Task Order No. 10

SCOPE OF WORK REPORT

Summaries of
Minnehaha Creek Watershed District
Plans / Studies / Reports

US Army Corps
of Engineers ®
St Paul District

Prepared for:

United States Army Corps of Engineers
St. Paul District

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Prepared by:

HDR

HDR Engineering, Inc.
6190 Golden Hills Dr.
Minneapolis, MN 55416

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14. ABSTRACT

This report is to be used in the development of a project management plan for the feasibility study and environmental assessment for the Minnehaha Creek Watershed in Hennepin County, Minnesota. The report includes a review of previous studies, a Gantt chart (critical path schedule) and recommendations for analysis.

15. SUBJECT TERMS

Water Resources Development   Environmental assessment
Water quality

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Index of Recommendations

Additional water quality monitoring stations should be established for minor watersheds outletting to Lake Minnetonka. In particular, monitoring should be expanded to some of the Minor Watersheds that encompass lake/stream systems such as Classen Creek.

The MCWD should begin a long-term effort to integrate data collection on watershed loading, internal Lake Minnetonka loading and in-lake circulation for development of a whole-lake model.

A comprehensive lake wide model should be completed for Lake Minnetonka. These bays, however, are poorly understood. The BATHTUB computer model, or a similar model, can be used as a tool to help define this critical behavior.

The MCWD should begin a long-term effort to integrate data collection on watershed loading, internal Lake Minnetonka loading and in-lake circulation for development of a whole-lake model.

A comprehensive lake wide model should be completed for Lake Minnetonka.

The Grays Bay dam operating plan should be amended, if possible, to minimize water level fluctuations and improve the in-stream flow regime of Minnehaha Creek

Key Elements of this assessment include:

1. *Using XP-SWMM Model, complete water balance analysis of Lake Minnetonka Basin for dry, wet and normal precipitation year conditions*
2. *Check/reset rating curve (stage-discharge) for Grays Bay Dam*
3. *Evaluate low flow maintenance options for Minnehaha Creek below Grays Bay Dam*
4. *Evaluate role that upstream storage plays in attenuating lake level bounce*

The MCWD should pursue becoming a Cooperating Technical Partner with FEMA and work with communities within the watershed to update their FEMA floodplain maps based on the HHPLS results. The proposed mapping may not qualify for any of the Federal Continuing Authority Programs (CAP) and may have to be considered under Section 22 Program for Assistance to States (in this case with FEMA work). One potential solution may be to seek a Letter of Map Revision (LOMAR).

The MCWD should incorporate into its Monitoring Program the collection of flow data in Minnehaha Creek that would better define the relationship of the creek to groundwater.

The MCWD should supplement its routine data collection program with additional data collection to address the questions raised above.

HDR concurs with the Corps' review of the H&HPLS model. THE MCWD should add gauges to the lower watershed to improve the XP-SWMM model for design purposes. It is HDR's understanding that the NCWD is converting the XP-SWMM model to HEC1/HEC-HMS format. The Corps may wish to use this converted model if design of projects on the creek is pursued.

While not identified in the HHPLS recommendations, it is the opinion of the MCWD that there are opportunities for corridor restoration along Long Lake Creek. The outlet from Long Lake, and the immediate downstream areas of the creek, will be altered as a result of the current MNDOT T.H. 12 project. Downstream reaches of the creek will subsequently receive higher volumes of water as a result of this and other development within the sub-watershed. It may be advantageous at this time to investigate the potential for bank restoration and maintenance of a hydrologic flow regime.

This is a powerful demonstration site for realizing infiltration goals that should be used for educating other stakeholder groups in the years ahead, including:

- *CAC members*
- *Community Leaders*
- *Key City Personnel*
- *Elected Officials within the MCWD*
- *Stewardship Leaders in Faith Groups*
- *Education Leaders*
- *Media*
- *Others TBD*

This provides a wonderful and colorful media opportunity to educate about the role carp play in stirring up the phosphorus and other sediment-pollutants in a lake. If the occasion arises again, MCWD should target the activity for local media within the subwatershed in which it occurs and the general TV broadcast media (which, to date, have not done anything in this area).

After a successful groundbreaking two years, the MCWD is planning a ceremonial opening of the ponds with the three key neighborhood groups in the subwatershed, once the protective fences come down from around the landscaping. This is one of the few special educational/media events the district is currently involved in.

After a groundbreaking at a local Edina grade school two years ago to teach about the wetland pond system and a subsequent field trip to the sites, the MCWD has since reconfigured its educational outreach to curriculum development and adults.

A Rule M plan was created last year, which will be implemented with staff should Rule M go out for public discussion. The plan would not need modification, even with H&H considerations and a subwatershed focus, except for adding some key graphic elements.

This program needs to be summarized for key stakeholders at the city and policy levels in a WaterPro Bulletin so that its applications can be better used and understood. The same should be done for H&H, MCRAM and other studies.

A "Heal the Bay"-like program should be developed in this subwatershed area, modeled loosely after the one in Santa Monica. After convening a national panel of experts in 2001 to create a plan for treating this subwatershed, the MCWD needs to put a target program in place. (See Subwatershed Section VIII.).

Possible events planned around the headwaters and Upper Watershed are discussed in Section VII, p.30.

See Subwatershed Section IX.

Since a great deal of time and money has been spent defending and protecting Camp Coldwater Springs, it behooves the district to begin thinking about what role it should play at CCS. As construction wraps up in 2004, the plan recommends efforts to implement or incorporate the area's rich historical information and land use profile into the developing curriculum.

The canoe map should be revised to feature more information about habitat, native plants and buffers, BMPs in action, land use features and examples along the creek where people can see erosion problems and solutions, infiltration techniques, historical markers and other visually educational sites, aided by appropriate signage along the creek.

Re-position select paintings to the website as graphics for different page sites.

The MCWD is currently developing a strategy to approach member cities with the outline for the U.S. Army Corps Feasibility Study and to gather support for the Study. The Communications plan should be updated to include this initiative by the end of December 2003.

The MCWD should initiate the development of a public involvement master plan for the Minnehaha Creek Corridor plan development and U.S. Army Corps Feasibility Study Process. This plan should be completed and in-place by the end of January 2004.

A comprehensive lake wide model should be completed for Lake Minnetonka.

The Grays Bay dam operating plan should be amended, if possible, to minimize water level fluctuations and improve the in-stream flow regime of Minnehaha Creek. Key Elements of this assessment include:

1) *Using XPSWMM Model, complete water balance analysis of Lake Minnetonka Basin for dry, wet and normal precipitation year conditions.*
2) *Check/reset rating curve (stage-discharge) for Grays Bay Dam*
3) *Evaluate low flow maintenance options for Minnehaha Creek below Grays Bay Dam*
4) *Evaluate role that upstream storage plays in attenuating lake level bounce*

The District should support the on-going Eurasian Watermilfoil control programs under way by other agencies.

1.0 TASK ORDER INFORMATION

HDR Engineering, Inc. (HDR) reviewed numerous plans, studies and reports produced by the Minnehaha Creek Watershed District (MCWD). The MCWD has recently invested considerable resources in updating the body of knowledge available about the district in preparation for the third generation watershed plan development process. Major reports that were reviewed for this effort to provide guidance to the U.S. Army Corps Project Delivery Team (PDT) included the following:

1) MCWD Watershed Management Plan – 1997 *(See page 10.)*
2) Comprehensive Wetland Functional Assessment *(See page 12.)*
3) H&HPLS Model *(See page 17.)*
4) Education and Communications Plan and Audit *(See page 42.)*
5) Minnehaha Creek Stability and Habitat Assessment Report *(See page 101.)*
6) MCWD 2002 Hydrologic Data Report *(See page 109.)*

HDR also reviewed numerous other documents and reports completed by the MCWD in years prior. While they serve to give the reader a flavor of the MCWD and its mission, the most pertinent documents to the Feasibility Study are the aforementioned six (6) reports.

1.2 PURPOSE OF THIS TASK ORDER

The purpose of this task order, Task Order No. 10, was for HDR to assist the St. Paul District, U.S. Army Corps of Engineers in preparing a Scope of Work Report (SOWR) for the Minnehaha Creek Watershed Final Feasibility Report and Environmental Assessment and/or Environmental Impact Statement (FFR/EA/EIS). The SOWR will be used by the St. Paul District to develop a Project Management Plan for the FFR/EA/EIS. The required work to complete the SOWR includes:

1) An inventory of existing reports, computer models and data

2) A data gap analysis including the identification of the number and type of any additional inventories

3) A Scope of Work (SOW), which includes the identification of tasks

4) Documentation of the assumptions used in the SOW to include the number of proposed initial project alternatives, how many will remain after the Alternative Screening Letter Report (see Table 1), etc.

5) A Gantt Chart for use as a road map leading to the FFR/EA/EIS

6) A description of the proposed In-Kind services to be provided by the non-federal sponsor

1.3 GENERAL BACKGROUND INFORMATION

The federal interest in initiating the feasibility phase of study for the Minnehaha Creek Watershed was identified in the Reconnaissance Study for the Upper Mississippi River – Lake Itasca to Lock and Dam No. 2, dated June 2001. The Reconnaissance Study provided a basis for negotiating the Project Study Plan (PSP, dated Nov. 2002) and Feasibility Cost Sharing Agreement (FCSA). The FCSA was executed on 14 January 2003.

The Final Feasibility Report and Environmental Assessment and/or Environmental Impact Statement (FFR/EA/EIS) will generally discuss the following two types of efforts:

1) **System evaluations:** focused on assessing the overall watershed needs and general locations for restoration, and;

2) **Site-specific evaluations:** focused on developing detailed restoration options for possible implementation at specific sites.

The system and site-specific evaluations in the FFR/EA/EIS will investigate restoration opportunities in the following general areas:

- **Watershed Stabilization** - Evaluate basin-wide, land use, conservation easements, wetland/water retention features, riparian filter strips, etc.
- **Creek Corridor System Restoration** - Evaluate opportunities to restore habits in the creek corridor system through, for example, stream restoration, etc.

- **Water Level Management and Flood Damage Reduction** - Evaluate options to reduce rapid fluctuations in creek water levels (from urbanization) and reduce flood damages by restoring the natural flow regime. Increase the retention time of runoff throughout the watershed.

- **Floodplain Restoration and Protection** – In concert with No. 2.iii. above, evaluate floodplain use, the potential for restoration of floodplain function, and the value/potential for acquisition of conservation easements of some floodplain lands.

- **Recreation** – The optimization of open space, greenway and associated recreation options will be considered as part of the overall plan.

- **Ecological integrity** – Consider alternatives that increase the diversity and quantity of flora and fauna in both upland and aquatic systems within the watershed.

- **Water quality** – Initiate projects and programs which: preserve, maintain and improve the aesthetic, physical, chemical and biological composition of surface waters and groundwater, reduce the overall nutrient and pollutant loading from MCWD to the Mississippi River, minimize the risk of threats to public health. Consider alternatives that promote the infiltration of surface water for the purposes of improving water quality and increasing groundwater recharge.

The information, tasks and milestones identified in the Scope of Work Report will assist the Project Delivery Team in developing the Project Management Plan for evaluating these problems and opportunities.

1.4 TASK DESCRIPTIONS

HDR will follow ER 1105-2-100 (Planning Guidance Notebook) in developing the Scope of Work Report. The contractor will review the applicable portions of the ER to include Appendix G, which contains information on the content of a feasibility report.

The Contractor will conduct a site visit as needed; coordinate and confer with the non-Federal Sponsor (Minnehaha Creek Watershed District, Minnesota), pertinent State and Federal agencies and other stakeholders during the process of developing the report.

The completion of this contract will require the execution of the following tasks:

1. **Collect, Compile and Evaluate Existing Plans, Studies and Reports**

   The Scope of Work Report (SOWR) will evaluate the existing plans, computer models, studies and reports and identify and summarize the applicable goals and objectives that relate to the issues listed above. The report will identify gaps in the data and, if needed, identify the number and type of any additional inventories. The SOWR will include an inventory of reports, computer models and other sources of information for later reference by the Project Delivery Team. A partial list of existing reports is included in Section V of the Project Study Plan (dated Nov. 2002). The completion of this task will assist the contractor in developing the Gantt Chart identifying the work items and milestones leading to the Final Feasibility Report and Environmental Assessment and/or Environmental Impact Statement (FFR/EA/EIS).

2. **Identifying Major Milestones for the Final Feasibility Report and Environmental Assessment and/or Environmental Impact Statement (FFR/EA/EIS)**

   The Scope of Work Report (SOWR) will include a Scope of Work and a Gantt chart (critical path schedule) that leads to a Final Feasibility Report and Environmental Assessment and/or Environmental Impact Statement (FFR/EA/EIS). The SOWR will include documentation of the assumptions used to develop the SOW for the FFR/EA/EIS to include, for example, the number of proposed initial alternatives and the number remaining after the Alternative Screening Letter Report (see Table 1 below). Table No. 1 contains a list of the Corps' major tasks/milestones for use in the Gantt chart. Each task and sub-task will include documentation of the assumptions used. The SOWR will expand on the list in Table 1 to include sub-tasks that lead up to each milestone. The contractor will study the existing Project Study Plan (dated Nov. 2002) to ensure that all the applicable tasks, required reports and coordination identified therein are included in the final list of tasks and milestones. The contractor will coordinate with the U.S. Army Corps of Engineer, the Minnehaha Creek Watershed District, local units of government, and identified stakeholders to insure that the list in Table 1 includes all the milestone requirements of each organization. Milestones will need to be added, for example, for additional stakeholder meetings (public meetings etc.) and meetings with the Minnehaha Creek Watershed Board.

Each sub-task/task and milestone will include the identification of the proposed in-kind services that the non-federal sponsor will provide (when applicable to a task). A short description of the in-kind service as well as its monetary value will be included.

Table 1 Feasibility Phase Milestones, Minnehaha Creek Watershed Study	Date	In-Kind Services	In-Kind $
Notice of Intent/ Notice of Initiation of Feasibility Study	Feb-03		
Complete the Scope of Work Report Plan			
Complete the Project Management Plan			
Complete the Public Information and Communication Plan			
EA/EIS Scoping Meeting – Public Workshop			
Field Investigations Complete			
Alternative Screening Letter Report			
Alternative Formulation and Evaluation Complete			
Alternative Formulation Report Complete			
Alternative Formulation Briefing for Corps MVD and Hdq USACE			
DFR and Draft EA/EIS review/comment/revision			
Prepare Draft Feasibility Report (DFR) and Draft EA/EIS			
Transmit DFR and DEA/DEIS to Division and HQ and mail to public			
Comment and Response Period			
Prepare Final Feasibility Report (FFR) and Final EA/EIS			
Transmit FFR and FEA/FEIS to Division and HQ			
Division Commander's public notice			

1.5 REPORT REVIEW

A draft version of the report shall be submitted to the St. Paul District for review. The St. Paul District will distribute the draft report to the local sponsor and to in-house personnel for review. The St. Paul District will submit written comments and suggestions to the contractor. The contractor will then revise the report based on the comments provided and submit a final report.

1.6 SUBMISSIONS FORMAT

All work required under this scope of services shall be prepared and submitted as follows:

1) The report shall be prepared using "Microsoft Word" word processing software. The project tasks and milestones (Gantt chart) will be prepared using "Microsoft Project" project management software. The file containing the Gantt chart will include a critical path analysis, documentation of the assumptions used, identification of resources and linked task relationships. Hard-copy submittals shall be on 8.5- by 11.0-inch white bond paper with accompanying 3.5-inch diskettes or CDs. The report should use the "Times New Roman" 12 font. The left-hand margin shall be 1 inch to allow for binding of the report.

2) The Contractor shall transmit twenty (20) hard copies and one (1) electronic copy of the draft report to the Contracting Officer for review by the St. Paul District and Sponsor.

3) The Contractor shall transmit twenty (20) hard copies and one (1) electronic copy of the final report to the Contracting Officer.

1.7 SCHEDULE

1.	Initiate work on the contract	September 2003
2.	Submit a draft Scope of Work Report (SOWR)	6 weeks after work is initiated
3.	Corps reviews SOWR	10 days for review
4.	Contractor submits a final SOWR	10 days after receiving Corps comments

The Contractor will commence work following receipt of a Notice to Proceed from the Contracting Officer. The draft report shall be submitted 6 weeks from the date of the Notice to Proceed. The final SOWR shall be submitted ten (10) days after the contractor is furnished the final comments. The period of performance for the delivery order will extend for 4 months from the date of the Notice to Proceed.

1.8 ADMINISTRATION, MEETINGS AND COORDINATION

The Contractor will assign a "Study Manager" prior to start of work for the routine administration and coordination necessary for the completion of work under this contract. The point of contact in the St. Paul District for this work is Kenton Spading, Project Manager, Project Management Branch, (651) 290-5623, E-mail: spading@usace.army.mil. Routine coordination of work will occur primarily between Mr. Spading and the Contractor's designated Study Manager.

1.8.1 STUDY MANAGER RESPONSIBILITIES

The Contractor's assigned Study Manager is responsible for the routine administration and coordination required to fulfill the contractual obligations to the St. Paul District. The Contractor's personnel shall be expected to work in close coordination with the Contracting Officer, the authorized representative, or other assigned St. Paul District personnel. The Study Manager is the person responsible for the validity of the material presented in the documentation, and in the event of controversy or court challenge, may be called upon to testify on behalf of the St. Paul District in support of the findings.

1.8.2 MEETINGS AND SITE VISITS

The Contractor shall be responsible for coordination with the necessary St. Paul District personnel prior to field inspections and meetings to discuss problems, opportunities, and needs related to the work.

1.8.3 COORDINATION

The Contractor is expected to maintain close coordination with the St. Paul District during the work. At least every two weeks, the contractor shall provide an email update on the status of the study. The Corps of Engineers encourages the Contractor to contact the St. Paul District at any time to resolve issues or arrange meetings. The Contractor will record minutes of each meeting and provide a copy electronically to the St. Paul District's Project Manager.

1.9 OTHER CONTRACTOR RESPONSIBILITIES

1.9.1 PUBLISHING RESTRICTIONS

Neither the Contractor nor a Contractor's representative shall release or publish any sketch, photograph, report, or other material of any nature obtained or prepared under this contract without specific written approval of the Contracting Officer or authorized representative. The Contractor agrees not to assert any rights and not to establish any claim with respect thereto.

1.9.2 CONTRACTOR QUALITY CONTROL

The Contractor shall be responsible for quality control (e.g. internal contractor staff review, non-federal sponsor review as appropriate, proof reading etc.) during the life of this contract.

1.9.3 SAFETY

The Contractor shall comply with EM 385-1-1, "Safety and Health Requirements Manual", dated September 1996. This manual presents Government requirements to promote worker safety in the field.

1.9.4 BILLING AND PAYMENT

The Contractor will comply with the requirements of the basic contract for billing.

1.10 GOVERNMENT FURNISHED DATA

The St. Paul District will provide the Contractor with available background information and project documentation in hard copy or electronic format. This information will include:

- A copy of the Minnehaha Creek Watershed Project Study Plan dated November 2002.
- Estimates of the time involved in executing/coordinating some of the Corps-related tasks listed in Table 1 (e.g. coordinating with high authority etc.).
- ER 1105-2-100, Planning Guidance Notebook, dated 22 April 2000 (provided in electronic format).
- An example of a Feasibility Report.

1.11 INSPECTIONS AND ACCEPTANCE

The performance of the Contractor and quality of the work delivered, including services rendered, and the documentation in support thereof shall meet generally accepted professional standards and shall be subject to inspection, review, and acceptance by the St. Paul District. The St. Paul District's review process may include higher Corps echelons and other Federal and State resource protection and management agencies. Draft and final documents will be reviewed for content, completeness, organization, and responsiveness to the requirements of the individual tasks assigned under this scope of work.

2.0 SUMMARY OF REPORT CONTENTS

2.1 MAJOR REPORTS REVIEWED

Six major reports were reviewed for this effort to provide guidance to the U.S. Army Corps Project Delivery Team (PDT):

1) MCWD Watershed Management Plan –1997 *(See page 10.)*
2) H&HPLS Model *(See page 12.)*
3) Comprehensive Wetland Functional Assessment *(See page 17.)*
4) Education and Communications Plan and Audit *(See page 42.)*
5) Minnehaha Creek Stability and Habitat Assessment Report *(See page 101.)*
6) MCWD 2002 Hydrologic Data Report *(See page 109.)*

The following is a summary of each major report reviewed. The complete summary for each report can be found in the appropriate appendix listed above.

REPORT 1

SUMMARY OF "MCWD WATERSHED MANAGEMENT PLAN" (1997)

MCWD was established in 1967 and extends approximately 181 square miles. It consists of two distinct hydrologic basins: on the western boundary, the Upper Basin (Lake Minnetonka), and on the eastern boundary, the Lower Basin (area east of Lake Minnetonka and extends to the Mississippi River). Local government includes two counties, three townships and 27 cities. These are listed in the summary. In 1967, the MCWD implemented a permit program. Through this program, the district has approved stormwater management plans, shaped projects in floodplains/wetlands and covered dredging/stream and lake crossings/projects to improve shoreline.

MCWD goals include:

1) Reduce the severity/frequency of flooding/high water, and improve the chemical/physical quality of the surface water.
2) Control temporary sources of sediment resulting from construction and land development activities and identify/minimize/correct the effects of sedimentation from erosion-prone and sediment source areas.
3) Preserve existing water storage capacity below flood evaluation on all water bodies in the watershed to minimize the frequency and severity of high water.
4) Preserve the natural appearance of shoreline areas and minimize degradation of surface water quality that can result from dredging operations.
5) Maintain the hydraulic capacity of and minimize obstructions to navigation in watercourses and preserve the water quality and navigation appearance of shoreland areas.
6) Improve water quality by promoting best management practices (BMPs), requiring their adoption in local management plans and their implementation on development sites.
7) Protect the recreational opportunities associated with MCWD water resources by improving water quality and enhancing fish and wildlife resources.
8) Enhance public participation in MCWD activities and provide informational and educational material to municipalities, community groups, businesses, schools, developers, contractors and individuals.

9) Maintain public ditch systems within the MCWD as required under ditch authority jurisdiction.
10) Support efforts to provide for the protection of groundwater and to regulate its use to preserve it for beneficial purposes.
11) Protect existing wetlands and restore diminished or drained wetlands.

Concerns identified:

1) Existing water quality degradation in numerous MCWD lakes due to urbanization.
2) Potential water quality degradation of upper watershed lakes and wetlands due to increased nutrient loading associated with widespread development in the upper watershed.

Solutions identified:

1) Regulatory controls
2) Public information/education programs
3) Annual data collection programs (precipitation, water level/discharge, water quality, stream flow and groundwater level data)
4) Management programs (BMPs)
5) A proposed Capital Improvement Program for high priority projects

Numerous projects have been completed since 1967 including: Lake Nokomis Water Quality Improvement Project, Lake Calhoun Water Quality Improvement Project, Lake Hiawatha Water Quality Improvement, Painters Creek Project, Spring Park Bay Water Quality Improvement Project, Painters Creek (Jennings Bay) Water Quality Improvement Project, Excelsior Bay Water Quality Improvement Project, Cooks Bay Water Quality Improvement Project, Minnehaha Creek Channel Modifications/Erosion Management Project, Regional Water Quality Detention Storage, Regional Wetland Restoration, Lake Harriet Water quality Improvement Project, Long Lake Improvement Project Wetland Mitigation, Twin Lakes Improvement Project Wetland Mitigation, Six Mile Creek/Halsteds Bay Water Quality Improvement Project and the Langdon Lake Restoration Project.

For more information about the Minnehaha Creek Watershed District visit its website at http://www.minnehahacreek.org.

REPORT 2

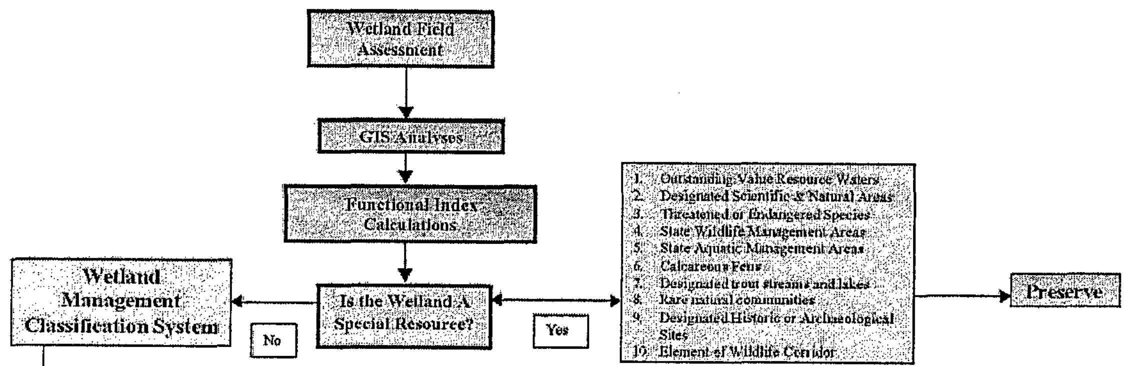
SUMMARY OF "MCWD FUNCTIONAL ASSESSMENT OF WETLANDS" (MCWD, HCD, AND BARR, 2002)

This Functional Assessment of Wetlands (FAW) within the Minnehaha Creek Watershed District was developed to provide a comprehensive inventory and assessment of existing wetland functions within the MCWD. Many of the municipalities contained or partially contained within the MCWD are in the process of developing first or second generation water management plans. In an effort to provide consistent, comprehensive wetland resource data to these municipalities, the MCWD initiated the FAW in 2000. The project also provides comprehensive wetland resource data to improve wetland management throughout the MCWD (see Figure 2.11). This plan includes:

- A field inventory of all wetlands greater than 0.25 acres in size
- A functional assessment of all wetlands greater than 0.25 acres in size
- A digital photograph of each wetland greater than 0.25 acres in size
- The establishment of reference wetlands within the entire watershed, each major subwatershed and each municipality
- Identification and evaluation of potential wetland restoration opportunities
- Identification of critical wetland resources
- Management of all wetland functional assessment data in a Microsoft Access© database
- Development of a GIS wetland data management system
- Recommendations for classifying wetland management standards and criteria

The primary goal of the FAW is to inventory wetlands within the MCWD and to provide guidelines for developing a comprehensive approach to regulate and protect wetlands based on wetland functions. The FAW includes the results of a field inventory and functional analysis of the majority of the wetlands within the MCWD. It is intended to provide detailed wetland resource data to the MCWD, municipalities within the MCWD, landowners, developers and other parties to guide future development and redevelopment with the goal of protecting and managing wetland resources for overall public benefit.

Wetland Management Classification Process Flowchart Minnehaha Creek Watershed District



	Vegetative Diversity	Wildlife/ Amphibian Habitat	Fisheries Habitat	Shoreline	Aesthetics Wildlife Habitat	Stormwater Susceptibility Veg. Diversity	Wetland Water Quality & Vegetative Div.	Hydrologic Regime & Veg. Diversity	Flood Storage & Protection Commercial	Downstream Water Quality Protection
Preserve[1] [2]					Exceptional	Exceptional	High	High	N/A	N/A
	Exceptional	Exceptional	Exceptional	High	High	Medium	High	High	High	
Manage 1[3]						High	High	High	N/A	N/A
	High	High	High	Medium	High	Medium	Medium	Medium	N/A	
Manage 2					N/A	N/A	Medium	Medium	N/A	N/A
	Medium	Medium[4]	Medium	Low	N/A	N/A	N/A	N/A	N/A	
Manage 3	Low								High	High

[1] Each wetland will be ranked into Wetland Management group by the highest rated function for the wetland according to the flow chart above.
[2] Follow the arrows to progress through the tables and classify wetlands into the first group that applies.
[3] Manage 1 = Wetland Management Classification
[4] Flood Storage also = low or medium.

P:\23\27\D06\Reports\HCD_WetMgmtClass_Flowchart011503.DOC

01/31/03

Each wetland and potential wetlands greater than 0.25 acres in size identified in the Hennepin Conservation District Wetland Inventory (HCWI), were visited in the field to verify the presence of the wetland, map the approximate wetland boundary, take a digital photograph and assess the functions of the wetland using the *Minnehaha Creek Routine Assessment Method for Evaluating Wetland Functions* (McRAM). The McRAM includes the evaluation of 11 primary wetland functions and gathering three additional pieces of information important for improving wetland management. The location and extent of each wetland and the approximate location from which each photograph was taken are mapped in a Geographic Information System (GIS) using ArcView© software.

A summary of wetland resources within the entire watershed, a recommended wetland management classification system and recommended wetland management standards were developed. A description of the land and water resources within the MCWD is provided. Section 4.0 of the report describes the wetland classification systems used, the wetland functional assessment methodology and critical wetland resources. A summary of the wetland resources within each subwatershed is provided in Section 5.0. Section 6.0 of the report presents the detailed wetland resources information for each city or township within the MCWD including:

- A summary of the wetland functional ratings;
- A table describing each wetland's classification, size and hydrologic information;
- A table of the functional ratings for each wetland;
- A table of the functional rating scores;
- A map of all existing wetland resources and potentially restorable wetlands; and
- A map of reference wetlands.

This section describes the process that was used to develop wetland management recommendations. The objective of this process is to provide a wetland management classification system and management standards to achieve no net loss of wetland functions and values within the District. Impacts to wetlands include not only direct impacts such as filling, draining and excavating, but also indirect impacts from stormwater inputs. This process is based largely on the functional ratings of wetlands determined from conducting detailed field assessments of the wetlands.

The wetland protection process began with an inventory and field assessment of all the District's wetlands. The wetland inventory identified wetland vegetation, type, location, size and wetland functions. Following completion of this assessment, each wetland was assigned to a recommended management classification based on the wetland's current functions as well as the evaluation of critical wetland resources and the wetland's susceptibility to stormwater degradation. Each wetland was classified according to a recommended level of wetland protection and tolerable hydrologic changes based largely on the state guidance document *Storm-Water and Wetlands: Planning and Evaluation Guidelines for Addressing Potential Impacts of Urban Stormwater and Snow-Melt Runoff on Wetlands* (State of Minnesota Stormwater Advisory Group, 1997).

A summary of the number of wetlands and wetland acreage within each functional rating category for each wetland function is provided below. More than half of the wetlands (1,767 of 3,282) rated exceptional for downstream water quality due to the close proximity of wetlands to the many recreational lakes in the District. The majority of the wetlands within the entire watershed (2,280 of 3,282) rated low for vegetative diversity/integrity, apparently due to the abundance of invasive and non-native plant species. It should be added that the vegetative diversity/integrity is an evaluation only OF the dominant vegetation present within the wetland as surveyed from limited vantage points and additional vegetative diversity may be present, but would require more detailed evaluation.

Drained and partially drained wetlands were evaluated in the field for their potential to be restored. The potential for wetland restoration is determined based on the ease with which the wetland could be restored considering factors including: the number of landowners within the historic wetland basin, the size of the potential restoration area, the potential for establishing buffer areas or water quality ponding, the extent and type of hydrologic alteration and the potential for flooding adjacent properties. Using those parameters, a functional rating of High, Medium, or Low is computed where High means that there will be fewer obstacles to completing a successful restoration. The following table summarizes the number of wetlands in each rating group and the acreage of the identified restoration basins in each category.

Potential Wetland Restoration Site Rating Summary
Minnehaha Creek Watershed District

Rating[1]	High	Medium	Low	Total
Number of Wetlands	29	257	22	346
Total Area (acres)	105	635	27	767

[1] A high rating means that there is a greater likelihood that a wetland restoration would be feasible while a low rating indicates that there may be substantial obstacles to completing a wetland restoration.

A. EXTERNAL REVIEW/RECOMMENDATION (HDR 2003)

Overall, the report appears to be very thorough and well written. At this point in time no additional studies or data are needed for this report. It will provide a valuable tool in identifying potential aquatic ecosystem restoration projects.

The wetland sites that have been identified as potential candidates for restoration should be prioritized using the H&HPLS model and then carried forward into the public review process for consideration on a subwatershed basis by the CAC/TAC groups. As wetland basins and complexes are restored, the Wetland Assessment should be updated to reflect where the restoration took place and what type of habitat was restored.

At some point in time, the MCWD may wish to go back and complete a similar inventory and assessment of restorable basins that are less than 0.25 acres in size.

REPORT 3

SUMMARY OF "H&H STUDY HHPLS 2003" (EOR, INC.)

In early 2001, the MCWD began the most ambitious watershed study ever undertaken by a Watershed District in Minnesota. The MCWD initiated a multi-year *Hydrologic/Hydraulic and Pollutant Loading Study*, or HHPLS, to:

- Document the nature of the physical and biological characteristics of the watershed;
- Quantify the amount of water moving through the watershed and the quality of that water as it moved and as it gathered in various receiving waters;
- Gather detailed public input to assist in problem identification and solution definition;
- Formalize management programs on a sub-watershed basis; and
- Provide the study results to implementation partners in an easily understood manner.

The over-arching goal of the HHPLS is to improve and maintain the surface water, groundwater and associated natural resources of the MCWD. This HHPLS Report presents a compilation of three years of work by MCWD staff, technical consultants, elected officials and the public. This report identifies existing water management issues resulting from current and past land uses. It also seeks to define the impact of future land use changes and to recommend how the District Managers can address these changes.

A. CONNECTIONS TO RELATED EFFORTS

As with any large-scale effort in water resources, the MCWD recognizes that it cannot address all of the needs of the Watershed alone. There are many existing agency and private or citizen programs under way that can assist in achieving the overall goal of good water management.

Following are summaries of some of those key programs.

1. NPDES Point and Nonpoint Source Permits

Past Lake Minnetonka water quality problems and to a certain extent lingering problems, were due to the high loads that the lake received from numerous municipal wastewater treatment plants. Since the 1970s, the State and Metropolitan Council removed all of these point source discharges and routed the flow of wastewater to more effective treatment facilities that do not discharge to the Lake. However, many of the receiving waters that were in the path of the past wastewater flows still likely harbor some residual pollutants.

Today, only six point source discharges of any treated material occur in the Minnehaha Creek Watershed. These discharges are for non-contact cooling water, groundwater contaminant pump-out, or water treatment iron removal backwash water. The specific impact of each discharge is discussed in *Volume IV: Watershed Modeling and Discussion.*

In March of 2003, the Phase II NPDES nonpoint source management program officially began. This program requires, among other things, that communities operating stormwater systems undertake controls for those systems that improve water quality. The new permit requirements also mandate construction runoff control for sites disturbing as little as one acre of land, whether individually or as part of a larger project. The MCWD will be working closely with the communities within the Watershed to make sure that effective control programs result from this round of nonpoint source permitting.

2. TMDL-Like Process

The HHPLS was intentionally set up to parallel the Minnesota Pollution Control Agency's (MPCA's) "Total Maximum Daily Load" or TMDL program. The TMDL program identifies waterbodies that are "impaired" because they do not meet an adopted water quality or narrative standard. The impaired list of waterbodies, known as the "303d list", is submitted by the MPCA to the U.S. Environmental Protection Agency (EPA) as part of its routine reporting under the Federal Clean Water Act, under Section 303.

The actual 303d list waterbodies in the Minnehaha Creek Watershed are limited to seven lakes, for which "excess nutrients" led to listing. The process to address these problems can begin with the implementation programs proposed as part of the HHPLS, with eventual tie-in to the official MPCA TMDL program. The TMDL process develops a management program wherein input loads are identified and a control program implemented to reduce pollution inputs to the total maximum daily load, or the upper limit of input from all sources. Once this load is determined, control programs work to incrementally reduce its component until the load is no longer exceeded.

The HHPLS effort is referred to as "TMDL-like" because it follows a similar process, going far beyond the state program in some respects. The previous paragraph noted that the HHPLS will provide a framework for implementation, thus completing the process for the seven listed lakes. The HHPLS actually paralleled the TMDL process for every major and minor waterbody (lake and stream) in the Watershed, incorporating also a public input process. Goals recommended through this process are contained within this report. For many of the waterbodies, no goal was established in the District's 1997 Plan, so the recommendations will be the first established. Some of the seven lakes, plus additional lakes including all of Lake Minnetonka, are also listed for PCB and mercury fish consumption advisories (FCA). Regional control programs for both PCB and mercury removal, are being orchestrated out of U.S. EPA Region 5 (Chicago) and will address the entire EPA Region.

The last MCWD Watershed Plan was adopted in 1997. This plan was a very comprehensive approach to watershed management, but is in need of updating. New information from the HHPLS, as well as numerous other projects, studies and data collection efforts, can now be used to update the manner in which the MCWD implements its programs.

Specific changes related to the HHPLS include: the adoption of revised water quality goals for many lakes; new hydrologic and hydraulic views of water movement and flooding; an up to date inventory of land cover; wetland functions and values (available from the Hennepin Conservation District [HCD] inventory); watershed load limits recommended for receiving water goal achievement; new technical assistance that the MCWD can provide using the HHPLS models; and priority recommendations for capital, monitoring, education and program development.

The public involvement component was a major collaborative process between technicians, MCWD staff and managers and local representatives. It promoted stakeholder understanding, involvement and community action throughout the entire project. It was designed to meet the following key objectives:

- ❖ Maintain and enhance MCWD's working relationships;
- ❖ Capture stakeholder interest and involvement;
- ❖ Develop and enhance stakeholder understanding;
- ❖ Progressively integrate city, county and state resources and
- ❖ Generate management recommendations for the MCWD to consider.

The water quantity (flow, hydraulics, flooding, structure assessment) model used for the HHPLS is the XP-SWMM model. Model output includes both the hydrologic and hydraulic character of various elements within the Watershed. From a hydrology viewpoint, information is generated on single events simulated for the water quantity modeling includes:

- ❖ 100-year 24-hour rainfall (6.0 inches)
- ❖ 100-year 10-day snowmelt runoff (7.2 inches)
- ❖ 1.5-year 24 –hour rainfall event (2.6 inches)

Rainfall, various climatic factors and sub-watershed hydrologic character all influence the amount and nature of water movement within the Watershed. From a hydraulic viewpoint, information can be generated on storage, behavior near structures (weirs, dams, pipes, bridges, drop structures, etc.) and flow routing. To provide accurate representation of water levels and discharge throughout the District, the XP-SWMM model was calibrated to available flow and water elevation data at:

- ❖ Painter Creek at West Branch Road
- ❖ Minnehaha Creek at Browndale Dam
- ❖ Minnehaha Creek WOMP station at 32nd Avenue S.

