MISSISSIPPI MAKEOVER

A Plan for Restoration in

Spring Lake (Pool 2), Mississippi River – Pool 3 & The Lower Vermillion River

- ✓ An Implementation Plan for the Lower Vermillion River Turbidity Total Maximum Daily Load (TMDL)
- ✓ A Scoping Plan for Implementation in Spring Lake, Pool 2 and Pool 3 of the South Metro Mississippi River TSS TMDL

June 2011

Prepared for the Minnesota Pollution Control Agency
by
Dakota County and the Dakota County Soil and Water Conservation District

Mississippi Makeover Implementation Plan

June 2011

Dakota County Soil and Water Conservation District

Dakota County

Contents

1.0 Executive Summary

This document serves as the Implementation Plan for the Lower Vermillion River Turbidity Total Maximum Daily Load Study (TMDL) and as a scoping document for implementation in a portion of the South Metro Mississippi Total Suspended Solids TMDL. It is the result of the first phase of the Mississippi Makeover Project which had the objective of engaging local stakeholders in the development of restoration plans for Spring Lake (in Mississippi River Pool 2), Mississippi River Pool 3, and the Lower Vermillion River (LVR). This Project was funded by a Federal 319 non-point source grant from the Minnesota Pollution Control Agency (MPCA) to Dakota County with project management from the Dakota County Soil and Water Conservation District (DSWCD) and assistance from the Minnesota Department of Natural Resources (MDNR) and the MPCA.

The waterbodies in the Project Area (Spring Lake, Pool 3, LVR) are each impaired for turbidity, are physically similar, and in close proximity to the other – beginning just upstream from Hastings and extending downstream to Red Wing (Figure 1). Due to the similar nature of the impairments and needs in these areas, and the need for public involvement in a variety of projects, the Mississippi Makeover Project attempted to combine the efforts of multiple agencies into one civic engagement and planning project.

Learn More: What is a TMDL?

A TMDL (total maximum daily load) is like a pollution diet for a waterbody. It's a calculation of the maximum amount of a pollutant that a waterbody can receive and still meet water quality standards. First, the sources of the pollution are determined through data collection and modeling. Then, the TMDL allocates (assigns) a certain amount of pollution (or a "load" amount) that can come from each pollution source in the future. Sources that are currently above their load amount must decrease their pollutant output by a calculated percentage. Pollutant sources are characterized as either point sources like wastewater treatment plants and urban stormwater systems, or nonpoint sources like farm fields and streambanks.

The specific TMDL projects are summarized in Sections 3 and 4.

In 2008, a Citizen Advisory Group (CAG) was convened to assist with restoration planning in the Project Area. The CAG consisted of local residents, elected officials, and various stakeholder groups. Members from federal and state agencies were also involved to inform the process on a technical level. CAG members were invited to be involved due to their knowledge, use, and history with the resources in the Project Area. They were charged with envisioning successful ecological restoration in the area and listing what indicated restoration for them. Their list of indicators included water clarity, sedimentation rates, fish assemblage, waterfowl numbers, mussels, and aquatic vegetation. A group of technical experts then developed a list of metrics or ways of measuring each indicator and suggested numeric targets for each. A table of indicators, metrics, and quantifiable targets was approved by the CAG in August 2009 (see Table 1).

While much of the sediment pollution in the Project Area comes from upstream sources, the CAG and technical experts considered *local* restoration and sediment-reducing projects and programs. These local projects must work in concert with sediment reductions from upstream if ecological restoration is to be successful. Section 5 of this document lists in-river management techniques and land use-based programs, as well as recreation and education opportunities that will make progress towards meeting the restoration targets.

1.1 Acknowledgements

The Mississippi Makeover Project and this document are the result of much time, vision, learning, and work on the part of many individuals and with the support of the organizations they represent. It was funded by a Federal 319 non-point source grant from the Minnesota Pollution Control Agency with Project Managers, Norman Senjem and Jennifer Ender. Other primary coordinating members of the project include Tim Schlagenhaft (MDNR), and Jeff Luehrs (Dakota County). Additional support, including much time spent preparing and giving presentations at meetings and developing or reviewing additional material came from Scot Johnson (MDNR), Jon Hendrickson (ACOE), and Jeff Janvrin (WDNR).

This project was based on the vision of restoration developed by group of citizens and stakeholders (the Citizen Advisory Group or CAG), with important technical information from a group of dedicated technical experts. We thank both groups for their insight, input, expertise and time!

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Thank you for sharing your knowledge, insight and expertise!

-Laura Jester, Dakota County SWCD
Mississippi Makeover Project Coordinator

1.2 List of Acronyms

ACOE	Army Corps of Engineers
AMA	Aquatic Management Area (under MDNR jurisdiction) (see Section 5)
BMP	Best Management Practice
BWSR	Board of Water and Soil Resources
CAG	Citizen Advisory Group (for Mississippi Makeover Project)
CURE	Clean Up our River Environment (organization)
EMP	Environmental Management Program (of ACOE) (see Section 5)
EPA	U.S. Environmental Protection Agency
FMR	Friends of the Mississippi River
LA	Load Allocation (within TMDL equation) (see Sections 3 and 4)
LMRHCP	Lower Mississippi River Habitat Corridor Partners (see Section 5)
LPLA	Lake Pepin Legacy Alliance
LTRMP	Long Term Resource Monitoring Program (see Section 6)
LVR	Lower Vermillion River
MDNR	Minnesota Department of Natural Resources
MMO	Mississippi Makeover
MOS	Margin of Safety (see Sections 3 and 4)
MPCA	Minnesota Pollution Control Agency
MS4	Municipal Separate Storm Sewer System (see Sections 3 and 4)
NESP	Navigation and Environmental Sustainability Program (of ACOE) (see Section 5)
NPDES	National Pollutant Discharge Elimination System (see Sections 3 and 4)
NPS	National Park Service
NRCS	Natural Resources Conservation Service
NTU	Nephelometric Turbidity Units (see Section 3)
PIIC	Prairie Island Indian Community
RRF	River Resource Forum (see Section 5)
SAV	Submerged (submersed) Aquatic Vegetation
SNA	Scientific and Natural Area (State owned and designated)
SWCD	Soil and Water Conservation District
TMDL	Total Maximum Daily Load (study)
TNC	The Nature Conservancy
TPL	Trust for Public Land
TSS	Total Suspended Solids
USDA-NRCS	U.S. Department of Agriculture – Natural Resources Conservation Service
VRWJPO	Vermillion River Watershed Joint Powers Organization
WLA	Wasteload Allocation (within TMDL equation) (see Sections 3 and 4)
WMA	Wildlife Management Area (under MDNR jurisdiction) (see Section 5)
WWTP	Wastewater Treatment Plant (see Sections 3 and 4)

2.0 Mississippi Makeover Project

The Mississippi Makeover Project grew out of a Federal 319 non-point source grant from the Minnesota Pollution Control Agency (MPCA) to Dakota County for the development of plans to implement the Lower Vermillion River Turbidity TMDL and local portions of the South Metro Mississippi River Turbidity TMDL (see Sections 3 and 4). Citizen engagement is an important part of any plan development process, and with the need for various agencies to get stakeholder input for future projects in this same area, the "Mississippi Makeover Project" and Citizen Advisory Group were established. Project coordination was sub-contracted to the Dakota County Soil and Water Conservation District (DCSWCD) and planning and technical assistance was provided by Dakota County, the Minnesota Department of Natural Resources (MDNR), the Wisconsin Department of Natural Resources (WDNR), the Minnesota Pollution Control Agency (MPCA), the U.S. Army Corps of Engineers (ACOE), and the National Park Service (NPS).

Using input and visioning from local stakeholders, the ultimate goal of the project was a common one: a healthy and protected ecosystem that attracts abundant wildlife and draws outdoor enthusiasts of all types. A logo in the shape of an arrow and the tagline "a plan for restoration just around the bend" were developed to help the public understand the location of this area – just around the river bend from a major metropolitan area. It is hoped that with a shift from a degraded to a restored ecosystem and enough public and political support, this area will offer a range of outdoor recreation opportunities including canoeing, wildlife viewing, fishing, hunting, camping, hiking, and others. See Project fact sheet in Appendix A.

Another project objective was to bridge projects and priorities of different government agencies and other groups that have responsibility or interest in protecting and improving water quality and wildlife habitat in the Project Area. It is hoped this will result in congruent and complimentary project goals among local stakeholders and agencies.

2.1 Project Area

The waterbodies in the Project Area, Spring Lake, Pool 3, and the LVR, are each impaired for turbidity; are physically similar; and are in close proximity to each other – beginning just upstream from Hastings and extending downstream to Red Wing (Figure 1). Due to the physical similarities, restoration needs in these areas are also similar, which offered a chance to combine these areas into one project and to look holistically at this stretch of River.

Spring Lake lies within the boundaries of the South Metro Mississippi River TMDL which extends from Lock and Dam 1 to Upper Lake Pepin. Spring Lake is 1,483 acres with an average depth of 1.3 meters and lies to the south of the main shipping channel in a bend of the river upstream from the City of Hastings. Though river water flows steadily through the lake, the flow is slow, allowing sediment to settle out of the water column. However, wind-stirred sediments and planktonic algae cause high turbidity, limiting aquatic plant growth. Many submerged tree stumps – remnants of the floodplain forest that used to cover the area – are also common and create a boating hazard. This wide expanse of water has a few islands along its edge but nothing to break the effects of sweeping winds that stir the

flocculent sediments, one source of the turbidity in the lake. While duck hunting used to be a popular pasttime here, waterfowl numbers are very low compared to navigation Pools further downstream. The land adjacent to Spring Lake is owned in large part by Dakota County and consists of the Spring Lake Park Reserve with the exception of a few private in holdings.

Pool 3 of the Mississippi River encompasses 18.2 river miles between Lock and Dam 2 in Hastings to Lock and Dam 3, five miles upstream of Red Wing, MN. The Lower Vermillion River (LVR) lies adjacent to and often mingles with the Mississippi River along much of this Pool. Floodplain lakes, side channels and backwaters dominate the water resources in this area. High turbidity and resulting sedimentation have adversely affected many channels and backwater areas (River Resources Forum, 2004).

The ***Lower Vermillion River*** (LVR), also known as the Vermillion Bottoms, comprises the last 20 miles of the Vermillion River that stretches across Dakota County. Hydrologically, the LVR system is highly complex. Below the Old Peavey Mill Dam in Hastings (downstream of the falls), the Vermillion River splits: a small branch (the Vermillion Slough) flows to the north to join the Mississippi River, while the main branch flows to the south to join the floodplain of the Mississippi River. Interchange of water between the LVR and Pool 3 occurs through various sloughs that connect the waterbodies and depends on the relative stage in the two systems.

The LVR watershed (land that drains directly to the LVR) consists of two subwatersheds draining approximately 77 square miles. Land use in the LVR watershed is approximately 57 percent agriculture although steep topography limits cultivated fields to the uppermost portions of the area. Below the fields, forested but steep and eroding ravines and typically dry creek beds dominate the remainder of the area. When heavy rains move through the area, the ravines quickly drain muddy water through the area and into the LVR.

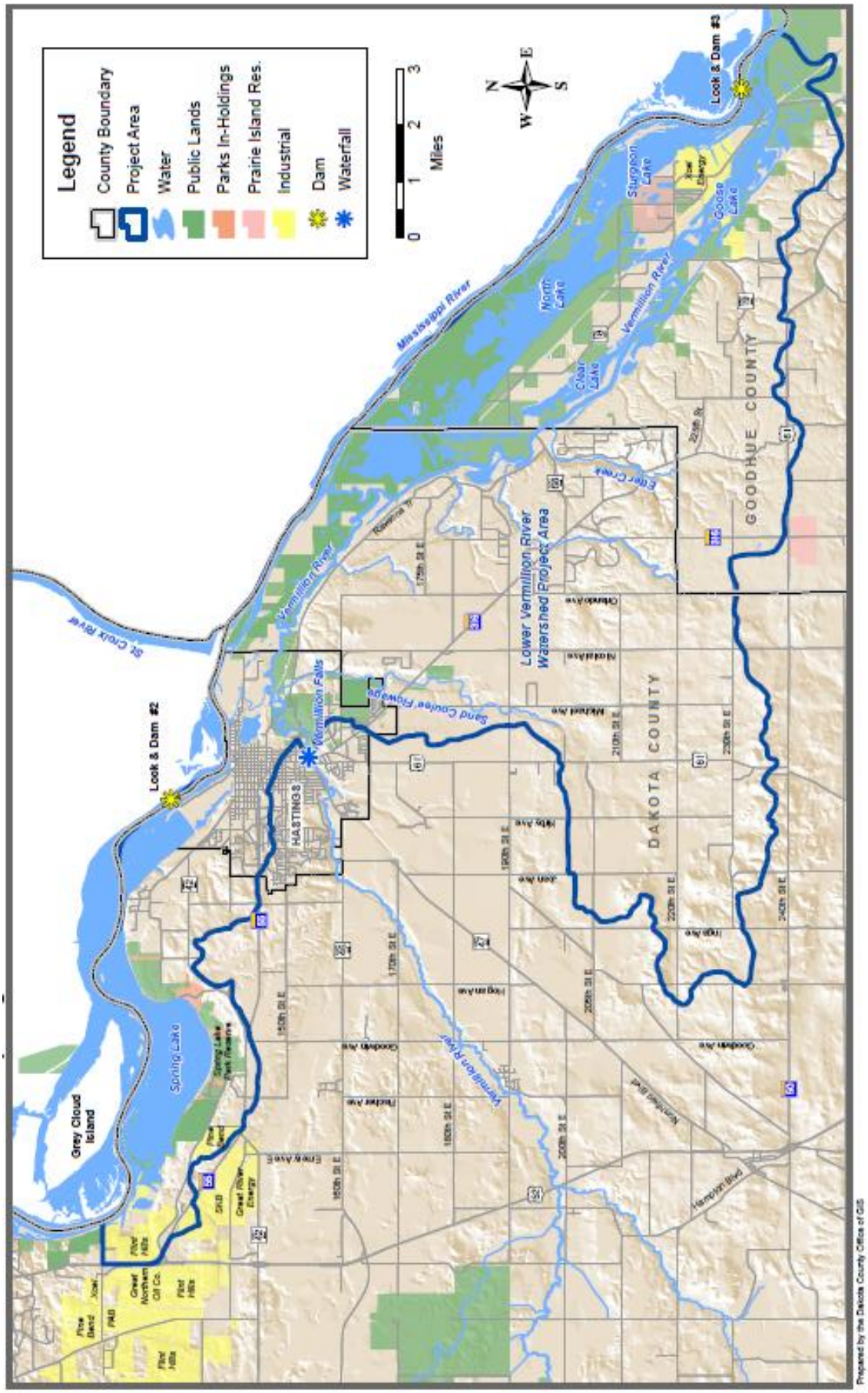


Figure 1. Mississippi Makeover Project Area including Spring Lake, Pool 3 and the Lower Vermillion River and the land draining directly to these waterbodies.

2.2 Development of Indicators by Citizen Advisory Group

Although written Implementation Plans for the TMDLs are the ultimate products of the Mississippi Makeover Project, the contributions of the Citizen Advisory Group (CAG) with input from technical experts comprise the most valuable results of the project.

The CAG was formed by inviting certain members of various groups, agencies, organizations, and the public to be part of a visioning exercise for the Project Area. A primary goal of the group's composition was to gather those who use these waterbodies and know them the best, hoping to understand their personal and professional insights in this area.

The CAG first convened in December 2008. At that meeting, participants received a general overview of the Project and the Project Area, and were asked to envision successful ecological restoration in this area. While the group acknowledged the need for pollution reductions from upstream, they were asked to focus on a vision of restoration in the Project Area and to describe what that looked like: what were their indicators of restoration? While the discussion evolved around each participant's top indicators, questions arose about natural or background conditions in the rivers before European settlement, and the availability of historical and current data. But by the end of the first meeting, a preliminary list of indicators of ecological health was a generated that included water clarity, aquatic vegetation, sedimentation rates in Lake Pepin, invertebrates, and fish. Waterfowl was added to the list of indicators at a later meeting.

