Use Best Professional Judgment to decide the likelihood and value of multiple uses from the list above, or of others not noted.

57. Is the vegetation or hydrology currently controlled or modified to sustain a commercial product?

A = Highly Sustainable Use: commercial use of the wetland does not permanently alter the wetland characteristics.

B = Somewhat Sustainable Use: wetland characteristics have been altered but vegetation is still hydrophytic.

C = Hydrology dramatically altered to produce a commercial product such as row crops or peat.

N/A = This wetland is not used for commercial products.

57. Guidance: Commercial Quality. Is the wetland being used for a commercial product that does not sustain the wetland? If so, consider the nature of the use. Sustainable uses of the wetland would not require modifying a natural wetland. Products in this category would include collection of botanical products, wet native grass seed, floral decorations, wild rice, black spruce, white cedar, and tamarack. Other sustainable uses may require modification of the natural hydrology, such as for wetland-dependent crops that rely on the wetland hydrology for part of their life cycle (rice, cranberries). Haying and grazing are less intrusive agricultural activities utilized more or less casually when hydrologic conditions permit; light pasture and occasional haying might be considered highly sustainable [A], whereas heavier use would result in a rating of [B]. Row crops such as corn and soybeans can be planted in some wetlands after spring flooding has ceased and still have adequate time to grow to maturity. Like peat-mining, cropping is an unsustainable use of the wetland as it is results in severe alterations of wetland characteristics (soil, vegetation, hydrology).

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[53] Ammann and Stone, 1991.

The following questions (#58-63) relate to the movement of groundwater into and out of the wetland. Base your answers on the best available information. Classification of a given site as a primarily recharge or discharge wetland will be based on how a majority of the questions are answered and does not offer a definitive result as to the actual movement of groundwater in the assessment area. When the primary hydrology comes from ground-water, wetlands are labeled discharge, whereas recharge wetlands are those whose hydrology is primarily supported by surface-water that then seeps into a ground-water system.

~ **58. Describe the soils within the wetland[54]:**

Recharge = Mineral soils with a high organic content (all soils not included in discharge system).

Discharge = Organic/peat soils, formed due to more continuous wetness associated with a ground water discharge system

58. Guidance: Wetland Soils. Wetlands with mineral hydric soils typically represent drier hydrologic regimes where groundwater recharge is more likely (i.e. saturated, seasonally flooded, and temporarily flooded) where the wetness does not significantly limit oxidation of organic materials. Groundwater discharge wetlands represent more stable and permanent hydrologic regimes where excessive wetness limits the oxidation of organic matter resulting in the accumulation of peat and/or muck. In addition, coarser-grained mineral hydric soils may have higher permeabilities allowing groundwater recharge, while histosols generally have low permeabilities, reducing groundwater discharge. Disturbed soils in excavated wetlands or stormwater ponds are subject to best professional judgement for this question.

~ **59. Describe the land use/runoff characteristics in the local subwatershed upstream of the wetland[55]:**

Recharge = Land is primarily developed to high-density residential, commercial, industrial and road land uses (equivalent to lots 1/4 acre or smaller) indicating impervious surfaces (>38%), which result in more runoff to wetlands and lowered water tables creating a gradient for recharge under wetlands.

Discharge = Upland watershed primarily undeveloped or with low to moderate density residential development (i.e. lots larger than ¼ acre) with low percentage of impervious surfaces (<38%) so upland recharge (to groundwater) and higher water table will be more likely to contribute discharge to wetlands.

59. Guidance: Land Use/Runoff. The local subwatershed boundary, smaller still than the DNR minor watershed, is available from the local Soil and Water Conservation District office. Watersheds with extensive paved surfaces, topographic disruptions, and the presence of wells are associated with human development that lowers the potentiometric contours. Lowered or diversified potentiometric contours enhance the likelihood of recharge, not discharge[56]. Wetlands with unpaved watersheds are more likely to allow groundwater discharge to occur.

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[54] R.P. Novitzki, 1998 personal communication in MnRAM 2.0; Magee and Garrett, 1998.
[55] Adamus et al., 1991.
[56] Fetter, 1980.

60. Indicate conditions that best fit the wetland based on wetland size and the hydrologic properties of the upland soils within 500 feet of the wetland[57].

Recharge = Wetland is <200 acres and surrounding soils (within 500 feet) are primarily in the C or D hydrologic groups.

Discharge = Wetland is >200 acres in size or wetland is <200 acres and the surrounding soils (within 500 feet) are primarily in the A or B hydrologic groups.

60. Guidance: Wetland Size and Surrounding Soils. The size or area of the wetland and the soil texture in the surrounding upland are two factors controlling the wetland's water budget. A large wetland with a proportionately small watershed may indicate subsidization of its water budget by groundwater discharge. The probability of groundwater discharge occurring may thus increase as the wetland/watershed ratio increases. The wetland size also controls the amount of recharge potential. The more fine-grained the soil texture in the surrounding uplands, the more water will flow to the wetland via overland flow and less likely water is to flow to the wetland via groundwater discharge. Williams (1968) observed that a small wetland situated in a large watershed favored groundwater recharge, because surface water inflow from a large watershed was sufficient to create a water mound conducive to recharge. Sandy and loamy upland soils allow more infiltration of precipitation than clayey soils. The infiltrated water will percolate downward vertically and/or flow laterally becoming groundwater discharge where wetlands intersect the water table.

Hydrologic soil groups are based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms. The four hydrologic soil groups are as follows[58]:

← higher) **Runoff Potential** (lower →

Soil Group	Infiltration rate	Depth and drainage characteristics	Water Transmission Rate
A	High	Deep, very well drained to excessively drained sands or gravelly sands.	high
B	Moderate	Moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture.	moderate
C	Slow	Soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture.	slow
D	Very slow	Clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material.	very slow
A/D B/D C/D	The first letter (for drained areas) should be used for the determination of recharge/discharge; if unsure, the second letter (D) would be used for undrained areas and therefore put it into the recharge category.		

61. Indicate the hydroperiod of the wetland[59]:

[57] Adamus et al., 1991; Magee and Garrett, 1998.
[58] USDA Natural Resources Conservation Service Hennepin County Soil Survey – Issued 2004.
[59] Adamus et al., 1991; Lee et al., 1997.

Recharge = Cowardin et al. water regimes: A, C, D, E, and J (i.e. temporarily flooded, seasonally flooded, seasonally flooded/well drained, seasonally saturated, and intermittently flooded as well as wetlands with the B regime (saturated) that: (1) are on flats; and/or (2) are acid bogs (indicates precipitation-driven systems).

Discharge = Cowardin et al. water regimes: F, G, H, (i.e. semi-permanently flooded, intermittently exposed, and permanently flooded), as well as wetlands with the B water regime (saturated) that: (1) consist of sloping organic soils; (2) are on a river valley terrace or at the toe of a bluff or beach ridge, etc.; or (3) have any observed springs or seepages.

61. Guidance: Hydroperiod. Permanently flooded, semi-permanently flooded, and saturated water regimes, especially in regions having high evaporation rates, often indicate groundwater discharge to a wetland. Exceptions are saturated wetlands on flats and/or bogs that are precipitation-driven systems. Wetlands that are seasonally- or temporarily-flooded are more likely to recharge groundwater.