Model results were generated and analyzed for both existing and 2020 conditions to provide base information and to identify potential problems. The 100-year 24-hour rainfall and the 100-year 10-day snowmelt runoff events were used to evaluate potential flooding and provide design peak flow and high water level (HWL) information. A 1.5-year magnitude single event was simulated to provide discharge, water level and volume elevation information representative of higher frequency (smaller) storm events. The 1.5-

year magnitude return event generally defines the bank-full elevation in creeks and channels. The amount of actual water quality data upon which to evaluate the condition of waterbodies within the watershed is variable. Although some data exist for many years, and thus provides a firm basis upon which to calibrate water quality models for streams and lakes, other areas have little or no data.

The water quality parameters that were modeled were total phosphorus (TP), total nitrogen (TN) and total suspended solids (TSS). Fecal coliform was initially requested by the MCWD. However, through work with the project's Technical Advisory Committee, fecal coliform modeling was eliminated due to the lack of accurate correlations between land use and fecal coliform concentrations and the difficulties in calibrating a fecal coliform model with existing monitoring data.

Given the amount of data available, the modeling approach chosen was a loading model (PLOAD) that relies upon published pollutant export coefficients, land use, land cover and calibrated annual hydrology to estimate loads reaching creeks or other water bodies. The estimated loads are calibrated against calculated annual loads based on monitored data. The models are prepared for current conditions and for predicted future conditions in the year 2020, based on city local comprehensive land use plans as compiled by the Metropolitan Council.

Land cover is based on extensive data assembled under the Minnesota Land Cover Classification System (MLCCS) described previously and serves as the primary database for the modeling input parameters. The land cover is augmented with the land use in the developed areas of the watershed.

Event Mean Concentrations (EMCs) for pollutants were developed for each land cover/land use category based on a literature review, knowledge of local water quality monitoring data and professional assessment. EMCs for modeling purposes are considered the "typical" quality that occurs as a result of a rainfall or snowmelt runoff event. EMC values can be applied to the flow data generated above to predict water quality loading within the watershed. There are some areas within the watershed district with historic wastewater inputs and wetland alterations where these EMC values may not be appropriate. That is, literature values collected on watershed loading do not necessarily reflect the unique local conditions within the watershed where the data are applied. Thus, although the loads generated by the modeling have been calibrated to watershed outflow loads, model results should be considered preliminary until verified with future collected flow-weighted data.

Model calibration was more extensive for the total phosphorus (TP) export model than for the total suspended solids (TSS) and total nitrogen (TN) models. In the MCWD, more monitoring data are available for TP than for the other parameters. For the TSS and TN pollutant loading models, EMCs were mostly determined from literature values and applied to the runoff volumes calibrated in the TP model. Where TSS and TN monitoring data were available, observed loads were compared to the predicted loads.

A very detailed lake analysis, with in-depth modeling, was done for 14 lakes identified at the beginning of the HHPLS. It became apparent, however, that much more information was needed on additional lakes deemed locally or regionally important, as well as for bays of Lake Minnetonka. As a result, models were prepared for about another 16 lakes, and lake components were done as an integral part of every watershed analysis.

The complexity of the bay drainage system in Lake Minnetonka makes it very difficult in the current HHPLS framework to do a full evaluation of each of the bays. Pollutant inputs to the bays come from external loads, which can generally be quantified, but also from internal sources and from circulation from the rest of Lake Minnetonka, which is not sufficiently quantified.

However, due to lake morphology and watershed areas, it was possible to build a preliminary WiLMS model of a subset of the bays. Each of these bays is separated from adjacent bays by a relatively narrow constriction in the lake, and does not have a major bay located upstream, making it easier to determine the drainage areas of these bays. For modeling purposes, phosphorus loads to the bays were assumed to originate either in the watershed or from internal loading; intra-lake circulation (loads originating in adjacent bays) was not taken into account. If more accurate estimates of pollutant loading to the bays are desired, a model of intra-lake circulation must be developed in the future.

A scour analysis was performed on the six main creek channels in the MCWD, using the 1.5- year storm event (2.6 inch) and the XP-SWMM model. Creek sections with a velocity greater than 1.5 feet per second and local soil composition were used to determine a permissible velocity (see Table II.F.4-1). A 1.5-foot per second average threshold velocity was selected. Ranking criteria for the erosion potential was based on velocity above the established soil permissible velocity.

To provide a more effective framework for decision-making and implementation of recommendations of the HHPLS, a ranking was completed for each recommendation. The following criteria applied include:

- Public Access and/or Number of Users Impacted - This parameter gives consideration to whether public access (boat launch, trails, etc.) is provided for the benefited water body.

- Number of users refers to the number of people either directly or indirectly using the receiving water body. A high ranking is assigned for high use recreational water bodies or those water bodies adjacent to, or within, local and regional parks.

- Visibility of Problem - Resource management problems that are in a highly visible location may have a greater impact on the general publics demand for action. Problems such as erosion, poor water quality and flooding that regularly occur where the problem is perceived as significant by a large number of people receive the highest ranking, while those problems that are not generally visible to the public receive a low ranking.

- High Quality Water or Related Resource - Receiving water bodies with high water quality, high quality wetlands and high quality natural areas are all examples of high quality or related resources. Low quality resources include Lakes with low quality, low quality wetlands and disturbed natural areas.

- Ability to Improve/Protect Downstream Resources - These criteria address the level of positive impact that a given action will have. A high ranking would be assigned to an action that is likely to totally reverse the problem, while a low ranking would be assigned to an action that is unlikely to completely mitigate impacts.

- Costs vs. Effectiveness of Proposed Action - Actions that have a large, positive impact on downstream, receiving waters and yet are low cost are given a high ranking. Actions where the benefits are unclear or low and include high costs are ranked low.

For each action, a final priority ranking of high, medium, or low is assigned. These actions include completing an in-lake sediment analysis of Dutch Lake and determining the internal loading potential for future management attention, as well as, evaluating wetland functions with respect to phosphorus source/sink, using the results of the *Painter Creek Feasibility Study.*

3. Whole-Lake Modeling

Lake Minnetonka is an extremely complex lake, comprised of a collection of many bays and open-lake areas. The preservation of extremely good quality in some parts and the improvement from poor quality in others hinges upon watershed input, internal loading and intra-lake circulation. To better understand the very complicated relationships that occur within the lake and its bays, a whole-lake model that incorporates all of the factors is needed. The watershed input element of the needs for model improvement has been addressed in part by the MCWD through the addition of monitoring stations at several new locations. However, the remaining two items, internal loading and intra-lake circulation, have not been adequately addressed. The MCWD should begin a long-term effort to collect information on all major watershed inputs, internal Lake Minnetonka loading and in-lake circulation for development of a whole-lake model.

4. Water Level Fluctuation and Grays Bay Dam Operation

Users of the lake and residents around it stressed the importance of maintaining a high lake level to maximize the recreational potential of the lake and to maintain property value and lake access for lakeshore owners. However, downstream interests would like to see a continual release of water from the lake, no matter what the lake level conditions are. A minimum release of water would assure a continual Minnehaha Creek flow that would result in better water quality and improved biological conditions. A recommended re-evaluation of the Grays Bay operating plan could include input from the HHPLS model results on changing watershed hydrology for both the upper and lower Watershed. The HHPLS model could be used to determine how these changes will affect water moving into and potentially out of the lake under varying conditions.

B. TARGETED DATA COLLECTION

To properly assess the condition of waterbodies and the effectiveness of watershed management efforts, an adequate database is needed. Although the MCWD has had a data collection program for many years and has collected very valuable information, there is an occasional need to evaluate that effort and perhaps to re-focus at least part of the program on emerging needs.

Targeted data collection is the only way to quantify the behavior of water as it moves through the watershed. When monitoring programs are in the planning phase, the goals of the monitoring should be clearly stated, and the program should be evaluated based on whether or not the data can answer the questions that were set out to be answered.

C. LAKE MINNETONKA – WATER QUALITY/HYDROLOGIC MONITORING

Much of the watershed monitoring needs identified based on results of the HHPLS have been implemented by the MCWD through the authorization of five additional monitoring stations. Additional data collection should be focused on the direct drainage and minor drainage areas to the lake, since together these represent about 18,500 acres of land draining to the lake. Identification of runoff monitoring sites should become an integral part of the MCWD's overall monitoring program, with watershed-wide coverage occurring as a result of rotating stations based on priority loading and representative site selection. Evaluation of the success of these stations in filling the need should occur after at least two years of monitoring is complete.

RECOMMENDATION 1

Additional water quality monitoring stations should be established for minor watersheds outletting to Lake Minnetonka. In particular, monitoring should be expanded to some of the Minor Watersheds that encompass lake/stream systems such as Classen Creek.

D. LAKE MINNETONKA – INTERNAL LOADING AND INTRA-LAKE CIRCULATION

Internal loading and intra-lake circulation data needs have not been adequately addressed. Some attention is being paid to internal load reduction on Jennings Bay through the *Jennings Bay Feasibility Study* funded by the MCWD for 2003. However, the relationship of Jennings Bay internal load dynamics to the other bays has not been determined, and a need continues for additional data from other locations around the lake. The need for intra-lake circulation knowledge is paramount, since the movement of water from the upper portion of the lake to the outlet at Grays Bay seems to be a key factor in lake quality determination. For bays experiencing poor water quality (e.g., Jennings, Halsteds), water quality inputs including tributaries and direct runoff from the contributing watershed have been modeled. Outputs out of these bays, however, are poorly understood. The BATHTUB computer model, or a similar model, can be used as a tool to help define this critical behavior.

RECOMMENDATION 2

The MCWD should begin a long-term effort to integrate data collection on watershed loading, internal Lake Minnetonka loading and in-lake circulation for development of a whole-lake model.

E. LAKE MINNETONKA – COMPREHENSIVE LAKE-WIDE MODEL

There are several bays (for example Crystal, Wayzata and Spring Park) in Lake Minnetonka that are of exceptional quality. The preservation of these bays was identified as a high priority by many study participants. Similarly, there are at least two bays (Jennings and Halsteds) with very poor water quality. The range of water quality conditions within bays of Lake Minnetonka is governed by a number of different factors, including basin morphometry, watershed input, internal loading and intra-lake circulation. A lake-wide model would take the guesswork out of defining the true source of phosphorus and help to better target Lake Minnetonka management efforts.

RECOMMENDATION 3

A comprehensive lake wide model should be completed for Lake Minnetonka. These bays, however, are poorly understood. The BATHTUB computer model, or a similar model, can be used as a tool to help define this critical behavior.

RECOMMENDATION 4

The MCWD should begin a long-term effort to integrate data collection on watershed loading, internal Lake Minnetonka loading and in-lake circulation for development of a whole-lake model.

RECOMMENDATION 5

A comprehensive lake wide model should be completed for Lake Minnetonka.

F. LAKE MINNETONKA – WATER LEVEL FLUCTUATIONS

Users of the lake and residents around Lake Minnetonka stressed the importance of maintaining lake levels at an elevation that allows for recreational uses, yet is not so high as to trigger "no wake" restrictions. The Dam Operation Plan mandates how the outlet control at Grays Bay will be operated to maintain lake levels up to the ordinary high water mark (OHW). In contrast to lake residents, residents of the lower creek prefer a continual release of water from the lake, no matter what the lake level conditions are.

A minimum release of water would assure a continual Minnehaha Creek flow that would result in better water quality and improved biological conditions. Stagnant areas with low dissolved oxygen could be reduced with a continual flow of water. Minimum releases would mean, however, that a change in the current operating procedure for the dam would be needed, since low flow releases do not currently occur when the lake's water level falls below the historic outflow elevation. A low flow release could make up for the historic shallow groundwater seepage that has been lost because of development.

Alteration of the dam operation could also occur on the high flow end, with more water held back from Minnehaha Creek during high water periods. This end of the operation change would result in decreased peaks and flashiness, even though a similar volume might ultimately be released.

A re-evaluation of the Grays Bay operating plan could include input from the HHPLS model results on changing watershed hydrology for both the upper and lower watershed. That is, it could assess the long-term hydrologic changes likely to result as development proceeds. An analysis similar to the Corps' Reservoir Operation Plan Evaluation (ROPE) studies could be conducted.

Increased development usually means more runoff, less infiltration and shallow groundwater flow and flashier runoff conditions. The HHPLS model could be used to determine how these changes will affect water moving into and potentially out of the lake under varying conditions, as well as downstream implications, such as flooding potential and improved operation of the Lake Nokomis flexible weir under variable flow conditions. It could also answer such questions as time of travel from Grays Bay to the Mississippi River under differing flow scenarios and the effects of multiple high flow events (multiple peaks, higher volumes, timing and event separation).

Finally, maintenance of the Grays Bay structure has been raised as an issue. It is difficult to obtain accurate flow measurements over the dam due to frequent clogging and timing of cleaning. During the flow model calibration procedure, it was found that for a particular lake elevation, there could be discrepancy of up to 50% due to restriction caused by debris. Proper maintenance of the structure is essential and would be even more important in assuring reliability if the operation changed to allow a minimum flow release. See *Volume IV, Section J.6*

RECOMMENDATION 6

The Grays Bay dam operating plan should be amended, if possible, to minimize water level fluctuations and improve the in-stream flow regime of Minnehaha Creek.

Key Elements of this assessment include:

1. *Using XP-SWMM Model, complete water balance analysis of Lake Minnetonka Basin for dry, wet and normal precipitation year conditions.*
2. *Check/reset rating curve (stage-discharge) for Grays Bay Dam*
3. *Evaluate low flow maintenance options for Minnehaha Creek below Grays Bay Dam.*
4. *Evaluate role that upstream storage plays in attenuating lake level bounce.*

G. Basin-wide Flood Insurance Mapping

One option available to the Minnehaha Creek Watershed District, which was not available at the start of the HHPLS project, is the ability to create and maintain basin-wide flood insurance maps in partnership with FEMA (Federal Emergency Management Agency). Traditionally, the updating of flood insurance maps was the responsibility of municipalities. MCWD had anticipated that cities could choose to use the hydrologic and hydraulic model and data created as part of the HHPLS project as a foundation of a request to FEMA to remap their community. The additional tasks that a city would need to undertake would be use of the XP-SWMM model now accepted by FEMA, review of the data by Minnesota Department of Natural Resources, and, finally, submittal of the proper application forms to FEMA. However, FEMA has recently created a program titled Cooperating Technical Partners (CTP) which encourages flood insurance map revisions on a regional basis. FEMA's goal through this program is to create local maps with the most up-to-date technical information. Regional agencies, such as watershed districts and counties, now qualify for this program. In return FEMA is willing to participate by contributing funds towards specific remapping activities, providing technical support and training.

Advantages of MCWD acting as a regional partner in FEMA's flood mapping program:

- Refinement of Zone A (100-year flood plain) boundaries, especially in areas where
- FEMA flood boundaries are approximated.
- Consistent, up-to-date technical information (hydrologic, hydraulic and GIS) would be applied to flood maps on a district-wide basis.
- Consistency between MCWD flood boundaries and FEMA flood boundaries.
- FEMA is more likely to grant funds for remapping on a regional basis than on a local basis.
- Creation of digital flood maps for Carver County portion of MCWD. Digital maps are soon to be available for Hennepin County.
- MCWD would be involved in all future flood map maintenance and amendments.

RECOMMENDATION 7

The MCWD should pursue becoming a Cooperating Technical Partner with FEMA and work with communities within the watershed to update their FEMA floodplain maps based on the HHPLS results. The proposed mapping may not qualify for any of the Federal Continuing

Authority Programs (CAP) and may have to be considered under Section 22 Program for Assistance to States (in this case with FEMA work). One potential solution may be to seek a Letter of Map Revision (LOMAR).

H. INFILTRATION IN MINNEHAHA CREEK

The flow modeling and groundwater assessment both noted the importance of the role of infiltration in the behavior of Minnehaha Creek, but uncertainty remains over how and where this occurs. It was found that the creek runs dry in certain areas, and that a loss or gain of 5 to 10 cfs could take place along the creek. This could become a very important factor in considering the role of baseflow for ecological integrity. The collection of better data in specific locations of suspected creek infiltration or exfiltration would be very beneficial to overall understanding of creek behavior.

RECOMMENDATION 8

The MCWD should incorporate into its Monitoring Program the collection of flow data in Minnehaha Creek that would better define the relationship of the creek to groundwater.

I. ADEQUATE DATA TO DRAW CONCLUSIONS

To properly assess the condition of water bodies and the effectiveness of watershed management efforts, an adequate database is needed. The MCWD has had a data collection program for many years and has collected very valuable information. There is a need, however, to occasionally evaluate that effort and perhaps re-focus at least part of the program on emerging needs. Other sections of the HHPLS contain more details on the specific data needed, but in summary, a need has been identified for data on the following areas:

- Internal loading is a big unknown for many of the eutrophic lakes and bays, but is likely a significant source of phosphorus for many of these water bodies.

- Intra-lake circulation data are needed to document the interactions among the various bays of Lake Minnetonka and to properly build an in-lake model of Lake Minnetonka.

- The role that wetlands play as water moves through the watershed and the quality of that water is poorly understood; better understanding of this function and the role of ditches will lead to a more realistic expectation for the role of wetlands in water management. The remaining influence of closed wastewater treatment plants (WWTPs) is not fully known. Although anecdotal evidence exists that phosphorus-enriched sediment from them still causes problems, the details of this impact are unknown; further study is needed.

- Alum addition to various lakes in the watershed has had mixed results; it seems to be added without full knowledge of the source of phosphorus in the lake/bay. Better data are needed on the long-term effectiveness before alum addition continues.

Targeted data collection is the only way to quantify the behavior of water as it moves through the watershed. When monitoring programs are in the planning phase, the goals of the monitoring should be clearly stated, and the program should be evaluated based on whether or not the data can answer the questions that were set out to be answered.

RECOMMENDATION 9

The MCWD should supplement its routine data collection program with additional data collection to address the questions raised above.

J. Evaluation of XP-SWMM Model of the Minnehaha Creek Watershed District Focusing on Painters Creek

The XP-SWMM model created for the Minnehaha Creek watershed focused on the Painters Creek (Creek) area to evaluate using the model for the tasks listed below. The review was cursory due to the complexity of the model and the level of effort needed to take a detailed look at the model structure and input parameters. The model geometry and the resulting hydrographs were reviewed for reasonableness compared to the actual features modeled. The accompanying documentation indicates that substantial calibration efforts were made during the modeling process, though the present review is not sufficient to ascertain the accuracy on a definite basis.

K. Watershed Stabilization

The development of the model requires good landuse information, which would aid in this effort. The model hydrology is very sensitive to landuse and can be used to evaluate the effectiveness of land use changes such as conservation easements and retention features.

L. Creek Corridor System Restoration

Further site evaluation will probably be required along with the results of the XP-SWMM model to determine stream and habitat restoration requirements and options along the Creek. The flow velocities indicated in the model can be used to determine potential trouble spots for stream bank erosion.

M. Water Level Management and Flood Damage Reduction

The XP-SWMM model is most appropriate for this task. The model can be used to evaluate options to reduce the flashy nature of the watershed and efforts to reduce flooding along the Creek. The calibration efforts focused on water levels as well as flow volumes, which increase the level of accuracy of the predicted water levels during severe storms and runoff events.

N. Floodplain Restoration and Protection

The model results, combined with GIS mapping can be used to evaluate flood plain use, potential for restoration of flood plains. The inherent floodway encroachment options in the XP-SWMM package can also be utilized for this effort.

O. Recreation

The model is of minimal use in determining recreational aspects of the Creek.

P. Ecological Integrity

The model can be used to aid in water quality analysis in addition to the PLOAD model developed to analyze the water quality aspects of the watershed. In addition, the model can be used to determine flow velocities, depths and duration of inundation of overbanks along the Creek. Hence the XP-SWMM model can be used in an indirect way to evaluate the significance of changed or varying flow conditions on ecological diversity along the Creek.

Q. Water Quality

As discussed above, the XP-SWMM model can be used as an additional tool to evaluate the water quality aspects of the creek. The XP-SWMM package contains the ability to model water quality and nutrient transport phenomena.

The above discussion is based on a preliminary review of the XP-SWMM model of the Minnehaha Creek Watershed provided by Minnehaha Creek Watershed District. The model reviewed is titled '20030805_ALL_EXIST_100.xp'.

Additional data and further review is recommended for the following items:

- Accuracy of calibration effort: Are the limits of manipulation of a particular parameter, such as the watershed width, reasonable though achieving good correlation to measured/gauged data? A detailed third party review of the model documentation is needed. The geometry coefficients such as weir coefficients should be checked for reasonableness.

- Infiltration Parameters: The modeling effort includes an extensive literature review of the Green Ampt method and associated parameters. A review of this material and the application of this method in the model is warranted due to the significance of infiltration towards runoff volume in the results.

- When a particular channel reach is identified for stream restoration, additional cross section and stream/overbank roughness coefficient information should be added to increase the model to a design level of detail.

R. External Review / Recommendation (HDR 2003)

Overall, it seems that the MCWD wants a year-round base flow in the creek, but the creek is losing water to recharge in certain reaches. A possibility would be lining the channel with concrete in some reaches to stop the recharge and maintain the base flow. The MCWD could cast in place lunker boxes in the concrete to create habitat and dye the concrete brown to look like natural sediment.

Overall, the MCWD has to be pleased with the progress they have made over the last few years in advancing knowledge of the watershed. There now exists an extensive database of information and it appears well done and presented. In reviewing the reports, tables and figures, they are all clear and well written. HDR found it relatively easy to find our way through the information and find what we were looking for.

It is our understanding that HDR is reviewing this information to identify what additional studies or data are needed in order to complete a federal feasibility study relative to ecosystem restoration. It is from this standpoint that we make our comments:

The data contained in the various reports and databases is focused on measurement of specific numeric goals, such as concentrations, flows, elevations, acres, scour potential, etc. It is then inferred that, for example, improving pollutant concentrations is equivalent to improving environment. For example, if Nokomis goes from a C grade to a B grade in water quality parameters, success is declared if a B grade is the goal. This may be the case for the human use of Lake Nokomis. It is going to be more aesthetically pleasing, provide more direct contact days, etc. However, from the standpoint of an ecosystem, the amount of epilimnion, littoral and terrestrial habitat units and subsequent improvements in ecosystem counts (more turtles, frogs, fish, birds, butterflies, etc.) have not been defined.

A recent MCWD memo touches on the concept HDR is trying to address with the discussion on ecological integrity. This can be expanded into ecological restoration. HDR believes the next question that needs to be asked of each of the resources identified in these various reports is "What ecological role should this resource should play in the Minnehaha Creek Watershed and the Upper Mississippi River ecosystem?" The next question might be "What is the most economical way to achieve an increase in habitat units?" For example, HDR's observation is that the USACE would look at taking a lake from a C grade to a B grade and find it creates, perhaps five habitat units. But if we add a 50-foot prairie buffer and restore portions of the lake through bio-engineering techniques, but leave the WQ at a C grade, it could add 200 habitat units at a significantly lower cost. Therefore, the federal participation might be on the habitat side of the project, not the water quality side.

Other specific comments to date include:

- Rainfall events – the consultant utilized the standard 6.0-inch 24-hour and 7.2-inch runoff events for the analyses. Given all the data collection and new precipitation data it would have been prudent to consider more modern storm event information, especially considering all that was revealed in looking at the SWWD project. Hydro-climate trends and updates could easily be added to the project to improve its predictions and outcomes.

- Enhanced information on exotic species and potential management plans - since the Corps project is focused on ecosystem restoration, we are assuming that they are focused on natural systems and plant and animal communities. A discussion relative to important resources and this topic would be warranted.

- We recommend that the report address the issue of anthropogenic sediment (road sand) on the stream assessment work. HDR wonders what impact, if any that has on stream stability. This issue needs to be addressed.

- HDR did not pick up anywhere, but it would have been interesting to look at, historical accounts of how the creek behaved. Was there a base flow? What was it like? Some of the geological and land cover discussions started to head in that direction. If the MCWD were interested in restoring an ecosystem, a good historical appreciation of what the ecosystem looked like would be useful.

- Section 106 issues, since some of the landscapes are historical or potentially eligible, need to be reviewed relative to ecosystem restoration.

- The report gives the impression that what the MCWD and residents desire is a Minnehaha Creek that flows 24 hours a day, seven days a week, to support a diverse, stream/wetland/lake ecosystem, but that historical accounts of the creek would show it routinely went dry. Perhaps a model that looked at a pre-development landscape along with historical research would be able to predict or shed light on how the creek behaved and would give us information as to the direction the restoration effort should head.

- Will the USACE accept and use XP-SWMM? Does the model appear reasonable?

- Connectivity of the system. If the MCWD and USACE are looking at this from an ecological standpoint, don't we need to know how various components of the ecosystem are connected? For example, if a fish is in Hiawatha, where can it go and what are the barriers to movement? Is that good or bad? One could use other wildlife as an example.

S. COMMENTS / RECOMMENDATIONS (USACE)

The EOR H&HPLS report is very impressive and should be a valuable tool for the District. The linkage of GIS and the Green & Ampt method of infiltration are also state-of-the art and advancing the field. The following are suggestions and considerations for future study regarding hydrologic simulations. Some comments may have significance to the H&HPLS model and others are just in general.

1. Rainfall-runoff Transformation

It is not clear from reading the report what method was used to transform rainfall to runoff. Was it the kinematic wave method? Unit Hydrograph method? If it was the U.H. method then which method? If it was the NRCS dimensionless U.H. method, then there are some considerations about that. The NRCS dimensionless U.H. was developed from an evaluation of a large number of actual watersheds and then made dimensionless. The standard equation for the peak discharge is qp= 484(AQ)/tp, where A is area in sq. mi., Q is runoff volume in inches, tp is the time to peak in hours, and qp is the peak discharge in cfs. The constant 484 is standard in most programs such as HEC-1. Therefore, this U.H. shape would represent a particular watershed but may not be representative of other watersheds. The NRCS presumably alters this coefficient to fit their study watershed. The coefficient can vary from 600 for mountainous watersheds to 300 for flat, swampy areas. Typically most outside organizations do not adjust this coefficient. Therefore, if applied to flat areas such as the Red River Basin, it will tend to cause an over-estimation of the true peak discharge value after convolution with the adopted U.H. Conversely, if applied to the steep, bluff, terrain adjacent to the Mississippi River, it would cause an under-estimation of the true peak discharge value after convolution with this adopted U.H. To obtain a reasonable estimate of the peak flow value, an attempt should be made to regionalize this coefficient and adopt a value that is representative to the study watershed. Preferably deferment to other U.H. techniques would be desirable such as the Snyder, Clark, or ModClark U.H. methods if one were intent on using a lumped parameter model. In this way a "custom fit" of the U.H. to the study watershed can be made by optimizing their parameters to historic runoff hydrographs. The NRCS dimensionless U.H. may be acceptable for small drainage areas and if time and money is short.

2. Computation Interval

The computation interval can be one of the most important decisions made in the development of a rainfall-runoff model using the U.H. method and perhaps other methods. The general rule is that this interval must be small enough to give adequate definition of the U.H. peak from the smallest subdrainge area. If it is too long, then the U.H. shape will be solely the recession of the actual unit hydrograph. One can see this by choosing a smaller time interval, which would then define more of the peak U.H. shape and result in a higher computed peak discharge after convolution. Generally, as a minimum, a time interval of a least 1/7 the time of concentration of the smallest sub drainage area should be adopted. Of course, a smaller time interval could be used, however one needs to weigh this with the size of the watershed, computation time, and output volume. This consideration should be made when dividing a watershed into many smaller sub basins. Smaller basins will dictate a corresponding smaller time interval and many more basins to analyze with resulting vast amounts of output. With today's computer power this is no longer of much concern and post-processing methods are now being developed to visualize vast amounts of output rather than viewing text output tables. But still it is best to keep it simple but no simpler. The Hydrologic Engineering Center has indicated that not much more is gained by dividing a basin into too many smaller units.

3. Hypothetical Storm Duration

This is also another important decision made in development of the rainfall-runoff model. The storm duration should be at least as long as it takes for the farthest point in the watershed to contribute runoff to the outlet. Otherwise, the rain generating the runoff event will have prematurely "shut off" before the whole watershed has had a chance to contribute flow at the outlet. This can easily be seen in a simulation with short storm duration. By making successive runs with longer rainfall durations, the peak of the computed hydrograph should increase until a maximum is reached. This is sometimes referred to as the critical duration. The general rule is to use a duration of at least twice the time of concentration of the whole watershed. Generally, the critical duration that would produce the highest peak discharge is not known. But since the hypothetical rainfall distribution is triangular in shape, the critical duration should be "nested" within the hypothetical rainfall distribution if the duration is long enough. The 24-hr, SCS Type II rainfall distribution can be considered triangular in shape with the peak intensity occurring in the middle of the event. Unfortunately, most organizations have adopted this as a standard storm in which to simulate and compute the 100-yr flood. If the watershed is small, as are most of the watersheds studied by the NRCS, then this should be okay. However, if the watershed is large (i.e. tc > 24 hrs), then this rainfall event may not be long enough to be critical. Longer durations are needed. The NWS TP-40 lists rainfall volumes up to a 10-day duration and the HEC-1/HMS model includes simulation capability for durations of 2-, 4-, 7-, and 10- days.

In regards to the H&HPLS model, the 100-yr, 24-hr rainfall event and the 100-yr, 10-day snowmelt events were simulated. If the 100-yr, 10-day rain event was simulated the snowmelt event may still result in a higher 100-yr discharge value. Although the rainfall volume is higher for this duration compared to the 10-day snowmelt, there is very little if any loss for the snowmelt event and probably significant losses for the 10-day rainfall event for this watershed. If this is uncertain then this simulation should be made. In any case, the results should be calibrated to a representative and reliable discharge-frequency curve if possible (see later paragraphs).

For the Minnehaha watershed one may consider the basin as two, upper and lower. An analysis of the outflows from Grays Bay dam would have to be made to assess how much of this flow would contribute to the peak downstream during an event of this magnitude. It should also be remembered that the 100-yr rainfall values or any other hypothetical event are a direct function of the size of the drainage area. That is, the 100-yr basin average precipitation that generates the runoff at the outlet of a watershed may be significantly different than the basin average precipitation that generates runoff upstream with a smaller contributing drainage area depending on the relative size of these areas.

4. Calibration

Often times organizations will calibrate a rainfall-runoff model to actual historic events. For example the U.H. parameters and loss rates in HEC-1/HMS can be optimized to actual events and representative values can then be adopted. However, even after this fitting to historic events, it is often the case that the 100 – yr rain will <u>not</u> generate the 100 – yr flood. This can be seen if one compares the results of the model (which still should be considered un-calibrated) to the computed discharge-frequency curve of a stream gauging station with a fairly lengthy record (assuming that the model was developed for a basin above the gauge). (The Hydrologic Engineering Center considers an un-calibrated rainfall-runoff model to be equivalent to about 10-15 yrs of record). A frequency curve is considered to give a better estimate of the 100-yr discharge because it is based on actual gauged data. Calibration is complete if adjustments are made to the model parameters such that the model will generate the frequency curve value of the 100 – yr flood. This adjustment is generally made by adjusting loss rates or by assigning frequencies based on the discharge-frequency curve and is somewhat controversial.

If the watershed is ungauged then calibration is done at a gauge location with a drainage area that is hydrologically similar to the ungauged basin. Physically based model parameters are then transferred to the ungauged basin with some adjustments to the actual study watershed. In the case of the Minnehaha Creek watershed, this can be a real challenge, as there appears to be no discharge gauging station available, of any length of record, by which one can develop a reliable discharge-frequency relationship. This would then necessitate hunting for a hydrologically similar gauge basin. Review of USGS records indicate that there may not be available discharge gauging stations in the Metropolitan urban area with records long enough to develop a relationship. If there were one, then there would be the issue of whether or not it monitors flows from a watershed that is hydrologically similar to Minnehaha Creek. And then there is the issue of stationarity and homogeneity. For example, if there were a gauge within the Minnehaha Creek watershed that had a fairly lengthy record, the gauged record probably would not be considered stationary because of the changes with time due to urban development. Although adjustments would then be needed to the record, this is still preferable to a situation where there is no gauge at all.

One option that encountered some success was used for the Coon Creek watershed. Like the Minnehaha Creek watershed, Coon Creek watershed is relatively urban in the lower portion and rural in the upper portion and is experiencing rapid urbanization. The Creek drains almost 100 square miles. The "adopted" discharge-frequency curve at the mouth was based on a method by the USGS for developing these relationships in urban areas in the United States. This method uses regression equations with independent variables that relate or are a measure of, physical basin characteristics in the urban watershed. The publication is entitled, "Flood Characteristics of Urban Watersheds in the United States, USGS Water-Supply Paper 2207." The results were compared with another method

(HydroCad) that was developed independently with identical results, although the other method was most likely un-calibrated as well.

5. **Multiple Drainage Areas with SCS U.H**

Another consideration, although perhaps not significant for the Minnehaha Creek study, is the use of the SCS U.H method with many subbasins in HEC-1. It is not uncommon to find previous studies that used the TR-20 model of watersheds in this region. These models typically have many subbasins in their development, which used the dimensionless U.H. In TR-20, the U.H. duration is determined directly from the time of concentration of that particular basin. The appropriate duration of the U.H. is determined by multiplying tc by 0.133. This is done internally within the program. The program then uses the program computation time interval, which may be different than the U.H. duration, to list the time ordinates. Conversely, in HEC-1/HMS, the computation time interval is also the duration of the U.H. Therefore, if many subbasins are used the time of concentration should be such that each one is similar so that a computational time interval of 0.133*tc applies to each basin. The HEC-1/HMS manual gives a boundary range for this parameter. For this reason, it is best to shy away from the use of the SCS U.H. method in HEC-1/HMS if multiple basins are desired.

6. **Minnesota Hydrologic Review Committee**

Apparently there are now four 100-yr profiles for the Creek. Hopefully, the above suggestions will help in sorting out a representative profile. If the District wishes to pursue an update, it is suggested that the hydrologic analysis which is the basis for the profiles be submitted first to the Minnesota Inter-Agency Hydrologic Review Committee.

7. **Gauge Recommendations**

The Watershed District should seriously consider installing a continuous recording stream gauge near the outlet/mouth of Minnehaha Creek (as well as other at key locations in the basin). Adequate stream gauging in a watershed is a key component in the real-time and long-term management of a watershed. It is difficult to conduct water resources design initiatives, and watershed management activities, in an ungauged basin. At the very least, high-flow staff gauge(s) should be installed to capture the annual peak(s). The later can be installed very inexpensively while providing very valuable information.

At least two continuous recording rainfall gauges should be installed near the centroids of the upper and lower watersheds.

RECOMMENDATION 10

HDR concurs with the Corps' review of the H&HPLS model. THE MCWD should add gauges to the lower watershed to improve the XP-SWMM model for design purposes. It is HDR's understanding that the NCWD is converting the XP-SWMM model to HEC1/HEC-HMS format. The Corps may wish to use this converted model if design of projects on the creek is pursued.

RECOMMENDATION 11

While not identified in the HHPLS recommendations, it is the opinion of the MCWD that there are opportunities for corridor restoration along Long Lake Creek. The outlet from Long Lake, and the immediate downstream areas of the creek, will be altered as a result of the current MNDOT T.H. 12 project. Downstream reaches of the creek will subsequently receive higher volumes of water as a result of this and other development within the sub-watershed. It may be advantageous at this time to investigate the potential for bank restoration and maintenance of a hydrologic flow regime.

REPORT 4

SUMMARY OF "MCWD EDUCATION AND COMMUNICATIONS PLAN" (RRA AND MSC 2003) INTRODUCTION

In April 2003 the MCWD contracted with Richardson, Richter and Associates to conduct an Audit of its Education and Communications Programs to gauge their effectiveness with key stakeholders in the MCWD, including:

- Cities
- Schools
- Policy Leaders
- Builders, Developers, Contractors
- Permitees
- Other Regulatory Agencies
- Media
- The General Public

The MCWD also contracted with Media Savant Communications Company (MSC), to create a Five-Year Strategic Plan based on the audit results. In July of this year, the MCWD Board of Managers accepted the findings of the Communications and Public Outreach Audit Report. The audit studied the current messages and perceived goals of the education and communications through reviews of the district's (and select associated water resource organizations') current materials and strategies including:

- Current Education Programs/Methods/Events
- Current Communications Programs/Methods/Events
- Collateral Materials (e.g. brochures, newsletters, etc.) and Their Distribution
- Board Meetings and Workshops
- MCWD Website

The audit provided a "gap analysis" where education, communications and critical messaging appear to break down with key stakeholder groups. The audit also provided prominent recommendations for the development of the strategic plan to remedy gaps and to augment strategy that is working satisfactorily.

In preparation for the plan's development, the MCWD created an Education and Communications Task Force to set appropriate goals in each area. The Task Force included MCWD Board of Managers Pam Blixt, Monica Gross, Susan Goetz and Dick Miller. MCWD Communications and Education Manager Joan Ellis, MCWD Administrator Eric Evenson and Martin Keller of MSC + were also participants in the goal-setting task force.

A. STRATEGIC PLAN GOALS /OUTCOMES

1. Education Goals/Outcome

The Task Force set four major goals/outcomes for the five-year plan:

- Stakeholders will become more knowledgeable about the value of buffers in the general watershed but also more specifically within the localized communities of the MCWD's 12 subwatersheds.

- Stakeholders will reduce runoff volume on their properties, both commercial and residential.

- Permitee stakeholders from the general homeowner and the builder, developer and contractor areas will better understand the MCWD regulatory process and benefits through permitting and other MCWD education and communications activities.

- The Citizen Advisory Committee (CAC) will build a more influential membership base (ideally consisting of more zoning and planning commissioners, business leaders and other movers and shakers from MCWD cities) to promote and educate about the MCWD and its programs as a leader in water resources management to developers, builders, contractors, citizens and other targeted groups in their respective communities.

2. Communications Goals/Outcomes

The Task Force set four major goals/outcomes for the five-year plan:

- Effectively inform the general public, legislators, county commissioners, elected state and city officials and the localized communities in the MCWD's 12 subwatersheds about the MCWD and its projects, programs and rules, using the available communications tools and tactics targeted to current and newly identified MCWD stakeholders.

- Use science-based community relations for discussions about specific MCWD issues, programs, projects and rules.