2.3 Input from Technical Experts

Even before the CAG began meeting, technical experts from the Wisconsin and Minnesota DNRs (John Sullivan, Heidi Langrehr, and Megan Moore) were developing new water quality standards for total suspended solids (water clarity) and submersed aquatic vegetation that would be specific to the Mississippi River in this area. With these and other indicators listed by the CAG, a larger team of technical experts was convened by the MDNR in Lake City to address the questions of natural conditions, current data, and appropriate metrics (or ways of measuring) each of the indicators. These experts also developed fact sheets for each indicator, presented data, distributed information on specific issues, and described examples of restoration options. Through the course of two more CAG meetings and technical input, a final list of indicators with interim and long-term targets was generated (Table 1). CAG meeting notes, fact sheets, and meeting presentations were available throughout the process on a Mississippi Makeover website (maintained by the Dakota County SWCD) at: www.dakotaswcd.org/wshd_missmak.html.

The Mississippi Makeover indicators and targets represent a true collaboration and exchange of ideas among citizens, stakeholder organizations, and technical experts in this area. In particular, the water clarity and vegetation targets first developed by the technical experts clearly addressed important indicators for the CAG. These targets eventually became the site-specific water quality standards for the South Metro Mississippi River TSS TMDL (described in Section 4).

Table 1. Indicators of ecological restoration and corresponding targets for the Mississippi Makeover Project Area (Fish assemblage figures are included in Appendix A).

TMDL* and Mississippi Makeover Indicators	Natural background	Existing	8-year interim target	15-year target (meet standard)
Water clarity - TSS (mg/l) – June–Sept. avg 1976-08, L&D 2&3 avg - Secchi (cm) – June–Sept avg at Lock & Dam #3 - Secchi (cm) – June-Sept average in Lake Pepin	<10	47 38.5 68	39.5 43 74	32* 47 80
Aquatic vegetation - SAV % frequency of occurrence – EMAP sampling - species richness (maximum # species)		~9 9	15 10	21* 11
Sedimentation (Lake Pepin) - life span (years) - accumulation amount (metric tons/year)	4,000 80,000	300 865,600	450 683,000	~600 502,000
Mississippi Makeover Indicators			**10-year target**	**20-year target**
Invertebrates (mussels) - catch/unit effort (% sites with ≥ 10/min) - catch/unit effort (% sites with ≤1/min) - species richness (# species) - Mucket mussel (% of population) – Grier, 1920 Pools 5,6	 41 8	 5 33 28 0	 7 25 30 0.1	 10 20 35 1
Fish - fish assemblage (backwater areas) - fish assemblage (main channel and side channels)	See fish assemblage figures and table			
Waterfowl		Surveys will begin in fall, 2009 to establish baseline data and set targets		
Aquatic Habitat Quality Index (AHQI) – Pool 3		12		15

Learn More: Excerpt from Report to MPCA Citizen's Board on Proposed Site Specific Standards for the South Metro Mississippi River TMDL.

Aquatic vegetation is an important component of Upper Mississippi River pools and strongly influences fish and aquatic life habitat as well as providing food for waterfowl. Submersed aquatic vegetation is a particularly useful biological indicator to gauge the impacts of turbidity or total suspended solids (TSS) since it is sensitive to changes in light availability and is negatively impacted by conditions of high turbidity or low transparency. Further, submersed aquatic vegetation (SAV) has been used to assess water quality conditions and define restoration goals because it is an important ecological indicator of ecosystem health in freshwater aquatic systems.

River vegetation specialists from the WDNR and MDNR used four methods to determine suitable criteria for TSS and SAV in the turbidity-impaired reaches of the South Metro Mississippi River:
1. Physical: a TSS concentration of 30 mg/L as a long-term seasonal mean provides sufficient light to support healthy beds of SAV in shallow areas of the Mississippi, at a mean depth of 0.8 meters, according to criteria developed by the Upper Mississippi River Conservation Committee.
2. Historical: Aerial photographs from 1951 indicate the presence of emergent and submergent aquatic vegetation in upper Lake Pepin, Wacouta Bay area. John Sullivan of WDNR estimated prevailing TSS concentrations for this period of time using historical flow data combined with sediment core estimates of TSS loads. This resulted in an estimate of 34 mg/L TSS for the mid-1950s.
3. Spatial: Mississippi River Pools 4, 8 and 13 are regularly monitored by the USGS's Long-Term Resource Monitoring Program. Pool 13, just upstream of Clinton, Iowa, was chosen as a reference site with similar potential for supporting SAV as Pools 2-3, as both waterbodies are subject to a similar degree of influence from intensively farmed watersheds, and do not benefit from the role of Lake Pepin as a sediment sink. In Pool 13, healthy SAV was associated with summer average TSS concentrations of 31 mg/L.
4. Since 2006, dry weather has kept TSS levels relatively low at Lock and Dams 3 and 4 in a range of 30 to 40 mg/L. In response, SAV frequency has increased over this period to a range of 15 to 30 percent.

For these four analytical methods, SAV frequency ranged between 15 and 23 percent. The technical advisory group working on the project recommended 21 percent as a suitable target.

Based on the 2009 report: *Submersed aquatic vegetation targets for the turbidity-impaired reach of the Upper Mississippi River Pool 2 to upper Lake Pepin* by John Sullivan, Heidi Langrehr and Shawn Giblin, Wisconsin Department of Natural Resources, La Crosse, WI; Megan Moore, Minnesota Department of Natural Resources, Lake City, MN; Yao Yin, U.S. Geologic Survey Upper Midwest Environmental Sciences Center, La Crosse, WI

2.4 Projects Prioritized by the Citizen Advisory Group

In developing this Implementation Plan, a list of potential projects was developed with input from various local governments, agencies, and organizations. (See Section 5 for project lists.) At a meeting in May 2011, the CAG walked through a prioritization exercise and came to consensus on the ranking of the in-river management projects for implementation (Table 2). First, projects that were already started, in progress, or slated to happen regardless of the Mississippi Makeover Project were removed from consideration – not because they were not considered important, but because they would happen anyway. For the remaining projects, the primary factor influencing the priority ranking was the scale of the ecological impact (or degree of advancement toward the targets). Other ranking criteria included the current momentum of the potential project (politically and publicly), project visibility, project salability, and lead time needed for project completion. Project cost was not considered in the ranking exercise, although it was discussed by the CAG at length. The CAG recognized that the projects with the greatest ecological benefits also have the greatest cost. They decided that making strides toward reaching the restoration targets was a more important consideration, despite the cost of the project.

Larger projects with a greater impact on ecological restoration were given a numerical ranking. Smaller-scale projects that complement the large projects were assigned to "tier two" and were not ranked. Rather, the CAG noted that these important smaller projects (some of which are in progress in some areas) should be pursued vigorously, where and when opportunities arise. In this manner, the CAG laid out the following priorities for project implementation.

Table 2. CAG implementation priorities for in-river management projects.

Project	CAG Priority	Expected Outcome
Island building in Spring Lake and Lower Pool 2	# 1	Island Building: Increase habitat diversity, reduce wind-stirred sediments, allow establishment of aquatic plants behind islands
Island building in North and Sturgeon Lakes	# 3	
Island Building in Upper Lake Pepin	# 5	
Water level drawdown in Pool 3	# 2	Drawdown: Mimic historic flow patterns, allow consolidation of sediments and emergence of aquatic plants which reduces stirring of sediments
Water level drawdown in Pool 2	# 4	
Rough Fish Management in Floodplain Lakes (Mud Hen, Upper Clear, Lower Clear, Goose, Wildcat, Birch)	# 6	Reduce fish-stirred sediments and excess phosphorus release
Development of Comprehensive Management Plan for Gores WMA/AMA by MDNR	# 7	Used to holistically guide management decisions and funding; promotes cooperation by multiple MDNR departments

Table 2. Continued

Tier II Projects: To pursue/continue when opportunities arise	Description
Upland Invasive Species Control	Control buckthorn, etc. through cutting, burning – use volunteers when appropriate; improves habitat; decreases soil erosion from forest floor
Purple Loosestrife Control in Bullfrog Pond (LVR)	Use biological control (beetles) to reduce purple loosestrife in Bullfrog Pond and elsewhere
Prairie Restoration Throughout Area	Re-establish native prairie to improve habitat
Land Acquisition	Acquire land for protection and enhancement; increase recreational opportunities and public use

2.5 Additional Activities of the Citizen Advisory Group

In addition to the development of indicators, targets, and priorities, the CAG was active in a variety of functions to help educate the public and elected officials about the river.

- In January 2010, the group assisted with a large Mississippi Makeover public open house in Hastings where the indicators were presented and elected officials addressed the need for restoration in this area. Over a dozen agencies and organizations displayed information and data on all aspects of the River's natural resources for the 100 residents that attended. Media including newspapers, local cable and radio also covered the event.

- In August 2010, the CAG participated in the Mississippi Makeover Bus and Boat Tour showcasing areas in need of restoration starting at Lock and Dam 2, through Pool 3 and the Lower Vermillion River, and ending with a boat tour of restored areas in Pool 5 and the Weaver Bottoms. CAG members experienced, first hand, newly restored River habitats and learned about the potential to restore areas upstream.

- In August 2010, the Hastings Environmental Protectors coordinated and sponsored a large clean up day in and around Spring Lake. Over 100 volunteers collected 52 cubic yard of trash and debris from the Lake, its islands and shoreline!

- Throughout the Mississippi Makeover Project, a website was maintained by the DCSWCD that included CAG meeting notes, presentations, fact sheets, news articles, and other information at http://www.dakotaswcd.org/wshd_missmak.html.

3.0 Lower Vermillion River TMDL Report Summary

3.1 Project History

In 1994, the Lower Vermillion River (LVR), from the City of Hastings to its confluence with the Mississippi River, was added to the 303(d) list of impaired waters for high turbidity levels. Water quality monitoring indicated that the LVR exceeded the State water quality standard of 25 NTUs (Nephelometric turbidity units) 40 percent of the time, impairing its designated use for aquatic life.

A total maximum daily load (TMDL) study was completed in three phases from 2004 to 2009:

Phase I: Data gathering and conceptual model development
Phase II: Water quality sampling and model setup
Phase III: Model refinement and TMDL development

The goals of the LVR Watershed Turbidity TMDL Project were to describe the nature and extent of turbidity in the highly complex setting of the LVR, determine the turbidity source load allocations, and produce a report that expresses the turbidity dynamics in terms of an allocation among sources and recommendations for corrective actions.

The consulting firm, Tetra Tech, was hired by the Minnesota Pollution Control Agency (MPCA) to complete the goals of the TMDL project. The final TMDL document was approved by the U.S. Environmental Protection Agency (EPA) on September 29, 2009.

To view or download the entire Lower Vermillion River Watershed Turbidity TMDL document, please visit the MPCA website.

3.2 Watershed Characteristics

The entire Vermillion River travels approximately 59 miles from its headwaters in southeastern Scott County near the City of Elko New Market to the confluence with the Mississippi River south of Lock and Dam 3. The Vermillion River watershed drains about 356 square miles and consists of 17 subwatersheds (Figure 2). Below the Old Peavey Mill Dam in Hastings (downstream of the falls), the Vermillion River splits. One branch (Vermillion Slough) flows to the north to join the Mississippi River near mile 813, and the other branch flows to the south to join the floodplain of the Mississippi River. The floodplain of the LVR and Mississippi River is known as the Vermillion River Bottoms. On this alluvial floodplain, the LVR flows parallel to the Mississippi River for approximately 20 miles before joining it just downstream from Lock and Dam 3 near Red Wing, Minnesota. The LVR watershed consists of two subwatersheds draining approximately 77 square miles (Figure 2).

Land use in the LVR watershed is approximately 57 percent agriculture (corn, soybean, and pasture), 26 percent forest, 9 percent urban, and 8 percent “other” (e.g., wetlands, water). The majority of the agricultural lands are devoted to growing corn and soybeans, with approximately half of the corn-soy

rotation is in conservation tillage (personal communication from Brad Becker, Dakota County Soil and Water Conservation District to Kevin Kratt, Tetra Tech, September 25, 2006).

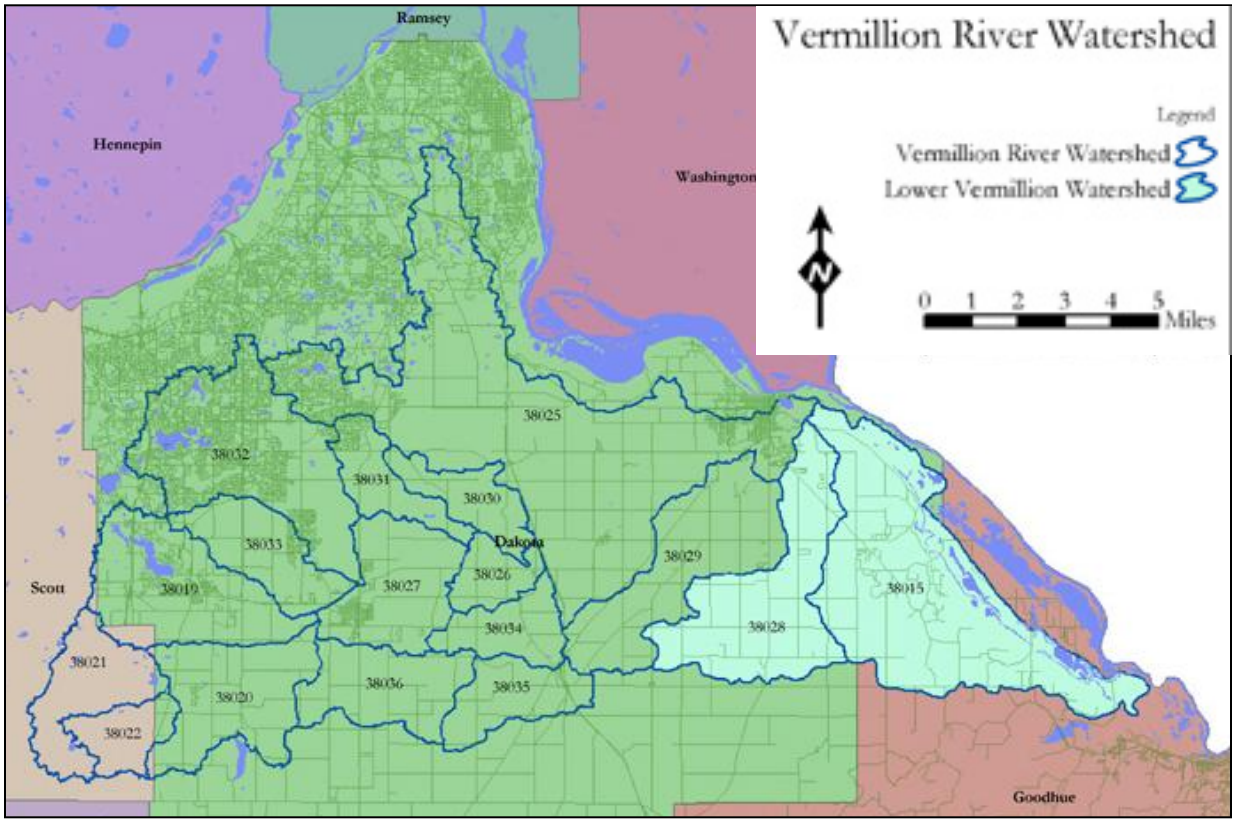


Figure2. Vermillion River Sub-watershed Boundaries

Historically, the construction of Lock and Dam 3 is the most important human activity affecting water quality within the LVR. However, a review of historic aerial photos reveals that the LVR was modified and influenced by human impacts even prior to construction of Lock and Dam 3. Since 1938 the LVR has undergone even more significant anthropogenic influences and changes to the hydrology, channel morphology, and floodplain corridor. The hydrology is very dynamic and complex, with subsurface flows and surface channels interconnected to the various ponds and rivers. The LVR appears to carry a large sediment load, which it deposits into bars and onto the floodplain during greater-than-bankfull flood events.