62. Describe the inlet/outlet configuration that best fits the wetland[60]:

Recharge = No outlet or restricted outlet in natural wetlands and lacustrine wetlands.

Discharge = Perennial outlet but no perennial or intermittent stream inlet; perennial stream riverine or floodplain wetland.

62. Guidance: Inlet/Outlet for Groundwater. A wetland with a permanent stream inlet but no permanent outlet is more likely to recharge groundwater than one with an outlet. Several factors support this ranking. First, a higher hydraulic gradient will likely be present in an area with no outlet, especially if an inlet is present. Second, the longer water is retained in an area, the greater the opportunity for it to percolate through the substrate. Third, wetlands without outlets generally experience more water-level fluctuations, resulting in inundation of unsaturated soils. Finally, lack of an outlet suggests that water is being lost either through recharge or evapotranspiration, especially if an inlet is present. A wetland with a permanent outlet and no inlet is more likely to discharge groundwater than one with other combinations of inlets and outlets. Continuous discharge of water (i.e. permanent outlet) without surface water feeding the wetland through an inlet suggests an internal source of groundwater (e.g., springs or seeps). Flow-through wetlands would be considered discharge wetlands for the purposes of this question.

~ **63. Characterize the topographic relief surrounding the wetland[61]:**

Recharge = Land slopes away from (below) the wetland (wetland is elevated in the subwatershed).

Discharge = Topography characterized by a downslope toward the wetland around the majority of the wetland (wetland is found lower in the subwatershed).

63. Guidance: Topographic Relief. This question refers to landscape-level topography at a large, subwatershed scale. Groundwater discharge is more likely to occur in areas where the topographic relief is characterized by a sharp downslope toward the wetland (i.e. wetland is located at the toe of a slope). Groundwater recharge is more likely in wetlands where the topographic relief is characterized by a sharp downslope away from most of the wetland. The slope of the water table with respect to the wetland influences the hydraulic gradient for groundwater movement. The water table usually slopes roughly parallel to the land surface topography. Thus, when local topography slopes sharply toward the

[60] Adamus et al., 1991; Lee et al., 1997.

[61] Adamus et al., 1991.

wetland, the result is typically a hydraulic gradient favorable for groundwater discharge.

END OF PRIMARY QUESTION SET FOR MNRAM 3.1

Optional Evaluation Information

64. Y N Does the wetland have the potential for hydrologic restoration without flooding: roads, houses, septic systems, golf courses or other permanent infrastructure (active agricultural fields are acceptable uses within potential restoration areas) within the restoration area? If yes, answer the following questions. If no, skip to question 71.

64. Guidance: Hydrologic Restoration Potential. The purpose of this question is to identify opportunities for restoration of drained or partially drained wetlands. Generally, this question applies to wetlands that have been ditched or tiled for agricultural or other purposes. Some drained or partially drained wetlands will not have the potential for restoration because of altered land uses that rely on continued drainage of surface and/or subsurface water. It is important to look at land uses upstream of the drained wetland to determine if any of the features mentioned could be flooded by plugging a ditch, breaking drain tiles or creating an impoundment.

65. Indicate the number of landowners that would be affected by the wetland restoration project:

- ❑ Completely within public ownership
- ❑ 1
- ❑ 2
- ❑ 3 or more

65. Guidance: Landowners. The number of landowners of the drained or partially drained wetland and any obvious upstream areas that would be flooded by hydrologic restoration of the wetland directly affects the feasibility of a restoration project. Typically, as the number of private owners of a potential restoration site goes up the project becomes more complex and the probability of success is reduced due to conflicting desires among the landowners. All public=Exceptional, 1=High, 2=Medium, 3 or more=Low.

~ **66. Enter the existing wetland area and estimated size of the total wetland if effectively drained or filled areas were restored (not including any buffer area).** Two characteristics will be computed from the following information: 1) total restored wetland size, and 2) percentage of historic wetland effectively drained.

Programming the overall restoration potential will assign the rank based on size.

A. Size of existing wetland (acres) _______ (should be the same as Question #10)

B. Total wetland including restorable and existing wetland (acres) ______

C. Calculated potential new wetland area (acres) ________

In the database, enter this at the General Information tab (first screen).

66. Guidance: Wetland Restoration Area. The size of the potential wetland restoration will be determined partially by the extent of historic hydric soils mapped on the site, but must also take into consideration upstream land uses, current land uses on the site, methods of hydrologic alteration that have occurred, and the current topography of the site. Restoring the natural hydrology to partially drained wetlands will restore the historic wetland type. Restoration of existing wetlands that had some ditching or tiling that did not effectively drain the entire wetland may result in some new wetland and some hydrologically restored wetland. Some wetland laws may allow for wetland replacement credit for hydrologically restored wetlands as well as restoration of drained wetlands. Two ratings will be determined for this question;

1) **Total restored wetland size (acres)**: (High >10 acres, Medium = 2 to 10 ac, or Low = less than 2 ac.)

2) **Percent of historic wetland effectively drained:** (High = >60%, Medium = 20 - 60%, or Low = < 20%)

67. Enter the average width of naturalized upland buffer that could potentially be established around the restored wetland:

______ feet (High = more than >50’ around the potential wetland restoration area;
Medium = between 25’ and 50’ around the potential wetland restoration area;
Low = less than <25’ around the potential wetland restoration area)

67. Guidance: Restorable Buffer Width. Upland buffer protects wetland function.

68. Rate the potential ease of wetland restoration:

A = Break tile line and/or plug ditch, discontinue pumping.
B = Break multiple tile lines and/or ditch plugs.
C = Diking, berming, excavation or grading.

68. Guidance: Restoration Ease. The easiest wetlands to restore are those that were drained by a single ditch or drain tile. Restoration of those wetlands will typically involve simply plugging the ditch or breaking the tile line. The most difficult situation for creating wetlands is by impoundment or excavation in uplands. This involves much more uncertainty and greater cost.

69. Indicate the type of hydrologic alteration:

____Ditching
____Drain Tiles
____Ground Water Pumping
____Lowered Outlet Elevation
____Watershed Diversion
____ Filling

69. Guidance: Hydrologic Alteration. Alterations may include ditching or tiling which is typical in agricultural settings. Also important are ground water pumping activities that can lower local ground water levels and drain wetlands (i.e. dewatering for quarries, underground construction, or utility construction; ground water pumping for residential, commercial or municipal water use). In metro areas, the natural wetland outlet elevation may be lowered by the construction of an outlet structure (i.e. weir, culvert, lowered overland outflow elevation). Development activities occasionally result in the diversion of drainage away from a wetland, which can change the natural hydrology. This information is not used in calculations.

70. **Indicate the potential restoration wetland classification** according to Circular 39 (USFWS, 1956): Type 1, 2, 3, 4, 5, 6, 7, or 8. (Informational purposes only.)

71. **The susceptibility of the wetland to degradation from stormwater input:** wetland type classification (Question #1, Community Type and Question #3, Vegetative Diversity/Integrity) will be utilized to determine the best fit to the following categories based on the most sensitive, dominant wetland community:

    Exceptional = Sedge meadows, open and coniferous bogs, calcareous fens, low prairies, wet to wet mesic prairies, coniferous swamps, lowland hardwood swamps, or seasonally flooded basins.

    A = Shrub-carrs, alder thickets, diverse fresh wet meadows dominated by native species, diverse shallow and deep marshes and diverse shallow, open water communities.