- Determine the most appropriate Best Management Practice (BMP) for each subwatershed within the MCWD and communicate strategically about how to put them into practice.

- Projects, issues, rules, controversies and crises with appropriate news releases, graphics and media relations.

The new plan and audit emerge at a time when the district's need for strategy is genuine and in sync with the need to continue to inform the general and community news media about programs, capital current developments throughout the watershed, as well as watershed policy at the state and federal levels. Key touchstones that impact the new, five-year plan include the following:

- The MCWD Board of Managers adopted a new Mission Statement in October 2002 that stresses the need to educate, inform and engage its constituents.

- Governor Tim Pawlenty has made improved water quality a statewide objective for the next 10 years, thereby keeping the value of Minnesota's varied and critical water resources top of mind for citizens, state agencies and all levels of government.

- The Bush Administration, recognizing Minnesota's leadership role in developing pioneering watershed law, dramatically upheld the watershed model in 2001 by sending then-Environmental Protection Agency Administrator Christine Whitman to visit the Minnesota River Valley. She announced that the administration would allocate more funding to select local communities to expand or improve existing watershed protection efforts.

- The MCWD 509 Plan calls for prioritized goals that are in step with the goals of the five-year strategic plan, including these top 10 issues:

  1) Infiltration
  2) Ecological Integrity
  3) Water Quality
  4) Water Quantity/Public Health
  5) Shorelines
  6) Navigation
  7) BMPs
  8) Education and Communications
  9) Public Ditches
  10) Wetlands

- The MCWD has now completed five major innovative studies, the Minnehaha Creek Rapid Assessment Methodology (MCRAM), the Hydrologic, Hydraulic and Pollutant Loading Study (H&H), the Functional Assessment of Wetlands study, the MCWD Hydrodata Program and the Minnehaha Creek Stability and Habitat Assessment Study. All represent a new level of intellectual watershed property capable of setting a fresh course for a more comprehensive understanding and toolset for watershed and water resource management.

- The H&H model provides an exemplary framework to develop finely-tuned strategic planning, since it focuses on the individual needs of the subwatersheds in the areas of education and communications. The 12 subwatersheds in the MCWD are unique and provide an excellent entry point for locally-based, micro-managed planning that will meet the overall goals on the MCWD mission throughout the 181-square-mile watershed.

- MCWD educational consultant Cairn & Associates has created a similar watershed-based curriculum, using digitally-formatted historical data, photos and other teaching tools, which is readily adaptable not only to schools but also to community groups and other stakeholders in the district.

- Watershed Partners is launching this fall an ambitious campaign with Periscope Advertising and working on the development of a watershed information segment for local television using the weather feature as a platform, thus creating real opportunities for the MCWD to play a greater role in these and other endeavors.

- The MPCA is making its water quality data more readily available at its website, including data from other websites and a map-based viewer. As government agencies begin to share/link information more regularly and the public becomes more sophisticated about finding and using water quality data and other information from agencies over the Internet, the MCWD stands to increase its information baseline and stakeholder outreach substantially through critical links and partnerships.

- With the current state fiscal crisis heading into its second year and the MCWD levying authority remaining relatively intact, cities, neighborhood organizations, civic groups and public education teachers and others will be looking for innovative direction, leadership and judicious taxpayer funding of programs critical to key stakeholder groups in the MCWD.

- The recent Bemidji State University study about the increased property values of lake homes with good water quality reported in the *Star Tribune* presents a great opportunity to educate realtors and subsequently new homeowners about the value of clean lake water, BMPs and related information. Combined with a previous, more obscure study, the two reports provides an opportunity for the MCWD to target a new niche audience (the real estate market) that can in turn help educate property owners about the value of clean water and lakeshore property.

❖ New strategic planning methods for environmental areas are now available in the book *Fostering Sustainable Behavior: An Introduction to Community-Based Social Marketing* by authors Doug McKenzie-Mohr and William Smith. Their pioneering views on how to best modify behaviors regarding environmental issues provide a timely approach that the MCWD should consider implementing in the District's planning process.

❖ The book demonstrates with quantitative and qualitative documentation how providing education and information alone rarely change behaviors. Rather it notes that in order to truly change behaviors, a strategy must eliminate the perceived barriers to performing the desired behavior and explain the resulting benefits.

❖ Community-based social marketing is becoming more prominent: Wenck and Associates will present a paper/case study called "The Lake Friendly Project Piloting Consumer-Based Social Marketing as an Approach to Foster Sustainable Urban Runoff Management" on October 21, with presenters Paul Nelson, Wenck Associates; Ron Struss, Board of Water and Soil Resources; and Barbara Luikkonen, Minnesota Water Resources Center. This paper presents the results of a Consumer-Based Social Marketing (CBSM) project tailored for stormwater runoff issues. During the summers of 2002 and 2003 the Prior Lake-Spring Lake Watershed District completed more than 60 visits to property owners to review and encourage stormwater management on urban lands. The reviews, follow-up contacts and incentives were patterned after the CBSM Approach for Fostering Sustainable Behavior.

❖ Audit results and recommendations are then viewed using CBSM concepts to drive new, and/or to improve, existing strategies over the next five years in appropriate subwatersheds.

❖ Like the audit, the strategic plan utilizes *The Minnesota Report Card on Environmental Literacy* created by Hamline University's Center for Global Environmental Education, the Minnesota Office of Environmental Assistance and other organizations and individuals. The Report Card was used in tandem with the audit findings as a comparative tool to understand the results and recommendations of the audit and as a guideline in developing more effective and targeted strategies for the future.

B. CREATING GREATER VALUE FOR ALL STAKEHOLDERS

The audit makes clear a number of key findings about the MCWD and the strategic plan has refined those findings, which serve as guidelines throughout the various phases of the plan. Based on the stakeholder interviews and a citizen survey, both the audit and strategic plans conclude:

- The district is perceived as a leadership organization focused on water resources management. According to Audit Recommendation #3 (p.30), "*MCWD is a recognized leader in public outreach about water resources, and several stakeholder interviewees expressed an interest in seeing the District take on more responsibility as a leader. Cities particularly mentioned that no other organization in the District has a singular mission associated with water quality and, therefore, no other organization can give this issue the focus that the District could.*" It should proceed in the next five years to become an even greater focal point for all water-related discussions with the communities it serves.

- The district has numerous partnership opportunities with its stakeholders, other water watersheds and natural resource management agencies, including departments at the University of Minnesota. It should maximize all of these partnerships, especially in the commercial sector, where it has yet to forge strong bonds. Working in tandem with the commercial sector and other organizations that share common goals on issues such as infiltration, shoreline erosion and buffers may prove the most effective use of public dollars to create sustainable behavior changes by providing hard incentives for citizens.

- Its regulatory functions must offer more convenience for permitees to act on and to understand that enhanced property values are a benefit of good water resource/land use management. This should help alter the occasional perception of the MCWD as an adversarial arm of regulatory government to a more positive view that the MCWD is a beneficial ally in the built and natural environment, providing added value to stakeholders engaged in the permitting process. The MCWD website provides an ideal opportunity to streamline and centralize the permitting process through links, mapping and other tools essential to finding and completing application forms on other regulatory sites so the process becomes a one-stop service.

- Given the barriers to changing public behaviors, MCWD staff, when possible, and its representatives on the Citizens Advisory Board and select consultants must provide more person-to-person interaction on critical and/or controversial issues and in achieving general watershed goals and subwatershed objectives, using community-based social marketing.

Perceived barriers and benefits are identified in the plan wherever appropriate.

- The MCWD should provide constituents with more focused educational and communications information, driven by specific needs in the subwatersheds, through the creative innovation of new programs and the inspired reinvention of those current programs and its website that are judged to be viable for the next five years. This is essential because of the MCWD's vast knowledge and databases, its under-utilized multi-media web capacity and not fully realized media and education strategies, plus the economic inability of cities within the MCWD to produce enough meaningful materials for its citizens and leaders. Some of the MCWD's efforts would include diversity/language issues to begin a dialog with inner urban watershed residents that include Somali, Hispanic and Asian populations and a community outreach to faith-based stewardship groups that are active in their individual communities and congregations.

  The MCWD will also produce targeted, first-class educational and communications programs enumerated in this document for key stakeholders and the public, using existing tools such as WaterPro, newly proposed WaterPro Bulletins (background information pieces), plus other materials.

  In short, the MCWD should begin to think of itself not as a regulatory agency, but as a water resource clearinghouse or Water Resource Network, with a "diplomatic water resource corps" of board leaders, staff experts, engineers, citizen advisors and other consultants. The USACE produces cutting-edge information and programming to break down perceived barriers to behavior changes, based on the water resource science found in such databases as MCRAM, H&H, Functions and Values and other MCWD knowledge pools and capital project assets.

These strategies will help the MCWD achieve its five-year goals and are in step with the 509 Plan. They will be executed with the sophistication becoming a leadership organization that is as education and communication savvy as it is scientifically focused on water resource protection and watershed management.

- The overall major result of the five-year plan then rests on the hope that heightened watershed awareness and effective education and communications programs build better relationships between the MCWD and its stakeholders and stronger, healthier communities.

Ultimately the MCWD will be viewed not just as good government, but as a wise and good neighbor fully vested in the communities it serves by bringing greater value to all stakeholders.

C. CURRENT EDUCATIONAL OUTREACH PROGRAMS AND ACTIVITIES

1. A Non-Point Source Pollution Education For Municipal Officials (NEMO)

> *"NEMO is a well-regarded program that is considered to be quite effective at educating elected officials. However, many stakeholders are not aware of the District's role in NEMO. Stakeholders suggested that a good role for the MCWD would be to follow up with communities that have had NEMO training to support policy and regulatory changes that may be needed."* – Analysis and Recommendations, Key Findings, Communications and Public Outreach Audit Report (p.25)

To date, the MCWD has done an effective job of interacting with cities about NEMO. Economics will be the most likely perceived barrier in the coming years for cities to implement practices to reduce pollutants into the watershed and to foster prudent stormwater management and land use policies. The audit reports that cities generally want more information for their residents, but are unable to produce it due to budget cut backs and/or lack of knowledge and good information. These shortfalls create leadership opportunities for the MCWD to step in and fill the gap.

The current program should remain intact, with the following caveats:

- Consider expanding to twice-yearly workshops to include more zoning and planning participants, as well as the public works and environmental departments currently attending, especially with new NPDES II mandates coming into play.

- The audit rightfully recommends follow-ups with cities to establish what their ongoing needs are and to assess to what degree city officials are implementing changes.

- Design a turnkey education/communications package for cities and their residents about stormwater, infiltration, buffers and erosion: With a planning shift in emphasis to using the H&H Study subwatershed model, more detailed background pieces (see WaterPro Bulletins, D) should be created for city newsletters, local utility bill inserts and local community papers to reprint, outlining latest techniques for watershed improvements. The package design also may include a public event and/or pilot program such as the Fulton Neighborhood Demonstration and the Cynthia Krieg incentive programs. (See E, Cynthia Krieg Stewardship Fund)

- To implement these programs, an average number of five or six cities, prioritized by need, size and budget constraints, as described in the H&H Study, should be targeted each year of the plan.

- Offer new information and insights about NPDES II in a user-friendly manner for city staff, residents and local media.

- To achieve the goal of increasing more buffers, city leaders need to be made aware of the Buffers Benefit Shoreline Incentive Program set up within that area's subwatershed. (See E, Cynthia Krieg Stewardship Fund.) Cities should become co-sponsors of the program, even if only in name, with the partnering nursery and the MCWD to create greater buy-in and leverage with its citizens.

- To achieve the goal of infiltrating more water into individual properties within that subwatershed, city leaders should be informed about the Water Infiltration Benefits Program (see E, Cynthia Krieg Stewardship Fund). Cities should become co-sponsors of the program, even if only in name, with the partnering landscape and/or hardware company and the MCWD to create greater citizen buy-in.

- Community newspapers need to be made aware of the program partnerships described above.

2. Events/Workshops

- Desired Outcome: Stronger MCWD identity and good will around water resources issues. Higher level of public awareness about water quality issues.

- Desired Outcome: For the regulated public, an increase in use of BMPs and higher levels of compliance with rules and regulations. Analysis and Recommendations, Key Findings, Communications and Public Outreach Audit Report (p.25).

The District has done various education/communications events in the past year(s), with varying levels of success. These programs are addressed throughout the plan in respective areas.

3. Educational Outreach to the Regulated Community

Of particular note are the workshop activities for the regulated community. The audit found that "*...builders and developers suggested that more workshops should be offered and provided in conjunction with BATC and others to provide 'credits' for licensed contractors (see Recommendation #4 of audit). It is recommended that the MCWD work with the regulated community to design and offer workshops that meet their needs. This would have the additional benefit of creating goodwill for the MCWD among the regulated community and thereby promote a greater willingness to comply with regulations.*"

4. Builders, Developers, Contractors, Landscapers (and Other Stakeholders)

While builders, developers and contractors have traditionally been under-served within the MCWD, the district has made great inroads in the past year to shore up its relations with this critical community. The MCWD can increase its impact, and subsequently the impact to natural water resources, over the next five years with these actions:

- ***Better Use of the MCWD Website:*** Streamline and consolidate cumbersome inter-agency permitting application process by utilizing the MCWD's new GIS mapping technology so these stakeholders can locate which subwatershed their project is in and what permits are required from the regulatory agencies, including cities, MPCA, DNR and others.

  Currently the system allows for this to some degree but it needs to be better designed in tandem with the mapping system so it is clear this is an online One-Stop-Permitting option that will reduce the time and perceived redundancy of the regulatory process.

- ***Link to the National Association of Home Builders,*** which can be located at www.nahb.com/epasurvey.htm, where NAHB has posted a recent stormwater survey done with developers. The site has the new EPA stormwater regulation that will require builders and developers who must get NPDES Stormwater Permits to use the best available technology to control, reduce or eliminate pollutants associated with stormwater discharges from construction sites.

  Link to your partner-builder/developer/contractor sites as a professional courtesy, which will help build relationships and equity with these groups.

  Link to other appropriate sites such as the Metropolitan Council and others involved in building and development in the metro area. Also look for partnering opportunities to present workshops and other information that isn't duplicated by other organizations.

- ***Create More Workshop Opportunities:*** Create with the appropriate trade associations, as recommended in the audit, a combined workshop that includes NEMO (i.e., stormwater management) and the MCWD permitting process for accreditation in March when Continuing Education Credits need to be completed.

  Other workshop topics might include infiltration techniques (utilizing the Arboretum site as a workshop location) and erosion, with one-page WaterPro Bulletins (see D) about these issues as leave-behinds.

- ***Create "Business for Watershed Supporter" Certificates and a Website Profile Platform*** (similar to the Chesapeake Bay site) for all your commercial participants of workshops and roundtables, which would also parallel the "compliance incentive awards given to industry associations" given by the San Diego Project Clean Water (see Appendix 4, p 3).

- ***Annual Land Use Management Roundtable: "Curb and Gutter Elimination/Alternative Stormwater":*** MCWD will host an in-depth annual roundtable about Land Use Management with key stakeholders such as builders and developers, also for credit, once a year. One of the primary platforms of this event would be a first-year focus on eliminating traditional curb and gutter features with alternative stormwater management practices now being pursued in select metro counties. The alternative stormwater roundtable would ideally take place in a subwatershed area where there is a nearby curb-and-gutter project that can serve as a demonstration site. A virtual – and real – tour of such an area is an option. Themes for subsequent years TBD. (2004)

- ***Water Resource Management for Government Officials:*** The above workshops and roundtables are also ideal programs for elected officials. The plan recommends extending invitations to this stakeholder group.

  As an incentive, offer a per diem to government officials to participate. Possibly coordinate or partner with the League of Cities or another coordinating government body. The workshops and roundtables present great occasions for builders and developers to meet their local officials in an ideal networking opportunity, facilitated by the MCWD. (2004-forward)

Targeting key media and trade media with these stories through a media campaign will also broaden the education and communications value for the greater public and workshop/roundtable participants.

- ***Create Builders and Developers Brochure or WaterPro Bulletin Fact Sheet(s):*** Develop a quick-read brochure or background piece(s), under the WaterPro Bulletin banner, outlining MCWD permit requirements for commercial, industrial and residential building and development projects. (If these vary greatly by category, the MCWD might want to consider doing a separate one for each niche). The permit process would be explained in detail and could feature a couple of exemplary case studies for greater understanding (same material to be repositioned for the website as well).

- ***Building and Development Trades:*** Timely Op-ed pieces by MCWD board and/or staff, plus news releases about regulatory water quality laws, BMPs, Rule M issues and watershed benefits for builders, plus ongoing relevant MCWD news will help build equity with this stakeholder group and educate them in the process.

- ***Get in Front of Them:*** MCWD should initiate open houses and schedule speaking engagements at builder, developer and landscape trade shows and with select offices throughout the next five years. This will demonstrate that the MCWD is an ally in the building process that can bring greater value to the development and re-development arena.

5. WaterPro Newsletter/WaterPro (EBlast) Bulletins

(REPLACES C IN THE PLAN DISCUSSION FOR THE NOW DEFUNCT NEWSSPLASH DISCUSSION LISTED AS C IN THE AUDIT)

"It is recommended that the District continue with the newsletter for technical professionals, and conduct a focus group of representatives from target audiences to get more specific ideas about what they want to see in future newsletters. Distribution methods could be examined as well to see if there are ways to increase readership." –

Analysis and Recommendations, Key Findings, Communications and Public Outreach Audit Report (p.24)

WaterPro is currently providing the MCWD's stakeholders with good scientific information and innovations about a variety of BMPs, personnel changes at MCWD and other newsworthy items each quarter. But it may not be reaching enough thought leaders in the communities it is designed to serve. The strategic plan recommends the following actions, based on the audit:

- Grow the list to include a larger audience, such as the addition of builders and developers, builders and developers trade publications, high profile real estate offices and their trade publications (see Proposed New Programs), and the offices of the mayor, planning, zoning, environmental and park/recreation and public works of each city within the MCWD. (2003-2004)

- Strive to Create Specific Editorial Content germane to each group in each issue, especially when hot-button issues pertain to them. (2004-forward)

- Use the Current Mailing List as a Focus Group: Select an appropriate number of current individual WaterPro recipients to provide feedback on subjects they would like covered in the publication. Either create a self-addressed feedback form inserted in a future issue or conduct a phone survey. (2003-2004)

- Issue Time-Sensitive WaterPro E-Blast Bulletins with breaking news between planned editions from the MCWD to the e-mail addresses of WaterPro recipients currently in the list serve database. (2004-forward)

- Build on the Name Recognition of WaterPro and its Indentification with the MCWD by creating all information one-sheets for constituents under the WaterPro Bulletin banner. These could include timely information from recent press releases, updates on issues, information one-sheets on erosion, infiltration, wetlands, buffers, etc.

❖ The WaterPro **Bulletin strategy also could be used to inform and engage:**

- County Commissioners
- MCWD Board of Managers
- MCWD Staff
- MCWD Website (Homepage)
- CAC Members
- Community Leaders
- Key City Personnel
- Elected Officials within the MCWD
- Stewardship Leaders in Faith Groups
- Education Leaders
- MCWD Consultants
- Others TBD

Anyone receiving a WaterPro E-Blast or a Bulletin will eventually come to recognize the importance of water quality issues at the MCWD and the need for interaction. It will also help the MCWD to be perceived as a natural resource leadership organization focused on water and land use issues and dedicated to keeping its constituents in the loop.

6. Cynthia Krieg Memorial Stewardship Fund

"This program is considered by stakeholders to be very effective at engaging the public in small, local projects. By funding projects that are seen by others, this program is considered effective in influencing a larger public as well. Some question its ability to effect change given the program's relatively small size. Nonetheless, it is recommended that this program be continued and possibly expanded as a way of supporting early adapters and leading edge citizens in demonstrating ways to protect water resources." – Analysis and Recommendations, Key Findings, Communications and Public Outreach Audit Report (p.26)

Cynthia Krieg was a tireless champion of watershed improvements. It is fitting that a personalized program dedicated to her memory and work is not only succeeding but has the potential to deliver some of the key new ideas and measurable changes in the next five years throughout the 12 subwatersheds.

The plan recommends utilizing the Cynthia Krieg Memorial Stewardship Fund (CKMSF) to achieve its main educational goals in the followings ways.

Barrier: Many people perceive that planting natural buffers and installing infiltration materials are cost-prohibitive. The programs below remove, in part, the barriers and educate about the programs' benefits.

- ***Buffer Benefits Incentive Program (under the auspices of the CKMSF):*** The strategic plan recommends establishing a fund for shoreline buffers, based on MCWD requirements and applicant sincerity, to help reduce the cost to citizens in subwatersheds where buffers are needed to improve water quality and prevent shoreline erosion. Forming an alliance with the Neighborhood Revitalization Program (NRP) might create greater synergy for the program and perhaps additional funding. The University of Minnesota might also play a role.

  This tactic has been used successfully by the Solid Waste Management Coordinating Board in offering discounted compost bins to citizens in the metro counties to reduce that part of the solid waste stream. Its first offering sold out.

  The Buffer Benefits Program would establish a Partner Nursery to provide discounts to buyers of native plants for buffering purposes in each of the 12 subwatersheds. An official display poster would identify the nursery as such, with background sheets or "shelf talkers" available near the native plants that are part of the buffer program.

  Neighborhood group leaders, CAC members and community media in each subwatershed could help get the word out about the program. All informational materials could likewise be re-purposed to the website. (2004-forward)

- ***Water Infiltration Benefits Program (under the auspices of the CKMSF):*** The strategic plan recommends establishing a parallel program for both residential and commercial property owners in the subwatersheds who wish to employ infiltration techniques on their property, with either rain garden landscaping, porous pavers or other methods. Forming an alliance with the NRP and the University of

Minnesota might create greater synergy for the program and perhaps additional funding. The University of Minnesota might also play a role.
The MCWD has already begun this practice in the Fulton Neighborhood of south Minneapolis, with help from NRP, and at the Minnesota Landscape Arboretum's demonstration site. And it recently providing finding for a similar development project in another part of south Minneapolis.

The program would establish a Partner Landscaping/Hardware company to provide discounts to buyers of the necessary materials for infiltration buffering purposes in each of the 12 subwatersheds. An official display poster would identify the partner as such, with background sheets or shelf talkers available near the pavers and plant materials that are part of the program. All informational materials could be re-purposed for the website.

Neighborhood group leaders, CAC members and community media in each subwatershed could help get the word out about the program. All informational materials could likewise be re-purposed for the website. (2004-forward)

- ***Related Educational and Informational Media Opportunities:*** These techniques are not only timely and perhaps cutting-edge, they are also educationally newsworthy to inform and engage wider audiences, including:

  - Nationally produced cable programs such as those on the Home and Garden Network (HGTV), much of which is produced locally. These production companies are always looking for fresh ideas that benefit viewers everywhere. Framed as leading-edge landscaping and smart, pervious surface practices, both techniques could influence local, regional and national audiences. A precedent has already been set for this by funding, in part, the Dean Johnson TV program in the past year for Trillium Bay.

  - Locally produced home and garden radio and television shows/segments and outdoor shows like Ron Schara's are a virtually unexplored area of MCWD influence. These programs are always in need of solid, viewer-friendly tip information and how-to stories. The MCWC could provide ready-made content delivered by a MCWD spokesperson.

- Locally produced monthly magazine and newspaper sections dedicated to home and garden issues have just started to pick up on these trend stories. With a targeted educational media campaign, MCWD spokespersons should be able to present these programs to wider audiences for greater impact on watershed awareness and the attendant issues of runoff and erosion control.

❖ The annual round of grant recipients need to be better publicized in community, neighborhood and daily press, perhaps by creating case studies for papers and the website including real-world examples of what type of application is funded and how the program works. The MCWD should plan far enough in advance to execute this tactic correctly and to maximize its value.

"Water professionals and the regulated community use the website and find it to be quite useful. However, informed stakeholders were not sure how effective the website was for communicating with the general public." – Analysis and Recommendations, Key Findings, Communications and Public Outreach Audit Report (p.22)

7. MCWD Website

The MCWD's website presents the greatest challenge of the strategic plan since it is the most paradoxical outreach tool currently in operation under both the Education (i.e. community outreach) and Communications programs. Established in 1996, the website has, like most websites, been a work in progress.

The good news is that the website is perceived by the audit to be all things to all stakeholders (especially the general public, elected officials, the regulated community and water professionals). The bad news is that it tries to be all things to all stakeholders and does not always hit the mark because of its poor design and color tone (less blue, more earth tones), use of meaningful graphics (or the lack thereof), comparatively lackluster architecture-navigation and failure to utilize consistently the current and merging multimedia techniques of expanded broadband and regular internet usage.

D. STRATEGIES FOR IMPROVEMENT

- Ideally the website should model the Chesapeake Bay site, the majestic, grand website of all watershed organizations in the country, if not the world.

- The site should become a web destination for primary stakeholders and anyone else interested in water resource/land use management through its remodel.

- The MCWD should choose a web company for its ability to create, design and maintain a site like the Chesapeake Bay site. Its homepage provides a road map for redesign and content upgrade. (Note that new materials created for certain stakeholder groups in the field could be used on the website and vice versa. See Section IV.)

- The new website remodeler should work with a Web Task Force that includes representation from appropriate staff, board, engineering and education and communications consultants for a general overview and for help with specific areas where each expertise is most needed.

Allow six-to-nine months for the site to be rebuilt before publicly re-launching it with a media event or an event like the launch of MinneWater that also could be tied to a current 2004 watershed issue.

- Appropriate enough resources to do the job right so that it will require only minor upgrades rather than a major overhaul in another five years, including better content creation, management and consulting. After all, this is potentially the MCWD's nerve center and it needs to provide greater value and convenience for all users.

- Begin creating multi-purpose, downloadable fact sheets, which also will serve as background for subwatershed needs, city and county commissioner updates, media information and other stakeholder needs. These would be much like those produced by the Department of Natural Resources (DNR).

- Set a target date of 2005 to have a truly finished site, with all archives, graphic images, maps, history, minutes, etc. loaded onto the site.

E. DISTRICT PROJECTS

The audit lists a number of district projects that blend communications and education. Each is listed below with a brief strategic recommendation.

- **Arboretum Pervious Surface Demonstration**

  RECOMMENDATION 12

  This is a powerful demonstration site for realizing infiltration goals that should be used for educating other stakeholder groups in the years ahead, including:

  - *CAC members*
  - *Community Leaders*
  - *Key City Personnel*
  - *Elected Officials within the MCWD*
  - *Stewardship Leaders in Faith Groups*
  - *Education Leaders*
  - *Media*
  - *Others TBD*

- **Commercial Rough Fish Removal at Lake Nokomis**

  RECOMMENDATION 13

  This provides a wonderful and colorful media opportunity to educate about the role carp play in stirring up the phosphorus and other sediment-pollutants in a lake. If the occasion arises again, MCWD should target the activity for local media within the subwatershed in which it occurs and the general TV broadcast media (which, to date, have not done anything in this area).

- **Lake Nokomis Wetland Restoration**

  RECOMMENDATION 14

  After a successful groundbreaking two years, the MCWD is planning a ceremonial opening of the ponds with the three key neighborhood groups in the subwatershed, once *the protective fences come down from around the landscaping. This is one of the few special educational/media events the district is currently involved in.*

- **Pamela Park**

RECOMMENDATION 15
After a groundbreaking at a local Edina grade school two years ago to teach about the wetland pond system and a subsequent field trip to the sites, the MCWD has since reconfigured its educational outreach to curriculum development and adults.

- **Rules**

RECOMMENDATION 16
A Rule M plan was created last year, which will be implemented with staff should Rule M go out for public discussion. The plan would not need modification, even with H&H considerations and a subwatershed focus, except for adding some key graphic elements.

- **Functions and Value Wetland Assessment**

RECOMMENDATION 17
This program needs to be summarized for key stakeholders at the city and policy levels in a WaterPro Bulletin so that its applications can be better used and understood. The same should be done for H&H, MCRAM and other studies.

- **Jennings Bay**

RECOMMENDATION 18
A "Heal the Bay"-like program should be developed in this subwatershed area, modeled loosely after the one in Santa Monica. After convening a national panel of experts in 2001 to create a plan for treating this subwatershed, the MCWD needs to put a target program in place. (See Subwatershed Section VIII.)

+ **Gray's Bay Headwaters and Causeway**

RECOMMENDATION 19

Possible events planned around the headwaters and Upper Watershed are discussed in Section VII, p.30.

+ **Gideon Glen**

RECOMMENDATION 20

See Subwatershed Section IX.

+ **Highway 55 Camp Coldwater Springs (CCS)**

RECOMMENDATION 21

Since a great deal of time and money has been spent defending and protecting Camp Coldwater Springs, it behooves the district to begin thinking about what role it should play at CCS. As construction wraps up in 2004, the plan recommends efforts to implement or incorporate the area's rich historical information and land use profile into the developing curriculum.

Now that the Department of the Interior/Fish and Wildlife has been given jurisdiction of the land, the MCWD should revive (and begin funding) the Camp Coldwater Community Outreach Plan it approved in 2002, by contacting the local office of Fish and Game to determine what the next steps should be.

F. CITIZEN ADVISORY COMMITTEE (CAC)

> *"Having a CAC is considered effective at engaging those citizens involved in the CAC, but some stakeholders do to not feel that this group has a significant role in Watershed business. It is recommended that the MCWD create a clearer role for the CAC with specific and visible responsibilities."* – Analysis and Recommendations, Key Findings, Communications and Public Outreach Audit Report (p.27)

The CAC needs to play a bigger, more effective role in watershed affairs. In short, as the above quotation illustrates, the CAC needs to help create the MCWD buzz. The plan recommends the following strategies to allow them to have a greater impact by:

- Recruiting more high profile business, community and movers and shakers into the ranks of those who can influence their industries and the subwatershed communities in which they live.

- Recruiting more zoning and planning commissioners to influence smarter water resource/land use in city policy and the communities in which they live.

- Make the CAC members "watershed ambassadors," charged with taking major initiatives and issues discussions to neighborhood associations, homeowner associations, faith-based stewardship groups, block party leaders and others who can localize watershed goals and benefits such as infiltration and buffers. Arm them with appropriate WaterPro Bulletins and the DNR booklet to leave behind.

Personal interaction with people to change behaviors is also one of the key elements of Community-Based Social Marketing and also one of the most effective, because it relies on buzz.

"...behavior change rarely occurs as a result of simply providing information...behavior change is most effectively achieved through initiatives delivered at the community level which focus on removing barriers...and simultaneously enhancing the activities' benefits." –Fostering Sustainable Behavior.

Or put in the commercial vernacular of the marketing and to some extend public relations worlds:

"[Buzz is] a subtle and imperfect art, dictated by changing tastes and the vagaries of human networks. If done right, though, marketing by buzz [or relating to MCWD's stakeholder groups] doesn't just work well, it works well for less money. Compared with most traditional marketing channels [and public relations is a function of marketing occasionally], spreading the word by word of mouth can bring enormous exposure for just a modest investment." (Fast Company, August 2003)

G. OTHER

The audit lists a number of other activities including the following. Recommendations are noted where appropriate:

- Support to cities, organizations, neighborhood groups and individuals:

  - Work with residents interested in receiving materials and information about shoreline stabilization and infiltration. [See WaterPro Bulletins.]
  - Deliver or mail educational materials to cities, organizations and neighborhood groups (e.g., distribution of brochure: Green Up Your Lawn, Not Your Lakes and Rivers). [See WaterPro Bulletins]
  - Work with cities to address obstructions in Minnehaha Creek.
  - Work with cities to address vandalism of signage in the MCWD.
  - Write educational Best Management Practices (BMPs) for city websites. [See WaterPro Bulletins]
  - Help develop signage and materials for projects, bridges, etc.
  - Mail requested canoe maps to individuals and retail outlets.

RECOMMENDATION 22

The canoe map should be revised to feature more information about habitat, native plants and buffers, BMPs in action, land use features and examples along the creek where people can see erosion problems and solutions, infiltration techniques, historical markers and other visually educational sites, aided by appropriate signage along the creek.

- Act as a resource for various people, entities, cities, organizations and neighborhood groups (e.g., individuals looking for a workshop about manure management). [See WaterPro Bulletins and Hobby and Horse Farm Initiative] Research websites.

- Consider doing more speaking engagements, conference participation and/or participating in environmental fairs held at neighborhoods, cities, schools or organizations.

- Set up display at the Minnesota Association of Watershed Districts (MAWD) Conference in 2000, 2001 and 2002.

- Partner with various organizations such as Watershed Partners on outreach and communications efforts.

- Meet with various interested persons who would like to work with the District (e.g., watercolor artist Carol Gray, who paints Minnehaha Creek).

RECOMMENDATION 23

Re-position select paintings to the website as graphics for different page sites.

H. MEDIA COMMUNICATIONS

1. Communications Strategy Complemented by Appropriate Images/Video

The MCWD will provide images about the news area within MCWD where that news is occurring from the GIS mapping page on its website as an attachment with the release. By providing the media with such images, the district can educate them about the scope of its work in the MCWD. (See also Recommendation c below.)

By providing an attachment with the graphic, the district also makes the media's job easier and helps to increase the public's knowledge about the watershed through a critical visual element, thus enhancing the overall reporting and understanding about the MCWD.

2. Media Relations Opportunities Better Defined

To clarify the district's media relations activities, news releases are generally tied to staff or board-directed requests to disseminate timely information for the following urgent actions:

- Event-driven educational opportunities for stakeholders and general public (e.g., neighborhood rain garden tours, Nokomis groundbreaking, etc.)
- Crisis situations (e.g., Hopkins Sewage Spill)
- Legislative Agenda (e.g., Camp Coldwater Springs, MnDOT Streamlining of Watershed Permit Process)

- Drafting and placing op-ed pieces to support critical district/water resource issues (Camp Coldwater Springs, dog parks, etc.)

- The aim of these efforts is to use the media as a communications vehicle to inform vast numbers of people, to influence legislators and the public in the shortest amount of time and to build support for the MCWD's agenda on issues, rules, controversies and crisis situations.

  For the past two years, the effectiveness of such activities is measured by the monthly clipping report, which analyzes coverage and identifies gaps or opportunities to interact or relate with stakeholder groups on a more detailed and/or personal level. These tactics have proven effective and should remain in place, with graphic and video upgrades to round out the text messages.

3. Better Framing and Modeling of MCWD Messages in News and Information

These communications can be improved by framing the key message better, using the suggestions recommended by Community-Based Social Marketing techniques such as:

- Sending a message "that emphasizes losses which occur as a result of inaction are consistently more persuasive than messages that emphasize savings as a result of taking an action." *(Fostering Sustainable Behavior, p. 90)*

- "Messages that describe actions to be taken in clear, straightforward steps are more likely to be understood and followed." (ibid, p. 93)

- Model the message to change the behavior: "One of the most effective methods of increasing the adoption of sustainable behavior is to model the behavior we wish others to adopt . . .Modeling can occur in person or through television or videotape." (ibid, pgs. 98, 96)

4. Produce Supporting Visual Materials to Communicate and Educate about Messages, Goals

In light of these instructive insights, the plan recommends two possible ways to better model the behavior changes desired in its messaging through the media:

- Create TV and newspaper-quality photographic and/or digital video depictions of the outcomes the district wants. For example, if the district would like buffers and infiltration systems to become more widespread, produce before and after images of buffers to illustrate and model the outcome and produce images of rain gardens, downspouts, etc.

  For television, these images (known commonly as "b-roll") are priceless – worth a thousand words – and are not only more likely to get air time, they can be re-programmed for the website.

  The plan recommends creating an annual Graphics/Production Budget to augment media efforts and educational initiatives. In the age of affordable digital cameras, creating professional quality still images and short video b-roll that is smartly shot and edited is economically feasible and should be a priority.

- Using such imagery on the website has other applications, including use by the staff for presentations to builders and developers, the CAC (and their neighborhood and block party leaders), the faith-based stewardship effort and others who can use the materials for the life of any program or outreach activity.

  In 2004, the district may want to consider producing two three-to-five minute videotape pieces on infiltration techniques and buffers, demonstrating barriers and benefits, to give to cities, CAC ambassadors and others as a way to teach about and change behaviors in subwatershed areas where these issues are most relevant and urgent.

  In subsequent years, the MCWD may want to produce two more pieces each year to resonate with its goals and the "message of the year" and to supplement its news releases to both print and broadcast media. (See Section VIII.)

5. Provide MCWD Speakers to More Community Organizations

Watershed goals impact many communities and the MCWD staff, Board, CAC and consultants (such as the Cairns) have a wealth of knowledge to share with the broader community to help affect change. The plan recommends speaking more to local Rotaries, chambers of commerce, home associations and other groups in the subwatersheds on watershed issues and goals important to stakeholders in that watershed. (2004-onward)

6. Annual State of the Watershed Event to Become Media Tour

Despite terrible public turnout for the MCWD's annual State of the Watershed tour, this is a media-friendly event that always generates coverage. The plan recommends turning the pubic event into a district-wide media tour each spring to highlight issues in the general watershed with bigger broadcast and print media and papers in the subwatersheds. Select MCWD staff and consultants would meet with editors of key papers and with appropriate broadcast media to present the state of the watershed and critical issues within any given area (roughly five to seven papers and a handful of broadcast opportunities). (2004-onward)

This presentation could likewise be folded into roundtable presentations for other groups such as builders and developers.

7. Upgrade Media List

The media list needs to be upgraded to include trade publications (2003). Possible additions to the list would include:

- Publications targeting builders, developers, contractors, landscapers
- Real estate publications
- Sportsman publications based here (Hunters and anglers are good supporters of water resource management.)
- Horse and hobby farmer publications (manure initiative?)
- Minority media (see Diversity Initiative, Section VIII.)
- Local cable access channels in subwatersheds
- Other city newsletters and publications TBD

8. Annual Messaging Opportunities for Greater Awareness of Water Quality Issues

The audit makes it clear that while the public may not recognize who the MCWD is and what it does, it understands and supports the need for water quality improvement and regulation. In the past, MCWD has relied on select public events to drive awareness about itself and select issues (see Sections II. and III.). The Five-year Strategic Plan recommends developing an annual key message (and tools where appropriate) to be incorporated each year throughout all of MCWD's education and communications efforts and materials in order to build the MCWD's identity with water quality issues at more practical levels.