Hydrologically, the LVR system is highly complex. Interchange of water between the LVR and Mississippi Pool 3 occurs through various sloughs that connect the waterbodies and depends on the relative stage in the two systems. Conditions can be broadly separated into two modes according to stage at the Prescott gage in Pool 3 of the Mississippi River and the corresponding relative importance of Pool 3 intrusions into the LVR. Under “Mode 1” the Mississippi River inflows dominate conditions in the Lower Vermillion, while under “Mode 0” significant inflow from the Mississippi does not dominate. When stage

at Prescott is above about 676' there is strong inflow from Pool 3 into the LVR, and days meeting this condition are designated as Mode 1. All other days are assigned Mode 0. Mode 0 occurs about 214 days per year (58.5 percent) and Mode 1 occurs about 151 days per year (41.5 percent). Characterizing the hydrology in this manner is roughly equivalent to creating a "two zone" flow duration curve for the system to serve as the basis for the modeling and TMDL allocations. On a long-term basis the LVR system appears to receive significantly more inflow from Mississippi Pool 3 than from the Upper Vermillion. Even when estimates of inflow from local tributaries to the LVR and groundwater discharge are added, the long-term inflow from Pool 3 is still more than twice the flow from other sources. Cumulative loading to the LVR (of water and pollutants) thus depends largely on the Mississippi. During low to moderate flow conditions, however, inflow to the LVR can be dominated by the river's own watershed.

3.3 Turbidity Impairment

Turbidity is a measure of water clarity and is an indicator of water quality. It is caused by suspended and dissolved matter such as clay, silt, organic matter and algae. Increased turbidity levels limit light penetration and inhibit healthy plant growth. It can also affect gill functions, damage spawning habitat, and make it difficult for aquatic organisms to find food. Prolonged periods of high turbidity can have significant negative impacts on aquatic ecosystems and affect the quality of local plant and fish communities.

The Minnesota Department of Natural Resources (MDNR) has collected aquatic vegetation data for the Vermillion River system since 1995. MDNR reports indicate that much of the system is devoid of any aquatic vegetation. When vegetation is present, biodiversity is low and the species present are considered common. The MDNR has also used these aquatic plant data in the development of an "Aquatic Habitat Quality Index Summary." This index is based on a qualitative assessment of aquatic vegetation diversity and density, bathymetric diversity, substrate composition, and water quality. Index values calculated for the Vermillion River system indicate that the majority of the system is characterized as fair to poor. On channel lakes such as Larson and Birch, as well as large backwater lakes like Clear and Goose, consistently scored in the poor to very poor range. In contrast, Rattling Springs and Jones Lakes, two smaller, off-channel waterbodies close to the bluffs, consistently scored in the good range.

The MDNR collected fisheries data in the LVR system from 1995 to 2000 and additional data has been collected since 2002. Compared with data from the Mississippi River Pool 3, game-fish populations in the Vermillion are generally healthy. This conclusion is supported by an MDNR report, which states, "Fish populations are generally healthy and appear stable. This is significant, considering that suspended solids within the water column reduce Secchi readings to less than one foot throughout most of the open-water period" (Dieterman, 2002).

However, while some fish species in the LVR appear to be healthy, qualitative evidence suggests that high turbidity levels might be affecting other species and overall species composition in the LVR. For

example, local residents have reported that aquatic vegetation was historically more abundant, and anglers in the area report catching fair amounts of yellow perch. Yellow perch are now found only in very small numbers in the Vermillion system. Research has shown that yellow perch are more susceptible to negative effects from turbidity and sedimentation than some other game-fish species (Newcombe et al., 1996).

3.4 Pollution Source Assessment

Monitoring data from 1990 - 2006 indicate that the LVR exceeded the State water quality standard of 25 NTUs (Nephelometric turbidity units) 40 percent of the time, impairing its designated use for aquatic life. The local watershed of the LVR, the LVR channel, the Upper Vermillion River, and Mississippi Pool 3 are all sources of loads of sediment and organic material that contribute to turbidity. In addition, phosphorus loads are important because they may promote algal growth in the LVR.

Modeling done through the TMDL study indicates that the largest source of sediment to the LVR is Pool 3 via the various sloughs that connect the two waterbodies. Truedale Slough is estimated to contribute about 35 percent of the average annual sediment load, while the Carter and Vermillion Sloughs contribute approximately 21 and 16 percent, respectively. The next most significant source of sediment was found to be the local tributaries draining from the LVR watershed (16 percent) followed by the Upper Vermillion River (8 percent). Internal sources of sediment, such as wind- and fish-induced re-suspension of fine sediments and the draining of wetlands were estimated to contribute approximately 3 percent of the sediment load; however, despite the relatively small load contribution from these sources, they were found to have a significant impact on turbidity during periods when there is little inflow from Pool 3.

3.5 Loading Capacity Allocations

A TMDL is the total amount of a pollutant that can be assimilated by the waterbody while still achieving water quality standards. TMDLs are composed of the sum of individual wasteload allocations (WLAs) for point sources and load allocations (LAs) for nonpoint sources and natural background levels. In addition, the TMDL must include a margin of safety (MOS), either implicitly or explicitly, that accounts for the uncertainty in the relationship between pollutant loads and the quality of the waterbody. TMDLs can also optionally be developed with a Future Growth Reserve for watersheds that are experiencing significant population growth. Conceptually, this is defined by the equation:

TMDL = WLA + LA + MOS + (Future Growth Reserve)

The TMDL for the LVR watershed was derived by using the calibrated W2 model to determine the allocations necessary to achieve the TMDL target (Table 3).

Table 3. Total suspended solids (TSS) allocation summary for the LVR turbidity TMDL (adjusted to NTU)

Allocation Component: Source	Mode 0 (Minimal Pool 3 Inflow)			Mode 1 (Significant Pool 3 Inflow)		
	Existing TSS Load (kg/day)	**Allowable TSS Load (kg/day)**	**Percent Reduction Needed**	**Existing TSS Load (kg/day)**	**Allowable TSS Load (kg/day)**	**Percent Reduction Needed**
TMDL = LA+WLA+MOS	**12,117**	**7,793**	**36%**	**234,993**	**70,321**	**70%**
LA: UVR	1,478	1,478	0%	9,383	9,383	0%
LA: Pool 3	1	1	0%	204,913	45,081	78%
LA: Pool 4	1	1	0%	1	1	0%
LA: Internal Sources	6,928	3,464	50%	1	1	0%
LA: Local Tributaries	2,648	1,788	32%	14,892	10,052	33%
WLA: Facilities	149	149	0%	149	149	0%
WLA: MS4s	912	912	0%	5,654	5,654	0%
MOS (implicit)	(1) 20% based on running model to achieve 20 NTU instead of 25 NTU (2) Conservative value used to adjust from NTRU to NTU-based reduction requirements for local tributaries and internal sources.					

UVR = Upper Vermillion River
MS4s = Municipal Separate Storm Sewer Systems

It is the percent reductions in the columns above that this Implementation Plan will attempt to address, providing potential strategies, projects and programs that can or should be established in order to meet the water quality goals of the Lower Vermillion River. It is important to note that during Mode 1, water quality goals in the LVR would be met if the goals of the South Metro Mississippi River Turbidity TMDL are met (Section 4.0). However, addressing the most significant sources of sediment within that TMDL is beyond the scope of this document. Rather, this document will concentrate on meeting LVR water quality goals during Mode 0 by addressing internal sources and runoff from the watersheds of local tributaries.

4.0 South Metro Mississippi River TMDL Report Summary

At the time of this writing, the South Metro Mississippi River TMDL Report is in draft form. It will be formally submitted to the U.S. Environmental Protection Agency in 2011.

4.1 Project History

The South Metro Mississippi River Turbidity/Total Suspended Solids (TSS) TMDL has been under development since 2004 as a companion project to the Lake Pepin eutrophication TMDL initiated the same year. A river model extending from Lock and Dam 1 to Lock and Dam 4 was developed to allow analysis of both turbidity and eutrophication impairments, and interactions between the two. After the model was completed in 2008, the MPCA put the issues of turbidity and eutrophication on separate tracks, starting with the development of site-specific standards and proceeding to the writing of TMDL

documents. In 2010, the MPCA proposed a site-specific standard of 32 mg/L TSS and 21% frequency of occurrence of submersed aquatic vegetation for the South Metro Mississippi River, replacing the statewide turbidity standard of 25 NTU for these reaches. This site specific standard was approved by the U.S. EPA in November 2010 and provides the basis for the South Metro Mississippi TSS TMDL.

4.2 Waterbody Characteristics

The South Metro Mississippi River extends from Lock and Dam 1 to Upper Lake Pepin. However, this Implementation Plan addresses only that portion of the area which includes Spring Lake within Pool 2, the downstream portion of Pool 2 between Spring Lake and Lock and Dam 2, and Pool 3 (Figure 1 above).

Spring Lake is a large, shallow expanse of water in a bend of the river upstream from the City of Hastings. Once a marsh and floodplain forest, the addition of a mill in the 1850's and Lock and Dam 2 in 1930 submerged the area, creating Spring Lake. This turbid body of water, 1,483 acres in size with an average depth of 1.3 meters and a maximum depth of 4.6 meters (Metropolitan Council, 2002, pp 18-19), is dominated by planktonic algae which restricts the growth of submersed aquatic vegetation (SAV). The Lake contains permanent islands as well as temporary islands, sandbars, and floating debris, making it an interesting and constantly changing waterbody. Due to a lack of SAV and the long unbroken fetch, sediments are unconsolidated and flocculent; easily stirred by wind, rough fish, and boat motor turbulence. The high turbidity decreases light penetration and reduces the chance for SAV to become established. Barely submerged tree stumps, remnants of the floodplain forest, lie just below the surface, often surprising unsuspecting boaters. Anecdotal evidence suggests this was once a renowned waterfowl hunting ground but recent surveys indicate few waterfowl frequent the area now as compared to pools further downstream. Further, those using the Lake recently say sedimentation appears to be getting worse, with some areas becoming shallower and turbidity increasing.

The land adjacent to Spring Lake is owned in large part by Dakota County and consists of the Spring Lake Park Reserve with the exception of a few private holdings. The 1,200 acre park includes sweeping views of Spring Lake and the Mississippi River, cultural and historical resources, and an impressive assemblage of varying landscapes including bluffs, ravines, prairies, and oak savannas. An unimproved MDNR boat landing on Spring Lake is also housed in the Park as well as a privately owned landing.

Pool 2 of the Mississippi River extends from Lock and Dam 1 at the Ford Dam in St. Paul, downstream to Lock and Dam 2 in Hastings. In the lower portion of this Pool, from Spring Lake to Lock and Dam 2, land submerged by impoundment has become a shallow water area swept by wind and boat-generated waves, preventing aquatic plants from taking root. Side channels are submerged and slowly filling with sediment and approximately 37 wing dams and miles of submerged revetment keep the higher velocities in the main navigation channel (River Resources Forum, 2004). A 1994 survey of this area found only 7 acres of islands and 5 acres of submersed aquatic vegetation (River Resources Forum, 2004).

Pool 3 of the Mississippi River encompasses 18.2 river miles between Lock and Dam 2 in Hastings to Lock and Dam 3, five miles upstream of Red Wing, MN. The Lower Vermillion River lies adjacent to and often

mingles with Mississippi River along much of this Pool. Floodplain lakes, side channels and backwater areas dominate the water resources in this area. High turbidity and resulting sedimentation has adversely affected many channels and backwater areas (River Resources Forum, 2004).

4.3 Water Quality Impairment

Turbidity, caused by total suspended solids (TSS), is the pollutant of concern for the South Metro Mississippi TMDL. Four reaches of the South Metro Mississippi were placed on the 303(d) list of impaired waters for turbidity in 1998. TSS includes both inorganic, geologically derived particles, and organic particles from algae, detritus and other sources. These two components are distinguished as non-volatile and volatile suspended solids in the water quality model used to develop the TMDL.

Sediment levels in the South Metro Mississippi are five times higher in recent decades than in the 1895 – 1905 decade. In fact, in the period from 1930 to 1960 sediment loads more than doubled from 300,000 to 700,000 metric tons per year as measured by sediment cores in Lake Pepin (Engstrom et al., 2009). High sediment loads have led to elevated turbidity levels in the South Metro Mississippi, particularly since the flood of 1993, resulting in sparse submersed aquatic vegetation due to poor light penetration which hampers plant growth (Sullivan, et al., 2009). An exception is a resurgence of vegetative growth in 2009 following several years of low flows when turbidity levels remained suppressed. These facts underscore the empirical relationship among turbidity, total suspended solids and aquatic vegetation.

Besides plant life, high turbidity also reduces populations of site feeding fish species and harms the larvae of sensitive native mussel species. Further, high sediment loads have accelerated the sedimentation of Lake Pepin. A continuation of current sedimentation rates would result in the in-filling of the upper third of Lake Pepin by the end of this century and filling of the entire Lake within 300 years (Engstrom et al., 2009).

4.4 Pollution Source Assessment

Sources of sediment in the South Metro Mississippi are numerous and vary by location, year, and climatic conditions. Some sediment sources are “internal” and originate within the river channel and include stream banks, streambeds, floodplains and bluffs. Algal growth and decay can also be considered internal sources. A small portion of the TSS in this TMDL is contributed by the resuspension of sediments deposited on the river bed, side-channels and backwater areas such as Spring Lake and lower Pool 2. While this problem is significant to the localized habitat, it is episodic in nature, triggered by wind and waves and limited to areas with vast expanses of shallow, open water. Boat-induced wave action has also been identified as a potential problem, particularly in Pool 3 where wave action from recreational boats may cause or magnify stream bank erosion (Johnson, 1994; Johnson 2003).

The more significant sediment sources are external or originating in the riparian areas and watersheds that are tributary to the River. Water quality monitoring from 1985 – 2066 shows that 74% of the sediment originates in the Minnesota River Basin, while the Upper Mississippi, St. Croix, and Cannon/Vermillion basins contribute 16%, 3%, and 6%, respectively (Figure 3).

External sources of sediment include runoff from both urban and rural areas. During the period after European settlement, it is estimated that 90 percent of the native prairie and wetlands in the contributing watersheds were converted to agriculture through tillage and artificial drainage. This altered a landscape that was geologically predisposed to high erosion rates (Schottler et al., 2010 pg 32). Today, sedimentation levels in Lake Pepin are almost 10 times higher than natural background levels, or those that occurred pre-settlement. Urban areas are also known to contribute sediment pollution to waterbodies. Sources here include construction sites, winter application of sand and salt, unpaved or exposed surfaces, and general road and parking lot use.

4.5 Loading Capacity Allocations

See Section 3.5 for TMDL equation.

Empirical water quality data, flow data and information from sediment cores were used in elaborate modeling scenarios to calculate the ultimate load reductions needed from each identified sediment source. In summary, the TMDL calls for the following set of TSS load reductions:

- 60% from Minnesota River Basin at high and very high flows; 50% at medium and lower flows;
- 50% from the Cannon River Basin;
- 20% from the Upper Mississippi River Basin;
- 0% from the St. Croix River Basin;
- 0% from all tributaries from December to February;
- 25% from regulated MS4 communities;
- 50% from internal sources such as wind-induced resuspension; and
- 20% from local tributary loads in MN and WI, including the Lower Vermillion, Hay Creek and Wells Creek in MN, and the Trim Belle, Isabella and Rush River in WI.