    B = Floodplain forests, fresh wet meadows dominated by reed canary grass, shallow and deep marshes dominated by cattail, reed canary grass, giant reed or purple loosestrife, and shallow, open water communities with moderate to low diversity.

    C = Gravel pits, cultivated hydric soils, or dredge/fill disposal sites.

    71. Guidance: Stormwater Sensitivity. Guidelines are taken from State of Minnesota, 1997, Section IV, Wetland Susceptibility.

72. **The sustainability of the wetland with regard to stormwater treatment prior to discharge into the wetland.** (This rating uses the calculated outcome from the Wetland Water Quality Protection Function (H, M, or L) and applies it as follows):

    A = No additional stormwater treatment needed.

    B = Additional stormwater nutrient removal needed.

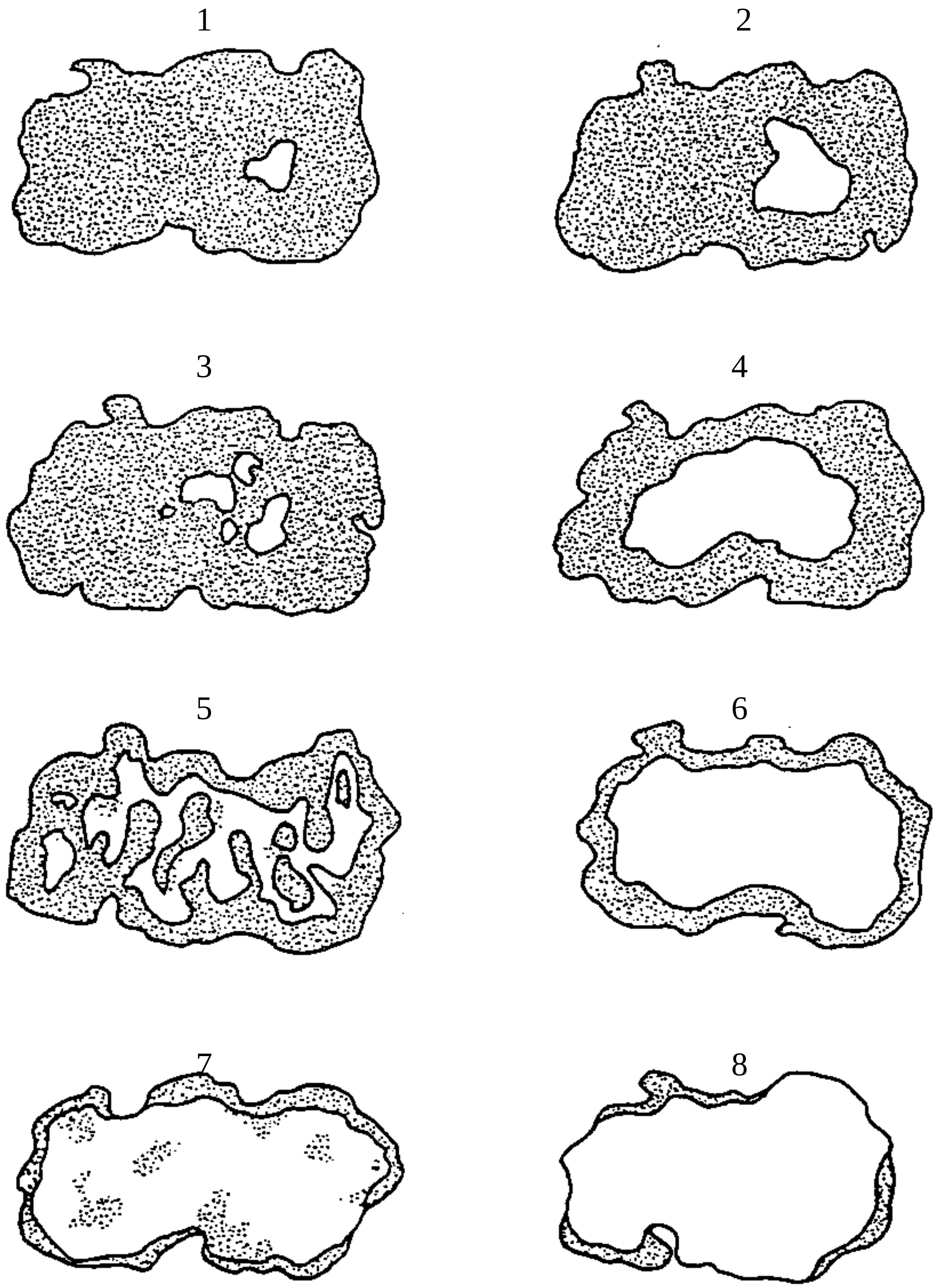
    C = Additional sedimentation and nutrient removal needed.

    72. Guidance: Nutrient Loading. Wetlands that receive untreated, directed stormwater containing sediment and nutrients will not be as sustainable as in a native landscape. Typically, wetlands receiving stormwater treated to approximately NURP standards will have a higher likelihood of sustainability. Wetlands receiving stormwater with just sediment removal will be subject to nutrient loading and excessive plant growth.

Appendix 1 – Figure 1

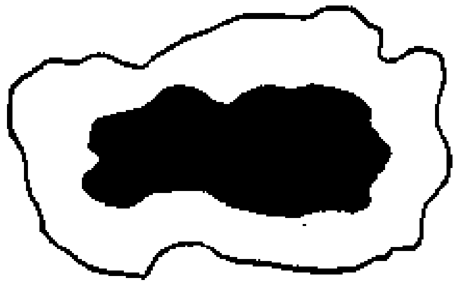
Open Water Types

White areas indicate open water (including floating and submerged plants). Stippled areas indicate emergents, shrubs, and trees.