Government and commercial concern regularly designate a week, month or whole year to a subject. The EPA, for example, recently named April 2003 Stormwater Month in commemoration of the 30th Anniversary of the Clean Water Act in 2002-2003. By creating an annual message focus, with attendant tools to help raise awareness, the MCWD can build stronger relationships and begin to overcome barriers with its stakeholders and the general public.

PAINTER CREEK SUBWATERSHED

A. NEEDS ANALYSIS

Painter Creek is one of the district's primary problems. Large phosphorus loading to this subwatershed through Jennings Bay and Dutch Lake remains a problem and its flow is yet to be understood. The area still retains many wetlands and features more agricultural land than other nearby subwatersheds further east of it , making it ripe for new development.

According to the H&H, "*Wastewater from a wastewater treatment plant was responsible for 45% of the phosphorus load to Jennings Bay while it operated. Potentially impacted parts of the watershed include the main Painter Creek channel, Katrina Lake (immediately downstream from the waste lagoon), South Katrina Wetland, Painter Marsh and Jennings Bay. Remaining phosphorus possibly exists in the sediment of wetlands and water courses, but comprehensive sediment data do not exist.*

"Data from this system is being collected as part of the Watershed District's Painter Creek Feasibility Study being conducted during 2003" (A-34). Until the data is finished and can be integrated into the MCWD's regimen, the plan recommends some short-term strategies.

B. EDUCATION AND COMMUNICATIONS STRATEGIES

Barriers: Developers and builders may not be aware of the area's history. Horse and other farms may be an additional source of pollutants in the subwatershed. Currently there is no incentive to curb runoff or erosion.

Benefits: The MCWD can demonstrate that decreases to phosphorus and other pollutants can mean cleaner water for Jennings Bay and affected lakes.

The following strategies would be used at Painters Creek:

- *Area Residents:* Develop a brief one-page WaterPro background piece (direct mail or flyer) about the area's problems and the benefits of appropriate BMPs. (See Horse and Hobby Farm Initiative, p. 37.)

- *The cities of Maple Plain and Orono:* Hold regular meetings with key department staff to develop a partnership and create greater awareness, including possible funding to purchase buffer vegetation from area nursery, if needed, for public parks and other public areas impacted by excessive phosphorus loading and erosion.

- *Other Stakeholders, Horse and Hobby Farm Owners, Builders, Developers, Real Estate, Recreational Users:* Use customized WaterPro Bulletins and workshop/roundtable discussions to educate about the history of the area and its current challenges and remediation strategies. Employ CAC and faith-based consultants to work with local community organizations, churches and others TBD.

- *Other Agencies and Potential Partners, such as Three Rivers Park District, University Extension, Local Marinas and Bait Shops:* Work in tandem with these groups to avoid duplication of education and communications outreach efforts. Develop strong partnerships with identified groups to win support and change behaviors in the area.

- *Media:* Prepare and distribute timely news releases to coincide with capital improvements in the area. Prepare a guest editorial from a city official, a local resident, and/or a MCWD Board Manager in the area explaining the benefits of decreasing phosphorus loads, buffers and other BMPs.

DUTCH LAKE SUBWATERSHED

A. NEEDS ANALYSIS

According to the H&H Study, "*Land use in the north and western portions of the watershed is dominated by agriculture and open space in the form of forests, woodland and wetlands. Connectivity between natural areas in this portion of the watershed is fairly good. Moving east through the watershed, land use becomes increasingly dominated by single family residential. Land use in the City of Mound immediately south of Dutch Lake is dominated entirely by single family residential. Currently in the Dutch Lake watershed, the forests and woodlands category and the wetlands category dominate the landscape, with each of these categories making up over 20% of the landscape*"(B-6).

B. EDUCATION AND COMMUNICATIONS STRATEGIES

Barriers: As this area continues to develop, runoff and erosion will present challenges. Because of the area's relatively low density, residents and developers may not perceive that Dutch Lake has any genuine issues, despite having only low-to-moderate water quality rankings.

Benefits: The MCWD can demonstrate that decreases to phosphorus and other pollutants can mean cleaner water for Dutch Lake and the entire subwatershed.

The following strategies would be used at Dutch Lake:

- *Area Residents:* Prepare a brief one-page WaterPro background piece (direct mail or flyer) about the area's potential for greater phosphorus loading with more development and the benefits of appropriate BMPs. (See also Horse and Hobby Farm Initiative, p. 37.) Also use Permitting Brochure.

- *The cities of Minnetrista and Mound:* Hold regular meetings with key department staff to develop a partnership and create greater awareness, including possible funding to purchase buffer vegetation from area nursery, if needed, for public parks and other public areas impacted by phosphorus loading and erosion. Make Permitting Brochure available through various channels.

- ***Other Stakeholders, Horse and Hobby Farm Owners, Builders, Developers, Real Estate, Residents, Recreational Users***: Use customized WaterPro Bulletins and workshop/roundtable discussions to educate about the history of the area and its current challenges and remediation strategies to prevent more phosphorus loading and achieve cleaner waters.

- ***Other Agencies and Potential Partners such as Three Rivers Park District, University Extension, Local Marinas and Bait Shops:*** Work in tandem with these groups to avoid duplication of education and communications outreach efforts. Develop strong partnerships with the identified groups to win support and change behaviors in the area. Provide materials such as the Permitting Brochure and WaterPro Bulletins whenever possible. Employ CAC and faith-based consultants to work with local community organizations, churches and others TBD.

- *Media:* Prepare and distribute timely news releases to coincide with education efforts to inform the public of BMPs and other MCWD actions that affect them directly. Prepare a guest editorial from a city official, a local resident, and/or a MCWD Board Manager in the area explaining the benefits of decreasing phosphorus loads, buffers and other BMPs.

LANGDON LAKE SUBWATERSHED

A. NEEDS ANALYSIS

According to the H&H Study, "*Land use in the watershed changes dramatically across the political boundary between the cities of Minnetrista and Mound. Open space in the form of woodlands, forests, grasslands and maintained natural areas dominates the western portion of the watershed that lies within the City of Minnetrista. The Dakota Rail line that divides the watershed into north and south sections hinders connectivity between natural areas in this portion of the watershed. The eastern part of the watershed is dominated almost entirely by residential land use types. Single family residential land use surrounds Langdon Lake to the south and north. To the east the lake is surrounded by commercial and institutional land use."(p. C-6)*

This interesting mixed land use puzzle, in one of the larger subwatersheds within the MCWD, presents its own set of challenges: Redevelopment and stormwater issues in Mound, coupled with potential for increased phosphorus loading in areas of new development and an overall increase in pervious surfaces, call for coordinated efforts between all stakeholders, since the Metropolitan Council and MnDOT are also involved in the area.

B. EDUCATION AND COMMUNICATIONS STRATEGIES

Barriers: Retrofitting of stormwater systems in the area may be seen as business as usual for city and contractors involved in redevelopment projects, while new development is viewed as a positive, despite the fact that it brings increased phosphorus loads to area water bodies.

Benefits: The MCWD can demonstrate that decreases to phosphorus and other pollutants means cleaner water for the Langdon Lake area, while appropriate stormwater BMPs can help the cities abate stormwater volume through infiltration techniques employed by residents and contractors.

The following strategies would be used at Langdon Lake:

- *Area Residents*: Prepare a brief one-page WaterPro background piece (direct mail or flyer) especially for shoreline residents about the area's potential for greater phosphorus loading with more development and the benefits of appropriate BMPs (especially infiltration techniques and buffers). Also, use Permitting Brochure.

- ***The cities of Minnetrista and Mound:*** Hold regular meetings with key department staff to develop a partnership and create greater awareness, including possible funding to purchase buffer vegetation from area nursery, if needed, for public parks and other public areas impacted by phosphorus loading and erosion. Make Permitting Brochure available.

- ***Other Stakeholders, Builders, Developers, Real Estate, Residents, Recreational Users*:** Use customized WaterPro Bulletins and workshop/roundtables discussions to educate about the history of the area and its current challenges and remediation strategies to prevent more phosphorus loading and achieve cleaner waters.

- ***Other Agencies and Potential Partners such as Three Rivers Park District, MnDOT, Metropolitan Council, Local Marinas and Bait Shops:*** Work in tandem with these organizations to avoid duplication of education and communications outreach efforts. Develop strong partnerships with the identified groups to win support and change behaviors in the area. Provide materials such as the Permitting Brochure and WaterPro Bulletins whenever possible. Also employ CAC and faith-based initiatives, especially for shoreline residents.

- ***Media:*** Distribute timely news releases to coincide with education efforts to inform the public about BMPs and other MCWD actions that affect them directly. Prepare a guest editorial from a city official, a local resident, and/or a MCWD Board Manager in the area explaining the benefits of decreasing phosphorus loads, buffers and other BMPs.

SIX MILE CREEK SUBWATERSHED

A. NEEDS ANALYSIS

According to the H&H Study, *"Land use throughout the watershed is primarily agricultural. Residential and commercial land uses within this watershed are primarily confined to the cities of St. Bonifacius and Victoria. Remaining natural areas are primarily confined to the area of Carver Park Reserve (surrounding Lakes Steiger, Auburn, Lunsten and parts of Zumbra). Within Carver Park Reserve, land cover consists mostly of grasslands, forests and woodlands. Currently in the Six Mile Creek watershed, agricultural land and "natural areas" dominate the landscape; agriculture makes up over 25% of the landscape, and wetlands, forests, woodlands, and grasslands together make up approximately 40% of the landscape."* (p. D-7)

The largest subwatershed within the MCWD, Six Mile Creek is noteworthy for its agricultural character, development along the Highway 7 corridor, complex drainage system and the need to preserve its landlocked depressions, or basins, "to minimize development impacts to downstream water bodies."

The study also notes that "The Six Mile Creek watershed encompasses over 17,000 acres, approximately 15% of the entire MCWD. The watershed contains a mixture of agricultural land, protected natural areas and the rapidly developing municipalities of St. Bonifacius and Victoria. Additionally, the many lakes and wetlands of the Six Mile Creek watershed represent valuable natural resources."

Nonetheless, *"Six Mile Creek outlets to Halsteds Bay, one of the poorest water quality bays of Lake Minnetonka. Due to both the size of the watershed and its land uses, pollutant loads from the Six Mile Creek watershed are high, contributing to the high nutrient levels in the bay itself. Overall, pollutant loads in the watershed are expected to increase (Table IV.D.5-1). Phosphorus loads represent the highest increase at 53%. In order to maintain current pollutant loading rates, about 900 lbs. per year of phosphorus will need to be removed in the watershed. Similar relative increases in total nitrogen and total suspended solids will also have to be eliminated."* (p. D-41)

Many of its educational and communications needs then, rest with informing area cities, townships and residents of the area's diversity and value as it cycles from farmland to new development frontier on the suburban sprawling western edge of the metro area.

B. EDUCATION AND COMMUNICATIONS STRATEGIES

Barriers: Farmers may know what the agricultural BMPs are, or perceive that they are too expensive to implement. Developers may not be aware of alternative stormwater options and other BMPs. Cities and townships may need help with NEMO and NPDES II issues.

Benefits: Smart Development will mean a cleaner upper and lower watershed for the district as a whole. For stakeholders, better water resource management should lead to better land use.

The following strategies would be used at Six Mile Creek:

- ***Area Residents*:** Develop a brief one-page WaterPro background piece (direct mail or flyer) especially for farmers about agricultural BMPs. For the area's residents, provide background information about the proposed "Greenway Corridor Approach," the "showcase LID development (Laketown Township) and drainage issues (especially infiltration techniques and buffers). Also, use Permitting Brochure.

- ***The cities of Minnetrista, St. Bonifacius and Victoria and Watertown Townships:*** Hold regular meetings with key department staff to develop a partnership and create greater awareness of the MCWD's activities, culminating in a subwatershed town meeting to make the public more sensitive to BMPs and other programs the district has to offer. Set up pilot infiltration and buffer program sites to educate the wider community. Also hold NEMO workshop.

- *Other Stakeholders, Builders, Developers, Real Estate, Crown College, Residents, Farmers, Hunters*: This provides many opportunities to educate about the history and future of the area and its current challenges and remediation strategies.

- ***Other Agencies and Potential Partners such as Three Rivers Park District, UM Extension, Crown College, DNR, Conservation Associations, Local Marinas and Sportsman Shop and Associations:*** Work in tandem with these organizations to avoid duplication of education and communications outreach efforts. Develop strong partnerships with the identified groups to win support and change behaviors in the area. Provide materials such as the Permitting Brochure and WaterPro Bulletins whenever possible. Also employ the CAC and faith-based initiatives, especially for farmers and city residents. H&H recommends a partnership with Crown College "to implement stormwater improvement" and "boat access shoreland demonstration" area that would be staged, perhaps, with DNR.

This area is prime for a number of pilot programs using CBSM techniques.

- *Media:* Distribute timely news releases to coincide with education efforts to inform the public about BMPs and other MCWD actions that affect them directly. Prepare a guest editorial from a city official, a local resident, and/or a MCWD Board Manager in these areas explaining the benefits of capital projects, pilots and other issues.

LONG LAKE CREEK SUBWATERSHED

A. Needs Analysis

According to the H&H Study, "two main headwater sources feed into Long Lake, from which Long Lake Creek flows. In the northwestern corner of the watershed is School Lake and in the northeastern corner is Holy Name Lake. Both lakes feed small creeks flowing in a southerly direction." The area has pocketed wetlands and landlocked basin areas vital to protect. It also has volume control and load-level increase issues.

Long Lake Creek also *"has substantial appeal as a water body of local interest. Its location within the center of the watershed, adjacent to the City of Long Lake, adds to its appeal. The lake has not been of exceptional quality, but does offer public access for swimming, fishing, and boating. The District-wide interest is primarily as a highly valued local resource of average quality that also serves to remove some watershed load as it moves from the land to Lake Minnetonka."* (p.E-50).

With MnDOT construction ongoing on the Highway 12 expansion project, the MCWD, its cities and residents within this subwatershed area will be more visible than usual.

B. Education and Communications Strategies

Barriers: Residents and city officials around Mooney Lake and other key areas may see natural buffers as too expensive to implement in order to help control volume and pollutants from entering into the water body.

Benefits: Residents will realize cleaner water even with heavy recreational use of water resources and chronic flooding around Mooney Lake can be diminished, in part, with BMPs and programs.

The following strategies would be used at Long Lake Creek:

- *Area Residents*: Prepare a brief one-page WaterPro background piece (direct mail or flyer) especially about infiltration and volume control and phosphorus loading – and the importance of land-locked wetland pockets and basins. Also, use Permitting Brochure.

- *The cities of Long Lake, Medina, Plymouth, Wayzata:* Hold regular meetings with key department staff to develop a partnership and create greater awareness of the District's activities. Make MCWD incentive programs made available.

- *Other Stakeholders, Builders, Developers, Real Estate, Marinas, Boaters and Anglers*: This provides many opportunities to educate about the history and future of the area, BMPs and with the Beautiful Bays Initiative.

- *Other Agencies and Potential Partners such as Three Rivers Park District, MnDOT, Local Marinas and Sportsman Shop and Associations:* Work in tandem with these organizations to avoid duplication of education and communications outreach efforts. Develop strong partnerships with the identified groups to win support and change behaviors in the area. Provide materials such as the Permitting Brochure and WaterPro Bulletins whenever possible. Also employ the CAC and faith-based initiatives, especially for lake users and Mooney Lake residents.

- *Media:* Prepare and distribute timely news releases to coincide with education efforts to inform the public about BMPs and other MCWD actions that affect them directly. Prepare a guest editorial from a city official, a local resident, and/or a MCWD Board Manager in these areas explaining the benefits of capital projects, pilots and other issues.

GLEASON LAKE SUBWATERSHED

A. NEEDS ANALYSIS

According to the H&H Study, "*The Gleason Lake Creek watershed is dominated almost entirely by single- and multi-family residential land uses. On the whole, the watershed has urbanized and very little open space or natural areas remain.*" Impervious surface seems more dominant in this particular subwatershed than most in the upper watershed, while it has a well-defined erosion location plan and a chronic problem with geese management.

"Gleason Lake is a highly valued local water body that also serves an important water quality function for Lake Minnetonka. Gleason is of average water quality because of the influence of macrophytes. The lake does, however, serve as a treatment system for the large, fully developed watershed draining to it. This means that all water draining Gleason Lake Creek is settled prior to discharge to the extremely high quality Wayzata Bay." (p.F-41)

B. EDUCATION AND COMMUNICATIONS STRATEGIES

Barriers: Residents and city officials around the lake and other key areas may see natural buffers as too expensive to implement in order to help control volume and pollutants from entering into the water body, cease erosion control and better help manage geese.

Benefits: Residents will realize better water and land quality through the use of natural shoreline buffers.

The following strategies would be used at Gleason Lake:

- ***Area Lakeshore Residents*:** Prepare a brief one-page WaterPro background piece (direct mail or flyer) especially about infiltration and volume control, phosphorus loading and erosion control. Also, use Permitting Brochure for pollutant runoff problems.

- ***The cities of Plymouth, Wayzata, Orono, Minnetonka:*** Hold regular meetings with key department staff to develop a partnership and create greater awareness of District's activities. Make MCWD incentive programs available.

- ***Other Stakeholders, Gleason Lake Improvement Association, Real Estate, Marinas, Boaters and Anglers*:** This provides many opportunities to educate about the history and future of the area, BMPs, the Beautiful Bays Initiative, plus the Buffer and Water Infiltration Benefits Programs. H&H recommends also supporting the existing "Adopt a Pond" Project for area residents to achieve buy-in for better water quality.

  The area is ripe for a key water infiltration demonstration site and/or pilot as well as an H&H recommended Shoreline Stabilization demonstration site.

- ***Other Agencies and Potential Partners such as Three Rivers Park District, MnDOT, Local Marinas and Sportsman Shop and Associations, Nursery and Landscaping Partners, Gleason Lake Improvement Association:*** Work in tandem with these groups to avoid duplication of education and communications outreach efforts. Develop strong partnerships with the identified groups to win support and change behaviors in the area. Provide materials such as the Permit Brochure and WaterPro Bulletins whenever possible. Employ the CAC and faith-based initiatives, especially for lake shore residents.

- *Media:* Distribute timely news releases to coincide with education efforts to inform the public about BMPs and other MCWD actions that affect them directly. Prepare a guest editorial from a city official, a local resident, and/or a MCWD Board Manager in the areas explaining the benefits of capital projects, pilots and other issues.

SHULTZ LAKE SUBWATERSHED

A. Needs Analysis

According to the H&H Study, "*Land use in the northern part of the Shultz Lake watershed* [located in Victoria] *is split fairly evenly between the open space found in Carver Park Reserve and residential land use types found in the east. The southern part of the watershed is dominated by agricultural and residential land uses. Currently in the Shultz Lake watershed, agricultural land use dominates the landscape, making up 17% of the landscape. Forests, woodlands, and grasslands together make up over 20% of the landscape" (p.G-6].*

As the area becomes further developed, its load to the lake is expected to increase as well and the study calls for no net gains over existing conditions.

"Based on limited data, Shultz Lake received a lake grade of "B" in 2002, suggesting that the lake is fully supporting of swimming. Recent lake transparency data and a small lake to watershed ratio suggest that with good management, Shultz Lake could continue to have good water quality in the future. However, the Shultz Lake watershed is in transition and based on projected 2020 land uses, will lose existing agricultural areas to residential development. For this reason, good stormwater management will be critical to maintaining or improving the quality of Shultz Lake in the future.

"As described.... changes in Schultz Lake water quality are primarily expected to result from the conversion of vacant/agricultural land to residential land uses. Because load reductions are also required under existing conditions, recommendations are made to address existing development and agricultural land uses as well." (p.G-35)

B. Education and Communications Strategies

Barriers: Stormwater management may be perceived as too expensive to implement in order to help control volume and pollutants from entering into the water body, cease erosion control and better manage the area's transition from under-developed and farming to developed.

Benefits: Residents will realize better water – and land – quality through the use of natural shoreline buffers.

The following strategies would be used at Shultz Lake:

- ***Area Lakeshore Residents, Farmers:*** "The MCWD should work with residents living within the Shultz Lake Shoreland District (1,000 feet from OHW) to implement stormwater management practices. Stormwater ponds, infiltration, rain gardens and riparian buffers are among the practices that should be emphasized. Stormwater management should also be incorporated into reconstruction of roads and other common infrastructure as improvements are made." (H&H Study, p. G-36.)

These can be accomplished with brief one-page WaterPro background pieces (direct mail or flyer) especially about infiltration and volume control, phosphorus loading and erosion control and Agricultural BMPs. Also, use the Permitting Brochure for pollutant runoff problems.

- ***The city of Victoria:*** Hold regular meetings with key department staff to develop a partnership and create greater awareness of District's activities, including NEMO, NPDES II and MCWD Incentive programs.

- ***Other Stakeholders, Builders, Developers, Real Estate, Marinas, Boaters and Anglers, Local Conservation District and Associations***: This provides many opportunities to educate about the history and future of the area, BMPs, Beautiful Bays Initiative, plus the Buffer and Water Infiltration Benefits Programs. Also conduct a Builder-Developer workshop on the area.

- ***Other Agencies and Potential Partners such as Three Rivers Park District, Minnesota Arboretum, UM Extension, Marinas and Sportsman Shop and Associations, Nursery and Landscaping Partners:*** Work in tandem with these organizations to avoid duplication of education and communications outreach efforts. Develop strong partnerships with the identified groups to win support and change behaviors in the area. Provide materials such as the Permitting Brochure and WaterPro Bulletins whenever possible. Employ the CAC and faith-based initiatives, especially for farmers.

- ***Media:*** Distribute timely news releases to coincide with education efforts to inform the public about BMPs and other MCWD actions that affect them directly. Prepare a guest editorial from a city official, a local resident-farmer, and/or a MCWD Board Manager in the areas explaining the benefits of capital projects, pilots and other issues.

LAKE VIRGINIA SUBWATERSHED

A. NEEDS ANALYSIS

The Lake Virginia Subwatershed lies in the Lake Minnewashta area and features mostly farmland ripe for development. According to the H&H Study, "*Land use north and west of Lake Minnewashta is dominated by single family residential. Lake Minnewashta Regional Park lies to the east of the lake. Within the park, land use is dominated by forest, woodland, wetland and grassland. South of Highway 5, the watershed is also dominated by open space land use types (forest, woodland and wetland). Currently in the Lake Virginia watershed, the '26% to 50% impervious cover' and lakes and open water wetlands categories of land use dominate the landscape.*" (H-6)

"*Lake Virginia receives almost four times the load of phosphorus that Lake Minnewashta receives annually, yet it is about one seventh the surface area of Lake Minnewashta. The result is that while Lake Minnewashta has excellent water quality, Lake Virginia's water quality is rated as fair and is non-supporting to marginally supporting for swimming. In general, the recommendations for this watershed focus on protecting the water quality of Lake Minnewashta by maintaining or slightly reducing phosphorus loads, while seeking to achieve significant load reductions for Lake Virginia.*" (p.H-40)

B. EDUCATION AND COMMUNICATIONS STRATEGIES

Barriers: Shoreline residents may view buffers as intrusions into their property and/or not affordable.

Benefits: Residents will realize better water and land quality through the use of natural shoreline buffers.

The following strategies would be used at Lake Virginia:

- ***Area Lakeshore Residents and Farmers***: "Encourage shoreline buffers. On the north shore of Lake Virginia and portions of Lake Minnewashta, lawns often extend all the way to the water's edge. Encourage lakeshore property owners to install or maintain naturally vegetated buffers and 'lakescaping,' especially on steep slopes and where shoreline erosion is occurring. Many residential areas also contain wetland fringe areas along lakeshores, separated from the lake by narrow beach ridges. These wetlands provide excellent natural vegetated swales that can intercept stormwater runoff draining to the lake from residential areas and should ideally be maintained in a natural state." (H&H Study, p. H-42.)

See tools previously described for this issue.

- ***The closest cities are Victoria and Chanhassen:*** Outreach focused mainly on lakeshore residents (See above).

- ***Other Stakeholders, Builders, Developers, Real Estate, Marinas, Boaters and Anglers, Local Conservation District and Associations*:** This provides many opportunities to educate about the history and future of the area, BMPs, the Beautiful Bays Initiative, plus the Buffer and Water Infiltration Benefits Programs. This is ideal for a Builder-Developer workshop on the area.

- ***Other Agencies and Potential Partners such as Three Rivers Park District, MnDOT, County, DNR, Minnesota Arboretum, Marinas and Sportsman Shop and Associations, Nursery and Landscaping Partners:*** Work in tandem with these groups to avoid duplication of education and communications outreach efforts. Develop strong partnerships with the identified groups to win support and change behaviors in the area. Provide materials such as the Permitting Brochure and WaterPro Bulletins whenever possible. Employ CAC and faith-based initiatives, especially for farmers. Use the Arboretum demonstration site for residents, builders and real estate companies interested in working in this area.

  H&H recommends: "*Implementing boat access shoreline buffer demonstration sites. The DNR Boat Access at Lake Virginia and Lake Minnewashta provide excellent locations to demonstrate proper shoreline management techniques to area lake residents. Other users of these areas can gain exposure to the role that land use management plays in water quality.*" (p. H-42)

- *Media:* Prepare and distribute timely news releases to coincide with education efforts to inform the public about BMPs and other MCWD actions that affect them directly. Prepare a guest editorial from a city official, a local resident-farmer, and/or a MCWD Board Manager in the areas explaining the benefits of capital projects, pilots and other issues.

CHRISTMAS LAKE SUBWATERSHED

A. NEEDS ANALYSIS

"Christmas Lake has the highest water quality of any lake in the MCWD. This condition is due to a combination of factors including lake morphometry, small watershed to lake ratio, low levels of impervious surfaces, substantial areas of native vegetation, and probable strong groundwater surface water interaction. The general approach, therefore, is to maintain and protect the existing conditions that, taken together, sustain the high quality of Christmas Lake. Since much of the lake is well buffered by natural vegetation and receives minimal runoff, the recommendations contained herein are focused on managing the shoreline buffer, minimizing stormwater runoff and addressing several areas of known erosion."(p.I-34)

Christmas Lake has been receiving a discharge of sediment from Powers Boulevard where a gully has formed that delivers the runoff to the lake. Corrective actions will require a number of measures, including resident BMPs and awareness about shoreline and bluffline erosion issues, buffers, permitting requirements and sensitivity to land-locked basins areas.

B. EDUCATION AND COMMUNICATIONS STRATEGIES

Barriers: Residents and the city may not have funding to do shoreline buffers, if needed, or understand the merits of buffers. MCWD should try to attract both of these audiences by offering discounts at a partnering nursery for native, shoreline plants.

Benefits: There are genuine opportunities to educate about the benefits of shoreline buffers to help correct erosion and infiltration techniques for water quantity problems. According to the H&H study, *"much of the lake is well buffered by natural vegetation and receives minimal runoff. The recommendations contained herein are focused on managing the shoreline buffer, minimizing stormwater runoff and addressing several areas of known erosion."* (p. I-34) Christmas Lake has the highest water quality grade of any lake in the MCWD and already good buffers in place – two positive factors to emphasize in any information and education campaign.

The following strategies would be used at Christmas Lake:

- *Lakeside Residents, Local Associations*: Prepare a brief one-page WaterPro background piece (direct mail or flyer) about the lake's problems and the benefits of BMPs and buffers for the lakes to affected residents living in the targeted improvement area. The discount coupons for neighborhood nursery purchases of native vegetation would be part of the piece. The MCWD Permitting Brochure also would be enclosed.

- *The cities of Shorewood and Chanhassen:* Hold regular meetings with key department staff to develop a partnership, including possible funding to purchase buffer vegetation from an area nursery, if needed, for public parks and other public areas in impacted section of the lake.

- *Other Stakeholders, Builders, Developers, Real Estate*: Use WaterPro Bulletins about buffers and workshops/roundtables to educate about preserving the lake's shoreline and water quality. Also employ CAC and faith-based Initiatives.

- *Other Agencies and Potential Partners such as Three Rivers Park and MnDOT:* Work in tandem with these organizations to avoid duplication of education and communications outreach efforts.

- *Media:* Distribute timely news releases to coincide with capital improvements at the lake. Prepare a guest editorial from a city official, an influential resident and/or a MCWD Board Manager in the area explaining the benefits of buffers and infiltration techniques.

LAKE MINNETONKA DIRECT DRAINAGE SUBWATERSHED

A. NEEDS ANALYSIS

According to the H&H Study, *"The Lake Minnetonka direct drainage area covers approximately 23,330 acres (about 36.5 square miles); this area includes the surface area of the lake itself (approximately 13,980 acres), which covers a little over half of the total area. It contains portions of Orono, Wayzata, Minnetrista, Minnetonka, Shorewood, Woodland, Mound, Deephaven, Minnetonka Beach, Spring Park, Tonka Bay, Excelsior, and Victoria. The direct drainage area includes 26 subwatershed units.*(p.J-3)

"Surface water (in the form of lakes) covers half the total area in the Lake Minnetonka Direct watershed. In remaining areas and in areas immediately adjacent to these lakes, land use is dominated by single family residential. Isolated pockets of forest and woodland are common throughout the watershed, covering slightly more than 10% of the upland landscape. Commercial and industrial land uses are concentrated along major transportation corridors such as County Road 15 and State Highway 7." (J-6)

"The Lake Minnetonka Direct Drainage area encompasses one of the most important and heavily used recreational lakes in Minnesota. Because of its large size and numerous bays, the public and resource managers alike often view water resource problems from the context of a single bay of the lake. The relationships and interaction between different bays, the numerous tributaries, the impacts of invasive species (i.e., Eurasian water milfoil), and the changing land uses surrounding the lake are not well understood; however, the HHPLS serves as an excellent first step towards the integration and understanding of these variables.

The characteristics of Lake Minnetonka bays vary considerably, with most bays of the upper and western portion of the lake shallow and moderately to highly eutrophic. To the south and east, the bays are mesotrophic with good to excellent water quality. For this reason, water quality goals across the lake vary considerably. In general, phosphorus load reductions are a priority for the western-most bays such as Halsteds and Jennings, while maintaining existing conditions is the priority for the eastern bays" (p. J-40)

B. EDUCATION AND COMMUNICATIONS STRATEGIES

Barriers: Residents and the cities may not be aware of permitting issues related to redevelopment of large and other-sized lakeshore properties, or shoreline erosion/stabilization issues.

Benefits: There are genuine opportunities to educate about the benefits of shoreline buffers/stabilization and permitting issues.

The following strategies would be used at Christmas Lake:

- ***Lakeside Residents*:** Prepare a brief one-page WaterPro background piece (direct mail or flyer) about the lake's problems and the benefits of BMPs and buffers for the lakes to affected residents living in the targeted improvement area. The discount coupons for neighborhood nursery purchases of native vegetation would be part of the piece. The MCWD Permitting Brochure also would be enclosed.

- ***Cities (see list above):*** Hold regular meetings with key department staff to develop a partnership, including possible funding to purchase buffer vegetation from an area nursery, if needed, for public parks and other public areas in impacted section of the lake. H&H recommends a shoreline stabilization pilot to further educate other cities, residents and other stakeholders. NPDES II and NEMO for retrofit stormwater plans may be important workshop topics.

  H&H also recommends that, *"The District should work with local units of government to encourage more low impact approaches to redeveloping lake-front residential lots. Particularly important are protection of steep slopes, use of buffers, protection of native aquatic and riparian vegetation, and retention of stormwater on site. While some excellent publications on lakescaping exist, a more technical BMP Guide for Lakeshore Development could be designed for contractors and local officials."*(p. J-44).

- ***Other Stakeholders, Builders, Contractors, Real Estate*:** Use a WaterPro bulletin on buffers and workshops/roundtables to educate about preserving the lake's shoreline and water quality. Employ CAC and faith-based Initiatives.

- ***Other Agencies and Potential Partners such as Three Rivers Park, MnDOT, LMCD, DNR-Fisheries, Boating, Marina, Angler and other Lake and Bay Associations :*** Work in tandem with these groups to avoid duplication of education and communications outreach efforts.

- ***Media:*** Distribute timely news releases to coincide with capital improvements at the lake. Prepare a guest editorial from a city official, an influential resident and/or a MCWD Board Manager in the area explaining the benefits of buffers, shoreline stabilization and permitting issues, especially with spring and summer seasonal redevelopment.

MINOR SUBWATERSHEDS

A. NEEDS ANALYSIS

"Nineteen watersheds are grouped under the term 'minor watersheds' for purposes of this report. The majority of these watersheds are small relative to the watersheds in the other chapters, in addition to the fact that none of these watersheds contain lakes that were modeled for the water quality portion of this report. Some of these watershed names are names of Lake Minnetonka bays; however, they do not represent the direct drainage areas of the bays, but rather a group of subwatersheds that drain into the direct drainage areas." (p. K-4). They include:

- Browns Bay
- Carsons Bay
- Classen Lake
- East Upper Lake
- Forest Lake
- French Lake
- Galpin Lake
- Grays Bay
- Halsteds Bay
- Lake William
- Lost Lake
- Maplewood
- Mary Lake
- Peavey Pond

"Land use in the minor watersheds changes dramatically from one area to another. Generally, as one moves east through the watershed, land use becomes more intense. In the minor watersheds to the north and west of Lake Minnetonka, land uses are primarily dominated by agriculture and open space, with varying amounts of single family residential land use. The watersheds to the south and east of Lake Minnetonka are generally dominated more by single family residential and commercial land use." (p. K-7)

The H&H Study clearly sets some strategic priorities/goals for these minor subwatersheds areas, including:

*"**Halsteds Bay development controls:** Extra emphasis of stormwater management (quantity and quality) is warranted in the Halsteds Bay subwatersheds. This area of the District is developing rapidly and drains to the already impacted Halsteds Bay of Lake Minnetonka. Similar land use changes in the surrounding areas of St. Bonifacius and Minnetrista provide a picture of what may be expected as this area converts from agricultural to suburban development and hobby farms.*

The Halsteds Bay subwatersheds are some of the few remaining undeveloped areas of the District. For this reason, the District is presented with the potential opportunity to implement and showcase state of the art stormwater management techniques such as low impact design standards."

***Achieve a no net increase in phosphorus loading for new development.** New development should not result in a net increase in stormwater rate, volume or pollutant loading. Developments should be planned to provide on-site treatment of stormwater with the objective to avoid or minimize additional stormwater runoff to the extent possible. Offsite mitigation, where necessary, should be provided concurrent with the new development."* (p. K-50)

B. EDUCATION AND COMMUNICATIONS STRATEGIES

Barriers: Residents, builders/developers and the cities may not be aware of alternatives to stormwater management in developing areas, or infiltration techniques.

Benefits: The benefits of stormwater management options, permitting issues and preventative loading increases to subwatersheds means a better quality of life on the bays.

The following strategies would be used with these minor subwatersheds:

- ***Lakeside/Bayside Resident, SelectHorse and Hobby Farmers:*** Prepare brief one-page WaterPro background pieces (direct mail or flyer) about the lakes' and bays' problems and the benefits of BMPs and buffers for the lakes to affected residents living in the targeted improvement area. The MCWD Permitting Brochure, discount coupons for neighborhood nursery purchases of native vegetation and background about the Water Infiltration Benefits would be included..

- ***Cities (see list in study):*** Hold regular meetings with key department staff to develop a partnership, including possible funding to purchase buffer vegetation from an area nursery and provide information about Water Infiltration Benefits Incentive for public parks and other public areas in impacted section of lakes and bays. NPDES II and NEMO for stormwater plans, including Curb and Gutter Elimination seminar, may be important workshop topics.

- ***Other Stakeholders, Builders, Contractors, Real Estate*:** Use WaterPro Bulletin on buffers and workshops/roundtables to educate about preserving lake's shoreline and water quality. Employ CAC and faith-based Initiatives.

- ***Other Agencies and Potential Partners such as Three Rivers Park, MnDOT, Metropolitan Council, Marina, Angler and other Lake and Bay Associations:*** Work in tandem with these groups to avoid duplication of education and communications outreach efforts. Engage Beautiful Boat Initiative.

  H&H also strongly recommends, "*Work with St. John the Baptist Catholic Parish to implement stormwater BMPs. This facility is located on the south shore of Galpin Lake and is the single largest landowner on the lake. Much of the Parish facility consists of rooftop, parking lot, recreational areas (in turf grass) and other impervious or semi-impervious surfaces. Stormwater management efforts should focus on on-site retention and pretreatment of all runoff generated from this facility. The District could also include a shoreline demonstration component to this effort that could be used to educate local residents.*" (p. K-47)

- ***Media:*** Prepare timely news releases to coincide with capital improvements at the lakes and bays. Prepare a guest editorial from a city official, an influential resident and/or a MCWD Board Manager in the area explaining the benefits of buffers, shoreline stabilization and permitting issues, stormwater alternatives and other subjects as they arise.

MINNEHAHA CREEK SUBWATERSHED

A. NEEDS ANALYSIS

Because of the size and multiple component parts of this subwatershed, plus the scope of the upcoming USACE and HDR-driven partnership project with the MCWD on revitalizing Minnehaha Creek, the plan recommends creating a separate strategic plan for the lower watershed and its subwatersheds.

The plan would be covered under the existing MCWD retainer.

The plan could be created within three weeks of the Board acceptance of the Five-Year Strategic Plan, using the same analysis, tools and methods described

B. External Review / Recommendation (HDR 2003)

Overall, the plan is very well written and reflects the commitment of the MCWD to being a leader in public participation in development and consideration of watershed projects and initiatives. The plan includes numerous recommendations for newsletters, website updates, press releases and an active CAC/TAC process for major project initiatives. It also links the public process to projects and activities listed in the H&HPLS study. The plan does not include a public participation process for the Minnehaha Creek Corridor.

RECOMMENDATION 24

The MCWD is currently developing a strategy to approach member cities with the outline for the U.S. Army Corps Feasibility Study and to gather support for the Study. The Communications plan should be updated to include this initiative by the end of December 2003.

RECOMMENDATION 25

The MCWD should initiate the development of a public involvement master plan for the Minnehaha Creek Corridor plan development and U.S. Army Corps Feasibility Study Process. This plan should be completed and in-place by the end of January 2004.

REPORT 5

SUMMARY OF "MINNEHAHA CREEK STABILITY AND HABITAT ASSESSMENT REPORT

A. FLUVIAL GEOMORPHIC ASSESSMENT

1. Purpose

The purpose of this portion of the investigation is to:

- Evaluate the existing stability of Minnehaha Creek
- Determine if / where grade control structures should be installed

These goals were achieved by performing a field investigation and an analysis of the sediment transport characteristics of Minnehaha Creek. The results of this analysis are provided herein.