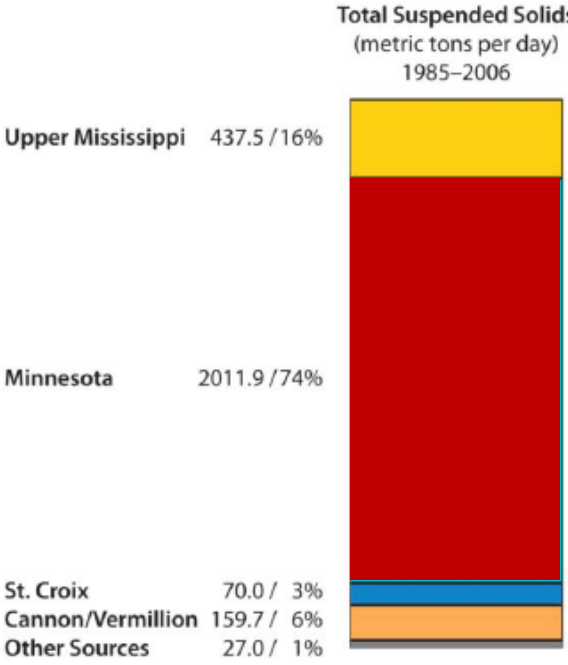


Figure 3. The majority of sediment – 74 percent – in the South Metro Mississippi derives from the Minnesota River, based on river monitoring data from 1985 to 2006 that was used in the water quality model for the TMDL. (MPCA graphic)

Table 4. Annual allocation of TSS for average flow conditions of the South Metro Mississippi

	Minor Tribs	Metroshed	Upper Mississippi	Minnesota River	St. Croix River	Cannon River	Total
	Metric tons/year						
Stormwater (Construction/ Industrial)*							1,841
Stormwater (MS4s)**	3,146	32,664	7,410	2,485	1,381	1,335	48,421
WWTPs***	107		1,506	2,204	454	48	4,319
Natural Background	503	1,416	8,646	58,403	3,034	4,559	76,559
Load allocation	7,267	11,828	90,440	290,015	20,008	24,122	443,680
Total loading capacity	11,022	45,908	107,954	353,154	24,877	30,063	574,819

*MPCA manages stormwater across the state with permitting programs for industrial and construction stormwater
**Includes natural background
***WWTP: Wastewater Treatment Plants

5.0 Implementation Strategies

The strategies presented in this document include in-river management techniques, riparian treatments, and local land use practices to address internal loading in Spring Lake, lower Pool 2, Pool 3, and the Lower Vermillion River, and external loads originating from lands directly adjacent to these areas in Dakota and Goodhue Counties. However, the majority of total suspended solids impacting these resources originate from areas upstream of the project area, especially the Minnesota River Basin. Although the strategies in this document are important components of overall restoration, a significant reduction in sediment from upstream sources is imperative if restoration is to succeed here.

Funding Options and Government Programs

Many of these strategies (e.g. island building and water level management) are large-scale restoration efforts require extensive planning, engineering, stakeholder involvement, and funding. In many cases, the U.S. Army Corps of Engineers (ACOE) would be the lead agency and funding source for the large projects. However state and local governments can also initiate and fund projects both large and small.

There are several sources of funding for the projects in this document. The primary sources include 1) federal funding through the ACOE's Environmental Management Program (EMP), Navigation Environmental Sustainability Program (NESP), or their Operations and Management budget for maintenance of the 9-ft channel (O&M); 2) state funding from state agencies or through the Legacy

Amendment (which includes Clean Water Legacy Funds and Outdoor Heritage Fund); 3) local government funding; and 4) other sources such as grants and funding from organizations.

The ACOE's EMP for the Upper Mississippi River System was authorized in 1986 in order to balance navigation management with ecosystem management (UMBRA, 2007). Currently, the EMP averages around $18 million in annual appropriations, which funds both the habitat restoration and long-term monitoring components. Many large-scale restoration projects have been implemented under the EMP in lower Mississippi River pools. In the Mississippi Makeover Project Area, projects initiated under the EMP would require a 35% local matching funds. Projects also need prioritization by the ACOE against other potential EMP projects.

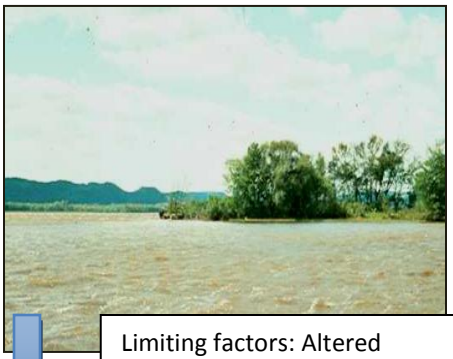
More recently, as part of the 2004 Navigation Feasibility Study, the Corps of Engineers recommended an integrated program of navigation improvements and ecosystem restoration measures designed to ensure the long term sustainability of the Upper Mississippi River System. With support from the States and many stakeholder groups, the new Navigation and Ecosystem Sustainability Program (NESP) was authorized in 2007 (UMBRA, 2007). Unfortunately, NESP has never been funded enough to complete large-scale projects. Through the River Resources Forum (RRF), however, work to conceptualize, prioritize and develop preliminary plans for projects does continue under the auspices of NESP. RRF subgroups including the Fish and Wildlife Workgroup and the Water Level Management Task Force have researched and prioritized projects within the Mississippi Makeover Project Area and are included in the tables below. The River Resources Forum is a state and federal agency partnership for addressing resource issues concerning the Upper Mississippi River system within the ACOE St. Paul District jurisdiction.

O&M funding is specific to maintaining the navigation channel and lock and dam infrastructure, but under certain situations has been used to help construct islands (providing sand) and complete additional dredging prior to implementing drawdowns. O&M funding would need to be directly tied to navigation maintenance or improvements.

Minnesota Legacy amendment was passed in November 2008 and is intended to fund both water quality (Clean Water Legacy Funds) and habitat improvement projects (Outdoor Heritage Funds). This could include island building, water level management, land acquisition and other protection and restoration projects. It may be possible to link Legacy funding with EMP funding to provide the non-federal cost share for island projects. The MDNR, along with a group of agencies and organizations called the Lower Mississippi River Habitat Corridor Partners (LMRHCP), have been developing proposals for Outdoor Heritage funding each year since 2009. This has resulted in funding mainly for land acquisition and some minor habitat restoration projects. This partnership will continue to apply for Outdoor Heritage funding. Projects within the Mississippi Makeover Project Area are on their list of priorities and will hopefully be funded in the future.

Relationship of Strategies and Indicator Targets

It is difficult to relate the implementation of specific restoration strategies with results in specific restoration indicators. For example, almost every strategy will help improve water clarity on some level – island building interrupts fetch which decreases wind suspension of sediments, which improves water clarity; water level management increases aquatic vegetation, which holds sediment in place, which improves water clarity; best management practices on land decrease erosion, which improves runoff water clarity; and so on. Further, improvements in one indicator usually mean improvements in a corresponding indicator. Improvements in water clarity and aquatic vegetation, in turn, lead to improvements in the biological indicators of fish, waterfowl, and invertebrates. Inter-relationships between indicators and strategies are illustrated by the following series of photos.

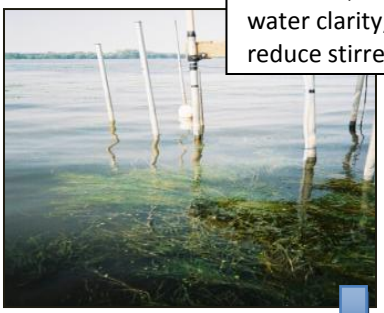


Limiting factors: Altered flows/water levels, loss of physical diversity, poor water clarity

Action: Build islands; drawdown water levels to simulate natural summer low water levels

Result: Flow pattern diversified, vegetation emerges behind islands; sediments consolidated and vegetation emerges from dormant seed bank

Vegetation collects sediment, improves water clarity; islands reduce stirred sediments



Waterfowl return to eat vegetation, clear water improves mussel habitat

In addition to habitat and water quality improvements, another component of successful restoration includes increased public awareness, engagement, and recreational use in this area. Geographically, this area is just around the bend from a major metropolitan area on the most significant river in the county. Increased recreational access, knowledge and awareness of these resources will help ensure current and future successes in restoration.

There are many entities involved with resource management within the project area. This section attempts to identify those agencies and organizations with a role in water resource management here, and to list their current and future programs, projects, and plans.

5.1 In-River Management

Internal sources of sediment pollution (internal loading) are typically due to flocculent or unconsolidated bottom sediments being stirred by wind, waves, fish, and boats. Practices and projects that work to minimize these sources include a variety of in-river management techniques such as island building, water level management, and rough fish management.

Most of these techniques have been tested and utilized in downstream Pools with successful results. Increased aquatic vegetation, improved water clarity, and greater numbers of waterfowl using the areas have been documented in Pools 5 and 8 (River Resources Forum, 2007). However, it should be noted that the same techniques may not result in the same changes in Pools 2 and 3 due to the high concentration of total suspended solids in the water originating from upstream sources. Despite this unknown, the management tools discussed here should be used and tested in these areas, in order to begin restoration here, and to advance the body of knowledge on the success of these techniques under varying conditions.

5.1.1 Island Building

Prior to the construction of locks and dams, the Mississippi River was a mosaic of braided channels, islands, slow backwaters, and wetlands (U.S. ACOE, 2004). Impoundment of the river increased water levels throughout much of the year and resulted in permanently flooding the river's valley and creating numerous islands. Islands provide habitat for terrestrial species, and their shorelines provide nesting sites for some aquatic species. Islands can also protect aquatic vegetation and reduce sediment resuspension by deflecting wind and river currents and breaking up waves (reducing the fetch within a river segment) (River Resources Forum, 2004). Islands also enhance channel geomorphic diversity and modify the exchange between channels, floodplains, and backwater areas (Scot Johnson, MDNR – presentation to MMO CAG).

Erosion by waves, ice, and river currents has reduced the number and acreage of islands in the lower section of many pools (River Resources Forum, 2004). In addition to losing habitat, island loss allows river currents to enter once protected areas, uprooting vegetation and stirring up sediments. As the water clouds up from suspended sediment, sunlight is blocked, further reducing aquatic plants and

degrading habitats. Building islands can help break this cycle and offer quiet areas for boaters and wildlife.

Island building within the Project Area is a priority due to the benefits described above. Island building in lower Mississippi River Pools (particularly Pools 5 and 8) has successfully improved aquatic plant beds and has been a significant tool in habitat restoration. In this Project Area, however, if sediment pollution from upstream does not decrease, the benefits of island building may not reach their full potential. While some habitat improvements will certainly be attained, it is difficult to predict the potential effect of these actions.

Potential Island Building Projects	**Lead Agency**	**Status**	**What's Needed**
Spring Lake and Lower Pool 2	ACOE and/or MDNR	**Ranked #1 among top priorities by CAG** High on list of NESP priorities w/ ACOE ranked by Fish and Wildlife Workgroup of the RRF May result from shipping channel shift – ACOE project On list of priorities with LMRHCP seeking Outdoor Heritage Funds	• Funding (potential sources = NESP, O & M, Outdoor Heritage, local partners) • Specified plans/modeling • Data collection
Lower Pool 2; Spring Lake	Private Industry	Possible mitigation action for mining	• Agencies and organizations continue to follow this issue
North and Sturgeon Lakes	ACOE and MDNR	**Ranked #3 among top priorities by CAG** Preliminary plans drafted; on ACOE list for EMP funding On list of priorities with LMRHCP seeking Outdoor Heritage Funds	• Funding from EMP – 65% cost share • Funding from non-federal match of 35% • Specified plans/modeling • Data collection
Upper Lake Pepin / Pierce County, WI	ACOE and WDNR	**Ranked #5 among top priorities by CAG** High on list (within top 7) of NESP priorities by Fish and Wildlife Workgroup of the RRF	• Submit draft concept proposals to ACOE • Secure federal and non-federal cost shares • Specified plans/modeling
Pool 3 – upstream of Prairie Island Marina	PIIC with MDNR	Completed 2010; wild rice restoration planned for 2011	NA – Already in progress.

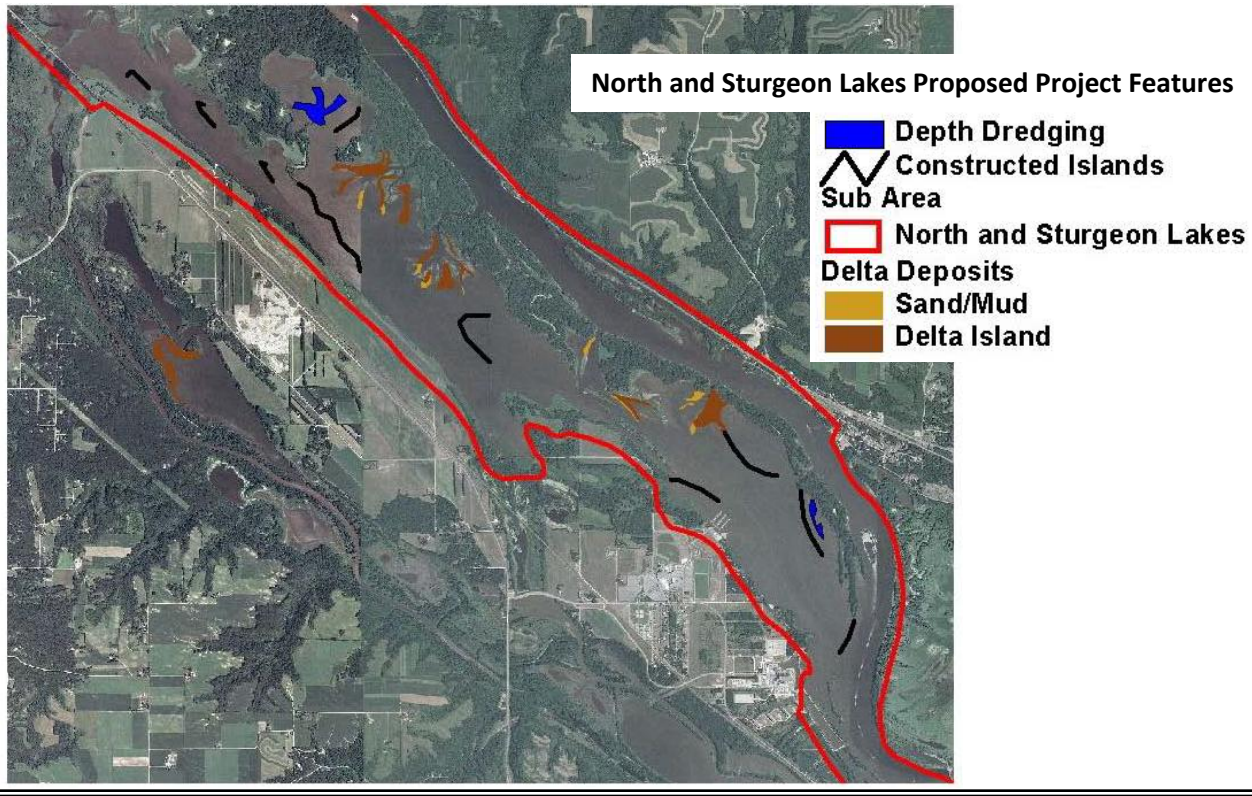
Learn More: Excerpt from ACOE website

North and Sturgeon Lakes are large backwater complexes located in Pool 3 of the Upper Mississippi River, west of the navigation channel. The project area includes a marshy area at the upstream end and encompasses Sharp Muskrat Lake as well. The lakes today are shallow and subject to frequent wind and wave action that keeps sediments suspended and limits aquatic plant growth. Historically, these two lakes had an extensive marshy fringe and considerable submersed aquatic plant beds.

Major habitat concerns for North and Sturgeon lakes are sedimentation, island dissection, vegetation loss, and reduced depth for over-wintering fish. A significant loss of emergent and submerged aquatic vegetation has occurred throughout North and Sturgeon Lakes. Flood effects, wave generated erosion, and resuspension of fine sediments caused by continual inundation have reduced the fish and wildlife value of these areas, which once provided outstanding waterfowl hunting and winter fishing.