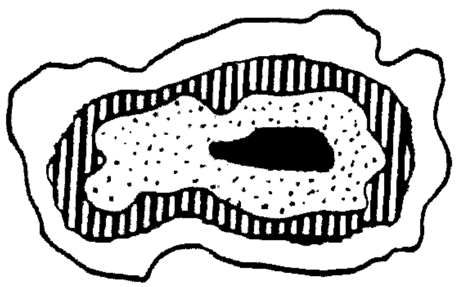


Source: Adapted from Golet, 1976

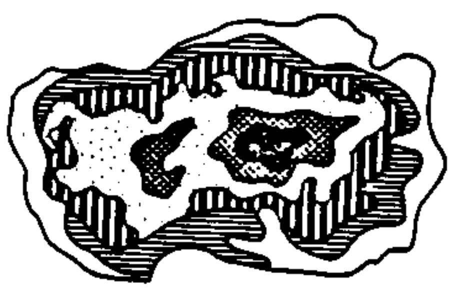
Appendix 2 – Figure 2



INTERSPERSION CATEGORY 1



INTERSPERSION CATEGORY 2



INTERSPERSION CATEGORY 3

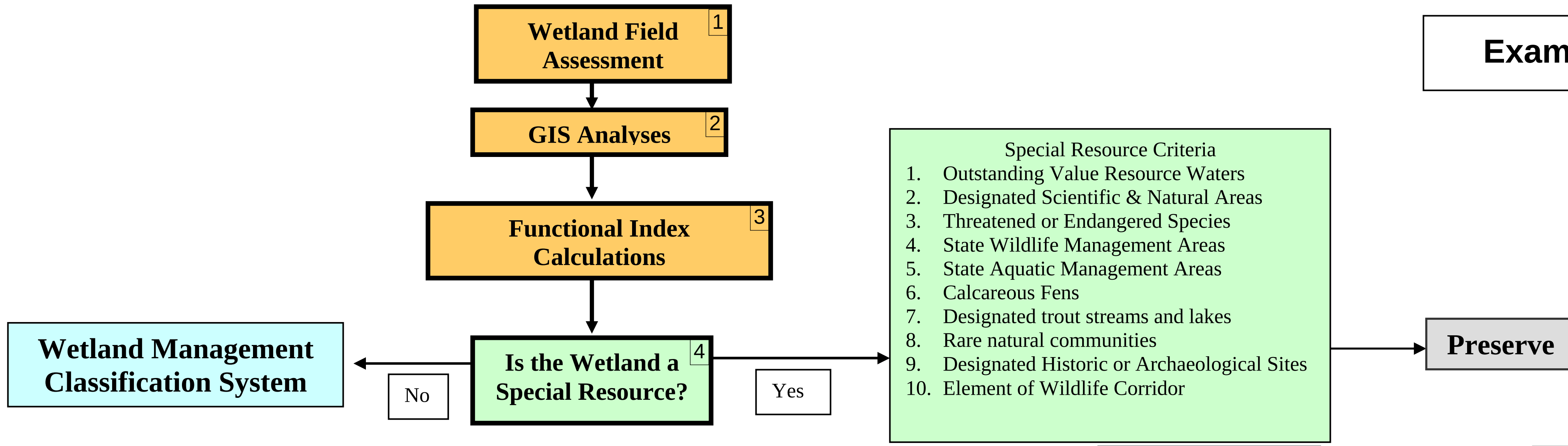
INTERSPERSION CATEGORIES OF VEGETATIVE TYPES ADAPTED FROM GOLET, 1976

The figures shown here are examples of complexity, not meant to be exact representations of any individual site. Choose one that most closely approximates the degree of interspersion at your site, regardless of structural differences.

Figure 1.1
Wetland Management Classification Process Flowchart for Basic Wetland Protection

Each wetland will be ranked into a Wetland Management group by the highest rated function for the wetland.
Follow the arrows through numbered boxes in progression through the tables; classify wetlands into the first group that applies.

Example 1.1: Basic Protection Standard



	Vegetative Diversity/ Integrity	Habitat Structure (Wildlife)	Amphibian Habitat	Fish Habitat	Shoreline Protection	Aesthetic/ Cultural.. & Habitat	Stormwater/ urban sensitivity[1] & Veg. Diversity	Wetland H_2O Quality & Vegetative Div.	Characteristic Hydrology & Veg. Diversity	Flood/ Stormwater Attenuation	Commercial Use	Downstream Water Qual. Sensitivity
PRESERVE	[5] Except'l	[6] Except'l	[7] High	[8] Except'l	[9] High	[10] Except'l & High	[11] Except'l & Medium	[12] High & High	[13] High & High	[14] *	[15] *	[16] *
MANAGE 1	[17] High	[18] High	[19] Medium	[20] High	[21] Medium	[22] High & Medium	[23] High & Medium	[24] High & Medium	[25] High & Medium	[26] *	[27] High	[28] *
MANAGE 2	[29] Medium	[30] Medium	[31] Low	[32] Medium[2]	[33] Low	[34] Medium & Low	[35] *	[36] *	[37] *	[38] *	[39] *	[40] *
MANAGE 3	[41] Low	[42] Low	[43] N/A	[44] Low	[45] N/A	[46] Low & Low	[47] * *	[48] Low & Low	[49] Low & Low	[50] High	[51] *	[52] High

[1] For types as shown in Table 1.2.

* This rating does not apply here.

Appendix B

MNRAM Full Summaries and Site Response Forms for Existing Conditions

Sochacki Park Subwatershed Assessment

Wetland Functional Assessment Summary

Wetland Name	Hydrogeomorphology	Maintenance of Hydrologic Regime	Flood/ Stormwater/ Attenuation	Downstream Water Quality	Maintenance of Wetland Water Quality	Shoreline Protection
North Rice Pond	Depressional/Flow-through (apparent inlet and outlet), Depressional/Flow-through (apparent inlet and outlet)	0.30	0.54	0.55	0.31	0.00
		Low	Moderate	Moderate	Low	Not Applicable

Wetland Name	Maintenance of Characteristic Wildlife Habitat Structure	Maintenance of Characteristic Fish Habitat	Maintenance of Characteristic Amphibian Habitat	Aesthetics/ Recreation/ Education/ Cultural	Commercial Uses	Ground-Water Interaction	Additional Information: Wetland Restoration Potential	Additional Information: Wetland Sensitivity to Stormwater and Urban Development	Additional Information: Additional Stormwater Treatment Needs
North Rice Pond	0.56	0.46	0.05	0.60	0.00	Exceptional Recharge	0.00	0.50	0.31
	Moderate	Moderate	Low	Moderate	Not Applicable		Not Applicable	Moderate	Low

Wetland Community Summary

		Vegetative Diversity/Integrity								
		Community								
Wetland Name	Location	Cowardin Classification	Circular 39	Plant Community	Wetland Proportion	Individual Community Rating	Highest Wetland Rating	Average Wetland Rating	Weighted Average Wetland Rating	
North Rice Pond	27-029-24-07-001	PAB2H	Type 5	Shallow, Open Water Communities	40	0.5	0.50	0.23	0.26	
							Moderate	Low	Low	
		PEM1C	Type 3	Shallow Marsh	40	0.1	0.50	0.23	0.26	
							Moderate	Low	Low	
		PSS1C	Type 6	Shrub Carr	20	0.1	0.50	0.23	0.26	
							Moderate	Low	Low	
					100		0.50	0.23	0.26	☐

☑ *Denotes incomplete calculation data.*

MnRAM: Site Response Record

For Wetland: North Rice Pond

Location: 27-029-24-07-001

Sochacki Park

Plant Community: Shallow, Open Water C

Cowardin Classification: PAB2H — Circular 39: Type 5

Plant Community: Shallow Marsh

Cowardin Classification: PEM1C — Circular 39: Type 3

Plant Community: Shrub Carr

Cowardin Classification: PSS1C — Circular 39: Type 6

4	*Listed, rare, special species?*	No
5	*Rare community or habitat?*	No
6	*Pre-European-settlement condition?*	No

Hydrogeomorphology / topography:

7		Depressional/FlowThru
8-1	*Maximum water depth*	62 inche
8-2	*% inundated*	80%
9	*Immediate drainage--local WS*	63 acres
10	*Esimated size/existing site:*	*(see #66)*
11-Upland Soil		Urban land Dundas complex
11-Wetland Soil		Houghton and Muskego

12	*Outlet for flood control*	B
13	*Outlet for hydro regime*	B
14	*Dominant upland land use*	C
15	*Wetland soil condition*	C
16	*Vegetation (% cover)*	80%
17	*Emerg. veg flood resistance*	B
18	*Sediment delivery*	B
19	*Upland soils (soil group)*	B
20	*Stormwater runoff*	B
21	*Subwatershed wetland density*	B
22	*Channels/sheet flow*	B
23	*Adjacent buffer width*	50 feet