2. Assumptions

The stability of Minnehaha Creek was evaluated based upon the *existing* conditions. The stability of the creek can be modified through changes in the:

- Hydrology (modification to dam operating procedures, continued urbanization, construction of detention basins, etc.)
- Hydraulics (in-channel modifications)
- Sediment Supply (see above reasons)

An evaluation of the impacts of proposed modifications to the system was not considered as part of this project.

3. Reach Designation

The first step in the fluvial geomorphic investigation process is the separation of Minnehaha Creek into reaches based on geomorphic and hydraulic character. The purpose of the reach designation is to provide the MCWD with a spatial register for classification and straightforward tabulation of both biological and geomorphic results.

Criteria used to establish stream reaches and reach breaks conducive to future urban water resource management activities were based on the following, listed in order of relative priority:

1) Similar geomorphic character, including bed, bank and planform characteristics,
2) Similar bed slope, hydraulic and/or hydrologic change;
3) Break in channel continuity and grade control resulting from permanent physical features such as road crossings, culverts, bridges and railroads; and,
4) Reaches less than 1.0 mile in length (for watercourse management purposes).

4. Channel Stability

There were no identified areas of active downcutting in Minnehaha Creek. Some areas of historical incision were observed, but none warrant immediate attention. Upstream of the Browndale Dam, the creek is impounded by several grade controlling riffles or structures, and these are considered to be aggrading, despite their anthropogenic origin. In total, there are five major impounded reaches and 14 of the 30 sampled reaches are at least partially impounded, usually by misplaced riprap transitions under bridge crossings. The most dramatic of these impounding rock riffles can be found under Lyndale Avenue, I-35W, 44th Street and I-494.

The Inter-Fluve channel field stability rating shows most reaches within the stable or slightly aggrading range, with a slight trend toward aggradation in the upstream reaches. This trend is mainly due to the presence of wetlands near Lake Minnetonka and the density of impoundments upstream of Wooddale Avenue (Reach 16), all of which are rated as aggrading. There is localized bank erosion along Minnehaha Creek in nearly every reach. Usually, localized, excessive bank erosion is caused by poor riparian zone management, exaggerated by stormwater inlets, degrading restoration projects or bridge abutments, or exposed infrastructure such as concrete or buried pipes. Removal of trees and shrubs near the stream is extensive, and widespread maintenance of grasses to the stream edge has removed stabilizing root structures on much of Minneapolis park land. The lack of stabilizing root structure has led to bank failure in several reaches, most notably from Bloomington Avenue to 35W. The lack of an intact buffer is illustrated in a graph of the NRCS Stream Visual Assessment Protocol (SVAP), which places significant weight on riparian buffer quantity and quality (Figure 3). In lotic reaches without grade control or impounded water, the highest quality riparian zones (Reaches 1, 10, 13, 20 and 27) all show good bank stability. Reaches with the most extensive erosion, including 5, 6, 7, 8 and 12 all scored at or below 5.0 on the SVAP scale.

5. Stream Classification

Rosgen classification of Minnehaha Creek reaches revealed 22 of the 26 classified reaches as a "C4" or "C5" channel. Five reaches are completely impounded with virtually no water slope, while 14 of the 30 reaches have some degree of impoundment. The five impounded reaches have lost much of their stream character and thus could not be accurately classified. Stable C4/5 channels are meandering streams with wide floodplains, moderate width to depth ratio, high sinuosity, alternating riffle and pool sequences and gravel or sand substrates. Fifteen (15) of the 22 reaches were classified as being low gradient, despite having much of their sinuosity reduced through channelization.

Because of the general stable bedform and lack of active incision, the Schumm was only applied to two reaches. Reaches 8 and 9 show some evidence of recent downcutting and subsequent lateral instability. Both reaches have a high potential for restoration.

B. FISH HABITAT

The fish population in Minnehaha Creek is largely a reflection of that found in Lake Minnetonka, with a few riverine species found throughout. Fish habitat was generally poor throughout the stream, with zero large woody debris, low heterogeneity of habitat, shallow residual pool depth and poor riparian zone vegetation. Several reaches showed either some complex habitat features or active spawning Redds. Those reaches are listed below.

1. Fish habitat in selected reaches of Minnehaha Creek - Reach Notes

- **27:** Excellent riparian zone, LWD in low density. Redds observed here, high sand bedload, good pool cover and cobble riffles.
- **13:** Excellent riparian zone, some LWD, deep pools, good sediment transport and floodplain access, Redds were observed here, but low density.

- **1:** Decent riparian vegetation, moderate gradient, cobbles throughout. Poor residual pool cover, good riffles, no spawning habitat (substrate large, velocity high).
- **10:** Moderately dense forested cover here. No redds seen, but significant deep pool habitat mainly due to grade controlling riffles downstream that impound water.
- **12:** Variable riparian coverage, but better than the managed park sections downstream, some lawns to the stream edge. Numerous active redds were seen throughout this reach, most dense just up and downstream of Upton Avenue. Residual pool depth is marginal, but spawning size gravel is common.
- **9:** More parkland, some riparian zone coverage, poor restoration projects with oversized rock Redds were observed here. Some deep pool cover at bends and cobble riffles at significant grade breaks.
- **16:** Very short reach with poor riparian zone. Numerous active redds seen here, but pool habitat is poor. Large dam at the upstream end (Browndale dam).
- **20:** Wetland reach, primarily sand substrate. Dense redds observed 1000 ft. upstream of Louisiana Avenue, deep pool cover in places
- **4:** Poor riparian zone, small gravels, some cobble Redds were observed here, but few.

C. Riparian Vegetation and Floodplain

Riparian zone vegetation density is directly correlated with bank stability in Minnehaha Creek. Where large trees and understory shrubs dominate the streambank, soils are stable, but where turfgrass is managed to the stream edge and trees have been removed, streambanks are unstable and eroding.

Reaches 1, 10, 11, 13, 27, 28 and the upper half of 14 have at least partially intact riparian zones of at least 50 feet in width. The dominant tree species growing in these reaches are cottonwood, black willow, silver maple, boxelder and American elm. Black willow, boxelder and cottonwood are the most common streamside species, with black willow and cottonwood providing extremely dense root systems.

Reaches 3 through 8, 15 and the lower half of 14 have turfgrass dominated riparian areas with sometimes extensive riprap coverage. These reaches have no ecological or geomorphic stability value. Many of the reaches have some riparian forest patches or are covered with extensive wetlands. The wetlands are dominated primarily by aggressive exotic species such as reed canarygrass and cattail, but native species are present. Reaches 19, 25 and 30 have extremely wide riparian zone wetlands, although stream habitat quality is limited in these reaches due to gradient.

The large majority of restoration projects observed utilize large riprap, sometimes greater than 2.0 feet in diameter, to stabilize the stream above the lower limit of woody vegetation. Most bioengineering projects utilize hard engineering toes, non-biodegradable materials and a monoculture of short-lived sandbar willow. None of the projects observed utilized long-lived flood tolerant hardwood species.

Overall, the sediment transport analysis confirms the results of the field analysis that indicate the stream is generally considered a stable system. There are areas of aggradation behind dams and within lakes and wetlands. A significant portion of the creek appears to be armored. This is not surprising given the protracted high flow condition that occurred in 2002.

An armored channel is one that has a surficial layer sediment that is infrequently mobilized. This has the effect of 'protecting' the sediment beneath it from being mobilized. In addition, the required shear stress for initiation of movement for an armored channel can be significantly higher than for a non-armored channel with the same sediment characteristics. This is due to the reduced effective height of individual stones as they become more integrated into the surficial matrix. The maintenance of high flow conditions during 2002 is conducive to channel armoring.

D. CONCLUSIONS

Relative to other urban streams in the region, Minnehaha Creek has a remarkably stable channel cross-section and profile. Portions of the stream are straightened and much of the riparian zone has been removed and is managed for turfgrass or parkland. Riparian zone and in-stream habitat quality is marginal, but similar to that found in other urban corridors.

What makes Minnehaha Creek unique is its potential for restoration. The upper watershed is dominated by wetland and lake forms, and so the hydrograph is largely a function of water control at Gray's Bay Dam. Therefore, it may be possible to establish a flow regime that is both geomorphically stabilizing and less harmful to the aquatic ecosystem.

Frequent grade controls at small dams and road crossings impound the stream and degrade the riverine ecosystem by warming water, depositing fine sediment and preventing fish passage.

Efforts to remove these grade controls would significantly improve the habitat quality in Minnehaha Creek and would help to restore geomorphic stability and sediment transport equilibrium. Grade control riffles under bridge crossings could be modified to lower the head and decrease velocities. Examples of these grade control riffles were found at I-35W, I-494, 44th Street and Blake Road.

Changes in riparian zone plantings and park management that maintain wooded buffers would result in multiple benefits for little cost. Increased buffers in reaches such as 3 through 9, where the riparian zone is dominated by turf, would greatly improve habitat for fish and macroinvertebrates, help to cool the stream in summer and provide green corridors for wildlife.

Because widespread erosion and degradation is not a problem, streambank stabilization and natural channel restoration are a cost-effective possibility. Reach 8 is an example of a reach with significant bank erosion problems. This type of bank failure has resulted from poor riparian zone management and could easily be remedied through bioengineering stabilization methods and aggressive planting schemes. Channelized segments, such as those in Reaches 3 through 8, 23, 24, 28 and 29 can be restored through natural channel design and relocation, using bioengineering methods that maximize long-term stability. A more sinuous planform helps to create hydraulic conditions that scour pools and transport sediment more efficiently. The alternating riffle and pool sequence of meandering streams also creates vertical complexity of habitat for aquatic organisms. As mentioned above, past restoration projects in Minnehaha Creek feature large rock (>2.0 ft), non-biodegradable materials and shrub willow monocultures. Hydraulic engineering and bioengineering practices are available that can minimize the use of rock and ensure long term bank stability with a more diverse tree species assemblage.

E. External Review / Recommendation (HDR 2003)

Overall, the report looks well-prepared. All of the major bases are covered, perhaps with the exception of the following:

- HDR has a question on the "big picture". Page 20 of the report indicates that Minnehaha Creek is "remarkably stable" for an urban stream, though some reaches have been straightened and there has been a loss of riparian area. Another section of the report indicates that water quality is good except for temperature. Page 20 also indicates that the unique potential for restoration of Minnehaha is to restore a hydrologic regime, "that is both geomorphically stabilizing and less harmful to the aquatic system." (Page 29 indicates that the major factor affecting macroinvertebrate populations is flow regime rather than water quality).

- In reality, based upon the conclusion that the channel is stable and that water quality is good, the restoration is for enhancing riparian and aquatic habitat through change in flow regime. This point needs to be highlighted more; and in our opinion, it brings up the question as to whether "no action" should be considered (at least for some reaches; although the report does indicate several reaches with extensive localized erosion due to infrastructure and lack of riparian habitat, where localized action may still be needed). What is the goal of streams in the urban environment? We suggest that it is different than streams in a non-urban environment. In our opinion, streams in the urban environment should be (a) stable so as not to endanger infrastructure and (b) maintain good water quality. Obviously good aquatic and riparian habitats are an essential requirement for a healthy urban stream, but this stream appears to have enough in order to be stable. Enhanced aquatic and riparian habitats are beneficial and desirable, but we think "no action" may also be an alternative here.

- Section 2.1.1, page 4 – Creek analyzed based upon existing conditions. Duly noted, however, the report should probably have some sort of assessment as to potential future changes. How should potential recommendations / plans be prepared in light of anticipated future changes? If no significant changes are expected, indicate that design will not need to consider increased Q's, loss of floodplain, changes in sediment load, etc. and their impact on proposed mitigation.

- The report indicates additional grade control is not needed, as the stream is vertically stable (page 20). The report also suggests potentially removing existing grade control structures that are fish barriers (page 20). Removal of existing structures may induce upstream vertical instability. Removal options should be heavily scrutinized in regard to potentially impacted an existing stable stream.

- Page 25, bold equation, shouldn't IBI be replaced with FBI?

The report indicates that although the channel is stable, it is not in geomorphic equilibrium as evidenced by the aggrading sections of the stream. Is the volume of sand used for winter roadway protection a significant factor in the current aggrading streams, and if so, how should this be addressed?

REPORT 6

SUMMARY OF "MCWD 2002 HYDROLOGIC DATA REPORT"

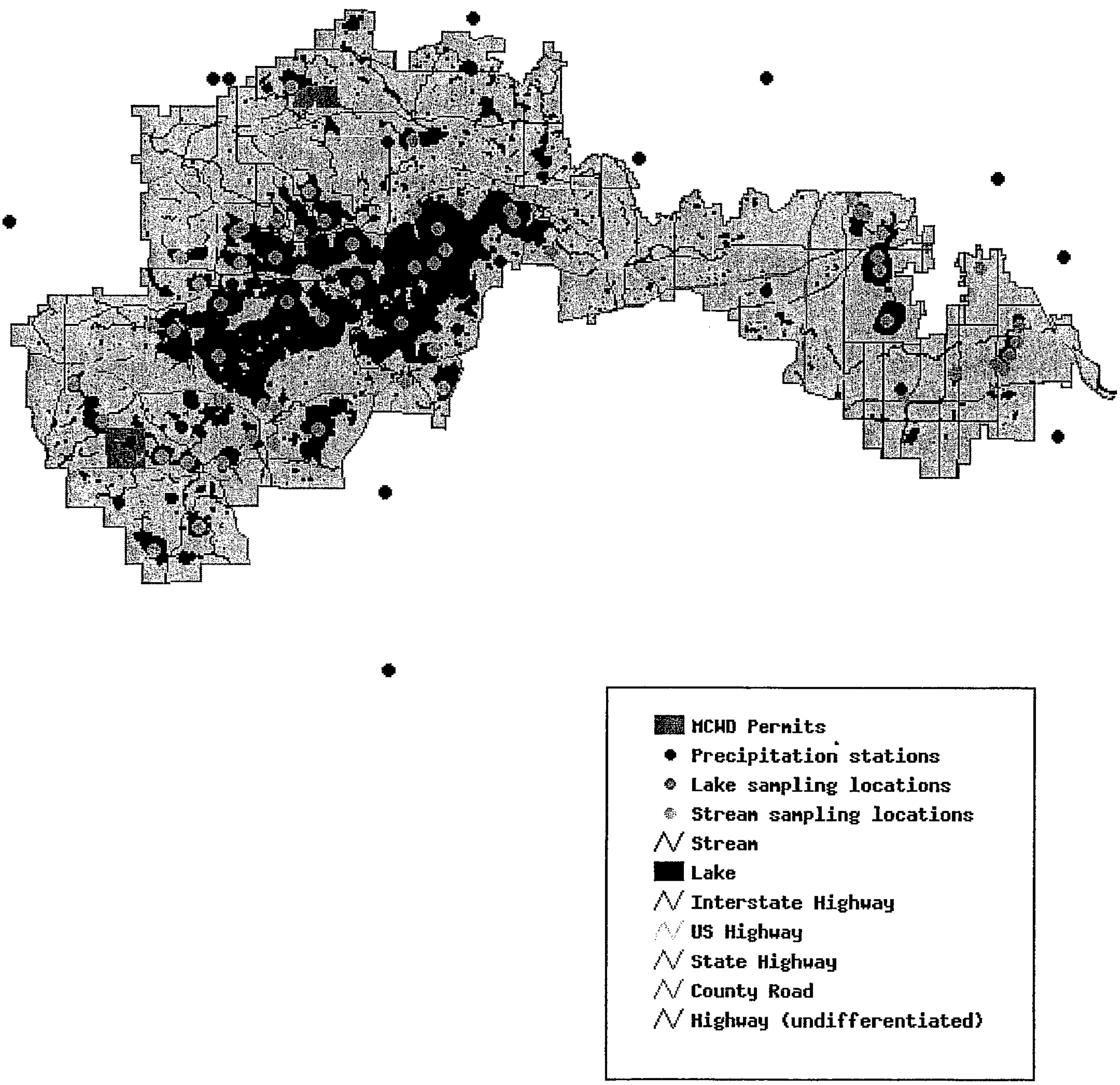
The MCWD was established in 1967 to protect the drainage basin's water resources, which include Lake Minnetonka, the Minneapolis Chain of Lakes and Minnehaha Creek. Since 1968 the district has collected hydrologic data, generally publishing the results annually. Beginning in 1997, the MCWD undertook an expanded monitoring program to provide a comprehensive view of water quality throughout the watershed and to focus improvement projects in areas with the most need.

This report presents hydrologic data collected and compiled during 2002. Data can be categorized into four main types: precipitation, lakes, streams and groundwater. Precipitation data compiled at several sites in and near the watershed provide an account of the varying precipitation amounts over the watershed. Lake water quality samples and elevations collected from Lake Minnetonka, the Minneapolis Chain of Lakes and other lakes throughout the watershed provide data for the Annual Lake Report Cards, first developed in 1998.

Stream discharge was measured and water quality samples were collected in Minnehaha Creek and various tributaries to Lake Minnetonka. Continuous water level monitoring was conducted on Minnehaha Creek at Grays Bay Dam (Lake Minnetonka outlet) in Minnetonka, Browndale Dam in Edina and Hiawatha Avenue in Minneapolis.

Continuous water level monitoring was also conducted on Painter Creek in the upper watershed. Stream Report Cards are presented in Appendix B. Groundwater elevations are reported at several wells throughout the watershed, for most of which there are long-term elevation records.

Gage Location Map



Findings based on the 2002 monitoring results include:

A. PRECIPITATION

- The upper watershed, defined as Lake Minnetonka and its tributary watershed area, received about 36 percent above normal precipitation (as compared to the Maple Plain 1951 to 1980 average).

- MCWD installed a tipping bucket rain gauge in April 2002 in Maple Plain. Precipitation measured at that station between April and December 2002 was 46.55 inches. Normal annual precipitation in the upper watershed is 29.93 inches (based on Maple Plain 1951 to 1980 average).

- The lower watershed, the portion of the watershed between Grays Bay Dam and Mississippi River, received precipitation about 31 percent above normal (based on three stations).

B. WATER QUANTITY

- Lake Minnetonka remained above the lakes' Ordinary High Water Level of 929.4 feet NGVD between June and November. The maximum lake elevation recorded during 2002, 930.47 feet NGVD, was recorded on September 10; the minimum 928.6 feet NGVD was reached on April 6, 2003 (the first day of record in 2003). Average lake elevation over the monitoring period was 929.5 feet NGVD.

- Grays Bay Dam operated in accordance with the MCWD's Headwaters Control Structure Management Policy and Operating Procedures. Due to extreme precipitation over the watershed in 2002, and the resulting high water levels on Lake Minnetonka, the DNR granted the MCWD permission to temporarily remove the fish screens from Gray's Bay Dam as they were greatly reducing discharge from the dam due to frequent clogging with macrophytes and other lake detritus.

Based on Grays Bay Dam discharge settings, the calculated discharge volume was 76,300 acre-ft, equivalent to 11.7 inches of runoff over the 122-square mile upper watershed; however, the actual discharge is smaller due to frequent clogging of the fish screens in the dam. The actual discharge from the dam is probably slightly less than the discharge calculated just downstream of the dam at I-494 which was 58,000 acre-feet, or 8.3 inches over the contributing 130.4 square-mile watershed.

A more accurate estimate of runoff including the upper watershed is reflected in the value calculated at Browndale Dam in Edina. Discharge volume there was 71,750 acre-ft, which is equivalent to 9.5 inches of runoff over the contributing 142-square mile watershed. This area encompasses the upper watershed plus an additional 20 square miles of drainage area between Lake Minnetonka and the Browndale Dam. Runoff from the downstream-most monitoring station on Minnehaha Creek, Hiawatha Avenue, was 84,200 acre-feet, which is equivalent to 9.1 inches of runoff over the 173.5 square mile watershed.

Cumulative discharge from Painter Creek at West Branch Road was about 13,200 acre-feet based on continuous flow monitoring. That is, 18.7 inches of runoff over the 13.13 square mile subwatershed, double the runoff in 2001. Maximum stages on Minnehaha Creek averaged 3.75-feet greater than the minimum recorded stages over the monitoring period.

The Minneapolis Chain of Lakes water level was above the run-out elevation, 851.8 ft NGVD, for the duration of the monitoring period. The maximum elevation observed in 2002, 854.18 ft NGVD, occurred August 21, the minimum elevation, 852.39 ft NGVD occurred April 15.

C. Water Quality

- Lake Minnetonka water quality grades ranged from A for Lower Lake South to D+ for Forest Lake. Based on average summer surface total phosphorus concentrations, nine of 16 bays monitored on Lake Minnetonka were classified as full use, no bays were classified as partial use and seven bays were classified as restricted use.

- The water quality grades for other lakes monitored by MCWD and the Metropolitan Council ranged from A at Christmas Lake to F at Lake Katrina. Long-term water quality trends for these lakes are generally positive, though some water quality grades have decreased since 1998. However, short-term fluctuations in grades are reflective of climate and hydrology and other natural year-to-year variation and do not necessarily represent an overall downturn in water quality. Of the 20 lakes monitored, eight are classified as full use based on total phosphorus concentrations. These eight include:

- Christmas Lake
- Lake Minnewashta
- Pierson Lake
- Zumbra Lake
- Schutz Lake
- Tamarack Lake
- Steiger Lake
- Lake Auburn

Three of the other watershed lakes monitored, Long Lake, Lake Virginia and Wasserman Lake, were classified as partial use. Eight lakes were classified as restricted use including, Stone, Dutch, Langdon, Gleason, Wasserman, Parley, Mud, Katrina, Twin and Tanager Lakes.

The Minneapolis Chain of Lakes water quality grades ranged from A for Lake Harriet and Lake Calhoun to C in Lake of the Isles. Cedar Lake, Lake Harriet and Lake Calhoun are classified as full use based on average summer surface total phosphorus concentrations. Lake of the Isles and Lake Nokomis are classified as partial use and Lake Hiawatha is classified as restricted use. All Minneapolis lakes monitored have long-term trends of decreasing surface total phosphorus.

Water quality in Minnehaha Creek is generally good compared to water quality in streams in the upper watershed. The large volume water with low nutrient concentration that is discharged from Lake Minnetonka at Grays Bay has a positive effect on water quality in Minnehaha Creek. Water quality in the creek progressively degrades in the downstream direction between Lake Minnetonka and locations in Minneapolis, as is common in urban streams.

During 2002 the maximum total phosphorus loading was observed at the farthest downstream station, Hiawatha Avenue in Minneapolis. During the previous three years, maximum total phosphorus loading in Minnehaha Creek was observed upstream of Lake Hiawatha. The observed decrease in the creek's total phosphorus loading as a result of detention time in this lake was 14% in 2001, 6% in 1999 and 43% in 2000. As stream flow increases, the creek is more likely to short-circuit the lake, moving straight from the inlet to the outlet. This reduces time for particulate phosphorus to settle and for algae to consume the soluble portion. A further factor is the large portion of the flow from lake Minnetonka. The relatively low phosphorus concentrations combined with the short residence time results in little or no removal.

- Total phosphorus concentrations observed in Minnehaha Creek were generally on the low end of the range of values observed between 1997 and 2001, however loadings were much higher due to precipitation and the resulting runoff from the watershed.

- Total phosphorus concentrations and loads in upper watershed streams were generally on the high end of the range of values observed between 1997 and 2001. Total loadings were higher than observed between 1997 and 2001 in Painter Creek, Gleason Lake Creek and Christmas Lake Creek due to of higher precipitation and runoff in 2002.

- As in past years, Painter Creek in 2002 delivered the largest phosphorus loading (some 8,700 pounds) of all Lake Minnetonka tributary streams. Between 1997 and 2002, between 38% and 60% of the load from streams gauged in the upper watershed has come from the Painter Creek sub-watershed, which is only 22% of the monitored area.

- Total phosphorus and total suspended solids concentrations in Minnehaha Creek watershed streams were lower than median 1986 to 1992 annual values for minimally impacted streams in the North Central Hardwood Forest Ecoregion (McCollor and Heiskary, 1993). Concentrations in Christmas Lake Creek, Classen Lake Creek, Dutch Lake Creek Langdon Lake Creek, Long Lake Creek and Painter Creek exceeded the 70 micrograms per liter (μg/L) phosphorus guideline and the 7.7 milligram per liter (mg/L) total suspended solids guideline.

- Fecal coliform concentrations in watershed streams were compared with the acute standard for fecal coliforms, 2000 colony forming units per 100 milliliter (cfu/100mL), listed Minnesota Rules 7050. Concentrations in upper watershed streams were below the standard, while concentrations at several sites along Minnehaha Creek between I- 494 and Hiawatha Avenue exceeded the 2,000 cfu/100mL between June and September.

- Flow-weighted average chloride concentrations in all watershed streams monitored during 2002 were below the chronic standard of 230 mg/L listed in Minnesota Rules 7050, though early spring readings in Minnehaha Creek exceeded the standard at 34th

Street and Excelsior Boulevard in St. Louis Park, Browndale Dam in Edina, Upton Avenue, 32nd Avenue and Hiawatha Avenue in Minneapolis.

D. EXTERNAL REVIEW / RECOMMENDATION (HDR 2003)

The MCWD has been collecting data for years and has an extensive history of precipitation, lake levels, stream flows and water quality parameters. However, the monitoring program could be modified in a number of ways to enhance the value to the MCWD:

- Lake report cards seem to focus solely on water quality parameters, especially as regards contact recreation. The report cards should be expanded to include measures of habitat and land use to more accurately reflect the watershed condition.

- There is no monitoring or annual assessment of the Hydrodata program in the report. The program should be amended to include an assessment of the data that is being collected, the need for additional or project specific data based on the capital projects program and the need to discontinue data collection at sites due to project completion or changes in program priorities.

- The current network of monitoring stations and rain gauges should be expanded to allow for a more accurate collection of precipitation across the district. The MCWD may wish to consider using radar traces of large, historic rainfall events and creating a model of the event and calibrating to the H&HPLS model to have a more accurate model that is calibrated to actual rainfall events as they are distributed across the watershed.

- The report card program could be expanded to include stream and creek reaches as identified in the H&HPLS and Stream Assessment report. Given the amount of interest in the Minnehaha Creek Corridor restoration, an annual report card of stream health based on habitat units and water quality would help the MCWD to better establish and rank restoration projects for order of implementation.

E. External Review / Recommendation (EOR 2002)

This memo is in response to your request for recommendations regarding the Hydrodata monitoring program. Throughout the process of the HHPLS, we have identified several gaps in the Hydrodata that, if filled in, would complement the existing monitoring program and help the MCWD in future model calibration efforts. We include recommendations for water quantity and quality data collection, as well as precipitation.

1. Water Quantity and Quality Monitoring Sites

The MCWD has expressed interest in completing the Lake Minnetonka BATHTUB model, and the Board has approved funding for five additional auto-samplers to help gather this data. Each continuous flow monitoring location should be accompanied by an auto-sampler for flowweighted water quality data collection. Based on current modeling data gaps, we recommend the following locations for these monitoring stations:

- Six Mile Creek at Highway 7. There is likely backflow at this location; therefore, a device that is able to measure reverse flow would be necessary. A Doppler reverse flow meter would serve this purpose, and would help quantify flow and pollutant loads entering Halsteds Bay from the Six Mile Creek watershed.

- Long Lake Creek outlet. From existing monitoring data, it appears that the creek picks up a substantial amount of pollutants between the Long Lake outlet and the current downstream monitoring site at Fox Street. A continuous flow monitoring site at the creek outlet into Tanager Bay would provide pollutant loading information from this relatively large watershed into Lake Minnetonka.

- Gleason Lake Creek outlet. Substantial pollutant loads enter Wayzata Bay from the Gleason Lake Creek watershed, which includes the watershed for Hadley Lake. An estimate of these loadings can be obtained with a monitoring site located at the outlet of Gleason Lake Creek into Wayzata Bay.

- Dutch Lake Creek. Quantifying the pollutant loading from Dutch Lake Creek would assist in the overall understanding of the pollutant dynamics of Jennings Bay, a bay already identified by the MCWD as being a priority issue.

- Classen Creek. Classen Creek flows into Stubbs Bay, a Lake Minnetonka bay of relatively poor water quality. Quantifying this input will help in the development of a management approach.

In addition to these five sites, we have identified the following data gaps regarding existing continuous flow monitoring sites:

- Painter Creek. There is a need for reliable continuous flow data, as well as a flowweighted water quality sampler to accompany the continuous flow meter already there. Due to the variability of pollutant concentrations, we recommend that weekly water quality grab samples be replaced by flow-weighted sampling to achieve a more reliable computation of annual pollutant loads. The lack of flow-weighted water quality data for a period of three years or more translated into very poor calibration of the HSPF model that was ultimately abandoned in favor of a less data demanding model.

- Grays Bay. Current discharge estimates at the Grays Bay outlet are skewed due to the frequent clogging of screens at the outlet by debris. A high capacity steel cable skimmer would help prevent clogging and allow for a more accurate flow estimate. Water quality sampling at the outlet, preferably weekly, is necessary to separate the pollutant loads in Minnehaha Creek that originate in Lake Minnetonka from loads originating below Grays Bay dam.

- Browndale Dam. Continuous flow data at this site should be continued. Similar to the situation at the Painter Creek site, these flow data should be complemented with flowweighted water quality sampling data. Having these continuous flow and flow-weighted water quality data, along with similar data from the WOMP site downstream of Lake Hiawatha, will provide a more complete comprehension of the creek dynamics in the lower watershed. It is very important to point out that these outlet monitoring stations involve only a portion of the data necessary to complete the BATHTUB modeling effort. A more complete understanding of the intra-lake circulation patterns among the various bays of Lake Minnetonka is equally as important. As part of our July 23, 2001 submittal entitled "An Evaluation of In-Lake/Watershed-Based Phosphorus Loadings from Painter Creek

Watershed and Jennings Bay" (see attachment), we identified the need to conduct a drogue/bromide tracer study to determine the circulation patterns in the lake. The "Jennings Bay Expert Panel" later recognized the importance of good intra-lake circulation data to assess water quality in Jennings Bay and the rest of Lake Minnetonka. We recommend that this type of monitoring be considered as part of the 2003 monitoring effort. Additionally, data regarding internal loading in the poorer quality bays are lacking.

2. **Secondary Monitoring Issues**

We have also identified several data gaps that are not directly related to the completion of the BATHTUB model; but rather they involve other emerging watershed issues:

- ***St. Bonifacius growth.*** This is a rapidly growing area of the watershed, and several options exist that would help identify this region's contribution to the total runoff and loads originating in the Six Mile Creek watershed. One option is to increase the frequency of monitoring at the Lunsten Lake outlet monitoring station. With weekly stage and water quality monitoring data, the flow and pollutant input originating between Lunsten Lake and Six Mile Creek's outlet into Halsteds Bay would be quantified. This area includes St. Bonifacius in addition to the wetlands associated with Parley Lake. A second option is to monitor the ditch that drains St. Bonifacius and runs along the south side Highway 7 before entering Mud Lake.

- ***Southdale Mall drainage.*** It is presently unclear to which watershed the runoff from Southdale Mall flows. One source identifies that it all flows into the Nine Mile Creek Watershed, while other available information seems to indicate that only high flows go into Nine Mile Creek and low, base-flows enter Minnehaha Creek through Pamela Park. Southdale Mall is a substantial area with a large impervious surface. In addition to influencing the creek model, the flow details have implications regarding Watershed District boundaries.

- ***Painter Creek wetlands.*** Both the Regional Team process and the Expert Panel identified the need for good data to define whether the large number of wetlands within the Painter Creek watershed are sources or sinks of phosphorus. In response to this, the District installed two new, limited stations within the basin. The data from these stations should be examined to determine whether the data collected are providing the needed information. Adjustments should be made if data collection is not meeting the objective of defining wetland phosphorus behavior.

- ***Gleason Lake inlet.*** The Gleason Lake Management Plan, along with Regional Team 3 of the HHPLS, have both identified a data gap with respect to loadings into Gleason Lake. The current monitoring site is at the Gleason Lake outlet. A site at the lake inlet would help to better quantify pollutant loadings to this highly eutrophic lake.

- ***Lake Hiawatha-Minnehaha Creek interaction.*** The extent of the short-circuiting of Minnehaha Creek as it flows through Lake Hiawatha is currently unknown. This information would improve the Minnehaha Creek model, in addition to providing more accurate information regarding the removal and origin of pollutant loads in and downstream of Lake Hiawatha.

3. Lake Water Quality

We recommend an expanded lake water quality monitoring program to include the collection of at least some data on each lake that has a suggested water quality goal from the Regional Team process. This would allow the MCWD to make more informed decisions when establishing lake water quality goals in the future.

4. Precipitation

Tipping buckets should preferably have their own data loggers, in order to avoid data losses. Additionally, we feel that these stations should not be moved around the MCWD, but rather be permanent data gathering sites. In this manner, a long-term record of precipitation at several sites will be collected, in conjunction with continuous flow and water quality data. Rain gauges should be located at or in the vicinity of all of the continuous flow monitoring stations discussed in the first section of this memo. An exception is Dutch Lake Creek, since a rain gauge at the Painter Creek site would be applicable to Dutch Lake Creek as well. Recommended rain gauge locations, to accompany continuous flow monitoring sites:

- Six Mile Creek at Highway 7
- Long Lake Creek
- Gleason Lake Creek
- Classen Creek
- Additional recommended rain gauge locations:
- Minnehaha Creek at Browndale Dam
- MCWD office in Deephaven
- Lake Minnewashta

This list assumes that there is a rain gauge associated with the WOMP site. If this is not the case, we recommend another gauge at that location. We also feel that additional precipitation data collected by volunteers spread out across the watershed would be helpful. If 22 sites were established, a station could exist approximately every four square miles. This would allow a better understanding of the spatial variability in precipitation throughout the MCWD.

2.2 OTHER REPORTS REVIEWED

2.2.1 PAINTER CREEK WETLAND RESTORATION

This report was taken from the MCWD website. There are two construction contracts for the restoration project (vegetation management and excavation). Minnesota Native Landscapes has applied herbicide, burned, mowed and disced the site. Contractor Doboszenski began excavation/tree clearing in December 2000; pond excavation began in January 2001.

In addition, information regarding this project was found on page 148 of the 1997 MCWD Plan. This was also called the Upper Watershed Improvement project. Its primary purpose was to provide floodwater detention storage in large wetland areas and improve water quality in Lake Minnetonka. It consisted of four control structures and two sedimentation basins and increased floodwater storage capacity. The two project sites are near the outlets of the South Katrina and Painter Marshes. Basins will be modified to better prevent outlet obstructions. Sediment will be removed from the existing basins. The existing basins will be enlarged and deepened to provide additional wet storage volume and improve water quality.

2.2.2 PAINTER CREEK INTERIM REPORT

This report was prepared for the MCWD in February 2002, by EOR. In May of 2000, the MCWD authorized EOR to undertake the Hydrologic, Hydraulic and Pollutant Loading Study (HHPLS) in anticipation of the need to develop a district-wide TMDL program and to address ongoing floodplain management issues. Painter Creek discharges to Jennings Bay. After years of extremely poor water quality, Jennings Bay has shown some recent improvement. The improvement causes, if there are any in addition to the elimination of wastewater, are not currently understood. Issues identified by the Regional Team (local officials and interested citizens) and EOR include:

1) Lack of event-based data covering the entire watershed
2) Continued poor water quality in Jennings Bay
3) Uncertainty over the role of wetlands in sub-watershed water quality
4) Urban runoff from a portion of Maple Plain
5) Horse waste
6) Large carp population
7) Impact of new development
8) Maintenance of the ditch system
9) Impact of runoff on sensitive natural communities

Key issues identified from HHPLS stakeholder involvement include:

1) Phosphorus loading in the Painter Creek sub-watershed to Jennings Bay is currently estimate at 2,036 lbs/year and is predicted to be 2,594 lbs/year in 2020.
2) Based on monitoring data, the fraction of total phosphorus that is in the soluble reactive form is consistently in the 60% range.
3) The Jennings Bay equilibrium phosphorus concentration has declined from 165 μg/l to 80 μg/l in recent years. This appears to be correlated with the discontinuation of Maple Plain wastewater discharges. Improvements attributable to watershed runoff changes are not known.
4) The Painter Creek sub-watershed is typified by extensive (~30%) wetland coverage, with some of the largest wetlands experiencing limited contact with the creek because of ditching.

5) Monitoring data suitable for water quality and quantity model calibration is generally lacking in the Painter Creek sub-watershed.
6) Flood-related impacts in the Painter Creek sub-watershed are not expected to increase significantly between now and 2020.
7) Natural technologies that emphasize floodplain/wetland restoration coupled with in-lake management strategies appear to offer the best combination of cost-effective approaches to protect the resources of the Painter Creek sub-watershed and Jennings Bay.

2.2.3 JENNINGS BAY-PAINTERS CREEK

This report was taken from the MCWD website. The report states that this is part of the Upper Watershed Improvement Project (1985). For this project, seven construction areas were identified and constructed in 1985. Overall, it increased storage capacity by approximately 900 acre feet for major runoff events and substantially reduced discharges to Jennings Bay. It discusses water quality and indicates that the water quality of Jennings Bay (extreme northwest of Lake Minnetonka) is inferior when compared to other portions of the lake. Point and non-point source phosphorus loading is the limiting nutrient factor for algae growth. Original project specifications were competed in 1985 by Hickok & Associates, and Wenck Associates, Inc. completed the upgrade in 1997.

In addition, information regarding this project was found on page 150 of the 1997 MCWD Plan. This report stated the following. Painter Creek is a county ditch that is the major drainage way for a subwatershed flowing into Jennings Bay. The first phase was to provide floodwater detention storage in large wetland areas and improve water quality in Lake Minnetonka. The focus of this project is to reduce phosphorus loading (internal and external). Phosphorus loading will be reduced by the construction of wet detention basins/wetlands.