The project goals include (1) maintain/enhance/create more natural sediment transport and deposition, (2) decrease suspended solid concentrations, and (3) reduce wind fetch. The project involves constructing a series of small islands (approximately five within North Lake and three within Sturgeon Lake) to reduce wind and wave generated erosion. Island construction would use substrates within North and Sturgeon Lakes to enhance bathymetric diversity and reduce resuspension of fine sediments. Island construction and backwater dredging would improve conditions for growth of aquatic vegetation and promote increases in depth by concentrating flows to promote scour.

ACOE authority for this project comes under the Upper Mississippi River System - Environmental Management Program (EMP). This program was authorized by Section 1103 of the Water Resources Development Act of 1986 and reauthorized by the Water Resources Development Act of 1999. The project will be planned and designed as a cooperative effort of the State of Minnesota, Prairie Island Indian Community, other interested organizations, and the public.



5.1.2 Water Level Management

Prior to construction of the lock and dam system and the maintenance of shipping channels, the Mississippi River was subject to a range of water levels that was beneficial to fisheries and wildlife. Fluctuating water levels exposed mudflats and sandbars, diversifying habitats and allowing the regeneration of submerged aquatic vegetation (SAV) and the establishment of emergent vegetation. Today, the operation of locks and dams stabilizes water levels, allowing for barge traffic but diminishing aquatic habitat diversity and vegetation. Over the years, high water levels have eroded away islands in the lower sections of the pools. Material carried by the river and eroded from islands gradually filled in channels and deep holes, reducing bathymetric diversity. Aquatic plants that grew in the shallow water bordering the islands were affected by these changes, and many formerly lush plant beds either decreased in size or disappeared completely. Many pools now have a wide open expanse of shallow water above the lock and dam. These areas are much less productive for fish and wildlife. To restore this habitat, river managers have been rebuilding islands, as well as restoring channels and deep-water habitat. Water level management offers a way to help restore the necessary seasonal fluctuation in water levels (River Resources Forum, 2007).

The Army Corp of Engineers (ACOE) maintains water levels in the Mississippi River at navigable levels. River resource management agencies and the public have expressed a growing interest in summer drawdowns of the navigation pools to promote growth of aquatic vegetation. While much planning and coordination is required to complete a drawdown, they have proven to be a successful restoration tool in lower Pools.

Experimental drawdowns of 1.5 feet at the dam were conducted on Pool 8 in 2001 and 2002, and on Pool 5 in 2005 and 2006. Drawdowns were started in mid-June, and continued until the end of September if flows were suitable to maintain the drawdown. Water levels were lowered approximately 2 inches per day until the desired elevation was reached. During 2001 in Pool 8 and 2006 in Pool 5, drawdowns ended early because of low flows. Although river flows change daily, thus changing the areas exposed, by mid-summer almost 2,000 and 1,000 acres were exposed in Pool 8 and 5, respectively (River Resources Forum, 2007).

Monitoring results indicate that the drawdowns produced a reduction of open water and an increase in areas dominated by marsh plants and submersed vegetation. Emergent vegetation continued to persist after the drawdowns. Waterfowl use also increased after the drawdowns. Recorded waterfowl use days were the highest in 10 years during 2006 (the year following the drawdown). Meanwhile, recreational boaters were surveyed during the drawdowns; 94% of boaters in Pool 5 were satisfied or very satisfied with their boating experience (River Resources Forum, 2007).

It should be noted that while drawdowns have been successful in lower Pools, the same level of success may not be achieved in Pools 2 and 3 due to lower water clarity in these areas. Upstream sources of sediment must be significantly reduced in order to gain complete restoration in the Project Area.

Potential Water Level Management Projects	Lead Agency	Status	What's Needed
Pool 2	ACOE	**Ranked #4 among top priorities by CAG** High on list of NESP priorities by Fish and Wildlife Workgroup of the RRF On list of priorities with LMRHCP seeking Outdoor Heritage Funds	• Stakeholder engagement and advocacy • Funding (potential sources = NESP, O & M, Outdoor Heritage, local partners) • Specified plans/modeling
Pool 3	ACOE	**Ranked #2 among top priorities by CAG** #1 priority of Water Level Mgmt Task Force of RRF On list of priorities with LMRHCP seeking Outdoor Heritage Funds	• Stakeholder engagement and advocacy • Funding (potential sources = NESP, O & M, Outdoor Heritage, local partners) • Specified plans/modeling
Lake Isabelle – City of Hastings	MDNR		

LEARN MORE: Excerpt from Newsletter for Water Level Management Task Force of the Upper Mississippi River Resources Forum, August 2009

Making Water Level Management Easier

For the past 13 years, the Water Level Management Task Force has worked to implement water level management changes to improve fish and wildlife habitat on the Mississippi River. These changes have included maintaining higher water levels during winter for fish, and summer water level drawdowns to re-establish emergent aquatic vegetation.

We have learned much about the effects of drawdowns on habitat and water quality. But many questions remain such as:

- How often should drawdowns be repeated?
- Would we get more benefit from deeper drawdowns?
- What if we started them earlier in the year?
- What are the long-term impacts on fish and mussels?

These questions and others are part of a long-term strategy being developed by the Task Force to improve the efficiency, reduce the cost, and get the greatest benefits from drawdowns. This strategy requires that each drawdown is conducted in a way that answers these questions and increases our overall knowledge base. Future drawdowns can be planned using this new knowledge.

As we learn, there will also be opportunities to make drawdowns easier to implement. Conducting a pool-scale drawdown, especially for the first time, takes years to plan and complete. It takes time to ensure that all affected parties including business owners, recreational boaters, and the commercial navigation industry understand the reason for drawdowns and how they might be impacted. The Pool 8 and Pool 5 drawdowns each took three years to plan.

The Water Level Management Task Force is working to make drawdowns easier to plan so they can be conducted more frequently and on more pools.

One way to accomplish this is to make water level drawdowns a normal part of the Corps' water management program. This is sort of a return to an earlier time when all the pools in the Corps of Engineers St. Paul District (Twin Cities to Guttenberg, IA) had lower water levels as the normal operating range.

Water levels were allowed to drop 1-2 feet below current levels. This was changed in the 1970's when the operating band was decreased to ½ - 1 foot in most pools to reduce the amount of dredging needed to maintain a 9 foot navigation channel.

The long-term strategy being developed now by the Task Force will improve our understanding about the effects of drawdowns. As we learn more, we will be able to establish a schedule that minimizes cost and maximizes benefits to fish and wildlife. Reverting back to a previous operating plan is one of the options to consider.

5.1.3 Rough Fish Management

The Lower Vermillion River Turbidity TMDL lists fish-induced resuspension of fine sediments as a potentially significant source of turbidity in the river's backwater lakes during low flows. Data indicate that backwater lakes connected to the Vermillion River have higher turbidity and lower amounts of submerged aquatic vegetation than backwater lakes seasonally isolated from the Vermillion River. In part, this may be due to the activity of rough fish like carp that travel freely between the Vermillion and the backwater lakes. Based on MDNR Fisheries managers' understanding of fish behavior, carp and other rough fish are generally expected to leave backwater areas in the early summer when flood waters are dropping to avoid being trapped in seasonally isolated backwaters and sloughs.

Projects to control rough fish may include constructing a temporary or permanent levee at the waterbody outlet to isolate the backwater during low water periods, usually during the growing season July – September. The constructed levee would limit carp and other bottom feeding fish access to these waters and induce them to leave when water levels drop. The structures would be designed to allow canoes, kayaks and small boats to be paddled or pulled over the structure to gain access to the backwater.

Other control methods for common carp are being investigated by researchers with the University of Minnesota. These include using radio transmitters on a number of carp to aid in locating a group fish and then targeting that area for physical removal through the ice in winter. As this method is further developed, it may be used for carp removal in backwater lakes.

Asian carp are being found in small numbers in Minnesota waters of the Mississippi River. One of the key strategies for minimizing or preventing the impact of Asian Carp in the Upper Mississippi River is to provide excellent habitat and water quality for native species. Native species, especially fish, will be better able to compete with Asian carp should they become established. The projects proposed for implementation through the TMDL are the exact same projects that will help prevent or reduce impacts from Asian Carp.

Potential Rough Fish Management Projects	**Lead Agency**	**Status**	**What's Needed**
Pickerel Slough	MDNR - Fisheries	Demonstration project completed in 2010; results evaluated in 2011	NA - Completed
Floodplain Lakes: Mud Hen, Upper Clear, Lower Clear, Goose, Wildcat, and Birch	MDNR - Fisheries	**Ranked #6 among top priorities by CAG** Dependent on results of Pickerel Slough demonstration project	• Evaluation of demonstration project • Funding • Permits/Landowner permission

5.1.4 Slough/River Connections Management

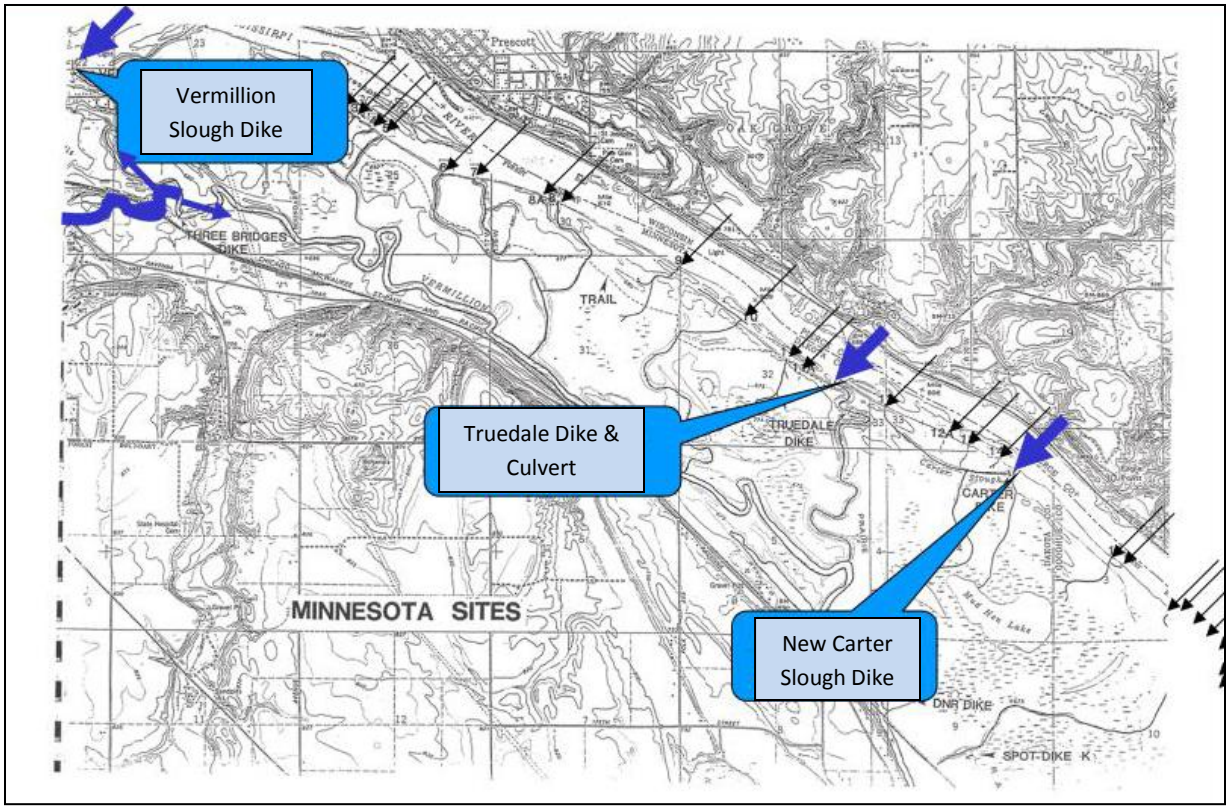
There are multiple connections between Pool 3 and the Lower Vermillion River and backwater lakes. Twenty-eight "sag points" were mapped through an ACOE inventory in 1987. Sag points are low spots in the natural river levee that convey water during high water levels in Pool 3 (Figure 4). The Vermillion, Truedale, and Carter dikes and corresponding sloughs (or connecting channels) are the most significant connections.

According to the Lower Vermillion River Turbidity TMDL, during the 11 year period that was modeled for the TMDL, the Vermillion Slough contributed 15% of the total flow in the Lower Vermillion River, while the Truedale Slough and Carter Slough contributed 31.0% and 21.0%, respectively.

Residents and users of the Lower Vermillion River and backwater lakes have raised concerns in recent years about the amount of sediment entering these areas from the Mississippi River. In slow backwater areas and lakes sediment accumulates, forms deltas, and can degrade water quality and habitats. Mud Hen Lake, with its connection to the Mississippi through Carter Slough has been of particular concern. Local residents contend that sediment-laden River water continually enters through the slough, furthering delta formation in the lake. Through a request from the Mississippi Makeover Citizen Advisory Group, the ACOE agreed to investigate the situation and chink the dike with sand in 2011.

Potential Slough Management Projects	**Lead Agency**	**Status**	**What's Needed**
Carter Dike Improvements – chink dike with sand or other materials	ACOE	Potential 2011 Project	• Spring 2011 site inspection • Decision on appropriate action

Figure 4. 1987 ACOE Inspection of Mississippi Riverbank (on Minnesota side); 28 sag points mapped in river levee above Prairie Island. (↙ = sag point)



5.1.5 Floodplain Habitat Management

Much of the floodplain along the Mississippi and LVR in the Project Area is owned by the State of Minnesota and managed by the Minnesota Department of Natural Resources (MDNR). The Hastings Scientific and Natural Area (SNA), the Gores Pool 3 State Wildlife Management Area (WMA) and the Gores State Aquatic Management Area (AMA) encompass over 6,700 acres in total and all lie within the floodplain between the LVR and the Mississippi River (Figure 5). In 2009, Friends of the Mississippi River completed a natural resource management plan for a 300 acre addition at the most northerly end of Gores WMA/AMA. Ecological management and restoration commenced in 2010, with initial phases of a prairie recreation, oak savanna restoration, and floodplain forest management. Although a technical guidance document exists for the Gores WMA (Texler, 2005), a comprehensive management plan would be beneficial to help guide and prioritize appropriate and cooperative work in the area. Various divisions within the MDNR have been working on projects such as invasive species control, prairie restoration, access improvements, wetland restoration, and forestry management experiments as time, funding, and partnerships allow. Acquisitions of private lands held within these areas (in-holdings) are also pursued in these areas in order to protect and improve contiguous tracts of floodplain habitats.

In addition to State land, the Prairie Island Indian Community (PIIC) encompasses about 3,029 acres including 1,170 acres of grasslands, 941 acres of bottomland forest, 705 acres of open water, and 140 acres of wetlands. Most of the tribal lands are on Prairie Island, located between the Mississippi and Vermillion Rivers. The PIIC works on various restoration projects on their land including native prairie restoration, wild rice establishment, installation of wood duck nesting boxes, island creation and riparian vegetation restoration (Figure 6). These restoration activities are perfect examples of the projects that can and should be undertaken by various entities to make progress towards MMO restoration targets.