Adjacent area management

24-A	*Full*	60%
24-B	*Manicured*	0%
24-C	*Bare*	40%

Adjacent area diversity/structure

25-A	*Native*	0%
25-B	*Mixed*	60%
25-C	*Sparse*	40%

Adjacent area slope

26-A	*Gentle*	0%
26-B	*Moderate*	50%
26-C	*Steep*	50%

27	*Downstream sens./WQ protect.*	A
28	*Nutrient loading*	C
29	*Shoreline wetland?*	No

Shoreline Wetland

30	*Rooted veg., % cover*	0%
31	*Wetland in-water width*	0 feet
32	*Emerg. veg. erosion resistance*	
33	*Erosion potential of site*	
34	*Upslope veg./bank protection*	
35	*Rare wildlife?*	No
36	*Scare/Rare/S1/S2 community*	No
37	*Vegetative cover*	A
38	*Veg. community interspersion*	A
39	*Wetland detritus*	NA
40	*Interspersion on landscape*	B
41	*Wildlife barriers*	B

Amphibian-breeding potential

42	*Hydroperiod adequacy*	Adequate
43	*Fish presence*	C
44	*Overwintering habitat*	A
45	*Wildlife species (list)*	
46	*Fish habitat quality*	B
47	*Fish species (list)*	
48	*Unique/rare opportunity*	No
49	*Wetland visibility*	A
50	*Proximity to population*	Yes
51	*Public ownership*	A
52	*Public access*	A
53	*Human influence on wetland*	C
54	*Human influence on viewshed*	C
55	*Spatial buffer*	A
56	*Recreational activity potential*	B
57	*Commercial crop--hydro impact*	NA

Groundwater-specific questions

58	*Wetland soils*	Discharge
59	*Subwatershed land use*	Recharge
60	*Wetland size/soil group*	Recharge
61	*Wetland hydroperiod*	Discharge
62	*Inlet/Outlet configuration*	Discharge
63	*Upland topo relief*	Discharge

Additional information

64	*Restoration potential*	No
65	*LO affected by restoration*	
66	*Existing size*	7.3
	Restorable size	0
	Potential new wetland	0
67	*Average width of pot. buffer*	0 feet
68	*Ease of potential restoration*	
69	*Hydrologic alterations*	0
70	*Potential wetland type*	0
71	*Stormwater sensitivity*	
72	*Additional treatment needs*	

Watershed: Mississippi (Metro)

WS# 20 — Service Area: 7

For functional ratings, please run the Summary tab report.

This report printed on: 5/3/2022

Wetland Functional Assessment Summary

Wetland Name	Hydrogeomorphology	Maintenance of Hydrologic Regime	Flood/ Stormwater/ Attenuation	Downstream Water Quality	Maintenance of Wetland Water Quality	Shoreline Protection
South Rice Pond	Depressional/Flow-through (apparent inlet and outlet), Depressional/Flow-through (apparent inlet and outlet), Floodplain (outside waterbody banks)	0.40	0.60	0.57	0.32	0.00
		Moderate	Moderate	Moderate	Low	Not Applicable

Wetland Name	Maintenance of Characteristic Wildlife Habitat Structure	Maintenance of Characteristic Fish Habitat	Maintenance of Characteristic Amphibian Habitat	Aesthetics/ Recreation/ Education/ Cultural	Commercial Uses	Ground-Water Interaction	Additional Information: Wetland Restoration Potential	Additional Information: Wetland Sensitivity to Stormwater and Urban Development	Additional Information: Additional Stormwater Treatment Needs
South Rice Pond	0.46	0.66	0.04	0.60	0.00	Exceptional Recharge	0.00	0.50	0.32
	Moderate	Moderate	Low	Moderate	Not Applicable		Not Applicable	Moderate	Low

Wetland Community Summary

Wetland Name	Location	Vegetative Diversity/Integrity: Community: Cowardin Classification	Circular 39	Plant Community	Wetland Proportion	Individual Community Rating	Highest Wetland Rating	Average Wetland Rating	Weighted Average Wetland Rating
South Rice Pond	27-029-24-07-002	PAB2H	Type 5	Shallow, Open Water Communities	40	0.5	0.50	0.23	0.26
							Moderate	Low	Low
		PEM1C	Type 3	Shallow Marsh	40	0.1	0.50	0.23	0.26
							Moderate	Low	Low
		PFO1A	Type 1	Floodplain Forest	20	0.1	0.50	0.23	0.26
							Moderate	Low	Low
					100		0.50	0.23	0.26

☑ *Denotes incomplete calculation data.*

MnRAM: Site Response Record

For Wetland: South Rice Pond

Location: 27-029-24-07-002

Sochacki Park

Plant Community: Shallow, Open Water C

Cowardin Classification: PAB2H — Circular 39: Type 5

Plant Community: Shallow Marsh

Cowardin Classification: PEM1C — Circular 39: Type 3

Plant Community: Floodplain Forest

Cowardin Classification: PFO1A — Circular 39: Type 1

4	*Listed, rare, special species?*	No
5	*Rare community or habitat?*	No
6	*Pre-European-settlement condition?*	No

Hydrogeomorphology / topography:

7 Depressional/FlowThru, Floodplain

8-1	*Maximum water depth*	53 inche
8-2	*% inundated*	70%
9	*Immediate drainage--local WS*	63 acres
10	*Esimated size/existing site:*	*(see #66)*

11-Upland Soil Urban land Dundas complex

11-Wetland Soil Houghton and Muskego

12	*Outlet for flood control*	NA
13	*Outlet for hydro regime*	B
14	*Dominant upland land use*	C
15	*Wetland soil condition*	B
16	*Vegetation (% cover)*	80%
17	*Emerg. veg flood resistance*	B
18	*Sediment delivery*	B
19	*Upland soils (soil group)*	B
20	*Stormwater runoff*	B
21	*Subwatershed wetland density*	B
22	*Channels/sheet flow*	B
23	*Adjacent buffer width*	50 feet

Adjacent area management

24-A	*Full*	80%
24-B	*Manicured*	10%
24-C	*Bare*	10%

Adjacent area diversity/structure

25-A	*Native*	10%
25-B	*Mixed*	80%
25-C	*Sparse*	10%

Adjacent area slope

26-A	*Gentle*	0%
26-B	*Moderate*	50%
26-C	*Steep*	50%

27	*Downstream sens./WQ protect.*	A
28	*Nutrient loading*	C
29	*Shoreline wetland?*	No

Shoreline Wetland

30	*Rooted veg., % cover*	0%
31	*Wetland in-water width*	0 feet
32	*Emerg. veg. erosion resistance*	A
33	*Erosion potential of site*	C
34	*Upslope veg./bank protection*	B
35	*Rare wildlife?*	No
36	*Scare/Rare/S1/S2 community*	No
37	*Vegetative cover*	B
38	*Veg. community interspersion*	B
39	*Wetland detritus*	NA
40	*Interspersion on landscape*	B
41	*Wildlife barriers*	B

Amphibian-breeding potential

42	*Hydroperiod adequacy*	Adequate
43	*Fish presence*	C
44	*Overwintering habitat*	B
45	*Wildlife species (list)*	
46	*Fish habitat quality*	A
47	*Fish species (list)*	
48	*Unique/rare opportunity*	No
49	*Wetland visibility*	A
50	*Proximity to population*	Yes
51	*Public ownership*	A
52	*Public access*	A
53	*Human influence on wetland*	C
54	*Human influence on viewshed*	C
55	*Spatial buffer*	A
56	*Recreational activity potential*	B
57	*Commercial crop--hydro impact*	NA

Groundwater-specific questions

58	*Wetland soils*	Discharge
59	*Subwatershed land use*	Recharge
60	*Wetland size/soil group*	Recharge
61	*Wetland hydroperiod*	Discharge
62	*Inlet/Outlet configuration*	Discharge
63	*Upland topo relief*	Discharge

Additional information

64	*Restoration potential*	No
65	*LO affected by restoration*	
66	*Existing size*	17.33
	Restorable size	0
	Potential new wetland	0
67	*Average width of pot. buffer*	0 feet
68	*Ease of potential restoration*	
69	*Hydrologic alterations*	0
70	*Potential wetland type*	0
71	*Stormwater sensitivity*	
72	*Additional treatment needs*	

Watershed Mississippi (Metro)

WS# 20 Service Area: 7

For functional ratings, please run the Summary tab report.