2.2.4 JENNINGS BAY FEASIBILITY STUDY, VOLUME 1

This report is dated June 1997 and was prepared by Wenck. In terms of water quality, Jennings Bay is one of the two poorest bays of Lake Minnetonka. (Halsteds Bay is the other.) It is characterized by relatively shallow basins with significant tributary streams draining large rural watershed. Total watershed area for Jennings Bay is approximately 11,200 acres; surface area itself is 290 acres. The major tributary is Painter Creek. The Painter Creek watershed has an area of approximately 8,760 acres, accounting for 78% of the total watershed of Jennings Bay (and 12% of Lake Minnetonka's total drainage area). Historically, Painter Creek water quality has been degraded due to discharge from the Maple Plain wastewater treatment plant and agricultural land use. Although this treatment plant discharge ceased in 1986, Painter Creek continues to carry substantial nutrient loads to Jennings Bay. A summary of their findings includes:

1) This area has the worst water quality (concentrations of phosphorus and chlorophyll-a and clarity).

2) Intensive monitoring occurred during winter and summer of 1996.

3) Analyses showed internal loading from Jennings Bay sediment accounts for over 40% of the total load to Jennings Bay.

4) A water quality response model was developed to predict improvements in water quality based on alternative reductions in the benchmark year phosphorus loads.

5) To improve water quality in Jennings Bay, both internal and external loads must be reduced.

6) Alternatives for phosphorus loading reductions include: wet detention basins/wetland treatment; alum treatment of Painter Creek; Alum treatment of Jennings Bay; sediment dredging to remove phosphorus; hypolimnetic aeration; artificial circulation to prevent stratification and eliminate anoxia

7) A combination of wet detention basins (Painters Creek-Pond 937) and alum treatment of Jennings Bay will improve water quality.

8) Wet detention will result in a 50% reduction phosphorus loads.

9) Alum treatment offers the most reliable near-term phosphorus load reduction. Costs are lower and the treatment has remained effective for over ten years in other lakes.

10) Wet detention combined with alum treatment was designed to reduce phosphorus by 60%, thus increasing water clarity by 1 foot (60%).

11) To measure wet detention effectiveness at Pond 937, monitor phosphorus concentrations along Painter Creek/tributaries. Significant loads identified must be addressed separately in future project design.

12) Soil surveys could proceed in fall 1997; detention basin construction could proceed in winter 1998/1999; alum treatment should proceed preferably on growing season after the wet detention basins are in place (spring 200).

13) Total annualized cost over 20 years is 132/phosphorus lb. load reduction.

14) Jennings Bay, already designated a quiet waters bay, needs boat traffic controls to keep boats out of shallow areas, to reduce resuspension of bottom sediments by boating activity.

15) The MCWD may wish to extend the Jennings Bay project to address suspected high internal loads in the eastern basin of West Arm.

Previous investigations and improvements were mentioned within this report. These include: Comprehensive study of Lake Minnetonka (1971); Metropolitan Waste Control Commission SW Area 201 study; MCWD monitoring; Painter Creek improvements in 1985 (that include various projects).

2.2.5 LAKE MINNETONKA WATER QUALITY ISSUES, JENNINGS BAY/PAINTERS CREEK RECOMMENDATIONS

This report, prepared by HDR, is dated May 7, 2001. Also included as part of this report was Attachment A, HDR's report from February 2, 2001. Contained within it is a phosphorus loading summary/pond net modeling results for Lake Katrina, PC-8 Wetland, Painters Marsh and Pond 937. This report is intended to identify some small-scale projects for pilot testing. These projects would include: Alum treatment of watershed runoff, constructed subsurface flow wetlands and wetland aeration. The following are the conclusions/recommendations:

1) The MCWD is currently engaged in a district-wide TMDL/GIS type study that is using the Painters Creek Watershed as sample watershed. The work plan contained in this report is not intended to duplicate these efforts, but to complement the study as a new approach to address watershed restoration concepts.

2) HDR recommends that the MCWD focus its efforts on Painter's Creek restoration and protection efforts rather than a Jennings Bay Water Quality Improvement project. The ecological value of the watershed's small lakes, wetlands and stream segments has likely been degraded by past activities such as wastewater discharges and drainage modifications. The ecological value of this watershed appears more impaired than the recreational suitability of Jennings Bay.

3) HDR is recommending a targeted approach of small-scale, semi-permanent alum treatment and/or constructed sub-surface flow wetland systems for phosphorus removal from the water column. These systems would be focused on improving water quality at individual stream segments or wetland locations within the watershed.

4) HDR is recommending that the current TMDL type study consider evaluation of wetland and stream habitat conditions along the Painters Creek Corridor as a potential limiting factor in attaining the desired use for the watershed.

2.2.6 GLEASON LAKE/CREEK WATER CLEANUP PROJECT

This information was taken from a media notice dated January 19. 2001 on the MCWD website. It stated that this pond (one of three designed ponds) was installed in 1995 by MCWD to clean water running through Gleason Lake/Creek by trapping pollution-laden sediment. In order to deal with water quality issues and flooding problems, a series of three restored wetland ponds were designed and built to treat polluted stormwater runoff. Periodic flooding in residential/commercial areas has been greatly reduced by the Gleason Lake Dam (also installed in 1995). Further information regarding these ponds/dredging schedule can be found on the MCWD website.

2.2.7 LONG LAKE IMPROVEMENT PROJECT

This information was taken from the MCWD website. The report stated that the project was initiated in 1989 (a combined effort of MCWD and the MPCA). Project framework included:

diagnostic study of water quality decline, development of water quality goals; determine performance standards for a remedial plan to improve water quality. Among the projects that will improve water quality are:

Construction of wet detention basins to reduce annual nutrient/sediment loading delivered to Long Lake via runoff from the northern watershed.

1) Phase 1: resulted in the construction of a 2-cell pond on the NE tributary south of Deer Hill Rd in Medina.

2) Phase II: resulted in the construction of a 2-cell pond south of Cty Rd 6 in Orono.

3) Two ponds located in Long Lake Park at the outlet of 2 storm sewers will be enlarged, deepened and connected by a pipe.

4) An alum treatment of Long Lake to seal the lake sediments and reduce internal phosphorus loading.

5) Enhancement of existing sedimentation basins in the City of Long Lake Park to reduce the nutrient/sediment load to Long Lake from the two major storm sewer subwatersheds.

2.2.8 Lake Nokomis/Lake Hiawatha Comprehensive Water Quality Study:

This is a water quality study of Lake Nokomis and Lake Hiawatha that will help to identify nutrient/pollution sources and create solutions to these issues. The following neighborhood associations proposed it: Standish Erickson Neighborhood Association (SENA), Nokomis East Neighborhood Association (NENA) and Hale Page Diamond Lake (HPDL). The study is made up of three components:

1) Monitoring/evaluation: This will be completed by MCWD with neighborhood input. Tasks include: identify water quality monitoring needs, identify pollution sources to be evaluated, scope a feasibility study for water quality improvement methods, identify

evaluation methods, evaluate water quality data, identify water quality improvement solutions, identify relative costs of alternatives.

2) Study/recommendations: an advisory committee called the Blue Water Commission will complete this. Tasks include: provide input on some Component 1 items, review/study materials completed in Component 1, make recommendations for implementing projects/methods for water quality improvement, publish a report.

3) Possible implementation: various parties will do completion of the recommendations.

NENA will serve as coordinator of the study in conjunction with HPDL and SENA.

2.2.9 Minnehaha Creek Restoration and Preservation Strategy

This document defines the Minnehaha Creek as being managed as an urban ditch, where storm sewers are directly routed to the creek carrying pollutants, causing flooding and causing damage to its natural ecosystem.

The recommendation of this document is that the MCWD initiate a long-term strategy to restore and preserve the Minnehaha Creek that contains the following elements.

1) A concentrated effort to work with policy makers in communities along the creek to adopt policies to retrofit their stormwater systems to reduce negative impacts on the Minnehaha Creek.

2) Application to the USACE for funds to assist communities to help accomplish #1.

2.2.10 Cedar Meadows Structure Maintenance Project

This information was taken from the MCWD website. Information was limited to a short news release dated 2/26/01. It stated, "Pumping of the water from the basin is expected to be completed by the City of Minneapolis by 2/27/01. The contractor who is performing the structure maintenance work had his equipment delivered to the site on 2/22/01, and when the de-watering is completed, the contractor can begin his work."

2.2.11 CHAIN OF LAKES PROJECT

Information was taken from the MCWD website. The Chain of Lakes Project is part of the Twin Lakes Subwatershed Improvement Project. A partnership between MCWD, the Clean Water Partnership, City of St. Louis Park, City of Minneapolis, Minneapolis Park and Recreation Board, and Hennepin County was formed in an effort to restore water quality for this area. The objective is to improve the water quality in the Minneapolis Chain of Lakes. The Chain of Lakes is a series of five lakes: Brownie, Cedar, Lake of the Isles, Calhoun and Harriet. The project specifically focuses on stormwater management in the Twin Lakes Subwatershed to improve the water quality of Cedar Lake (the receiving body of water).

1) Specific projects identified to improve the water quality of the runoff entering Twin Lakes and Cedar Lakes include:

2) Excavation of a 1.3 acre wet detention basin upstream of Twin Lakes within Twin Lakes Park; purpose is to improve stormwater quality prior to discharge into Twin Lakes, provide additional storage capacity for runoff for a high water prone area and restore part of a former wetland that has been filled.

3) Dredge Twin Lake to an average depth of 5.5 feet to increase the hydraulic residence time thereby increasing sediment and nutrient removal prior to discharging to Cedar Lake; lower Twin Lake outlet by one foot to enable adequate hydraulic gradient for the Twin Lakes Park improvements, provide additional lake storage capacity for stormwater and increase flow capacity of existing outlet to help alleviate local flooding problems.

4) Excavation of a 4.6 acre wet detention basin/wetland system at the Cedar Meadows area near the southwest corner of Cedar Lake located south of Cedar Shore Drive between France Avenue and Cedar Lake Parkway. This segment of the project includes diversion of a portion of the Twin Lakes outflow and local drainage to the Cedar Meadows area to further treat stormwater runoff.

Best Management Practices that are also recommended include:

1) Lawn and garden management (runoff, yard waste disposal).
2) Animal waste/livestock management.

3) Erosion and sedimentation control.
4) Public education.

2.2.12 NOKOMIS WETLAND SETTLING PONDS

This report was found on the MCWD website. Construction began fall 2000, with completion in summer 2001. Current wetlands were expanded from 5.88 acres to 8.2 acres and are located in the southwestern area of Lake Nokomis (near the area called the Lagoon). Three ponds were developed: Amelia Pond, Nokomis Knoll Pond and Gateway Pond. All three ponds will feature:

1) Natural, carefully designed landscaping and pondscaping with 55,000 hand planted native plants and plants started from seed.

2) Three types of plantings will include aquatic plants, prairie plants and emergent plants. Highlights include Blue-eyed Grass, Yellow Star Grass, Prairie Dropseed, Cardinal Flower, Bottle Gentain, Marsh Milkweed, Yellow Coneflower, Joe Pye Weed, Meadow Blazing Star, Prairie Lily, Showy Goldenrod, Sky Blue Aster and Black-Eyed Susan.

3) A maximum pond depth of 6.6 feet.

4) Gradual drop off with a bench shelf declination.

2.2.13 PAMELA PARK WETLAND RESTORATION

This is a 64-acre city park located within Edina, east of Highway 100 and north of Highway 62. Pamela Lake is an 18.4-acre DNR Protected Wetland. Plant and wildlife diversity has decreased over the past years. Average lake depth is approximately 2 feet, with a maximum depth of 4 feet in the center. Sediment deltas have formed at the storm sewer outlets. The overall goal is to restore Pamela Lake, improve water quality conditions and reduce external phosphorus and sediment loads to the lake and downstream to Minnehaha Creek. The restoration will occur in two phases. Phase I – Pamela Lake restoration includes:

1) Dredging of accumulated sediment that will increase average depth to 3.5 feet and will create 1.2 acres of deep-water habitat. Maximum depth will increase from 4 to 8 feet.

2) Sediment settling basins will be constructed at the two storm sewer outlets at the southern end of the lake. The sediment basins will treat stormwater runoff from 129 acres.

3) The stormwater system will be inspected and maintained in order to maintain effectiveness in removing nutrients, sediments and other pollutants.

Phase II – northern pond construction includes:

1) Construction of three wetland-settling ponds in the northern part of the park.

2) The three ponds will treat runoff from 297 acres.

3) Nature trail addition.

4) The City of Edina will implement various programs aimed at reducing nutrient/sediment discharges to Pamela Lake. These programs include developing management plans for snow storage activities, reduction of phosphorus fertilizer, goose management and city street sweeping.

2.2.14 MINNEHAHA CREEK WATERSHED DISTRICT: 30 YEARS OF WATER RESOURCES MANAGEMENT

This report covers from 1967 to 1997. Goals included:

1) Improving lakes, marshes and channels for water storage, drainage, recreation and other public purposes.

2) Develop projects to reduce flooding, keep silt out of streams and control erosion.

3) Reclaim wetlands, control stormwater and preserve water quality within the MCWD's lakes and streams.

Various programs were initiated during this timeframe. The following is a summary of those programs.

1) Regulatory Program (1967-present): to mitigate the impacts of new land development and other projects on water resources within the MCWD (such as stormwater management, floodplain/wetland plans). This program covers dredging, stream/lake crossings and shoreline improvements.

2) Annual Hydrologic Monitoring (1968-present): monitoring results have been summarized in annual hydrologic data reports published by MCWD.

3) Overall Plan for Water Management (1969): Focus was on three problem areas: water pollution, flood control and low water levels during dry periods. Recommendations included: remove all sewage treatment plant effluent from Lake Minnetonka to improve water quality and construct an outlet control structure to regulate discharge from Lake Minnetonka to reduce Minnehaha Creek flooding.

4) Elimination of Municipal Wastewater Discharges to Lake Minnetonka (17-971-1986): Discharges from seven treatment plants were phased out over a 15-year period.

5) Wayzata Wetland Study for USEPA (1975): Evaluated how well wetlands treat urban stormwater runoff and remove nutrients such as phosphorus.

6) Construction of Grays Bay Dam and Outlet (1979-1980): Purpose of the improvement was to manage water levels in Lake Minnetonka and reduce downstream flooding along Minnehaha Creek. Water is released at a controlled rate from May to November. Recreational facilities were also upgraded.

7) Minnehaha Creek Channel Improvements at I-94 in Minnetonka (1979-1980): A section of the creek was dredged to increase flow capacity. It involved lowering the creekbed by two feet along a 4,600 ft reach and stabilizing creekbanks.

8) Minnehaha Creek Recreational Improvements (1979-1980): Improvements were done in Minnetonka, Hopkins, St. Louis Park and Edina. Work included the construction of

canoe landings/portages, parking areas, picnic/sanitary facilities, bike racks, wildlife ponds, raising of pedestrian bridges, installation of culverts and minor channel maintenance/repair.

9) Minnehaha Creek Channel Improvements at West 44th Street in Edina (1981): Dredging here improved flow capacity resulting in lower upstream flood elevations.

10) Hydraulic/Flood Study of Minnehaha Creek in Minneapolis (198201983): Flood impacts were evaluated for six existing bridges and culverts. Beneficial hydraulic effects were investigated for three possible designs for the Logan Avenue Bridge, a larger culvert at Penn Avenue and removal of an abandoned bridge. Reductions of up to two feet in 50-year flood stage were found to result from these modifications. Study recommendations included a new single-span Logan Avenue Bridge and a wider/higher Penn Avenue culvert. Removal of the abandoned bridge was not justifiable on the basis of flood impacts alone.

11) TR-20 Runoff Model (1983): This model was later updated in 1997. It involved modeling of 153 individual subwatershed. Results are included in the District's water resources management plan.

12) Minnehaha Creek Channel Improvements at T.H. 100 in Edina (1984): Channel improvements to restore the creek channel profile to that of the original bridge design plans from 1970. This resulted in lowering of surface water profile upstream of Hwy 100.

13) Painter Creek Subwatershed Improvement Project (1984-1985): Four detention basins, two sedimentation basins and one fish barrier were constructed to reduce nonpoint source pollution from Painter Creek subwatershed. This improved water quality in Lake Minnetonka and provided an additional 900 acre-feet of flood storage under 100-year storm condition.

14) Draft Water Resources Management Plan (1987): Was designed to achieve the following five basic objectives: reduce public expenditure to control excessive volumes and runoff rates; improve water quality; prevent flooding/erosion from surface flows;

promote groundwater recharge; protect/enhance fish/wildlife habitat and water recreation facilities.

15) Long Lake Diagnostic/Feasibility Study (1989-1994): This is a study to assess water quality and to develop a plan for water quality improvements. Findings for Long Lake included: the lake was in advanced stages of eutrophication; Secchi transparency averaged 3 ft; frequent algae blooms; phosphorus concentrations two to four times higher than typical region lakes; internal phosphorus loads were comparable to external loads. Recommendations include: a wet detention pond along the lake's main tributary; upgrade stormwater ponds in the City of Long Lake; alum treatments.

16) Gleason Creek Improvement and Flood Control Project (1993-1995): In 1994, Phase One was completed. This project involved construction of a new outlet control structure on Gleason Lake; expansion of one and creation of a second stormwater pond; extensive storm sewer improvements. Improvements include flood control along Gleason Creek and water quality in Lake Minnetonka. In 1995, Phase Two was completed. This phase focused on improving water quality of Gleason Lake by reconstruction and enhancement of a wetland at the inlet to the lake.

17) Twin Lakes Subwatershed Improvement Project (1995-1996): This was a cooperative effort with the Clean Water Partnership (cities of Mpls and St. Louis Park, Minneapolis Park and Recreation Board and Hennepin County). The goal was to optimize water quality improvements of stormwater runoff entering Twin Lakes and Cedar Lake by removing phosphorus, sediment and other pollutants naturally through physical and biological processes. Improvements consisted of constructing a wet detention basin upstream of Twin Lakes and a wet detention basin/wetland system near Cedar Lake, dredging Twin Lakes and diverting stormwater runoff.

18) Long Lake Improvement Project (1995-1996): Involved construction of a large two-cell wet detention basin in Medina, expansion/enhancement of two existing sedimentation basins in the City of Long Lake, construction of a wet detention basin in Orono.

19) Long Lake Alum Treatment (1996): Goal was to remove phosphorus and retard the release of phosphorus from lake bottom sediments. Treatment was done in the spring of 1996. By late summer, water clarity increased from 2 feet to 15 feet.

20) MDNR Outstanding Watershed District of the Year (1996): Presented by the DNR. Four major achievements were cited: working with DNR to streamline permit process; enhancing MCWD rules to provide for better adherence to the land alteration requirement; adopting a wetland buffer requirement; and developing Minnesota's first watershed internet site. The MCWD was also recognized for using regulation, education and water resource projects in a comprehensive way to protect/improve the water resources.

21) Painter Creek Subwatershed Maintenance Project (1996-1997): designed to restore flood storage capacity and enhance water quality treatment capability. Accumulated sediment was removed and the two existing basins were enlarged and deepened. Existing outlets were modified to prevent blockages.

22) Minnesota Landscape Arboretum Wetland Restoration (1996-1997): The site's hydrology was restored by breaking the network of drain tiles below the soil surface. Native plants were planted, and a boardwalk/interpretive trail was constructed.

23) Gray's Bay Outlet Maintenance and Repair (1997): Consisted of installing timber piles to stabilize the steel sheet pile weir and constructing a new weir cap; placing riprap, boulders and cobbles along the lake side of the weir; filling and grading earth material for erosion protection and to confine lake overflow to the weir area; extending and adding fences for safety; and removing large downed cottonwood trees.

24) Approval of Second Generation Water Resources Management Plan (1997): The plan identifies: a series of capital improvements projects throughout the MCWD; specific strategies to reduce surface water degradation.

2.2.15 HEADWATERS CONTROL STRUCTURE MANAGEMENT POLICY AND OPERATING PROCEDURES

This adjustable structure controls Lake Minnetonka levels and discharge to Minnehaha Creek. It is a dam that was constructed in 1979. Lake Minnetonka discharge into the Minnehaha Creek is controlled from ice-out (approximately April 15) to mid-June. As a result, water is temporarily stored in Lake Minnetonka.

Management goals include:

1) Reduce downstream flooding by controlling discharge to the Minnehaha Creek to a rate not exceeding the maximum carrying capacity of the creek whenever Lake Minnetonka's water level is within the physical limits of control.

2) Reduce flooding on the lake by stabilizing lake levels between the elevation of the low point on the previous fixed weir and the OHW level, elevation 929.4.

3) Reduce flooding, on the lake and downstream, by temporarily increasing/decreasing discharge rates to accommodate predictable and large volumes of runoff into Lake Minnetonka or downstream prior to the time such runoff occurs.

4) Provide discharges, during and/or following dry periods, comparable to discharges that occurred historically under similar lake level conditions such that the detrimental effects of creek flow stagnation are not aggravated as a result of operating procedures.

5) Enhance recreation, wildlife and aquatic life survival and aesthetics, when feasible and consistent with the Management Policy, by augmentation of creek flow beyond the time discharges from Lake Minnetonka have historically ceased.

6) To improve or maintain conditions on the lake and the creek, over those which existed prior to construction of the Headwaters Control Structure.

Discharge settings/adjustment between lake level elevations 928.6 and 930.0 are described as 7 different zones. They are:

Zone 1: Maximum creek carrying capacity – the maximum flow that can occur without substantial overbank flow.

Zone 2: No discharge to maximum creek carrying capacity – discharges ranging from zero to maximum allowable

Zone 3: 150 CFS to maximum creek carrying capacity – In late summer and fall, 150 cfs up to the maximum allowable discharge rate is required when the lake levels is in Zone 3. This will increase the capacity to reduce an excessively high fall lake level and provide adequate storage capacity for spring snowmelt.

Zone 4: 150 CFS maximum – discharge rate ranging from approximately 20 cfs up to a maximum of 150 cfs is required provided the carrying capacity of Minnehaha Creek is not exceeded whenever the lake level is in this zone. This zone is considered to be desirable for operation of the structure.

Zone 5: Base flow discharge – is required whenever the lake level elevation is within this zone. Purpose is to reduce detrimental effects of creek flow stagnation during dry periods. It is expected that during most open water seasons the lake level will exceed the limits of this zone.

Zone 6: No discharge – whenever the lake level elevation is below 928.6, no discharge is allowed during the open water season.

Zone 7: Unrestricted discharge – whenever the lake level exceeds elevation 930.0, unrestricted discharge will occur. When lake level recedes to elevation 930.0 or below, discharge will again be limited to the carrying capacity of the creek.

Data collection and discharge adjustment procedures are included in this report. Also provided is a figure depicting discharge zones and allowable discharge rates.

2.2.16 1999 WATER QUALITY OF LAKE MINNETONKA

This report was prepared by Hennepin Parks on February 16, 2000. They sampled 19 bays in 1999. The objective was: determine existing water quality condition, collect baseline data and determine if internal recycling of phosphorus from the sediments was occurring. At each bay the temperature, DO, conductivity, clarity and pH were measured. In general, the 1999 water quality in many of the bays was the poorest in the five years of the monitoring program. Findings of this report were that water quality in 1999 was sufficient to support full recreational use in most bays at the east end of the lake. Conversely, the water quality of bays at the west and north sides of the lake was not sufficient to support full recreational use. The five-year monitoring program data showed a significant downward trend in the water quality of four bays, Halsteds, Maxwell, North Arm and West Arm. The poor water quality in the west end bays appears to be mainly related to internal loading. Reducing internal loading is the most critical factor in improving the water quality of the shallow bays.

2.2.17 STREAMBANK STABILIZATION/BUFFER PROJECT

The project petition is dated October 6, 1999. This is a combined effort with the Minneapolis Park and Recreation Board, the City of Minneapolis and the MCWD. The construction work to be completed as part of this proposed project involves the repair and stabilization of 71 streambank locations, movement of trail-related structures out of the creek, relocation of the pathway system away from the streambank and establishment of native vegetative buffers. Phase I of this project includes the portion of the creek in Minneapolis from Russell Avenue S. on the west to the East Minnehaha Parkway bridge at Hiawatha Avenue on the east (approximately five miles). Phase I includes streambank stabilization and buffer establishment work that is directly related to the trail reconstruction project. Phase II includes all of the remaining streambank stabilization sites in the corridor from Russell Avenue. to Hiawatha Avenue.

2.2.18 DESIGN ASSESSMENT: MINNEHAHA CREEK TRAILS STREAMBANK STABILIZATION

This report is dated November 10, 2000 and was prepared by FIScH Engineering. Report recommendations include:

1) Focus on arresting channel degradation.

2) Redevelopment of floodplains within the enlarged channels.

3) Stabilization of eroding streambanks with soil bioengineering treatments.

Eight specific sites were discussed. They are as follows:

1) Site 1: MHC 162: One area is scheduled for repair - upstream repair on the left descending bank.

2) Site 2: MHC 300, 305, 310 and 312: Four areas are scheduled for repair - two upstream on the left descending bank (sites 300 and 305) and two downstream on the left descending bank (sites 310 and 312).

3) Site 3: MHC 345, 347 and 349: three areas are scheduled for repair – site 347 on the left descending bank and two sites (345 and 349) on the right descending bank.

4) Site 4: MHC 375: Left descending bank.

5) Site 5: MHC 405: Left descending bank (may be dropped).

6) Site 6: MHC 435: Left descending bank.

7) Site 7: Meander section.

8) Site 8: MHC 490 and 492: Two sites are scheduled for repair at the new bridge location.

Another preliminary engineer's report related to this project is named Erosion Control Funding Petition from MPRB. It was prepared on November 19, 2000 by Wenck. The first section of this report covered project scope, a third party review/recommendation of the bio-technical designs, summarized temporary and permanent control measures, costs and project benefits.

As a second section to this report, Permit Application Review, many specific recommendations were listed (see report pages 1-2). MCWD rules that apply to this project were listed and described: Rule A (procedural requirements), Rule B (erosion control), Rule C (floodplain alteration), Rule D (wetland protection including WCA requirements), Rule E (dredging), Rule F (shoreland and streambank improvement), Rule G (stream and lake crossings), Rule K (performance bond or letter of credit), Rule N (stormwater management).

2.3 GANTT CHARTS

HDR developed three draft Gantt Charts for the MCWD feasibility study. The first Gantt chart is the USACE Feasibility Phase Milestone Gantt Chart (Appendix C). This is an abbreviated version of the Corps Feasibility Study Process. The second Gantt chart is the Sub-Products and Major Tasks Gantt Chart (Appendix D). This chart is an attempt to integrate and synchronize the Corps Feasibility Study Process to the MCWD local 509 Planning process. The Final Gantt chart is the MCWD 509 Plan Gantt chart (Appendix E). Ideally, in the Fall of 2004, the MCWD will insert projects identified for the Alternatives Formulation Briefing into the MCWD Capital Improvements Program.

3.0 ORGANIZATION OF THE MINNEHAHA CREEK WATERSHED DISTRICT

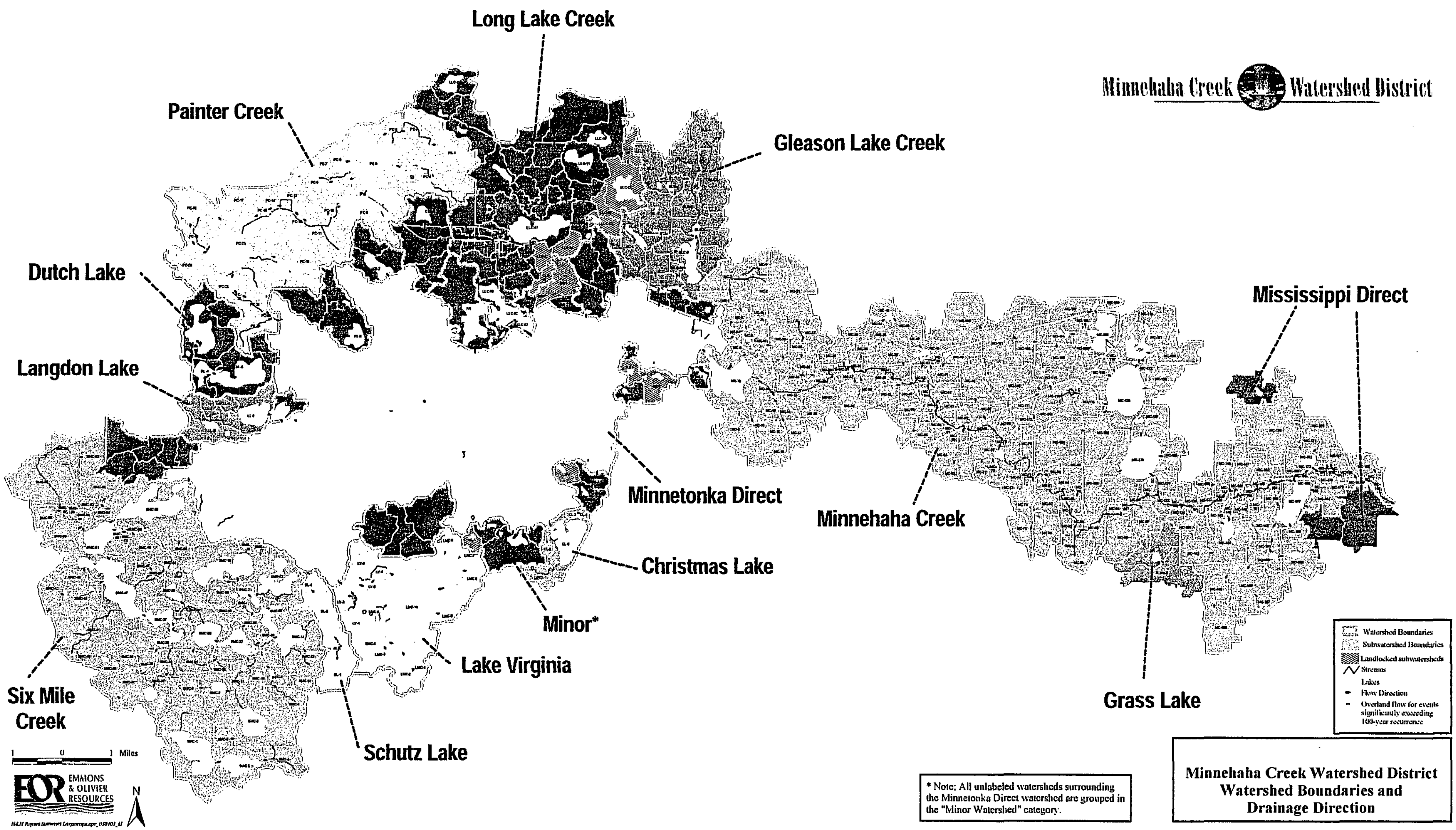
3.1 WHAT IS THE MINNEHAHA CREEK WATERSHED DISTRICT?

The Minnehaha Creek Watershed District is the regional governmental unit chiefly responsible for protecting the water resources of the Minnehaha Creek watershed, located in the Minneapolis area of Minnesota. The District was established in 1967 under the Minnesota Watershed District Act. For more information on that act see "What is a Minnesota Watershed" that appears at the end of this page. That act recognizes that hydrological boundaries rarely match political boundaries, so it established watershed districts to integrate water management efforts between city, county and state agencies.

The District covers approximately 181 square miles that ultimately drain into the Minnehaha Creek to (which then enters the Mississippi River). The watershed includes natural treasures such as Minnehaha Creek, Lake Minnetonka, The Minneapolis Chain of Lakes and Minnehaha Falls. There are eight major creeks, 129 lakes and thousands of wetlands within the MCWD. The MCWD also includes all or part of 27 cities and three townships in Hennepin and Carver Counties.

The MCWD is governed by a seven-member Board of Managers, who are appointed by the Hennepin and Carver county boards. As required by state law, the MCWD has developed a comprehensive Water Resources Management Plan that describes the existing water resources and water-related problems within the watershed, possible solutions to the problems and the objectives of the MCWD. The plan sets forth the goals and direction of the MCWD.

Minnehaha Creek Watershed District



* Note: All unlabeled watersheds surrounding the Minnetonka Direct watershed are grouped in the "Minor Watershed" category.

Minnehaha Creek Watershed District Watershed Boundaries and Drainage Direction

3.2 MINNEHAHA CREEK WATERSHED DISTRICT RESPONSIBILITES

- Water Quality Protection
- Stormwater Management
- Flood/Erosion Control
- Lake Level Management (via Grays Bay Dam)
- Lake Restoration
- Wetland Management

The goal of the MCWD is to enhance the water quality of the water resources within the Minnehaha Creek watershed while at the same time controlling flooding. The MCWD seeks to carry out this goal principally through analysis of the causes of harmful impacts on the water resources, public information and education, regulation of land use, regulation of the use of water bodies and their beds, and capital improvement projects.

Through its extensive analysis of the watershed, the MCWD has been able to effectively identify the root causes of water quality degradation and flooding. The MCWD has then successfully used this knowledge to develop and implement solutions that address these causes. These solutions include both nonstructural solutions (e.g. regulation of land and water use and public information and education) and structural solutions (e.g. construction of wet detention basins/wetlands, a headwaters outlet control structure and restoration of degraded wetlands).

3.3 MINNEHAHA CREEK WATERSHED DISTRICT DETAILS

The upper portion of the District drains through 27 square miles of agricultural land and suburbs west of Minneapolis to Lake Minnetonka. As Minnesota's 10th largest water body, this lake covers an additional 21 square miles before discharging to Minnehaha Creek. As the creek winds toward Minnehaha Falls, it accepts runoff from 80 square miles of the lower watershed, including Minneapolis.

3.4 MINNEHAHA CREEK WATERSHED DISTRICT CONTACT INFORMATION

Feel free to contact the District office at admin@minnehahacreek.org or by calling 952-471-0590. The District office is located at 18202 Minnetonka Blvd., Deephaven, MN 55391.

3.5 BACKGROUND INFORMATION OF MINNESOTA WATERSHED DISTRICTS

In 1955, the State of Minnesota implemented a pioneering new approach to management of water resources. The Minnesota Watershed District Act provides for the establishment of local units of government to protect and manage water resources based on hydrologic as opposed to political boundaries.

These local government units call "watershed districts" are charged by statute with the responsibility "to conserve the natural resources of the state by land use planning, flood control, and other conservation practices using sound scientific principles for the protection of the public health and welfare and provident use of the natural resource."

Watershed districts are formed for many reasons, including water quality protection, erosion control and flood control.

In adopting the Minnesota Watershed District Act, the State of Minnesota recognized two fundamental concepts in the effective management of water resources. First, the law recognizes that water does not adhere to political boundaries and, thus, allows for the establishment of watershed districts as local government units based on hydrologic as opposed to political boundaries. As a result, water bodies and the land draining into them are regulated by one local entity with a central comprehensive vision for managing the entire water resource. Second, the law recognizes that regulation of the use of land within a watershed is an essential component in protecting and preserving the water resources within the watershed. Again, watershed districts, as local entities with boards made up of local citizens, provide an effective tool in regulating land use and protecting water resources.

The concept of watershed management of water resources is now the preferred method of protecting and managing water resources and is being used by several states and the United States Environmental Protection Agency

4.0 GOALS, PROBLEMS AND OPPORTUNITIES WITHIN THE WATERSHED

In the 1997 Overall Watershed Management Plan (Plan), the MCWD identified eleven overall watershed management goals to address the problems and opportunities identified by the various stakeholder groups. The following goals are not listed in any particular order of importance. The goals are summarized as follows:

Goal 1

To reduce the severity and frequency of flooding and high water, and improve the chemical and physical quality of surface water.

Goal 2

Control temporary sources of sediment resulting from construction and land development activities and to identify, minimize, and correct the effects of sedimentation from erosion-prone and sediment source areas.

Goal 3

Preserve existing water storage capacity below 100-year flood elevations on all water bodies in the watershed to minimize the frequency and severity of high water.

Goal 4

Preserve the natural appearance and function of shoreline areas and minimize degradation of surface water quality which can result from dredging operations.

Goal 5

Maintain the hydraulic capacity of and minimize obstructions to navigation in watercourses and preserve the water quality and navigation appearance of shoreland areas.

Goal 6

Improve water quality by requiring best management practices (BMPs), which meet or exceed Minnesota Pollution Control Agency (MPCA) guidelines requiring their adoption in local management plans, and their implementation on development and redevelopment sites.

Goal 7

Protect the recreational opportunities associated with all District water resources by improving water quality and enhancing fish and wildlife resources.

Goal 8

Enhance public participation in District activities and provide informational and educational material to municipalities, community groups, businesses, schools, developers, contractors, and individuals.

Goal 9

Maintain public ditch systems within the District as required under ditch authority jurisdiction.

Goal 10

To support efforts to both provide for the protection of groundwater and regulate its use to preserve it for beneficial purposes.

Goal 11

To protect existing wetlands and restore diminished or drained wetlands.

The MCWD utilized an extensive public involvement process in conducting an assessment of existing and potential water resource related problems when developing the 1997 Overall Watershed Management Plan. The MCWD analyzed the land and water resource data and by soliciting input from the following sources:

1) All 29 cities/townships in the District
2) Hennepin and Carver Counties
3) 10 regional/state agencies
4) Citizens advisory committee
5) Public hearing on plan revision
6) Public hearing on draft plan
7) Numerous publicly noticed Water Resources Management Plan Revision Committee Meetings.

The most significant concerns identified in the 1997 Overall Watershed Management Plan were as follows:

1) Existing water quality degradation in numerous District lakes due to urbanization.
2) Potential water quality degradation of upper watershed lakes and wetlands due to increased nutrient loading associated with widespread development in the upper watershed.

Since the adoption of the 1997 Plan, the MCWD has conducted numerous studies and constructed many of the projects identified in the District's Capital Improvements program. The MCWD is currently in the process of revising the 1997 Plan and is utilizing the results of the HHPLS, Stream Assessment, Hydro Data Monitoring and other studies, in conjunction with the Corps Feasibility study to update the Plan.

The Plan revisions will require analysis of the data and recommendations produced by the HHPLS. Much of this information will serve as baseline diagnostic information for recommendations to the MCWD Board of Managers for future Capital Projects, Programs and Feasibility Studies. The recommendations as documented in the HHPLS for the Minnehaha Creek Subwatershed will be amended, revised, and edited prior to presentation to a stakeholder group which will produce a formal recommendation on potential projects and future capital expenditures within the Minnehaha Creek (Lower) Subwatershed. Included with this list are draft objectives for the Minnehaha Creek (Lower) watershed. Following the list of goals and draft objectives are the documented recommendations from the HHPLS. The MCWD has provided comments on potential objectives of each of these projects (management strategies) and has defined draft objectives for each in addition to linking the objectives to the larger goals of the Watershed District.