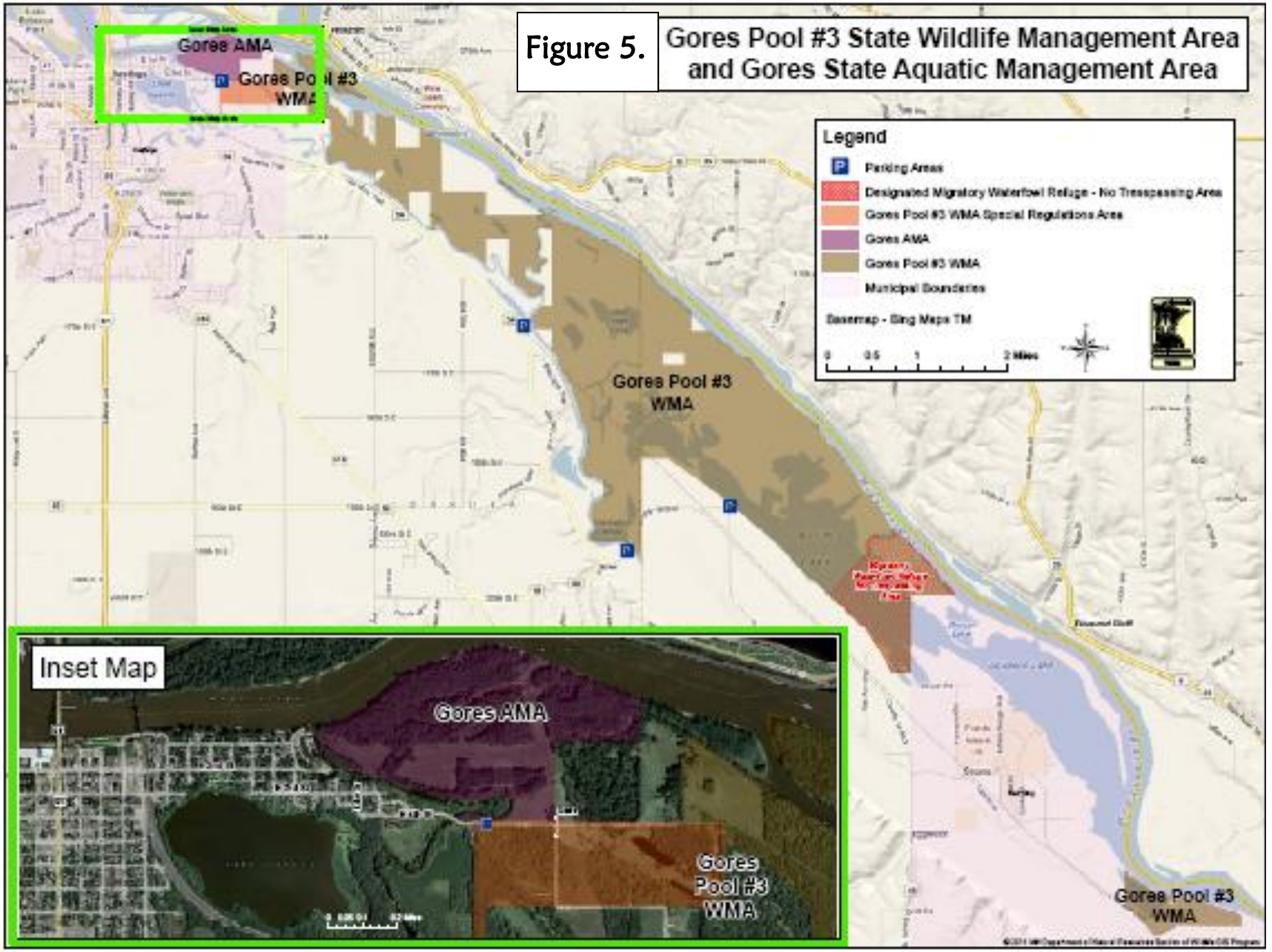
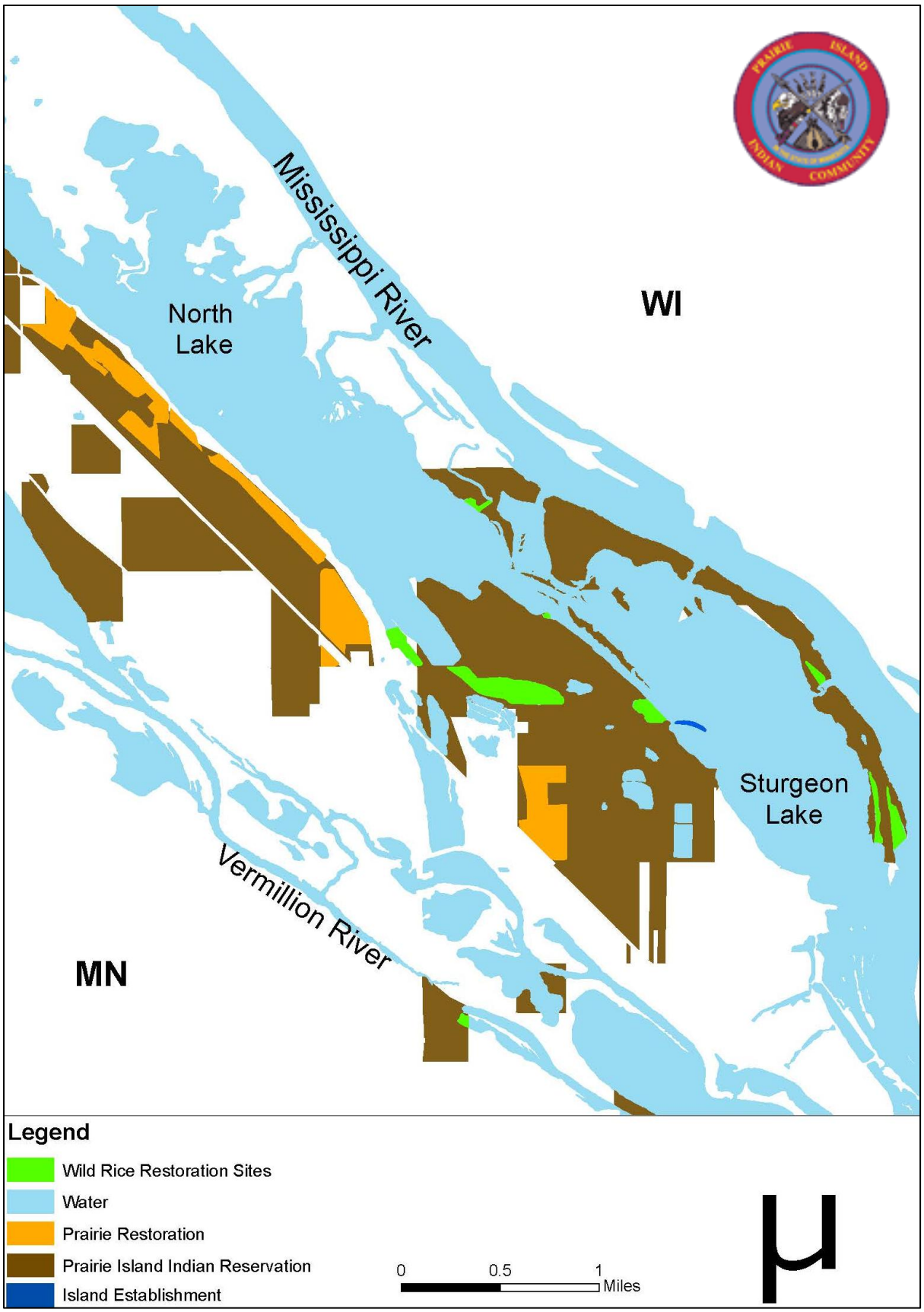


Figure 5.
Gores Pool #3 State Wildlife Management Area and Gores State Aquatic Management Area
Gores AMA
Gores Pool #3 WMA
Legend
Parking Areas
Designated Migratory Waterfowl Refuge - No Trespassing Area
Gores Pool #3 WMA Special Regulations Area
Gores AMA
Gores Pool #3 WMA
Municipal Boundaries
Basemap - Bing Maps TM
Inset Map
Gores AMA
Gores Pool #3 WMA
Gores Pool #3 WMA

Figure 6. Prairie Island Indian Community –Restoration Sites



Potential Floodplain and Shoreline Habitat Restoration Projects	Lead Entity	Status	What's Needed
Invasive Species Management in Gores WMA/AMA	MDNR with FMR and other partners	**Ranked as Tier II by CAG** Work is on-going in some areas through	• Continued funding • Continued partnerships • Volunteers
Invasive Species Mgmt on >200 ac. of floodplain forest in PIIC	Prairie Island Indian Community with partners	In progress through 2014 or as funding allows.	NA - Already in progress
Prairie Restoration in Gores WMA/AMA	MDNR with FMR and other partners	**Ranked as Tier II by CAG** Work is on-going in some areas through	• Continued funding • Continued partnerships • Volunteers
Purple Loosestrife Control in Hastings SNA (Bullfrog Pond area)	MDNR	**Ranked as Tier II by CAG** To be addressed in 2011 and beyond	• Support from SNA program
In-holding acquisitions	MDNR with partners (TPL, FMR, TNC, etc)	**Ranked as Tier II by CAG**	• Funding • Willing landowners
Wetland Restoration at southern end of Mud Hen Lake	MDNR	Low on priority list – may be considered in future if deemed feasible	• Time • Feasibility Study
Development of Comprehensive Plan for Managing Gores Pool 3 Management Areas and adjacent SNAs	MDNR – all divisions and partners	**Ranked #7 among top priorities by CAG** Potential future project by MDNR	• Cooperation among MDNR departments • Partnerships with all stakeholders • Advocacy from citizens
Wild Rice restoration over 38 acres along North and Sturgeon Lakes	Prairie Island Indian Community with partners	In progress since 2010 with grant funding. Will continue 5 – 7 years until funding is depleted.	NA - Already in progress
Prairie restoration of >220 acres in floodplain – conversion of row crops to prairie grasses	Prairie Island Indian Community with partners	In progress since 2004. Expanding into new sites until 2015. Maintenance of completed sites annually.	NA – Already in progress
Reclamation/stabilization 3,400 ft shoreline, Pierce Co., WI; Pool 4	ACOE WDNR	EIS Complete, project design re-evaluation in 2011, funding from ACOE (O &M)	• Continued support from stakeholders • Advocacy

5.2 Land Management

In addition to internal loading of sediment, lands that drain directly into the Mississippi Makeover Project Area also contribute to the turbidity and suspended solids in the Mississippi and Lower Vermillion Rivers. The Project Area includes 14 governmental jurisdictions including:

Dakota County and Dakota County Soil and Water Conservation District
Goodhue County and Goodhue County Soil and Water Conservation District
Minnesota Department of Natural Resources
Prairie Island Indian Community
Vermillion River Watershed Management Organization
City of Rosemount
City of Hastings
City of Red Wing
Nininger Township
Marshan Township
Ravenna Township
Welch Township

Each of these entities is, in part, responsible for land use management within its jurisdiction. Land use management strategies, regulations, restrictions, and incentive programs vary.

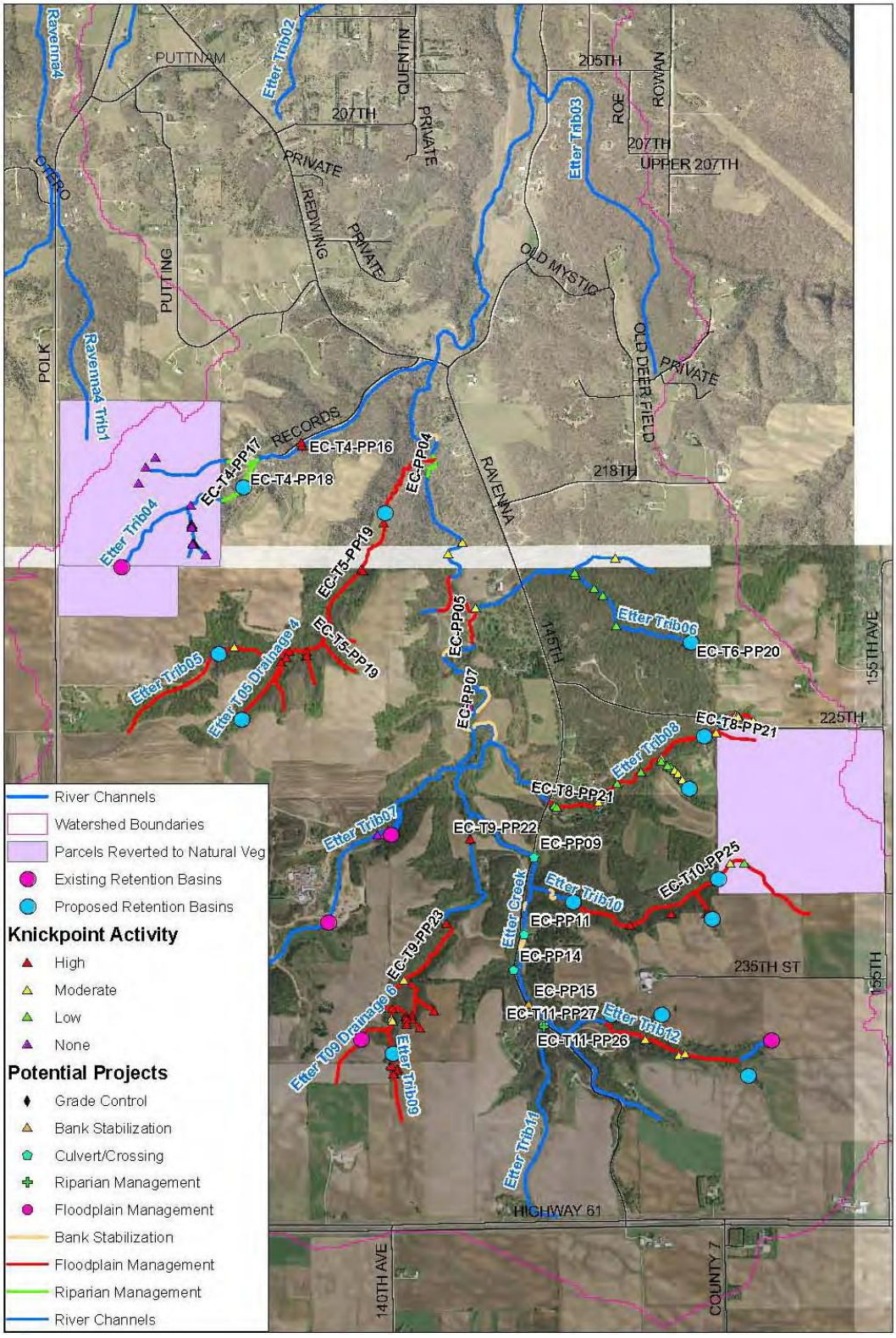
5.2.1 Agricultural and Open Land Management

The agricultural, rural, and open land directly adjacent to the Mississippi Makeover Project Area is characterized by steep topography and highly erodible soils. In the upper portions of the Etter Creek subwatershed, the largest area draining directly to the LVR, multiple feet of highly erodible loess soil overlie gravel and bedrock. Water flowing off of the steep slopes easily erodes through this material. These geologic features, combined with the land use change from forest and prairie to agriculture, likely contribute to the instability found in the Etter Creek subwatershed today (VRWJPO, 2011).

There are many different agricultural and riparian best management practices that can be used to help reduce runoff volumes and stabilize slopes and streambanks in these areas. In 2010, the Vermillion River Watershed Joint Powers Organization contracted with Interfluve, Inc. to assess the geomorphology of the Etter Creek subwatershed and Ravenna Coulees. The goals of this rapid assessment were to improve the understanding of stream bank stability throughout the subwatersheds; identify grade control points, knickpoints (places with sharp changes in slope), areas of accelerated erosion, and habitat quality issues; and identify opportunities where restoring geomorphic processes and conditions would be beneficial (Figure 7). The completed document (VRWJPO, 2011) offers a distinct plan for implementing projects and best management practices in this area including water and sediment basins, bank stabilization, culvert re-sizing, etc. Additionally, the use of practices that help retain water and sediment on the land in the cropped fields in the upper reaches of the watershed such as contour strips, residue management, conversion to permanent cover crops, and buffer strips should be pursued.

Potential Ag and Open Land Management Projects	Lead Entity	Status	What's Needed
Etter Creek Watershed: ravine and streambank stabilization projects, water and sediment control basins, conversion to perennial cover	Landowners, VRWJPO, USDA-Natural Resources Conservation Service, Dakota and Goodhue SWCDs	VRWJPO 2010 Fluvial Geomorphic Assessment of Etter Creek and the Ravenna Coulees; 29 projects identified and prioritized	• Landowner cooperation • Funding • Continued cooperation between Counties
Spring Lake Park Reserve: ravine and gully stabilization projects	Dakota County Parks Department	Currently not addressing gullies/ravines as water originates outside Park land	• Cooperation to address water sources outside Park lands
Implementation of VRWJPO standards in Dakota Co. townships	Nininger Twp Marshan Twp Ravenna Twp	Current and continuing implementation	• Continued oversight and administration
Conversion of row crops to native prairie grasses > 220 acres	Prairie Island Indian Community with partners	In progress since 2004. Expanding into new sites until 2015. Maintenance of completed sites annually.	NA – Already in progress

Figure 7. Map from 2010 Fluvial Geomorphic Assessment of Etter Creek and the Ravenna Coulees showing the headwaters of Etter Creek, the location and activity of knickpoints, and the location of potential projects, existing and proposed retention basins, and parcels that have been converted to native vegetation (VRWJPO, 2011).