This report printed on: 5/3/2022

Appendix C

MNRAM Full Summaries and Site Response Forms for Proposed Conditions

Sochacki Park Subwatershed Assessment

Wetland Functional Assessment Summary

Wetland Name	Hydrogeomorphology	Maintenance of Hydrologic Regime	Flood/ Stormwater/ Attenuation	Downstream Water Quality	Maintenance of Wetland Water Quality	Shoreline Protection
North Rice Pond proposed im	Depressional/Flow-through (apparent inlet and outlet), Depressional/Flow-through (apparent inlet and outlet)	0.52	0.54	0.50	0.58	0.00
		Moderate	Moderate	Moderate	Moderate	Not Applicable

Wetland Name	Maintenance of Characteristic Wildlife Habitat Structure	Maintenance of Characteristic Fish Habitat	Maintenance of Characteristic Amphibian Habitat	Aesthetics/ Recreation/ Education/ Cultural	Commercial Uses	Ground-Water Interaction	Additional Information: Wetland Restoration Potential	Additional Information: Wetland Sensitivity to Stormwater and Urban Development	Additional Information: Additional Stormwater Treatment Needs
North Rice Pond propos	0.72	0.64	0.06	0.76	0.00	Exceptional Recharge	0.00	1.00	0.58
	High	Moderate	Low	High	Not Applicable		Not Applicable	High	Moderate

Wetland Community Summary

Wetland Name	Location	Vegetative Diversity/Integrity: Community: Cowardin Classification	Circular 39	Plant Community	Wetland Proportion	Individual Community Rating	Highest Wetland Rating	Average Wetland Rating	Weighted Average Wetland Rating
North Rice Pond proposed im	27-029-24-07-001	PAB2H	Type 5	Shallow, Open Water Communities	40	1	1.00	0.67	0.70
							High	High	High
		PEM1C	Type 3	Shallow Marsh	40	0.5	1.00	0.67	0.70
							High	High	High
		PSS1C	Type 6	Shrub Carr	20	0.5	1.00	0.67	0.70
							High	High	High
					100		1.00	0.67	0.70

☑ *Denotes incomplete calculation data.*

MnRAM: Site Response Record

For Wetland: North Rice Pond proposed

Location: 27-029-24-07-001

Sochacki Park

Plant Community: Shallow, Open Water C
Cowardin Classification: PAB2H — Circular 39: Type 5

Plant Community: Shallow Marsh
Cowardin Classification: PEM1C — Circular 39: Type 3

Plant Community: Shrub Carr
Cowardin Classification: PSS1C — Circular 39: Type 6

4	Listed, rare, special species?	No
5	Rare community or habitat?	No
6	Pre-European-settlement condition?	No

Hydrogeomorphology / topography:

7		Depressional/FlowThru
8-1	Maximum water depth	62 inche
8-2	% inundated	80%
9	Immediate drainage--local WS	63 acres
10	Esimated size/existing site:	(see #66)
11-Upland Soil		Urban land Dundas complex
11-Wetland Soil		Houghton and Muskego

12	Outlet for flood control	B
13	Outlet for hydro regime	B
14	Dominant upland land use	C
15	Wetland soil condition	B
16	Vegetation (% cover)	80%
17	Emerg. veg flood resistance	B
18	Sediment delivery	B
19	Upland soils (soil group)	B
20	Stormwater runoff	C
21	Subwatershed wetland density	B
22	Channels/sheet flow	B
23	Adjacent buffer width	50 feet

Adjacent area management

24-A	Full	80%
24-B	Manicured	0%
24-C	Bare	20%

Adjacent area diversity/structure

25-A	Native	0%
25-B	Mixed	80%
25-C	Sparse	20%

Adjacent area slope

26-A	Gentle	0%
26-B	Moderate	50%
26-C	Steep	50%

27	Downstream sens./WQ protect.	A
28	Nutrient loading	B
29	Shoreline wetland?	No

Shoreline Wetland

30	Rooted veg., % cover	0%
31	Wetland in-water width	0 feet
32	Emerg. veg. erosion resistance	
33	Erosion potential of site	
34	Upslope veg./bank protection	
35	Rare wildlife?	No
36	Scare/Rare/S1/S2 community	No
37	Vegetative cover	A
38	Veg. community interspersion	A
39	Wetland detritus	NA
40	Interspersion on landscape	B
41	Wildlife barriers	B

Amphibian-breeding potential

42	Hydroperiod adequacy	Adequate
43	Fish presence	C
44	Overwintering habitat	A
45	Wildlife species (list)	
46	Fish habitat quality	B
47	Fish species (list)	
48	Unique/rare opportunity	No
49	Wetland visibility	A
50	Proximity to population	Yes
51	Public ownership	A
52	Public access	A
53	Human influence on wetland	B
54	Human influence on viewshed	C
55	Spatial buffer	A
56	Recreational activity potential	B
57	Commercial crop--hydro impact	NA

Groundwater-specific questions

58	Wetland soils	Discharge
59	Subwatershed land use	Recharge
60	Wetland size/soil group	Recharge
61	Wetland hydroperiod	Discharge
62	Inlet/Outlet configuration	Discharge
63	Upland topo relief	Discharge

Additional information

64	Restoration potential	No
65	LO affected by restoration	
66	Existing size	7.3
	Restorable size	0
	Potential new wetland	0
67	Average width of pot. buffer	0 feet
68	Ease of potential restoration	
69	Hydrologic alterations	0
70	Potential wetland type	0
71	Stormwater sensitivity	
72	Additional treatment needs	

Watershed Mississippi (Metro)

WS# 20 Service Area: 7

For functional ratings, please run the Summary tab report.