The following document the initial problems and opportunities as presented in the HHPLS. They have been further categorized by lumping them into the traditional Corps outputs of Navigation, Flood Damage Reduction, Aquatic Ecosystem Restoration and Multi-Purpose Projects. All of these areas will need to be explored as to their viability for inclusion in the Federal Feasibility Study Process.

4.1 NAVIGATION

To maintain the hydraulic capacity of and minimize obstructions to navigation without compromising wildlife habitat in watercourses and preserve the water quality and navigation appearance of shoreland areas.

- **Objective:** Maintain existing navigational capacity of Minnehaha Creek while recognizing and acknowledging other District goals

- **Objective:** Eliminate unnecessary dredging within surface waters; minimize disturbance as a result of dredging

4.2 FLOOD DAMAGE REDUCTION

4.2.1 WATER QUANTITY

To maintain or reduce the existing flows from drainage within the watershed to decrease the negative effects of stormwater runoff and bounce from existing and proposed development as well as provide low flow augmentation to surface waters.

- ***Objective:*** Define and identify flooding problem areas; eliminate flooding and minimize risk of property damage within problem areas with rain events less than a 10-year event

- ***Objective:*** Increase channel stability within Minnehaha Creek; upgrade all channels to minimum of a "fair" rating for Pfankuch stability; maintain and reduce rate of runoff to provide more consistent channel flow

- ***Objective:*** Reduce runoff velocity at high flow inlets from 2-year rain event

- ***Objective:*** Infiltrate 10% of total runoff within subwatershed from a one-year rain event

- ***Objective:*** Infiltrate 15% of total runoff within landlocked subwatersheds from one-year event

4.2.2 PUBLIC DITCHES

To maintain public ditch systems within the District as required under ditch authority jurisdiction.

- *Objective:* Perform all necessary improvements and repairs to public ditches as conditions require; perform such activities in observance of other District goals and policies

4.2.3 FLOODING

Reduce the severity and frequency of flooding, high water by preserving and increasing the existing water storage capacity below 100-year flood elevations on all waterbodies within MCWD.

- *Objective:* Preserve all existing storage capacity between the OHW and 100-year flood elevation of major surface waters

- *Objective:* Define and identify flooding problem areas; eliminate flooding and minimize risk of property damage within problem areas with rain events less than a 10-year event

- *Objective:* Maintain and/or reduce flow rates within Minnehaha Creek

4.3 AQUATIC ECOSYSTEM RESTORATION

4.3.1 INFILTRATION

Promote infiltration of surface water where feasible for the purposes of improving water quality and increasing groundwater recharge throughout the watershed.

- *Objective:* Infiltrate 10% of the total runoff within the Minnehaha Creek (lower) watershed with a one-year rain event

- *Objective:* Infiltrate 15% of the total runoff within landlocked subwatersheds classification wetlands within the Minnehaha Creek (lower) watershed

- *Objective:* No net loss of wetland acreage with recharge and/or recharge/discharge

4.3.2 ECOLOGICAL INTEGRITY

Promote activities which maintain, support and enhance floral, faunal quantity and ecological integrity of upland and aquatic resources throughout the watershed.

- *Objective:* Stabilize 10,000 linear feet of streambank, shoreline and/or buffer through the utilization of native landscaping

- *Objective:* Increase the median value of the Index of Biotic Integrity within Minnehaha Creek stream reaches by 10%; monitor through annual volunteer sampling

- *Objective:* Increase vegetative diversity classification as identified in the Functional Assessment of Wetlands for 100-acres of moderate to low classified wetland to the high to exceptional category

- *Objective:* Increase overall wetland acreage by 1% over amount identified in MCWD Functional Assessment of Wetlands, 2003.

4.3.3 WATER QUALITY

Preserve, maintain and improve the aesthetic, physical, chemical and biological composition of surface waters and groundwater within the District.

- *Objective:* Improve the water quality of all nutrient-impaired waterbodies identified by the Minnesota Pollution Control Agency under 303d; remove waters from Impaired Waters listing

- *Objective:* Adopt nutrient standards for all major surface waters; maintain or reduce nutrient loading levels to accepted target standards; monitor through Hydrodata Program

- *Objective:* Reduce phosphorus loading to Mississippi River by 10%

4.3.4 SHORELINES

Preserve the natural appearance of shoreline areas and minimize degradation of surface water quality which can result from dredging operations.

- ***Objective:*** Increase channel stability within Minnehaha Creek; upgrade all stream channels to minimum of a "fair" rating for Pfankuch stability

- ***Objective:*** Stabilize 100-acres of streambank, shoreline and buffer through the utilization of native landscaping

- ***Objective:*** Increase shoreline/streambank stability through management of water quantity and flow

4.3.5 BMPs

Improve water quality by promoting best management practices (BMPs) requiring their adoption in local management plans, and their implementation on development sites

- ***Objective:*** Serve as a technical resource for development and redevelopment; increase the utilization of innovative Best Management Practices within developments

4.3.6 EDUCATION/COMMUNICATIONS

Enhance public participation and knowledge regarding District activities and provide informational and educational material to municipalities, community groups, businesses, schools, developers, contractors and individuals.

- ***Objective:*** Mandate a education/communications budget by percentage of project cost to each structural project

- ***Objective:*** Increase public awareness of District activities; monitor through public polling/surveys

- ***Objective:*** Increase communications and improve relations with District Cities; participate in project partnerships for structural improvements within District Cities

- ***Objective:*** Serve as a technical resource for development and redevelopment; increase the utilization of innovative Best Management Practices within developments

4.3.7 WETLANDS

Preserve, create and restore wetland resources and maximize the benefits and functionality of wetlands to the watershed.

- ***Objective:*** Increase overall acreage of wetlands within subwatershed

- ***Objective:*** Increase vegetative diversity classification of 100-acres of moderate to low classified wetland to the high to exceptional category

- ***Objective:*** Increase overall wetland acreage by 1% over amount identified in MCWD Functional Assessment of Wetlands, 2003

4.3.8 GROUNDWATER

Protect and maintain existing groundwater flow, promote groundwater recharge and improve groundwater quality and aquifer protection.

- ***Objective:*** Develop program to monitor groundwater quality and flow

- ***Objective:*** Increase water quality of groundwater aquifers

4.3.9 EROSION CONTROL

Control temporary sources of sediment resulting from construction and land development activities and to identify, minimize, and correct the effects of sedimentation from erosion-prone and sediment source areas.

- ***Objective:*** Develop soil loss standard; require erosion control standards be met for all development

- ***Objective:*** Remediate the negative effects of erosion and deposition within Minnehaha Creek

- ***Objective:*** Reduce sediment load to Minnehaha Creek by 25%

4.3.10 LAND USE PLANNING

Promote effective land use planning to minimize the impact of development on water resources as well as achieve watershed district goals of water quality improvement.

- *Objective:* Manage subwatersheds to meet TMDL standards and surface water quality target goals

- *Objective:* Identify areas of high infiltration potential; encourage infiltration as a BMP; create structural projects to meet infiltration goal

4.3.11 PUBLIC INTEREST

Solicit input from the general public with the intent that policies, projects and programs will address local community values and goals as well as protect of historic and cultural values regarding water resources

- *Objective:* Mandate public input/stakeholder component into the approval process of every structural project

- *Objective:* Increase public awareness of District activities; monitor through public polling/surveys

4.3.12 PUBLIC INPUT

To strive to manage public expectations; base decisions on educated public; foster an educated, informed and involved public within the watershed

- *Objective:* Mandate public input/stakeholder component into the approval process of every structural project

- *Objective:* Increase public awareness of District activities; monitor through public polling/surveys

4.4 MULTI-PURPOSE PROJECTS

4.4.1 PUBLIC HEALTH

Minimize the risks of threats to public health through the development of programs, plans and policies that improve the quality of surface and groundwater resources.

- *Objective:* Reduce frequency of beach closings at urban parks and beaches

- *Objective:* Monitor waterbodies for bacteria which potentially threatens public health; develop program for reduction of bacteria loading into surface waters; identify key source inputs of bacteria to surface waters within urban areas; assist other entities in developing management program

- *Objective:* Provide assistance to eliminate combined sanitary/storm sewer overflows

- *Objective:* Protect and maintain water quality of drinking water aquifers

4.4.2 RECREATION

Promote the recreational use, where appropriate, of surface waters within MCWD by providing recreation opportunities for citizens by promoting the use and enjoyment of water resources with the intent of increasing the livability and quality of life within the watershed.

- *Objective:* Maintain both wildlife habitat and recreational opportunities on Minnehaha Creek

- *Objective:* Increase creek canoe usage

- *Objective:* Reduce frequency of beach closings within subwatershed

- *Objective:* Identify potential greenway corridors for recreational use and wildlife habitat; coordinate with other entities

4.4.3 FUNDING EQUITY

Fund projects through fair and equitable means throughout MCWD and assist other entities in funding projects which have a high value in relation to District goals.

- *Objective:* Fund 35% of District projects within the subwatershed with partnerships, grants, cost-sharing, and/or in-kind services from other agencies

- *Objective:* Mandate a cost-benefit analysis for all structural projects as well as programs, where appropriate

In addition, the MCWD developed recommendations documented in the HHPLS with comments provided by staff. The comments cite what additional items should be addressed in order to bridge the gap between the MCWD Board goals and the management strategies. In some cases, the objectives to accomplish this task are identified, but not completely quantified. If potential measurable objectives are identified, they have been correlated to a MCWD Board goal for reference.

4.5 RECOMMENDATIONS FOR INVESTIGATIONS FROM THE MCWD AND THE HHPLS

The Lower Watershed of Minnehaha Creek encompasses some 25 main lakes and 22 miles of Minnehaha Creek. The Lower Watershed includes the largest area of densely developed urban land in the MCWD and for much of its length, Minnehaha Creek is the center piece of park systems, particularly for the City of Minneapolis. Because of the heavy public use in this area, all of the lakes as well as the Minnehaha Creek are given a high priority.

To address the load reduction needs identified in Table IV.L.5-4 of the H&HPLS and to incorporate the management alternatives in Table III.B-3 (Volume III: Public Involvement, B. Regional Team 1 & 2), the management scheme outlined in Table IV.L.6-1 is proposed for the Minnehaha Creek ("Lower") watershed. Details of the recommendations follow the table.

4.5.1 CREATE SHORELINE STABILIZATION PROGRAM

One important source of water quality degradation is the continual erosion of soils into the creek and lakes. It is recommended that a comprehensive approach to shoreline management be created that establishes incentives for proper shoreline buffers, investment by public agencies in the most severe problem areas, and a balanced regulatory approach. Key to these recommendations is investments in matching grants and demonstration projects. Key components of this program include:

- Investment in shoreline stabilization in areas of most severe erosion
- Creation of matching grant program for private property owners willing to invest in creation of shoreline buffers (commercial and/or residential properties).
- Adoption of realistic shoreline buffer requirements that respect the space constraints of fully developed communities.

MCWD Comment: *A streambank/shoreline stabilization program should be implemented with emphasis on susceptible areas and recommendations identified in the Minnehaha Creek Stability and Habitat Assessment report. Objectives will quantify:*

- Linear feet of streambank/shoreline to be stabilized
  - Goal: Shorelines
  - Goal: Ecological Integrity
  - Goal: Infiltration
  - Goal: Water quality
  - Goal: Erosion control
- Maintenance or reduction of bounce level (target goal) with major storm events
  - Goal: Water quantity
  - Goal: Flooding
- Maintenance or reduction of peak flow level (target goal)
  - Goal: Water quantity
  - Goal: Flooding
- Potential riparian buffer improvement areas
  - Goal: Infiltration
  - Goal: Ecological integrity
  - Goal: Water quality

- Potential greenway/wildlife corridor riparian lands
  - Goal: Infiltration (through green space)
  - Goal: Ecological integrity
  - Goal: Water quality

And identify:

- Priority storm sewer inlets for sediment and flow reduction (HHPLS)
- Specific grade control structures to be removed
- At-risk, erosion prone areas to be stabilized (HHPLS/Stream Assessment)

4.5.2 Retrofit New Stormwater Practices into Redeveloping Urban Areas

As redevelopment opportunities arise, low impact development approaches should be incorporated into the stormwater management design. Pollutant load reduction goals for the lakes in the lower watershed and Minnehaha Creek could be partly met through this approach.

MCWD Comment: *Areas should be identified which currently exhibit problems and/or have development potential in the future. Objectives should be tailored to address existing or future problems in water quality and/or quantity. A BMP program should be developed with objectives of achieving quantified levels of:*

- Ponding capacity to achieve target subwatershed rate reductions
  - Goal: BMPs
  - Goal: Water quantity
  - Goal: Land use planning

- Infiltration target goals
  - Goal: Infiltration
  - Goal: Water quality
  - Goal: Water quantity
  - Goal: BMPs

    - Goal: Land use planning
    - Goal: Groundwater

- Nutrient load reductions
    - Goal: Water quality
    - Goal: Land use planning

Infiltration opportunities should be prioritized by areas identified in HHPLS, flooding problem areas and landlocked subwatersheds. Runoff rate reductions should target flooding problem areas (HHPLS), high deposition and scour inlets (Stream Assessment), strategic locations to address target bounce reductions (as identified above), as well as flow reductions. Nutrient load reductions should be a product of the HHPLS recommendations and the TMDL program.

4.5.3 PRESERVE AND MANAGE LANDLOCKED BASINS (MAXIMIZE INFILTRATION, BOUNCE, AND RETENTION).

Numerous natural wetlands and depressions characterize large portions of the upper Minnehaha Creek Watershed in Minnetonka, the west half of St. Louis Park, parts of Hopkins, and the area south of Meadowbrook Lake in the City of Edina. Some of these depressions contain wetlands or vernal pools, while others quickly lose water to infiltration or evapotranspiration. Landlocked subwatersheds are identified in Figure IV.L.1-2 and in Table IV.L.3-2. Maintaining existing hydrology and functions of these depressions will minimize potential downstream flooding and pollutant loading to receiving waters. This can be achieved through a combination of infiltration and volume control practices in the watershed as development occurs, along with specific management practices of the landlocked depressions. Management strategies recommended for landlocked basins include:

1) Design of 2-stage drop outlet facilities that mimic natural conditions by maximizing bounce, retention and infiltration in the basin. Where sensitive wetlands are present (wetlands designated as "preserve" in the Functional Assessment of Wetlands), stormwater pollutant loading and increases in bounce should not exceed MN Stormwater Advisory Group guidelines. These outlet structures would also include controlled emergency overflow and draw down maintenance gates.

2) Incorporate low maintenance infiltration enhancement techniques in the basin (i.e. infiltration gravel trenches, perforated tubes, subsoil unconnected drain tiles etc.) to ensure long-term performance.

3) Vegetation management to promote deep-rooted natural species and capillary suction and evapotranspiration at all hydrologic regimes in the basin.

MCWD Comment: *Infiltration of stormwater runoff should be the primary tool for management of landlocked subwatersheds. An objective (target goal) for infiltration should be established by analysis of infiltration potential of the landlocked subwatershed based on land use. The target should be achieved through regulation, capital projects, and incentives for land owners, municipalities and developers. Potential areas of restoration and expansion of wetlands should also be identified as management strategies for landlocked areas. Regulatory restrictions on filling of wetlands and/or diminishing wetland basin capacity should be strictly enforced.*

- Goal: Water quantity
- Goal: Flooding
- Goal: Wetlands

4.5.4 PRESERVATION OF SMALLER LANDLOCKED POCKETS

Areas containing smaller landlocked depressions in the watershed not explicitly modeled help reduce watershed impacts by minimizing downstream discharge rates, volumes, and transfer of sediment loads. Their preservation is important to minimize development impacts to downstream water bodies. To the extent possible, it is recommended that the smaller landlocked pockets in the watershed be retained, or their function be retained as the area develops.

MCWD Comment: *It is unclear whether or not these areas are identified in the HHPLS. If they are identified, they should be managed in the same or similar manner as the landlocked subwatersheds cited in recommendation #3. If not, the District could conduct a study to identify landlocked pockets.*

4.5.5 INSTALL ENERGY DISSIPATION AND EROSION CONTROL AT OUTFALLS WITH HIGH PIPE VELOCITIES

High pipe velocities predicted are listed in Table IV.L.3-3. Appropriate structural improvements will vary by site. Alternatives for energy dissipation may include:

1) Upstream ponding. The addition of upstream storage capacity in a stormsewer system allows for temporary extension of storage time and slower release of flows. This option also helps reduce peak rates.
2) In-pipe energy dissipation. Several devises have been used to reduce in-pipe velocities. Examples include various configurations of baffles and orifice rings within an expanded section of pipe.
3) Outlet energy dissipation. Apron configuration, submergence or partial submergence of outlet, plunge pools and baffles are all examples of methods used for energy dissipation at an outlet.

MCWD Comment: *Recommendations should identify:*

- Inlets susceptible to scour and erosion (Stream Assessment/HHPLS)
  - Goal: Erosion control
  - Goal: BMPs
  - Goal: Navigation
  - Goal: Recreation
  - Goal: Public ditches

- Areas eligible for grade control at inlets/within creek (Stream Assessment)
  - Goal: Erosion control
  - Goal: BMPs

- Infiltration target goals to reduce the volume of water in surface flows
  - Goal: Erosion control
  - Goal: Infiltration
  - Goal: Water quantity

- ✦ Ponding capacity required for rate reduction (specify level) in subwatersheds with high velocity outlets (HHPLS)
  - ❖ Goal: Water quantity
  - ❖ Goal: Erosion control

4.5.6 INVESTIGATE WATERSHED BOUNDARY NEAR SOUTHDALE MALL

As part of this study, modeling results appear to indicate that Southdale Mall, a portion of Highway 62, and some of the commercial area surrounding the Southdale Mall drain to an equalized pond system (Point of France Pond, Swimming Pool Pond, and Garrison Pond). Based on this information, it appears that areas currently outside of the MCWD jurisdictional boundary drain, at least partially, into Minnehaha Creek. It is recommended that a thorough investigation be conducted to clarify drainage boundary issues and assess the accuracy of the current jurisdictional boundary.

MCWD Comment: *The proposed action does not constitute a Capital Improvement nor does this recommendation achieve any of the goals created by the MCWD Board of Managers for the 509 plan. However, this effort could be included as a formal request for boundary change with the 509 Plan revisions if desired by the District Administrator and/or the MCWD Board.*

4.5.7 DEVELOP TMDL ALLOCATIONS AND MANAGEMENT STRATEGIES FOR LAKES WITH "EXCESS NUTRIENT" IMPAIRMENTS.

This report identifies load allocation requirements to meet phosphorus load reduction goals. The MCWD should work with local units of government to implement specific load reduction strategies to meet water quality goals for these lakes. Strategies include shoreline buffers, residential BMPs to achieve water quality improvements, use of rain gardens, infiltration and incorporation of new or additional stormwater practices into redeveloping areas.

MCWD Comment: *Staff recommends accepting the HHPLS recommended target loads as policy. TMDLs for impaired waters are currently under development and should be completed by February 2004. The results of this study should be incorporated as target goals for the 509 Plan revisions and will become the measurable objective for the waterbody.*

- ✦ Goal: Water quality
- ✦ Goal: Public Health

- Goal: Land use planning
- Goal: Recreation

4.5.8 REVISE WATER QUALITY GOALS FOR MINNEHAHA CREEK AND LAKES OF THE LOWER WATERSHED

As outlined in Table IV.L.5-4, water quality goals for Minnehaha Creek and many of the lakes in the lower watershed should be changed to reflect current water quality conditions. The District should consider revision of these recommended water quality goals as part of its 509 Plan update.

MCWD Comment: *The District should adopt the revised nutrient loading recommendations provided in the HHPLS.*

- Goal: Water quality
- Goal: Land use planning

4.5.9 DEVELOP IMPLEMENTATION PLAN TO IMPROVE MINNEHAHA CREEK AND LAKE HIAWATHA

Minnehaha Creek is often viewed as a storm drain outlet for discharge of runoff from the tributary communities. The HHPLS analysis views the creek as a resource which must be protected and as the primary hydrologic and pollutant input to Lake Hiawatha. Recommendations for management of the creek should be based on usage goals (recreation, flood protection, and protection of unique resources), rather than restoration of pre-development conditions. It is recommended, therefore, that the water quality management and flood management be inter-related and administered as combined rather than separate projects. This can be accomplished by thorough study of the creek and creation of an Implementation Plan that would define those capital improvement projects that will improve the water quality of Minnehaha Creek and/or create flood retention in areas defined with additional flood storage capacity. The Implementation Plan should include the following key elements:

1) Water quality monitoring of in-stream pond-like reaches to determine which ponds release phosphorus to creek flows vs. which ponds remove phosphorus (and sediment) from the creek.

2) Mixing study of Lake Hiawatha to determine the percentage of Minnehaha Creek flows which mix into the lake and the percentage of flows that bypass the lake. (Previous studies had made assumptions based on theory and not on field data).
3) Identification of subwatersheds which are major contributors of phosphorus to Minnehaha Creek and Lake Hiawatha. Investigate the feasibility of water quality improvement projects in these subwatersheds.
4) Identification of areas within Minnehaha Creek and adjacent floodplains which have unused flood storage capacity. Identify areas within the floodplain of Minnehaha Creek that have been hydraulically disconnected. Investigate the feasibility of reconnection for purposes of both flood mitigation and water quality improvement. Define specific projects.
5) Identification of areas within the floodplain of Minnehaha Creek with inadequate vegetative buffers and/or excessive sedimentation. Define specific projects.
6) Identification of wetlands tributary to Minnehaha Creek that are critical to the water quality of the creek. Define projects and regulatory protections to ensure long-term health of these wetlands.
7) Compilation and prioritization of all identified projects into a comprehensive Minnehaha Creek Implementation Plan with a menu of projects and preliminary cost estimates for the MCWD to include in future CIPs.
8) Identification of potential partners for each proposed project.
9) Identification of water quality goals for Minnehaha Creek.

MCWD Comment: *This proposal constitutes the most comprehensive proposal for the Minnehaha Creek (lower) subwatershed. Objectives should be quantified in regards to:*

- Target Loads for Hiawatha and Minnehaha Creek (TMDL/HHPLS)
  - Goal: Water quality
  - Goal: Public health

- Runoff rate reduction (HHPLS)
  - Goal: Water quantity
  - Goal: Flooding

- Reduction of the frequency of beach closings
  - Goal: Water quality
  - Goal: Public health

4.5.10 IMPLEMENT FLOOD MITIGATION POLICIES FOR FLOODING ALONG MINNEHAHA CREEK AND WITHIN NEIGHBORHOODS

Hopkins, St. Louis Park, and Minneapolis have identified areas within their municipalities where regular, and sometimes severe flooding occurs after intense rainstorms. The cause of this flooding often is related to the hydraulic relationships between their municipal storm drainage system and Minnehaha Creek. The problems range in severity from the less severe regular flooding of intersections to the most problematic backflow of sewage into basements. Typically the solutions to this sort of flooding involve increased capacities of the storm drains and/or retention in new ponds. Neither solution increases the volume of stormwater being discharged to Minnehaha Creek; however, each solution does impact the rate and timing of stormwater discharge to the creek. To compound this problem, the rainstorm that causes neighborhood flooding may also cause creek flooding. It is recommended that the MCWD manage flooding using a holistic approach, whether it is along the creek or within a neighborhood. Flooding would be accepted as a natural occurrence that should be tolerated whenever the flooding does create structural problems. Flooding that results in water or sewage in buildings must be corrected. Participants of the lower watershed Regional Teams favor flood management strategies founded on a range of flooding acceptability. For example, flooding that simply overtops the creek bank without creating structural and/or health and safety problems should be allowable. When flood mitigation is determined to be necessary, then the project should also include features that ensure that downstream problems do not occur. MCWD should adopt flood mitigation policies that look beyond the boundaries of the creek and balance the hydraulic inter-relationship between the creek and the municipal drainage systems. Key components of recommended MCWD flood mitigation policies include:

1) Flooding that overtops the creek banks without creating structural problems to bridges, buildings or other structures should be tolerated.
2) Flooding that creates structural and/or health and safety problems must be mitigated.
3) Flood mitigation projects should include measures that ensure downstream problems are not created where no current problem exists.

4) MCWD should adopt a separate flood mitigation permitting process rather than fit flood mitigation projects into permitting processes more suited to development reviews.
5) MCWD should include mitigation of health and safety problems as criteria when evaluating flood mitigation projects.
6) MCWD should accept additional rate of stormwater discharge to Minnehaha Creek in segments of the Creek where the hydraulic capacity exists and does not create downstream problems.
7) MCWD should require flood capacity compensation when accepting increased rates of stormwater discharge to Minnehaha Creek for all new stormwater discharges to Minnehaha Creek, regardless of whether the new discharges are related to increased development or neighborhood flood mitigation.

MCWD Comment: *MCWD should accept the recommendations of the HHPLS regarding flooding of Minnehaha Creek. Option f should be investigated for its feasibility. With this exception, objectives should include:*

- Maintenance or reduction of peak flow level (HHPLS)
  - Goal: Flooding
  - Goal: Water quantity
  - Goal: Erosion control

- Elimination of problem flooding areas (as identified through analysis – see below)
  - Goal: Flooding
  - Goal: Water quantity
  - Goal: Public Health

- Ponding capacity to achieve target rate control reductions within subwatershed
  - Goal: Flooding
  - Goal: Water quantity

- Infiltration target goals for subs/lower watershed
  - Goal: Infiltration
  - Goal: Flooding

- ❖ Goal: Water quantity
- ❖ Goal: Groundwater

Areas should be identified which:

- ✦ Fit the flooding problem areas as defined in recommendation a-b
- ✦ Subwatersheds with high infiltration potential
- ✦ Contribute significant volumes of surface runoff to problem areas

4.5.11 SIMULATE BACK-TO-BACK 100-YEAR STORM EVENTS ON CHAIN OF LAKES

The combined upper basin has an extended draw down time which exceeds one month to return to the NWL. The lakes were modeled starting at their NWL (851.9 feet NGVD 1929); however, because of the slow draw down, it is highly probable that initial water levels will be elevated prior to storm events. In order to define more conservative HWLs, the upper chain can be modeled differently from other lakes in the MCWD. To develop more conservative HWLs, the upper chain could be treated differently from other lakes in the MCWD model. Simulating the 100-year return events on slightly elevated initial water surface conditions is an option given the lengthy draw down time. In any case, the HWLs for the upper Chain of Lakes determined in this report would only be increased by 0.2 – 0.3 feet. Other modeling alternatives could include simulation of back-to-back 100- year storm events.

MCWD Comment: *Options should be investigated to reduce the rate and volume of water flowing into the Chain of Lakes focusing on areas upstream of Lake Harriet. Objectives should be quantified which:*

- ✦ Reduce the runoff rate of high frequency rain events into the lake without compromising the conveyance capacity for low frequency (high intensity) rain events (HHPLS)
  - ❖ Goal: Water quantity
  - ❖ Goal: Flooding

- ✦ Define an acceptable level of rise in lake water elevation
  - ❖ Goal: Water quantity
  - ❖ Goal: Land use planning

- Identify ponding capacity necessary achieve minimal lake elevation rise with back-to-back 100 year events
  - Goal: Water quantity

- Infiltration standards for subwatersheds
  - Goal: Water quantity
  - Goal: Infiltration
  - Goal: Flooding

4.5.12 IMPLEMENT VOLUME CONTROL STANDARDS IN ALL SUBWATERSHEDS DRAINING TO OR CONTAINING LANDLOCKED DEPRESSIONS

Landlocked basins are particularly sensitive to additional stormwater volumes. As development occurs, special emphasis should be given to volume control regulation within all subwatersheds containing or draining to landlocked basins and/or pocket wetlands. Simple runoff volume management techniques like rain gardens, infiltration swales, or dry ponding are strongly recommended in those areas to mimic natural watershed hydrology and control the runoff volumes discharged into landlocked basins. Local soils and groundwater issues (see Figure IV.L.2-6 Minor Watersheds Infiltration Potential) should be considered at the design and review (permitting) phase to assess the suitability, placement, and sizing of these runoff volume reduction techniques.

MCWD Comment: *Same as recommendation #3.*

4.5.13 STORMWATER RATE REDUCTION DOWNSTREAM OF BROWNDALE DAM

A significant increase in Minnehaha Creek flow and velocity can be observed between the Browndale Avenue dam and the WOMP station (at 32nd Avenue S) monitoring locations. The erosion and scour analysis also indicates that this portion of the creek contains many areas of high erosion potential.

MCWD Comment: *See recommendations #2 and 5.*

4.5.14 COORDINATE WITH CITIES' "ROADWAY RECONSTRUCTION/ INFRASTRUCTURE UPGRADE" PROGRAMS

This plan should incorporate stormwater management improvements and low impact designs as road and stormsewer infrastructure are maintained and upgraded. The MCWD should coordinate with the Cities' CIP and Maintenance Plans to look for opportunities to collaborate and reduce downstream impacts. Emphasis should be place in areas draining to highly erosive segments of the creek (see Table IV.E.4-1) or stormsewer systems with high velocities (Table IV.L.3-3). Re-grading of streets to include rain-gardens ("Gutters to Gardens") in areas of high infiltration potential (Figure IV.L.2-6) will help mitigate high discharge and velocity rates in Minnehaha Creek and reduce runoff volumes and sediment transport from streets.

MCWD Comment: *An acceptable flow level and nutrient loads should be established for Minnehaha Creek. Any (re)development should be assessed by its impact or potential impact to the acceptable standards. Street projects should thereby be assessed in accordance with recommendation #2.*

4.5.15 CONDUCT A NOKOMIS WEIR OPERATION INVESTIGATION

Simulation of the 10-year, 24 hour rainfall event (4.2 inches) on a 20 cfs base-flow showed that flows from Minnehaha Creek initially backflow into Lake Nokomis. Following the peak attenuation into Lake Nokomis, flows reverse and discharge moves in the direction of Lake Nokomis to Minnehaha Creek. This pattern was also observed during simulation of the 100-year rainfall and 100-year snowmelt events and would indicate that the inflatable weir does not prevent flows exceeding the 5-year recurrence from entering Lake Nokomis. Base on the new and more accurate model, it is recommended that the effectiveness of the Nokomis weir as currently designed be reassessed.

MCWD Comment: *The objective of this recommendation as presented should be discussed by staff. Reassessment of the weir will not fulfill any of the goals defined by the MCWD Board of Managers unless the presence of the weir aggravates pre-existing problems and/or creates new ones.*

4.5.16 CONDUCT A LEGION LAKE/INFILTRATION CAPACITY STUDY

Legion Lake is a unique area with naturally high infiltration/groundwater recharge capacity. Potential exists to take advantage of the basin's natural infiltration capacity to further reduce the runoff volume discharged into Lake Nokomis. The District, Minneapolis, and Richfield could co-sponsor an assessment/feasibility study to better determine Legion Lake's current infiltration capacity and hydrologic regime, and determine any potential infiltration enhancement practices (i.e. trenching, vegetation management, etc.). The study could also look at potential stormwater re-routing options.

4.5.17 KNOLLWOOD PLAZA STORMWATER IMPROVEMENTS

Knollwood Plaza encompasses one of the larger contiguous tracts of impervious surfaces in the lower watershed, yet generally lacks stormwater treatment facilities. The MCWD should work with the City of St. Louis Park to investigate options for retrofitting existing stormwater infrastructure and incorporating new practices wherever practical. In particular, the feasibility of installing large infiltration ponding facilities, should be investigated, since the area around Knollwood Plaza has a high infiltration potential. Additionally, vegetative buffers should be established along either side of Minnehaha Creek as it flows though this area.

4.5.18 CREATE INCENTIVES AND/OR MATCHING GRANTS FOR PROPERTY OWNERS (COMMERCIAL AND RESIDENTIAL) THAT ARE WILLING TO CREATE INNOVATIVE OR INFILTRATION PRACTICES TO BENEFIT RUNOFF WATER QUALITY.

Individual opportunities to improve the quality of runoff discharged should not be overlooked. Through the creation of matching grants and demonstration projects, the MCWD could lead the effort to rebalance the volumes of stormwater that infiltrates to the groundwater vs. the volume that is discharged to lakes and the creek. This would be coupled with the adoption of volume control requirements for new developments. Key components include:

1) Work with Lake Associations and Neighborhood Organizations to create one residential infiltration demonstration project in each minor watershed.
2) Create matching grant program to financially support creation of infiltration practices on private property (residential and commercial). Funding priority could be given to those infiltration projects that remove runoff tributary to a flood mitigation project.
3) Adopt volume control standards for new developments that require no net increase in volume discharged from site.

4.5.19 Further Strengthen Water Quality and Construction Site Management Requirements for Future Highway Projects

Local highway departments appear to give little attention to water resources issues that are related to either the construction of new highways and/or maintenance of existing highways. It is recommended that highway departments implement stronger measures to control sedimentation during construction, such as controlling access in and out of construction zones and daily sweeping in areas where no other sediment control is possible. Further, these road authorities should implement structural and non-structural Best Management Practices for highways not programmed for future reconstruction. Key components include:

1) Strengthen sediment control permitting requirements for highway construction projects.
2) Require post-project dredging for those projects where sediment control has failed and resulted in downstream sedimentation of water resource.
3) Include long-term sweeping and other non-structural BMPs in all highway construction permits.

MCWD Comment: *Same as recommendation #2 and 14.*

A complete presentation of the recommendations made for this watershed by Regional Team 1&2 can be found in HHPLS Volume III: Public Involvement, B. Regional Team 1&2. This includes information regarding the priority of each issue, who would be responsible for undertaking each suggested management approach, and a recommendation of when the approach should be undertaken.

In addition to the aforementioned possibilities for examination in a Federal Feasibility Study, the MCWD has provided the following guidance as to the local priorities for project examination and implementation in the Corps Feasibility Study Process. It should be noted that these recommendations do not limit the study to only these areas listed by MCWD. The intent of this listing is to provide additional review and comment on the proposed draft list of projects and alternatives as well as provide insight on priority areas of concern to MCWD to be included within the Scope of Work Report. For the purposes of this report, MCWD staff has differentiated its comments to those pertaining to the Upper Watershed and the Lower Watershed. Neither the Upper nor Lower Watershed should take precedence over one another, but rather should be approached, from the perspective of MCWD for the purposes of this analysis, as separate entities due to their hydrologic differences and separation via the Grays Bay Dam. In addition, the involved public stakeholder process that MCWD is currently planning for the development of a comprehensive plan for the Lower Watershed warrants, in the opinion of MCWD, separate review processes given that the Lower Watershed will be examined by the stakeholders as a whole under its own process. The MCWD has in the SOWR development process recommended that the USACE investigate the USACE investigate the following issues under the Feasibility Study:

4.6 LOWER WATERSHED

4.6.1 AQUATIC ECOSYSTEM RESTORATION, LOWER WATERSHED

Recommended actions for the Lower Watershed are listed in the attached *Table IV.L.6-1* of the HHPLS Report. Details on the recommended actions are included in the report in the accompanying text. The recommendations were coordinated through the MCWD Regional Teams 1 and 2 public involvement process. In addition see the recommendations in the HHPLS Volume III (Public Involvement). Recommendations of particular importance to AER are those projects involving shoreline stabilization (Rec. #1), management of landlocked basins (Rec. #3/4), energy dissipation and flow reduction (Rec. #5), and the development of a management plan for both Minnehaha Creek and Lake Hiawatha (Rec. #9).

Any aquatic ecosystem restoration effort along Minnehaha Creek should include a comprehensive look at the existing flow regime of the creek as influenced by both the base flow from Grays Bay Dam as well as the influence of storm sewer surge discharged into the creek. A reevaluation of both of these flow inputs may be critical in maintaining any investment made to restoration of the creek. Such analyses would also fall under the auspices of Recommendations #2, 3, 4, 9, 12, 13 and 16.

The Minnehaha Creek Stability and Habitat Assessment report identifies a number of areas of concern and has identified firm recommendations on potential remedies to perceived problems. Recommendations are highlighted in bold type in the attached *Minnehaha Creek Stability and Habitat Assessment Summary/Conclusions* table. Individual stream reach recommendations are provided which include projects involving the restoration of native buffers, bioengineering of stream banks, repair of stormwater infrastructure, removal of grade controls, and reduction of channelization through the creation of stream meanders.

The MCWD Minnehaha Creek Stability and Habitat Assessment also identifies areas of poor ecological health through a macorinvertebrate study by stream reach. The purpose of the study was to examine the aquatic macroinvertebrate population over the varying reaches of Minnehaha Creek in addition to correlating population data with habitat and reach features as identified in the Fluvial Geomorphic Assessment. MCWD encourages the USACE to consider the utilization of macroinvertebrate population data in its evaluation of existing habitat function as well as future use in the development of projects using the Habitat Evaluation Procedures (HEP) outlined under USFWS protocol. MCWD is currently working with the University of Minnesota to develop a macroinvertebrate stream monitoring program which will compliment the existing Hydrodata monitoring program by creating a quantified database evaluating the trends in the ecology of the creek. This may be a valuable tool to any AER projects in evaluating the success of the management tools implemented as a result of the USACE/MCWD Feasibility Study.

As stated in the HDR Engineering, Inc. draft Scope of Work Report, the MCWD Functional Assessment of Wetlands Report identifies approximately 767 acres of restorable wetland within MCWD. It should be noted that restorable wetland is defined in this study as areas of partial or fully filled and/or drained basins. As summarized in the attached FAW tables 2.4 and 2.1, wetlands in this study were evaluated by a number of functional metrics which include vegetative diversity, hydrologic regime, flood storage, downstream water quality, wetland water quality, shoreline protection, wildlife, fisheries, recreation/educational value, commercial value, restoration potential, stormwater sensitivity, stormwater treatment, and groundwater interaction. MCWD suggests that some parameters, particularly those of vegetative diversity, wildlife and fisheries may qualify for enhancement of the current functions which could contribute a value to the overall ecosystem through the creation of habitat units (HEP method evaluation). MCWD has a high interest in creating, preserving and enhancing connective systems of greenways and riparian corridors to preserve green/open space, provide recreational opportunities, improve water quality and promote wildlife habitat. The development of such connective systems should be considered a high priority.

4.7 UPPER WATERSHED (IN ORDER OF MCWD PRIORITIZATION)

4.7.1 PAINTERS CREEK WATERSHED (13.5 SQ. MI.)

Painters Creek contributes significant nutrient loading to Lake Minnetonka (into Jennings Bay) in addition to being an important area for ecological habitat within the Minnehaha Creek watershed (Painters Creek is mostly rural).