5.2.2 Urban and Suburban Stormwater Management

The cities of Hastings and Red Wing both enjoy their positions along the banks of the Mississippi River and both work to protect and improve the River's water quality. Hastings also boasts the Falls of the Vermillion River and the start of the Lower Vermillion River (Vermillion River Bottoms) within its city limits.

Hastings and Red Wing both implement the requirements of their stormwater discharge permits (MS4 permits) under the National Pollutant Discharge Elimination System (NPDES), delegated to the MPCA. Under the proposed waste load allocations in the South Metro Mississippi River TSS TMDL, these cities will be required to reduce sediment pollution in their stormwater by 25% from 1999 baseline conditions referred to in the TMDL. According to the draft TMDL, the MPCA will coordinate with partners to develop a set of best management practices (BMPs) which, when incorporated into the MS4 permit, will meet the waste load allocation by achieving an estimated 25% reduction in municipal areas already built up. Additionally, when these BMPs are applied to developing areas, in conjunction with the construction stormwater permit and minimum control measures, they will be considered to bring the cities into compliance with the TMDL. The Lower Vermillion River TMDL assigns no (0%) sediment load reductions needed from the cities of Red Wing and Hastings.

The City of Hastings has several specific and general water quality and stormwater management projects planned within the Mississippi Makeover Project Area. These projects will improve water quality and habitat of the Mississippi River and floodplain Lakes Rebecca and Isabelle and will assist the city with meeting the TMDL requirements.

The City of Red Wing is currently updating its Stormwater Management Plan with a new focus on protecting and improving surface water quality. The city's MS4 permit includes regulations for special resources such as the Wild and Scenic-designated Cannon River and Hay and Spring Creek – both designated trout streams – as well as the Mississippi River. Recently the city took action to convey a permanent conservation easement to the Minnesota Land Trust on 202 acres known as "Upper Harbor" that includes Bay Point Park, the Pottery Pond, and adjoining property along Hay Creek and the Mississippi River. The Upper Harbor Master Plan calls for the City to develop the Upper Harbor for open space, recreational and educational purposes while restricting industrial, residential, and large scale commercial use of the property. A variety of stormwater management and water quality features are planned as this area is re-developed and restored which will include demonstration projects of best management practices.

Red Wing also takes a proactive role in its "green infrastructure" systems for future generations through its Open Space Preservation Plan. Green infrastructure incorporates natural areas and open space to conserve the functions and values of natural ecosystems for a wide variety of benefits (City of Red Wing, 2008).

Potential Stormwater Management Projects	Lead Entity	Status	What's Needed
Lake Isabelle water level drawdown	City of Hastings		• Funding • Support from Lake residents
Pre-treatment of stormwater entering Lake Isabelle	City of Hastings		
Redevelopment of riverfront "Hudson" property – soil remediation and stormwater mgmt	City of Hastings	Reuse study complete by 12/2011. Dependent on development interest.	• Complete reuse study • Development interest
Redevelopment of Levee Park with stormwater mgmt integrated	City of Hastings		• Funding
Addition of raingardens during regrading and upgrades to Miss River boat launch parking lot	City of Hastings with partners (MDNR, DSWCD, VRWJPO)	Currently cooperating with Dakota SWCD for plans and cost share	• Project plans • Funding
Addition of stormwater mgmt projects as downtown redevelops	City of Hastings Property Owners		• Redevelopment opportunities
Addition of stormwater mgmt projects as Upper Harbor re-develops	City of Red Wing Commercial, transportation, marina operators	On list of priorities	• Completion of SWMP • Funding • Redevelopment opportunities
Erosion control from Cannonview Dr. to the Cannon River bottoms	City of Red Wing Cannon Valley Trail Association	Listed on priority concerns in Goodhue Co. Local Water Mgmt Plan	• Funding • Engineering and Design
Erosion control along Cherry St. from Oakwood Cemetery	City of Red Wing	Listed on priority concerns in Goodhue Co. Local Water Mgmt Plan	• Funding • Engineering and Design
Relocate city sand/salt storage from Upper Harbor	City of Red Wing	On list of priorities	• Alternate location • Funding Plan
Upper Harbor Storm Water Demonstration Project	City of Red Wing	On list of priorities	• Design and Engineering • Funding Plan
Urban erosion and sediment control technical assistance	Goodhue SWCD with partners	Objectives in 2010 – 2020 Goodhue Co. Comp. Local Water Plan	
Stormwater BMP installation - financial assistance	Goodhue SWCD with partners	Objectives in 2010 – 2020 Goodhue Co. Comp. Local Water Plan	• Funding

5.3 Public Awareness and Recreation

5.3.1 Civic Engagement

Engaged and informed citizens are a key component to restoration in the Project Area. Without support and action on the part of residents, recreationists, hunters, anglers, and outdoor enthusiasts, many of the strategies proposed above would not be accomplished. With budgets tight and funding scarce, the need and importance of restoration here must be proven through sound science and advocated by many in order for projects to be given priority.

The Mississippi Makeover Project took a unique approach to engaging citizens in the process of TMDL implementation planning. Through the citizens' visions and their indicators of successful restoration and with scientific input from technical experts, meaningful and quantifiable targets were identified for restoration in the Project Area.

While the work of making progress towards these targets advances, a continuation of civic engagement is imperative. The Mississippi Makeover Project, with additional funding from the MPCA will continue through at least 2012 with coordination by the Dakota County SWCD. This "next phase" of the project will include the development of a report card to track progress towards targets as well as events aimed at further education and understanding of the resources in the area and ways to restore them. Tours, informational meetings, events and continuing partnerships with similar organizations are components of the continuing Mississippi Makeover Project.

In addition to the Mississippi Makeover Project, several organizations strive to educate the public on ecological issues and involve them activities in the Project Area. While this is not an exhaustive list of all the great work being done in this realm, below is a list of the more significant programs in the area.

Civic Engagement Program	Lead Organization	Program/Organization Description
Mississippi River Forum	National Park Service	Intended to increase coordination between a multidisciplinary group of practitioners and decision-makers who are not consistently aware that related work is being done by others. The Forum is an opportunity for practitioners to connect their work to those in different fields who also impact the quality of the river. www.nps.gov/miss/naturescience/riverforum.htm
Lake Pepin Legacy Alliance outreach and education campaign	Lake Pepin Legacy Alliance	Leading with education and information; dedicated to slowing and reversing the trend of sediment and nutrient flow to Lake Pepin. Use of professional approach for public involvement in watershed restoration activities that elevate the importance of implementing the recommendations and "best practices" that science and reason dictate. www.lakepepinlegacyalliance.org/
Hastings Environmental Protectors outreach and volunteer programs	Hastings Environmental Protectors	To increase citizen awareness of the status of our unique natural resources. To achieve this goal we work with government, community, conservation groups, and individuals to preserve, restore and protect these resources. http://hastenviropro.org/
Vermillion Stewards	Friends of the Mississippi River	The Vermillion Stewards project aims to bring neighbors, groups and committed citizens from throughout the Vermillion watershed together to learn about and help the marvelous but troubled Vermillion River. Includes multiple hands-on volunteer opportunities. http://fmr.org/participate/ongoing/vermillion_stewards

5.3.2 Public Access and Use

The public's increased use and enjoyment of the vast natural resources in the Project Area is one goal of the Mississippi Makeover Project. In fact the "tag line" of the project – A Plan for Restoration Just Around the Bend – is used as a reminder that this area lies just outside of a major metropolitan area, or a just beyond a bend in the river. Perhaps local residents and those in the Twin Cities metro don't have to travel to northern Minnesota to experience a great outdoors adventure or a fantastic hunting or fishing trip. As the ecology is restored, the water quality improves, and healthy communities of plants and animals return and thrive, opportunities for hunting, angling, and tourism in the area should also improve.

Multiple agencies, organizations, and units of government work to provide public access and recreational opportunities in the Project Area. Below is a list of some of the more significant public lands and trails.

Access or Recreation Location	**Lead Entity**	**Description**
Spring Lake Park Reserve	Dakota County Parks	1,200 acres along Spring Lake; trails, boat landing (unimproved), facilities, scenic views www.co.dakota.mn.us/LeisureRecreation/CountyParks
State owned Gores Pool 3 WMA/AMA	MDNR	6,670 acres of floodplain forests and backwaters (Fig 5) with access to hunting, fishing, boating www.dnr.state.mn.us/wmas/index.html
Red Wing Wildlife League Lands	Red Wing Wildlife League	2,800 acres of bottomlands in the City of Red Wing along Lower Vermillion, Cannon and Mississippi Rivers; working to restore these areas to 1930's conditions ; management plan complete
Hastings City Parks and Trails	City of Hastings	Lake Rebecca Park and Levee Park are slated for improvements as grant funds arise and redevelopment occurs; 28 mi of trails, expanding as able www.ci.hastings.mn.us/Parks/index.htm
Red Wing City Parks and Trails	City of Red Wing	Series of riverfront parks with River Front Trail system; connections to Cannon Valley Trail and Goodhue Pioneer Trail; Red Wing Environmental Learning Center; hundreds of marina slips; two River public access points www.red-wing.org/redwingparks.html
Mississippi River Companion for the Mississippi National River and Recreation Area	National Park Service	Printed guide with maps and information about recreating on and along the Mississippi River from Dayton to Hastings, MN. www.nps.gov/miss/planyourvisit/missrivercomp.htm

5.3.3 Program, Project, Partner Coordination

One goal of the Mississippi Makeover Project is to implement congruent and complementary projects within the Project Area - attempting to bridge the efforts of many different agencies and organizations. The partnership among the stakeholders formed through this project serves to improve dialogue and cooperation among the various entities. Continuation of the Mississippi Makeover Project will strengthen this partnership.

Partners include:

Lake Pepin Legacy Alliance
Friends of Mississippi River
National Park Service
Audubon Society
Clean Up our River Environment
Prairie Island Indian Community
Local Government Units (counties, cities, townships)
Soil and Water Conservation Districts
Metropolitan Council
U.S. Army Corps of Engineers
Minnesota Department of Natural Resources
Wisconsin Department of Natural Resources
U.S. Fish and Wildlife Service
USDA-Natural Resources Conservation Service
The Nature Conservancy
Trust for Public Land
Universities and colleges

6.0 Long-term Monitoring

Monitoring changes in water quality and biological responses is a critical component in any implementation program. As projects, both large and small, are implemented through the Mississippi Makeover Project and the larger South Metro Mississippi TSS TMDL, progress toward the stated targets and goals must be documented through sound science and established protocols. The following monitoring strategy was prepared by the same group of technical experts that developed metrics and recommended short and long-term targets for indicators established by the Mississippi Makeover Citizens Advisory Group (Section 3 above).

Water Clarity

Total Suspended Solids

- Continue Metropolitan Council's bi-weekly sampling at Lock and Dam #2 and Lock and Dam #3 following well established and existing protocols.

Comments: This is an on-going monitoring program with currently no additional needs. However, long-term sampling capabilities may be affected by increasing laboratory analysis costs.

Secchi Disk Transparency

- Continue Long Term Resource Monitoring Program (LTRMP) bi-weekly sampling during summer and bi-monthly sampling during spring and fall in Pool 4 following well established and existing protocols. This includes four fixed sites in Lake Pepin and one fixed site in Upper Pool 4, and two sites near the confluence of the Vermillion and Cannon Rivers.
- Continue transparency tube measurements at Lock and Dam #3 collected by the ACOE following existing protocol.

Comments: This is an on-going monitoring program with currently no additional needs.

Sedimentation

Lake Pepin life span and accumulation rate

- Repeat sediment core sampling completed by the St. Croix Watershed Research Station (Science Museum of MN) at previously monitored sites in 2018 and 2025.

Comments: There are currently no plans to continue this sampling. Funding is needed to repeat these surveys. If funding is unavailable, bathymetry surveys or estimating accumulation rate based on TSS data could be considered.

Submersed Aquatic Vegetation

% Frequency of Occurrence and Species Richness

- Continue Environmental Monitoring and Assessment Program (EMAP) annual sampling during summer at approximately 200 randomly selected sites from Pool 2 to Upper Pool 4 following well established and existing protocols.

Comments: MN Dept of Natural Resources has funding to complete this monitoring for 2011-2013. Additional funding may be needed to continue this monitoring long-term. Data would be stored by the MN Pollution Control Agency.

Mussels

Catch per unit effort , number of species, and percent mucket mussel

- Complete timed surveys in 2018 and 2025 following methods used to establish baseline data (Kelner, et al 2002).

Comments: Repeating methods used in the initial survey (2000-2001) during 2018 and 2025 would provide an estimate of mussel catch per unit effort, species diversity, and percent mucket mussels prior to indicator target dates. There are currently no plans to continue this sampling. Funding is needed to repeat these surveys.

Fish

Fish assemblage

- Continue Long Term Resource Monitoring Program annual fish sampling for Pool 4, 8, and 13 following well established and existing protocols.
- Continue MN DNR backwater electrofishing surveys for Centrarchid species in Pool 3, 5, 5a, 6, and 9 following well established and existing protocols.

Comments: These are on-going monitoring programs with currently no additional needs

Waterfowl

- Complete third consecutive year (in 2011) of fall, weekly aerial surveys from Pool 2 to Lower Pool 4 following established and existing protocols.
- Establish sampling protocol and complete fall ground counts of Pig's Eye Lake and Lake Pepin

Comments: Targets for waterfowl have yet to be established by the Mississippi Makeover CAG. Completing a third consecutive year in 2011 of weekly, fall aerial counts combined with ground counts on Lake Pepin and Pig's Eye Lake will provide data for establishing indicators, targets, and determining a long-term monitoring strategy. Funding is needed to continue the surveys beyond 2011.

Aquatic Habitat Quality Index

- Continue MN Dept of Natural Resources annual surveys in Pool 2, 3, 5, 5a, 6, 7, and 9 following well established and existing protocols.

Comments: This is an on-going monitoring program with currently no funding needs. However, continued efforts to standardize and train additional staff in AHQI sampling methods should be considered.

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Appendix A

- Mississippi Makeover Project Fact Sheet
- Fish Assemblage Targets

MISSISSIPPI MAKEOVER

A Plan for Restoration, Just Around the Bend

Restoration Focus: The Mississippi River above Lake Pepin, the Lower Vermillion River, and Spring Lake are polluted with sediment and algae. Community support and sound science can protect and restore these ecosystems, creating a regional gem for recreation, wildlife and economic opportunities.

Healthy Ecosystem
Abundant Wildlife
Recreational Mecca

Spring Lake is a wide and shallow expanse of water within the Mississippi River upstream of Hastings in Pool 2. It was once a renowned duck hunting area and now boasts Dakota County's Spring Lake Park Reserve along much of its shore.

Pool 3 of the Mississippi River extends from Lock and Dam 2 in Hastings downstream to Lock and Dam 3 near Red Wing. Pool 3 includes many large floodplain lakes and the confluence with the St. Croix River.

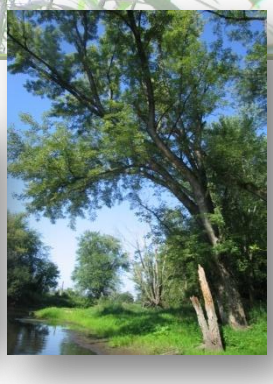
The Lower Vermillion River begins with a 60 foot waterfall in Hastings and travels parallel to Pool 3 for 20 miles. Its flows often mingle with Mississippi River water through a series of sloughs.