This report printed on: 5/3/2022

Wetland Functional Assessment Summary

Wetland Name	Hydrogeomorphology	Maintenance of Hydrologic Regime	Flood/ Stormwater/ Attenuation	Downstream Water Quality	Maintenance of Wetland Water Quality	Shoreline Protection
South Rice Pond proposed im	Depressional/Flow-through (apparent inlet and outlet), Depressional/Flow-through (apparent inlet and outlet), Floodplain (outside waterbody banks)	0.52	0.62	0.59	0.65	0.00
		Moderate	Moderate	Moderate	Moderate	Not Applicable

Wetland Name	Maintenance of Characteristic Wildlife Habitat Structure	Maintenance of Characteristic Fish Habitat	Maintenance of Characteristic Amphibian Habitat	Aesthetics/ Recreation/ Education/ Cultural	Commercial Uses	Ground-Water Interaction	Additional Information: Wetland Restoration Potential	Additional Information: Wetland Sensitivity to Stormwater and Urban Development	Additional Information: Additional Stormwater Treatment Needs
South Rice Pond propo	0.62	0.91	0.05	0.76	0.00	Exceptional Recharge	0.00	1.00	0.65
	Moderate	High	Low	High	Not Applicable		Not Applicable	High	Moderate

Wetland Community Summary

Wetland Name	Location	Vegetative Diversity/Integrity — Community: Cowardin Classification	Circular 39	Plant Community	Wetland Proportion	Individual Community Rating	Highest Wetland Rating	Average Wetland Rating	Weighted Average Wetland Rating
South Rice Pond proposed i	27-029-24-07-002	PAB2H	Type 5	Shallow, Open Water Communities	40	1	1.00	0.67	0.70
							High	High	High
		PEM1C	Type 3	Shallow Marsh	40	0.5	1.00	0.67	0.70
							High	High	High
		PFO1A	Type 1	Floodplain Forest	20	0.5	1.00	0.67	0.70
							High	High	High
					100		1.00	0.67	0.70

☐

☑ *Denotes incomplete calculation data.*

MnRAM: Site Response Record

For Wetland: South Rice Pond proposed

Location: 27-029-24-07-002

Sochacki Park

Plant Community: Shallow, Open Water C
Cowardin Classification: PAB2H — Circular 39: Type 5

Plant Community: Shallow Marsh
Cowardin Classification: PEM1C — Circular 39: Type 3

Plant Community: Floodplain Forest
Cowardin Classification: PFO1A — Circular 39: Type 1

4	*Listed, rare, special species?*	No
5	*Rare community or habitat?*	No
6	*Pre-European-settlement condition?*	No

Hydrogeomorphology / topography:

7 Depressional/FlowThru, Floodplain

8-1	*Maximum water depth*	53 inche
8-2	*% inundated*	70%
9	*Immediate drainage--local WS*	63 acres
10	*Esimated size/existing site:*	*(see #66)*
11-Upland Soil		Urban land Dundas complex
11-Wetland Soil		Houghton and Muskego
12	*Outlet for flood control*	NA
13	*Outlet for hydro regime*	B
14	*Dominant upland land use*	C
15	*Wetland soil condition*	B
16	*Vegetation (% cover)*	80%
17	*Emerg. veg flood resistance*	B
18	*Sediment delivery*	A
19	*Upland soils (soil group)*	B
20	*Stormwater runoff*	C
21	*Subwatershed wetland density*	B
22	*Channels/sheet flow*	B
23	*Adjacent buffer width*	50 feet

Adjacent area management

24-A	*Full*	90%
24-B	*Manicured*	10%
24-C	*Bare*	0%

Adjacent area diversity/structure

25-A	*Native*	20%
25-B	*Mixed*	80%
25-C	*Sparse*	0%

Adjacent area slope

26-A	*Gentle*	0%
26-B	*Moderate*	50%
26-C	*Steep*	50%
27	*Downstream sens./WQ protect.*	A
28	*Nutrient loading*	B
29	*Shoreline wetland?*	No

Shoreline Wetland

30	*Rooted veg., % cover*	0%
31	*Wetland in-water width*	0 feet
32	*Emerg. veg. erosion resistance*	A
33	*Erosion potential of site*	C
34	*Upslope veg./bank protection*	C
35	*Rare wildlife?*	No
36	*Scare/Rare/S1/S2 community*	No
37	*Vegetative cover*	B
38	*Veg. community interspersion*	B
39	*Wetland detritus*	NA
40	*Interspersion on landscape*	B
41	*Wildlife barriers*	B

Amphibian-breeding potential

42	*Hydroperiod adequacy*	Adequate
43	*Fish presence*	C
44	*Overwintering habitat*	B
45	*Wildlife species (list)*	
46	*Fish habitat quality*	A
47	*Fish species (list)*	
48	*Unique/rare opportunity*	No
49	*Wetland visibility*	A
50	*Proximity to population*	Yes
51	*Public ownership*	A
52	*Public access*	A
53	*Human influence on wetland*	B
54	*Human influence on viewshed*	C
55	*Spatial buffer*	A
56	*Recreational activity potential*	B
57	*Commercial crop--hydro impact*	NA

Groundwater-specific questions

58	*Wetland soils*	Discharge
59	*Subwatershed land use*	Recharge
60	*Wetland size/soil group*	Recharge
61	*Wetland hydroperiod*	Discharge
62	*Inlet/Outlet configuration*	Discharge
63	*Upland topo relief*	Discharge

Additional information

64	*Restoration potential*	No
65	*LO affected by restoration*	
66	*Existing size*	17.33
	Restorable size	0
	Potential new wetland	0
67	*Average width of pot. buffer*	0 feet
68	*Ease of potential restoration*	
69	*Hydrologic alterations*	0
70	*Potential wetland type*	0
71	*Stormwater sensitivity*	
72	*Additional treatment needs*	

Watershed Mississippi (Metro)

WS# 20 Service Area: 7

For functional ratings, please run the Summary tab report.

This report printed on: 5/3/2022

Appendix D

Detailed Cost Estimates for Improvement Options

Sochacki Park Subwatershed Assessment

SOCHACKI PARK SUBWATERSHED ASSESSMENT
Three Rivers Park District
Robbinsdale, Minnesota

EXPAND AND DREDGE EXISTING STORMWATER POND

PRELIMINARY ENGINEERS OPINION OF COST 9/11/2022

LOCATION: Basin J, South Rice Pond

ITEM DESCRIPTION	UNIT	AMOUNT	UNIT COST	TOTAL COST
MOBLIZATION	EACH	1	25000.00	25000.00
CONSTRUCTION ENTRANCE	EACH	1	2000.00	2000.00
SILT FENCE	LN FT	720	4.00	2880.00
SILTATION LOG	LN FT	360	5.00	1800.00
EROSION CONTROL BLANKET	SQ YD	4800	4.00	19200.00
CLEAR AND GRUBBING	AC	1	10000.00	10000.00
POND EXCAVATION AND PLACEMENT	CU YD	3170	30.00	95100.00
OUTLET STREAM CHANNEL STABILIZATION	LN FT	140	400.00	56000.00
SITE RESTORATION	AC	1	5500.00	5500.00
			SUB TOTAL =	$ 217,480.00
ENGINEERING AND DESIGN 15%				$ 32,622.00
CONSTRUCTION MANAGEMENT 15%				$ 32,622.00
LEGAL 5%				$ 10,874.00
PERMITTING 5%				$ 10,874.00
			TOTAL =	$ 304,472.00

PROBABLE RANGE -20% to +40% ($244,000) to ($426,000)

DOES NOT INCLUDE EASEMENTS OR WETLAND MITIGATION

SOCHACKI PARK SUBWATERSHED ASSESSMENT
Three Rivers Park District
Robbinsdale, Minnesota