MORE

What is the Mississippi Makeover Project?

The ultimate goal of this project is a healthy and protected ecosystem that attracts abundant wildlife, becomes a mecca for outdoor enthusiasts, and provides economic benefits to local communities.

- ✓ It is a smaller part of the ongoing Mississippi River/Lake Pepin Total Maximum Daily Load Study.
- ✓ It concentrates on the geographic area that includes Pool 3, Spring Lake, and the Lower Vermillion River.
- ✓ It aims to bridge multiple projects and priorities of agencies that have responsibility to protect and improve water quality, wildlife habitat, and recreational opportunities in this area.
- ✓ It will result in congruent and complimentary project goals among local stakeholders and agencies.
- ✓ It includes the following steps:
  1. Convene a citizen advisory group to recommend key indicators of restoration success to governmental agencies for these areas. (Winter 2008 - 2009)
  2. Convene a technical/scientific panel to determine how the selected indicators can best be achieved, accurately measured and tracked over time. (Late winter/Spring 2009)
  3. Develop a comprehensive plan for implementing the results of this project including timelines, budgets, responsible parties, and realistic outcomes. (Summer/Fall 2009)



Low Water Clarity Results in Big Habitat Problems

One of the biggest problems with the water quality in the Mississippi River, Spring Lake, and the Lower Vermillion River is low clarity. These waterbodies have high amounts of sediment, algae, and other materials suspended in the water, giving it a cloudy or turbid appearance. High turbidity is aesthetically offensive to humans, but it's even more unpleasant for plants and animals that live in these habitats. Cloudy water can prevent fish from finding prey, prevent light from reaching riverbed plants, allow sediment to bury insects and fish eggs, and generally degrades habitat quality. It is also contributing to the rapid filling-in of Lake Pepin which is occurring at 10 times the pre-settlement rate. The sources of turbidity are varied. Much of the solution to the water clarity impairment will require changes in the watersheds that drain to the Mississippi River. However, part of the solution includes river management. Activities such as water level drawdowns and island building can greatly improve both water clarity and river habitats.

A Partnership

The Mississippi Makeover Project is a partnership of the following groups:

- ✓ Local Citizens and Stakeholders
- ✓ Dakota County – project coordinator
- ✓ Dakota County Soil and Water Conservation District – project coordinator
- ✓ MN and WI Departments of Natural Resources
- ✓ MN Pollution Control Agency
- ✓ U.S. Army Corps of Engineers
- ✓ U.S. Fish and Wildlife Service

For more information please visit our website: www.dakotaswcd.org/wshd_missmak.html or contact Laura Jester, Dakota County Soil and Water Conservation District, (651) 480-7784 or laura.jester@co.dakota.mn.us.

MISSISSIPPI MAKEOVER

A Plan for Restoration, Just Around the Bend

Desired Fish Assemblages

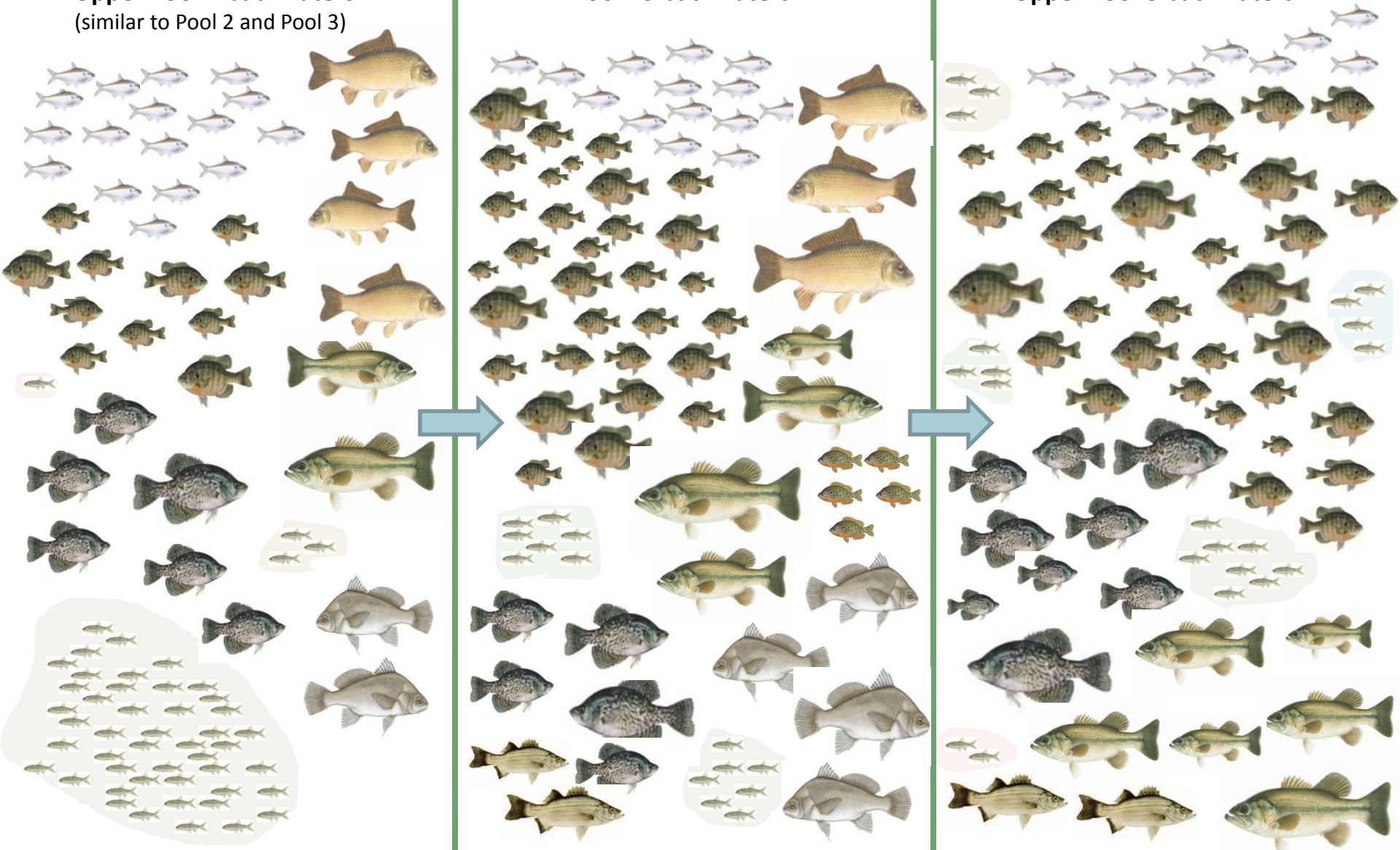
Assumptions and Background Information

1. The assemblage figures are broken out between “backwaters” and “channel.”
2. The figures use current data from Upper Pool 4 as an indication of existing conditions in Upper Pool 4, Pool 3, and Pool 2. Experts generally agree that data from Upper Pool 4 is comparable to conditions in Pools 2 and 3.
3. The figures use current data from Pool 13 as realistic desired assemblages for our project area for the 15-year timeframe. Secchi disk depth in Pool 13 reflects the 15-year target for Secchi depth in the completed part of the target table (as agreed to by the CAG at their 4/22/09 meeting).
4. The figures include current data from Upper Pool 8 as a *possible long term hopeful goal*. It would take many dramatic changes in water quality and habitat conditions over a period of decades to realize even the possibility of finding the fish assemblage that exists in Upper Pool 8.
5. It is important to keep in mind that habitat conditions vary greatly from site to site and among the Pools. Generally, improved water quality and increased aquatic vegetation will result in more desirable assemblages of fish. However, as conditions within and among Pools vary, so will the magnitude of shifts in fish communities. Subtle changes over time, rather than wholesale changes in communities, may be the more likely result of restoration efforts. It is for this reason that we choose not to use the term “target” as our endpoint, but rather “desired assemblages.”

Upper Pool 4 backwaters
(similar to Pool 2 and Pool 3)

Pool 13 backwaters

Upper Pool 8 backwaters

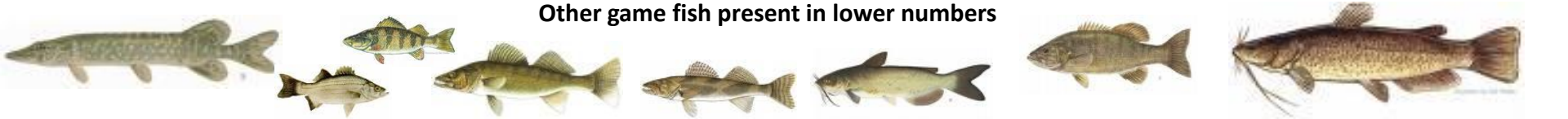


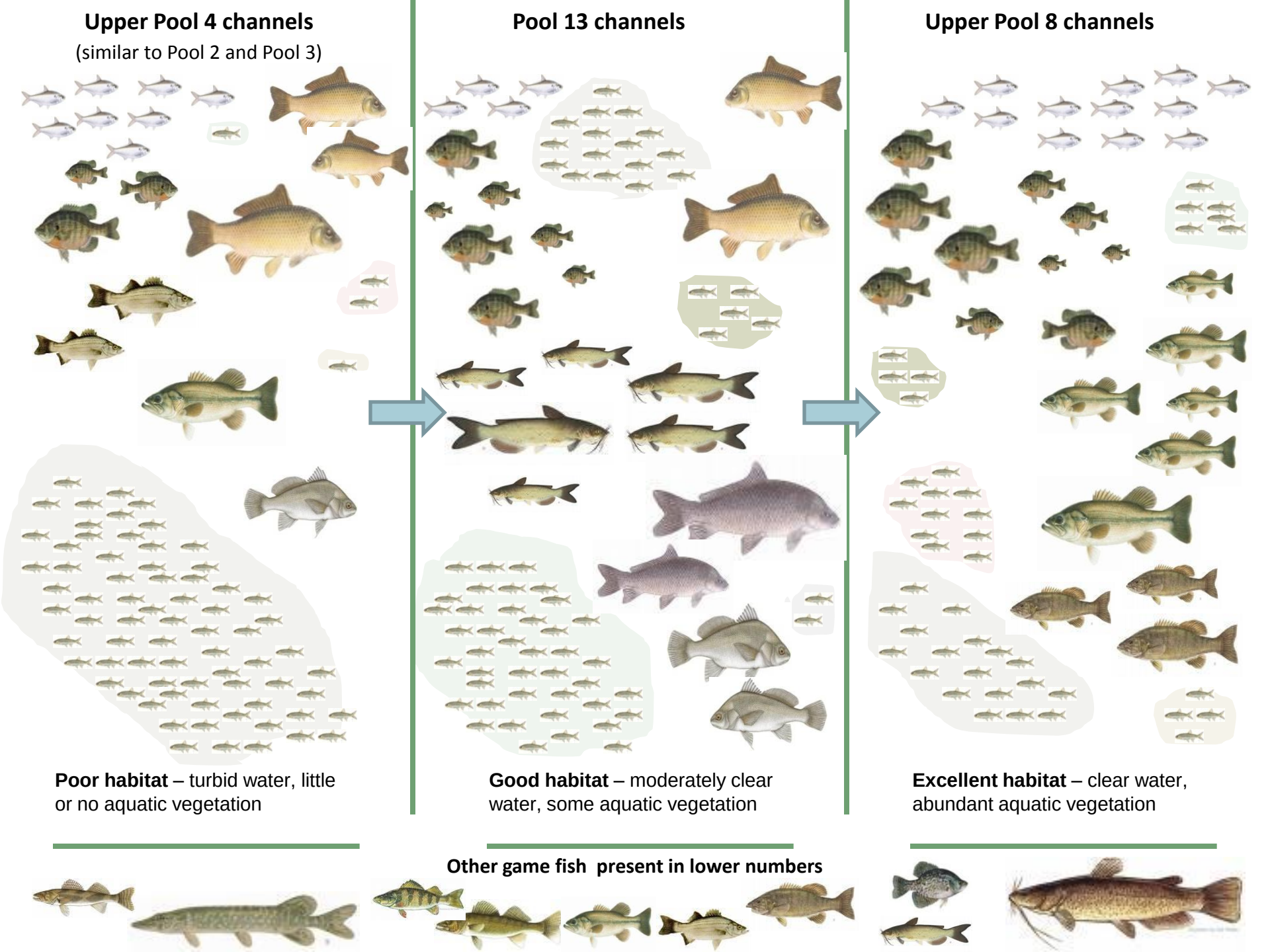
Poor habitat – turbid water, little or no aquatic vegetation

Good habitat – moderately clear water, some aquatic vegetation

Excellent habitat – clear water, abundant aquatic vegetation

Other game fish present in lower numbers




Upper Pool 4 channels
(similar to Pool 2 and Pool 3)
Pool 13 channels
Upper Pool 8 channels
Poor habitat – turbid water, little or no aquatic vegetation
Good habitat – moderately clear water, some aquatic vegetation
Excellent habitat – clear water, abundant aquatic vegetation
Other game fish present in lower numbers

Fish assemblage – species key

Gizzard shad – abundant and widely distributed forage species found in a variety of habitat types.

Common carp – common, pollution tolerant, non-native species found in all habitat types but preferring shallow backwater areas.

Bullhead minnow – abundant species that prefers sluggish pools and backwaters having some flow – fairly tolerant of turbid conditions

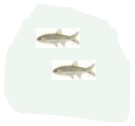
Freshwater drum – abundant, pollution tolerant species found throughout channels and pooled areas.

Weed shiner – less common, non-game minnow species preferring abundant aquatic vegetation and clear water .

Smallmouth bass- popular sport fish found primarily in flowing channels with rocks and riffles and good water quality.

Crappie – two species – ***black crappie*** are more common and prefer clear water with good vegetation – ***white crappie*** are often found in more turbid areas.

River shiner – usually found in channel areas over a variety of bottom types – tolerant of high turbidity.



Mimic shiner – prefers riffle areas with moderate flow, tolerates moderate to high turbidity

Largemouth bass – popular sport fish found in a variety of habitats, but preferring clear backwaters with abundant aquatic vegetation.

Spotfin shiner - prefers clear water areas with moderate or swift current.

Channel catfish – sport fish preferring flowing areas with deep pools and logs or other cover. Tolerates turbid conditions.

Smallmouth buffalo – less common, non-game species preferring clearer water and flowing channels with moderate current.

White bass – common sport fish that migrates long distances to spawn, tend to avoid highly turbid areas and prefer sandy or rocky bottom.

Emerald shiner - pollution tolerant, abundant minnow species that tolerates a wide-range of turbidity and bottom types, often found in flowing channels.

Orange –spotted sunfish – small sunfish species that is tolerant of silt and continuous high turbidity, more common in lower river pools

Bluegill – one of the most popular sport fish, found in many areas but preferring clear, backwater areas with abundant aquatic vegetation.

Channel shiner – prefer moderate to swift current over a variety of substrate types

Backwaters

Percent composition by species (top 10 species)

Species	Upper Pool 4	Pool 13	Upper Pool 8
Emerald shiner	46%	7%	8%
Gizzard shad	17	14	10
Bluegill	11	31	35
Black crappie	5	5	9
Carp	4	3	
Bullhead minnow	3		3
Freshwater drum	2	4	
Largemouth bass	2	4	6
Spotfin shiner	1		
White crappie	1		
Mimic shiner		7	4
Orange-spotted sunfish		5	
White bass		2	2
Spotfin shiner			2
Weed shiner			4

Channels

Percent composition by species (top 10 species)

Species	Upper Pool 4	Pool 13	Upper Pool 8
Emerald shiner	71%	18%	18%
Gizzard shad	8	4	12
Bluegill	3	7	11
Carp	3	2	
Bullhead minnow	1		4
Freshwater drum	1	2	
Largemouth bass	1		6
Spotfin shiner	2		12
Mimic shiner	1	41	6
White bass	2		
River shiner		5	4
Smallmouth bass			3
Channel catfish		6	
Channel shiner		2	
Smallmouth buffalo		2	