STORMWATER POND
PRELIMINARY ENGINEERS OPINION OF COST 9/11/2022
LOCATION: GR-6, Grimes Pond

ITEM DESCRIPTION	UNIT	AMOUNT	UNIT COST	TOTAL COST
MOBLIZATION	EACH	1	35000.00	35000.00
CONSTRUCTION ENTRANCE	EACH	1	2000.00	2000.00
SILT FENCE	LN FT	1000	4.00	4000.00
SILTATION LOG	LN FT	500	5.00	2500.00
EROSION CONTROL BLANKET	SQ YD	1500	4.00	6000.00
CLEAR AND GRUBBING	AC	1	10000.00	10000.00
TREE REMOVAL	EACH	10	350.00	3500.00
POND EXCAVATION AND PLACEMENT	CU YD	8000	30.00	240000.00
REMOVE BITUMINOUS PAVEMENT	SQ YD	45	11.00	495.00
24" RCP OUTLET	LN FT	75	90.00	6750.00
24" RCP FLARED END SECTION	EACH	1	1000.00	1000.00
RIPRAP CLASS 2	TON	10	74.00	740.00
FLOW CONTROL WEIR AND PIPING	LS	1	5000.00	5000.00
CLASS 5 AGGREGATE BASE	CU YD	23	35.00	805.00
REPLACE BITUMINOUS PAVEMENT	SQ YD	45	120.00	5400.00
SITE RESTORATION	AC	0.5	5500.00	2750.00
			SUB TOTAL =	$ 325,940.00
ENGINEERING AND DESIGN 15%				$ 48,891.00
CONSTRUCTION MANAGEMENT 15%				$ 48,891.00
LEGAL 5%				$ 16,297.00
PERMITTING 5%				$ 16,297.00
			TOTAL =	$ 456,316.00

PROBABLE RANGE -20% to +40% ($365,000) to ($639,000)

DOES NOT INCLUDE EASEMENTS OR WETLAND MITIGATION

SOCHACKI PARK SUBWATERSHED ASSESSMENT
Three Rivers Park District
Robbinsdale, Minnesota

STORMWATER POND
PRELIMINARY ENGINEERS OPINION OF COST 9/11/2022
LOCATION: NR-1, North Rice Pond

ITEM DESCRIPTION	UNIT	AMOUNT	UNIT COST	TOTAL COST
MOBLIZATION	EACH	1	15000.00	15000.00
CONSTRUCTION ENTRANCE	EACH	1	2000.00	2000.00
SILT FENCE	LN FT	400	4.00	1600.00
SILTATION LOG	LN FT	200	5.00	1000.00
EROSION CONTROL BLANKET	SQ YD	600	4.00	2400.00
CLEAR AND GRUBBING	AC	0.5	10000.00	5000.00
TREE REMOVAL	EACH	20	350.00	7000.00
POND EXCAVATION AND PLACEMENT	CU YD	3200	30.00	96000.00
12" RCP OUTLET	LN FT	35	65.00	2275.00
12" RCP FLARED END SECTION	EACH	1	1000.00	1000.00
RIPRAP CLASS 2	TON	8	74.00	592.00
SITE RESTORATION	AC	0.5	5500.00	2750.00
			SUB TOTAL =	$ 136,617.00
ENGINEERING AND DESIGN 15%				$ 20,492.55
CONSTRUCTION MANAGEMENT 15%				$ 20,492.55
LEGAL 5%				$ 6,830.85
PERMITTING 5%				$ 6,830.85
			TOTAL =	$ 191,263.80

PROBABLE RANGE -20% to +40% ($153,000) to ($268,000)

DOES NOT INCLUDE EASEMENTS OR WETLAND MITIGATION

SOCHACKI PARK SUBWATERSHED ASSESSMENT
Three Rivers Park District
Robbinsdale, Minnesota

STORMWATER POND
PRELIMINARY ENGINEERS OPINION OF COST 9/11/2022
LOCATION: SR-3, South Rice Pond

ITEM DESCRIPTION	UNIT	AMOUNT	UNIT COST	TOTAL COST
MOBLIZATION	EACH	1	20000.00	20000.00
CONSTRUCTION ENTRANCE	EACH	1	2000.00	2000.00
SILT FENCE	LN FT	500	4.00	2000.00
SILTATION LOG	LN FT	300	5.00	1500.00
EROSION CONTROL BLANKET	SQ YD	800	4.00	3200.00
CLEAR AND GRUBBING	AC	0.7	10000.00	7000.00
TREE REMOVAL	EACH	10	350.00	3500.00
POND EXCAVATION AND PLACEMENT	CU YD	4650	30.00	139500.00
12" RCP OUTLET	LN FT	35	65.00	2275.00
12" RCP FLARED END SECTION	EACH	1	1000.00	1000.00
RIPRAP CLASS 2	TON	8	74.00	592.00
SITE RESTORATION	AC	0.7	5500.00	3850.00
			SUB TOTAL =	$ 186,417.00
ENGINEERING AND DESIGN 15%				$ 27,962.55
CONSTRUCTION MANAGEMENT 15%				$ 27,962.55
LEGAL 5%				$ 9,320.85
PERMITTING 5%				$ 9,320.85
			TOTAL =	$ 260,983.80

PROBABLE RANGE -20% to +40% ($209,000) to ($365,000)

DOES NOT INCLUDE EASEMENTS OR WETLAND MITIGATION

SOCHACKI PARK SUBWATERSHED ASSESSMENT
Three Rivers Park District
Robbinsdale, Minnesota

ALUM TREATMENT OF NORTH RICE, SOUTH RICE AND GRIMES PONDS
PRELIMINARY ENGINEERS OPINION OF COST 9/11/2022
LOCATION: Grimes, North and South Rice Ponds

ITEM DESCRIPTION	UNIT	AMOUNT	UNIT COST		TOTAL COST
MOBLIZATION	EACH	1	15000.00		15000.00
ALUM TREATMENT	AC	13	10000.00		130000.00
			SUB TOTAL =	$	145,000.00
ENGINEERING AND DESIGN 15%				$	21,750.00
CONSTRUCTION MANAGEMENT 15%				$	21,750.00
LEGAL 5%				$	7,250.00
PERMITTING 5%				$	7,250.00
			TOTAL =	$	203,000.00

PROBABLE RANGE -20% to +40% ($162,000) to ($284,000)

DOES NOT INCLUDE EASEMENTS OR WETLAND MITIGATION

SOCHACKI PARK SUBWATERSHED ASSESSMENT
Three Rivers Park District
Robbinsdale, Minnesota

DRAWDOWN OF NORTH RICE, SOUTH RICE AND GRIMES PONDS

PRELIMINARY ENGINEERS OPINION OF COST 9/11/2022

LOCATION: Grimes, North and South Rice Ponds

ITEM DESCRIPTION	UNIT	AMOUNT	UNIT COST	TOTAL COST
MOBLIZATION	EACH	1	10000.00	10000.00
TEMPORARY PUMPING	LS	1	100000.00	100000.00
			SUB TOTAL =	$ 110,000.00
ENGINEERING AND DESIGN 15%				$ 16,500.00
CONSTRUCTION MANAGEMENT 15%				$ 16,500.00
LEGAL 5%				$ 5,500.00
PERMITTING 5%				$ 5,500.00
			TOTAL =	$ 154,000.00

PROBABLE RANGE -20% to +40% ($123,000) to ($216,000)

DOES NOT INCLUDE EASEMENTS OR WETLAND MITIGATION