Recommended actions for Painters Creek Watershed include the attached *Table IV.A.6-1* of the HHPLS Report. Details on the recommended actions are included in the report in the accompanying text. The recommendations were coordinated through the MCWD Regional Team 9 public involvement process. In addition see the recommendations in the HHPLS Volume III (Public Involvement).

It is suggested that the Feasibility Study include analyses of potential Aquatic Ecosystem Restoration involving:

1) The riparian areas of wetlands/lakes within the hydrologic system, for potential restoration efforts and preservation and/or enhancement of native buffering
2) The tributary ditches and streams to the major tributaries for issues related to the management of flow and reduction of sediment loading.
3) Wetland areas identified in the MCWD Functional Assessment of Wetlands which may be successful areas of restoration or enhancement. Areas where connective natural riparian corridors may be established are of particularly high priority.

Recommendations from the HHPLS of particular relevance to AER include stream reach restoration (Rec. #1), surface water runoff management (Rec. #3), development of a corridor management plan (Rec. #4), and energy/flow dissipation (Rec. #9). Similar to the Lower Watershed recommendation, MCWD staff also recommends that wetlands identified in the MCWD Functional Assessment of Wetlands are evaluated under the Feasibility Study for both restorability as well as enhancement.

MCWD is currently working with Emmons Olivier Resources and HDR Engineering, Inc. on developing an improvement project for Painters Creek and Jennings Bay (downstream receiving waterbody). A draft copy of the preliminary report has been included with this memo. MCWD is also in the process of completing work related to the Minnehaha Creek Stability and Habitat Assessment for Painters Creek. Information produced from this study and subsequent recommendations will be available prior to the end of the month.

4.7.2 SIX MILE CREEK WATERSHED (APPROX. 27 SQ. MI.)

Six Mile Creek contributes significant nutrient loading to Lake Minnetonka (into Halstead Bay) in addition to being an important area for ecological habitat within the Minnehaha Creek watershed (Six Mile Creek is mostly rural).

Recommended actions for the Six Mile Creek watershed are listed in the attached *Table IV.D.6-1* of the HHPLS Report. Details on the recommended actions are included in the report in the accompanying text. The recommendations were coordinated through the MCWD Regional Team 8 public involvement process. In addition see the recommendations in the HHPLS Volume III (Public Involvement).

Recommendations from the HHPLS of particular relevance to AER include development of tile inventory/wetland restoration plan (Rec. #3), corridor management plan (Rec. #4), installation of energy/flow dissipation (Rec. #11), establishment of lake and wetland buffers (Rec. #12), stabilization of connective streams (Rec. #13), wetland restoration (Rec. #15), lake restoration (Rec. #16), Turbid Lake/Lunsten Lake corridor restoration (Rec. #26). Similar to the Lower Watershed recommendation, MCWD staff also recommends that wetlands identified in the MCWD Functional Assessment of Wetlands are evaluated under the Feasibility Study for both restorability as well as enhancement. MCWD is also in the process of completing work related to the Minnehaha Creek Stability and Habitat Assessment for Six Mile Creek. Information produced from this study and subsequent recommendations will be available in the near future.

MCWD staff suggests that areas outside of the immediate creek corridor are considered for potential improvements including:

1) Riparian areas of Turbid Lake, Mud Lake, and other lakes within the hydrologic system, for potential shoreline restoration efforts and preservation and/or enhancement of native buffering.
2) Tributary ditches and streams to the major tributaries for issues related to the management of flow and reduction of sediment loading.

4.7.3 DUTCH LAKE, LAKE MINNETONKA, GLEASON LAKE, LONG LAKE CREEK, CHRISTMAS LAKE, SCHUTZ LAKE, LAKE VIRGINIA (IN ORDER OF PRIORITIZATION)

Each of the remaining subwatersheds face varying levels of threats from degradation as a result of development and contain objectives and potential projects identified in the HHPLS Report. Details on the recommended actions are included in the report in the accompanying text. The recommendations were coordinated through the MCWD Regional Teams public involvement process. In addition see the recommendations in the HHPLS Volume III (Public Involvement).

MCWD staff suggests that stream reaches and in/outflows from these watersheds merit additional investigation to the identification of potentially restorable corridors. MCWD has an interest in preserving and enhancing connective systems within these watersheds in much the same manner as the previous MCWD staff comments for Painters, Six Mile and the Minnehaha Creek watersheds.

4.8 SUMMARY

As evidenced from the comments above, one of the primary concerns of MCWD is that the potential improvements to the watershed made in partnership with the USACE are evaluated under a systems-managed approach to watershed management. To clarify, MCWD has a keen interest in not focusing solely on the implementation of Best Management Practices within site-specific areas, but rather the development of a comprehensive system plan which will utilize a host of management tools including BMP's, land (open-space) preservation, promotion of infiltration, ecological enhancement, creation/restoration of riparian corridors and protection of critical areas as tools in managing the overall effects of humans upon water resources within a developing and urbanized watershed. It is also important to MCWD in the context of Aquatic Ecosystem Restoration to gauge the future water quality, stormwater runoff rates, and volumes within the watershed necessary to sustain any such improvements over time.

5.0 RECOMMENDATIONS FOR ANALYSES IN THE FEASIBILITY STUDY

5.1 NAVIGATION

Most of the lakes within the MCWD have adequate public access and fish stocking programs as administered by the State of Minnesota DNR, and permitted, where applicable, by the MCWD. The majority of issues raised on Navigability center on the Minnehaha Creek corridor. While there are issues identified with the unfettered canoe-ability of Minnehaha Creek, it is unlikely that there would be a NED/NER Federal interest in changing out a couple of culverts and bridge structures to make the creek canoe-able from Gray's Bay to the Minnehaha Falls. This is especially true given that there are marked portages and that the "locals" are already used to using existing, marked portage routes to ferry portable watercraft around the existing barriers. It is not likely that this project alternative would pass the necessary Federal economic tests and barriers and it is not recommended that this Alternative be carried forward for further Federal review in the Feasibility Study.

5.2 FLOOD DAMAGE REDUCTION

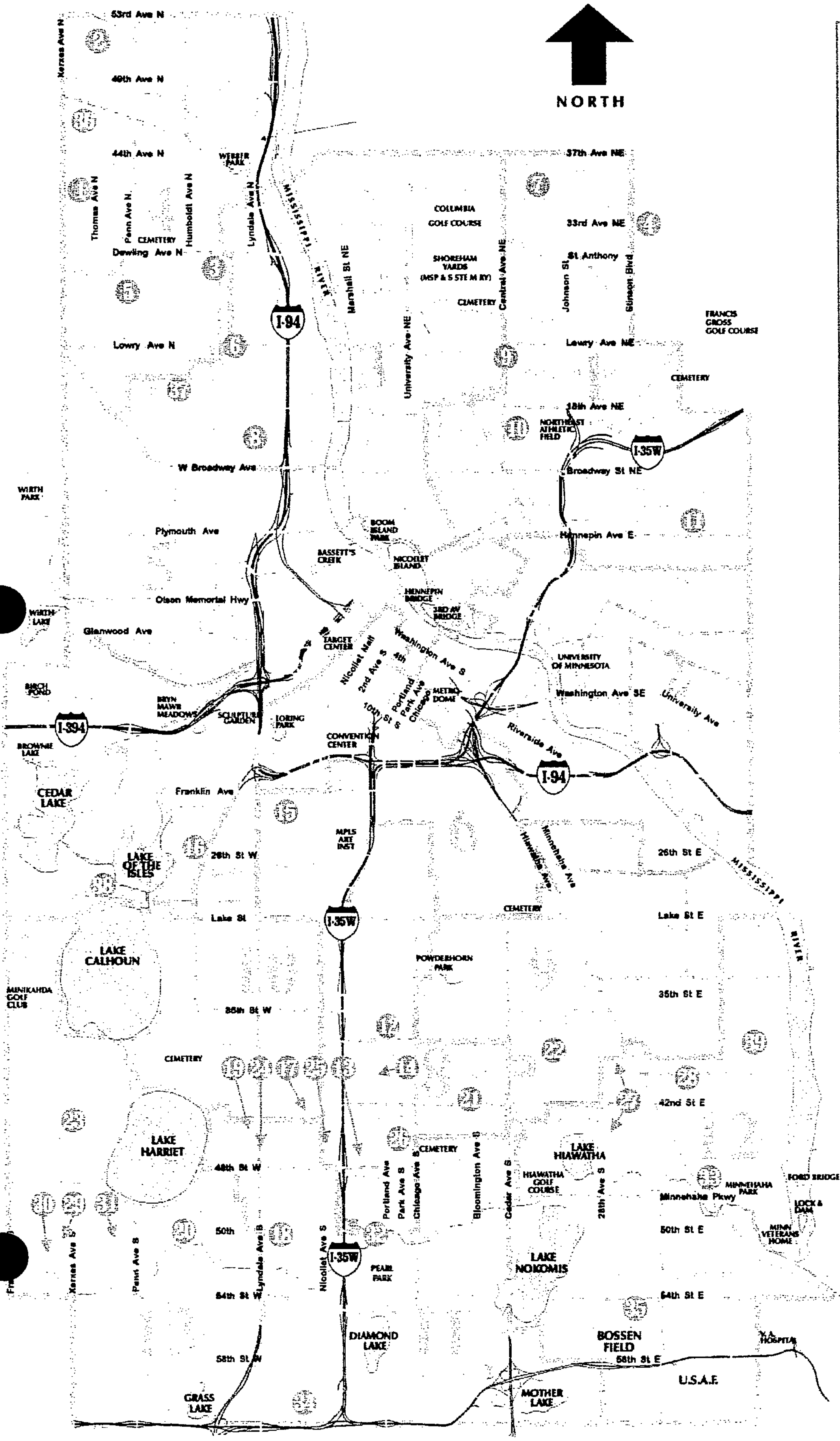
There are a number of flood damage reduction projects identified within the 1997 Minneapolis Flood Damager Reduction Report. Most involve urban stormwater management and infrastructure and associated FDR projects. Federal planning guidance 1105 clearly indicates that local stormwater management issues, excepting those that pass the 800 cfs rule, are not in the Federal interest and are best solved by local tax dollars and organizations.

The State of Minnesota has an active FDR Grant program, and it would be more likely that a consortium of applicants could proceed with FDR grant applications to the State to solve some of the localized flooding problems. It is recommended that the MCWD work with member cities to develop State of Minnesota FDR applications for grants that include Section 205 applications to the Corps in the event that Aquatic Ecosystem Restoration Projects and Multi-Purpose Projects do not advance out of this Feasibility Study.

The City of Minneapolis, in particular, has identified numerous flood damage reduction projects within the boundaries of the MCWD. These problems are most likely best addressed through either Aquatic Ecosystem Restoration projects or Multi-Purpose projects that rely heavily on the

NER calculation over the NED calculation of Federal Interest. Restoration of the hydrologic regime of Minnehaha Creek is a common thread and desire listed in all reports reviewed be they of the cities or the MCWD. It is likely that "packaging" is required to design studies of creek restoration that include restoration of hydrology, hydraulics and habitat that have ancillary benefits of flood damage reduction be proposed that will "pass" the Federal tests of NED and NER.

1997 PROBLEM FLOODING AREAS



Recommended Areas:	Water Outfall:
42ND AVE N & RUSSELL AVE N	20-210B
51ST AVE N & VINCENT AVE N	20-010
37TH & HUMBOLDT AVE N	10-110
33RD & BENJAMIN NE	10-100
38TH AVE N TO DOWLING AVE WASHBURN - MORGAN AVES N	63-010
30TH AVE N TO 33RD AVE N DUPONT TO IRVING AVES N	10-110
35TH AVE & POLK ST NE	10-100
3RD ST N AT 23RD AVE N	10-230
EDISON HIGH SCHOOL AREA	10-180
18TH & QUINCY NE	10-180
TALMAGE & HOOVER NE	10-460G (10-460R)
3700 BLOCK OF COLUMBUS S	76-010
CLINTON AVE S FROM 45TH TO 46TH STS E	70-330
40TH ST E FROM 4TH TO 5TH AVE S	10-430K
22ND ST W & GARFIELD AVE S	10-430J
26TH ST W & EMERSON AVE S	63-150
43RD ST W & WENTWORTH AVE S	10-430J
50TH & WENTWORTH AVE S	70-285
44TH ST W & ALDRICH AVE S	57-020
MINNEHAHA CREEK - HUMBOLDT TO NEWTON AVES S	70-110, 120, 130, 145
BLOOMINGTON HOLDING POND AREA	76-010
SIBLEY FIELD	76-010
43RD ST W & ABBOTT AVE S	54-080A/B/C
45TH ST W & LYNDALE AVE S	10-430U
45TH ST W - NICOLLET TO 1ST AVE S	10-430U
E 43RD ST TO M'HAHA CREEK PORTLAND TO CHICAGO AVE S	70-350
29TH AVE S & E 44TH ST, 30TH AVE S & E 39TH ST	70-475
E 40TH ST & SNELLING AVE	10-680
50TH TO 51ST STS - ZENITH TO YORK AVES	57-100A/B
51ST ST W & ABBOTT AVE S	57-100A/B/C
50TH TO 51ST STS W & SHERIDAN AVE S	57-070
49TH ST E & STEVENS AVE S	70-330
MINNEHAHA CREEK - 34TH AVE S TO 38TH AVE S	70-535, 545,555
60TH ST E - NICOLLET TO STEVENS AVES	71-070
54TH ST E & 28TH AVE S	10-720F
VICTORY MEMORIAL PARKWAY & XERXES AVE N	63-010
KNOX-MORGAN AVES N 27TH -29TH AVES N	40-010
DEAN PARKWAY	54-150
46TH AVE S 36TH TO 37TH STS E	10-670

MINNEAPOLIS
DEPARTMENT OF PUBLIC WORKS
OCTOBER 15, 1997

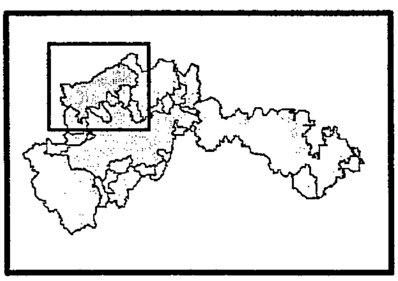
ENGINEERING DESIGN

5.3 AQUATIC ECOSYSTEM RESTORATION

Upon review of existing models, plans, studies and reports, this area of Federal Interest holds the most promise for the Federal Feasibility study. As was stated earlier in this report, the MCWD holds most of the information required to take these types of projects into either local feasibility reports or designs aside of the Federal Project requirements in planning guidance 1105. As is correctly noted in the H&HPLS model report, the Upper Watershed of Lake Minnetonka is inextricably connected to the Lower Watershed of Minnehaha Creek. This report attempts to summarize the Aquatic Ecosystem Projects accordingly.

5.3.1 UPPER WATERSHED

1. **Painters Creek and Six Mile Creek Restorations**
   Both projects involve the restoration of Painters and Six Mile Creeks and their tributaries that have been impacted by channelization and ditching to "natural" creek systems with associated wetlands and riparian habitats. They also involve the additional needs of water quality monitoring, precipitation information and identification of wetlands that are sources and sinks of phosphorous and other nutrients. Potential benefits of restoration of these creek systems include: restoration of "natural hydrograph, water quality improvements and creation and restoration of a more biologically diverse habitat with native plant species." Both projects will require a NEPA review of social costs, historic and cultural review, hazardous waste review, wetland delineations, soil borings, structural review, landscape architect review and habitat assessments, NED and NER calculations and other Federal reviews (i.e. ability to pay) as outlined in the GANTT charts.



Flow Direction

Subwatershed Boundaries

Major Watershed Boundary

Streams

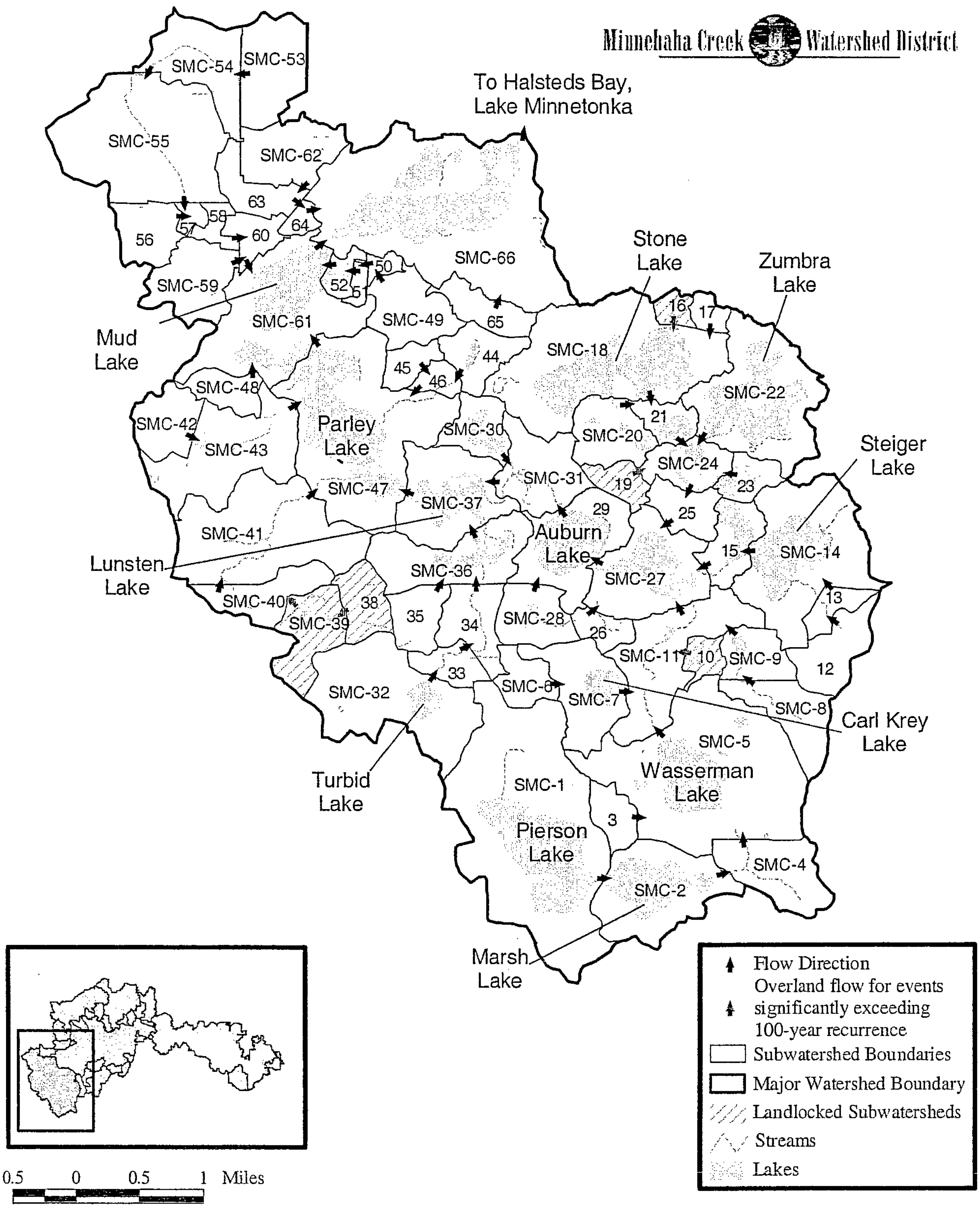
Lakes

0.5 0 0.5 1 Miles

EMMONS & OLIVIER RESOURCES

N

Painter Creek Watershed
Flow Direction



EMMONS & OLIVIER RESOURCES

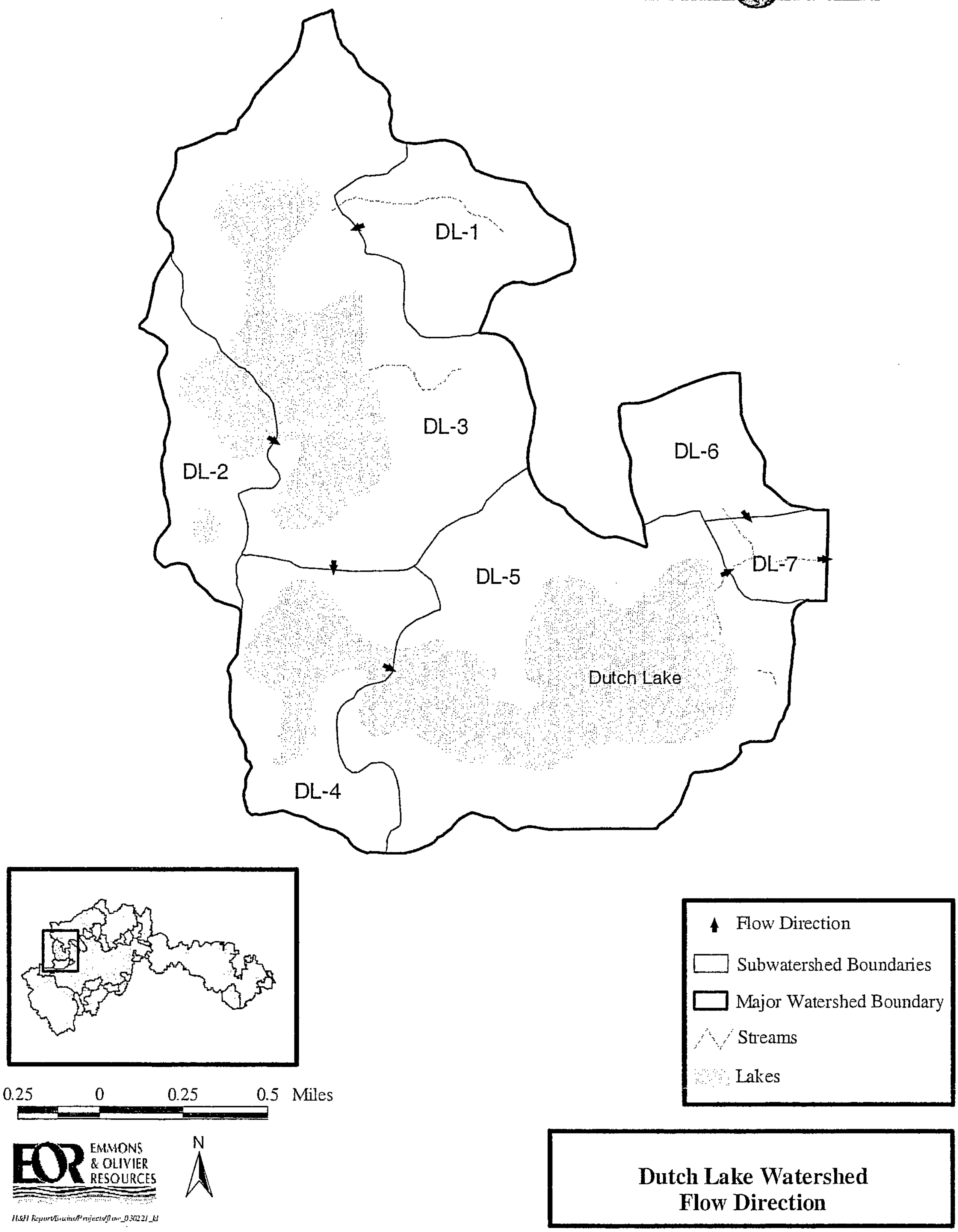
H&H Report/Basins/Projects/flow_030516_kl

Six Mile Creek Watershed Flow Direction

2. Dutch Lake, Langdon Lake, Long Lake, Gleason Lake, Schutz Lake and Christmas Lake Enhancement and Restoration Programs

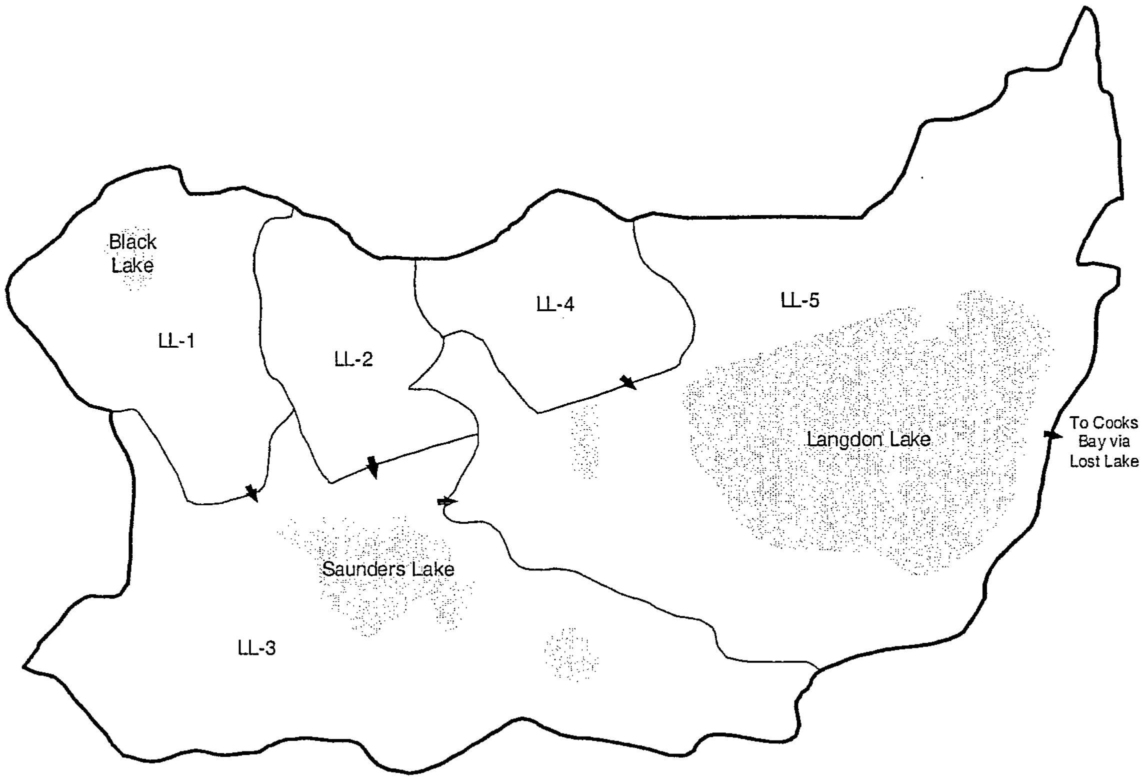
These projects involve the additional needs of water quality monitoring, precipitation information and identification of wetlands that are sources and sinks of phosphorous and other nutrients. Potential benefits of restoration include: restoration of "natural hydrograph, water quality improvements and creation and restoration of a more biologically diverse habitat with native plant species." These projects will require a NEPA review of social costs, historic and cultural review, hazardous waste, wetland delineations, tile and ditch inventories, assessment of drainage structures, soil borings, structural review, landscape architect review and habitat assessments, NED and NER calculations and other Federal reviews as outlined in the GANTT charts.

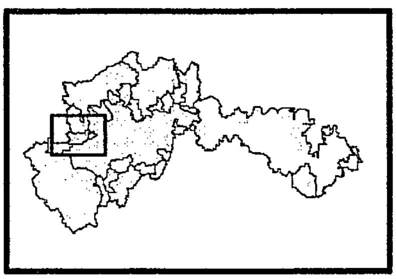
Minnehaha Creek Watershed District



EMMONS & OLIVIER RESOURCES

Dutch Lake Watershed
Flow Direction





0.25 0 0.25 Miles

EMMONS & OLIVIER RESOURCES

N

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- Flow Direction
- Subwatershed Boundaries
- Major Watershed Boundary
- Streams
- Lakes

Langdon Lake Watershed Flow Direction

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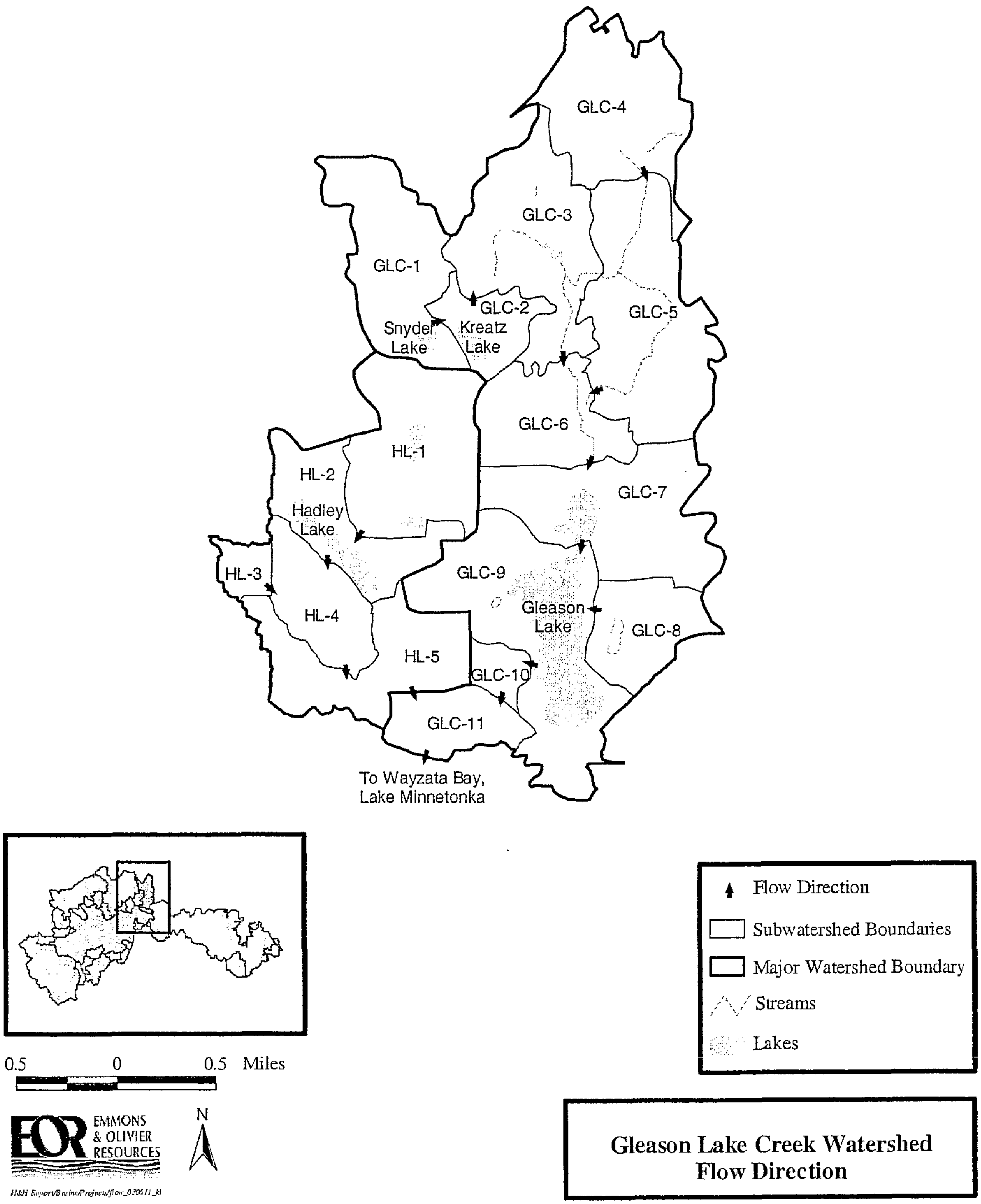
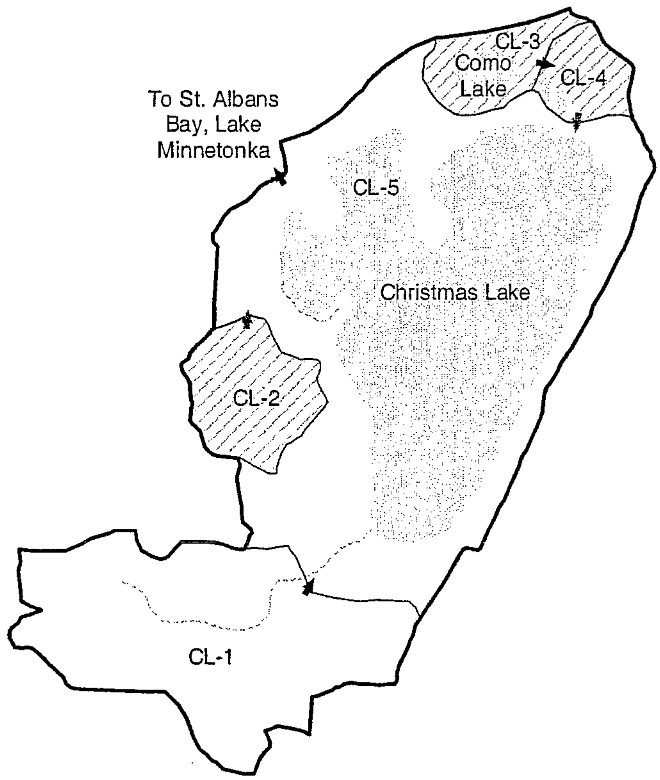
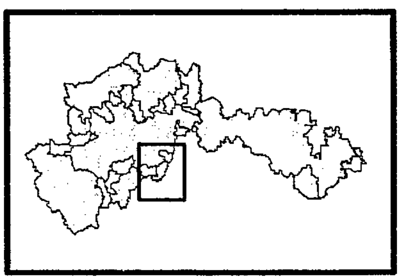
Long Lake Creek Watershed Flow Direction

Minnehaha Creek Watershed District



Gleason Lake Creek Watershed Flow Direction





0.25 0 0.25 0.5 Miles

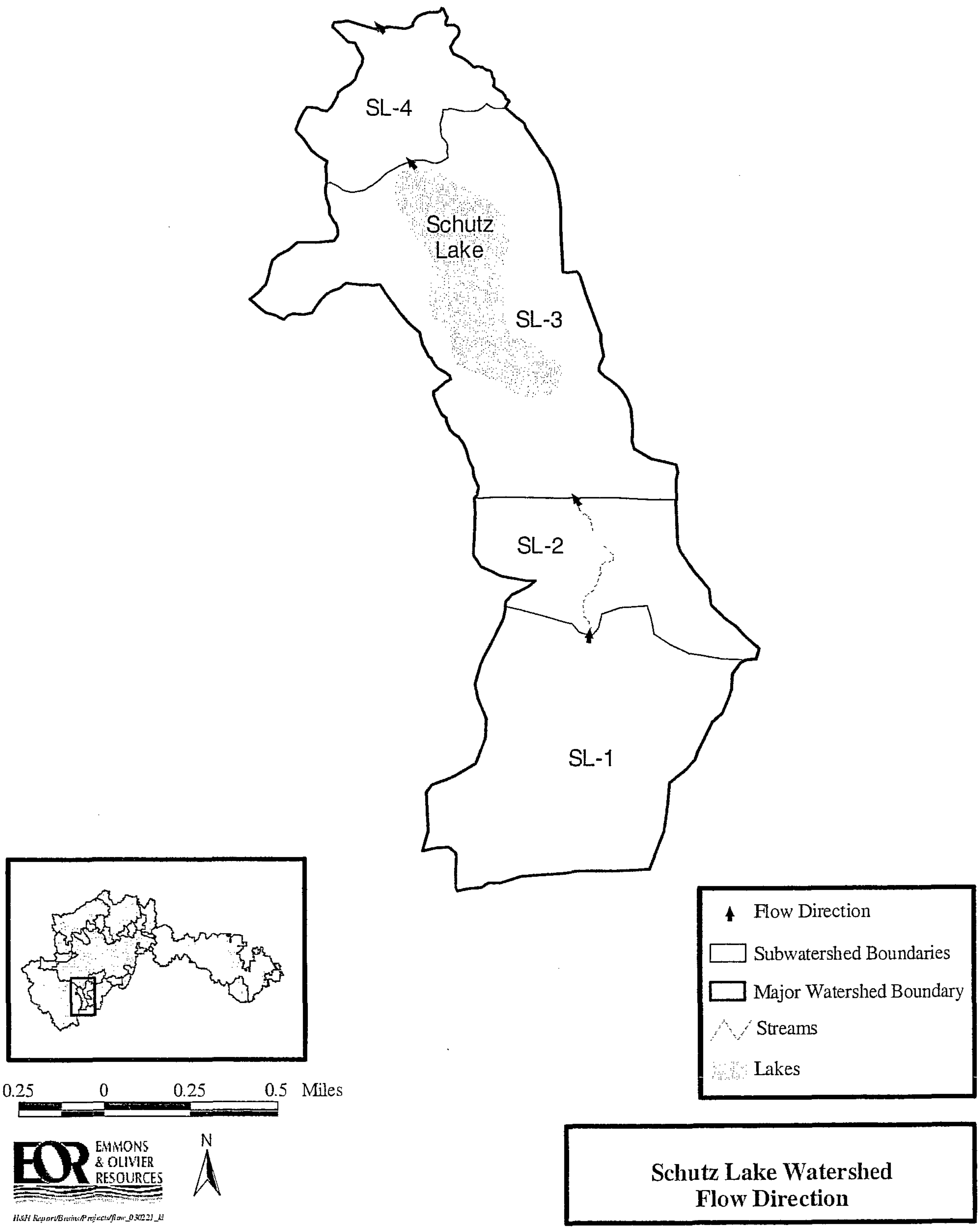
EMMONS & OLIVIER RESOURCES

N

H&H Report/Basins/Projects/flow_030417_kl

↑	Flow Direction
↑	Overland flow for events significantly exceeding 100-year recurrence
	Subwatershed Boundaries
	Major Watershed Boundary
	Landlocked Subwatersheds
	Streams
	Lakes

Christmas Lake Watershed Flow Direction



Schutz Lake Watershed Flow Direction

5.3.2 LAKE MINNETONKA

Completion of an in-lake circulation model and re-evaluation of the Gray's Bay Outlet Dam Operation Plan were both identified as high priority projects by the MCWD contractors. The local interest appears to be in establishing a baseflow in the creek that will better support aquatic life and will increase recreational opportunities. This project should require only a brief review of cultural, hazardous waste, social and economic reviews. The output will likely point to additional watershed projects that may require further Federal NEPA review. However, it is proposed that these modeling efforts be included in a programmatic EA/EIS as a part of this Feasibility Study. The outputs of an in-lake model could be readily used to assess the feasibility of projects in the direct Lake Minnetonka drainage area.

5.3.3 LOWER WATERSHED/MINNEHAHA CREEK

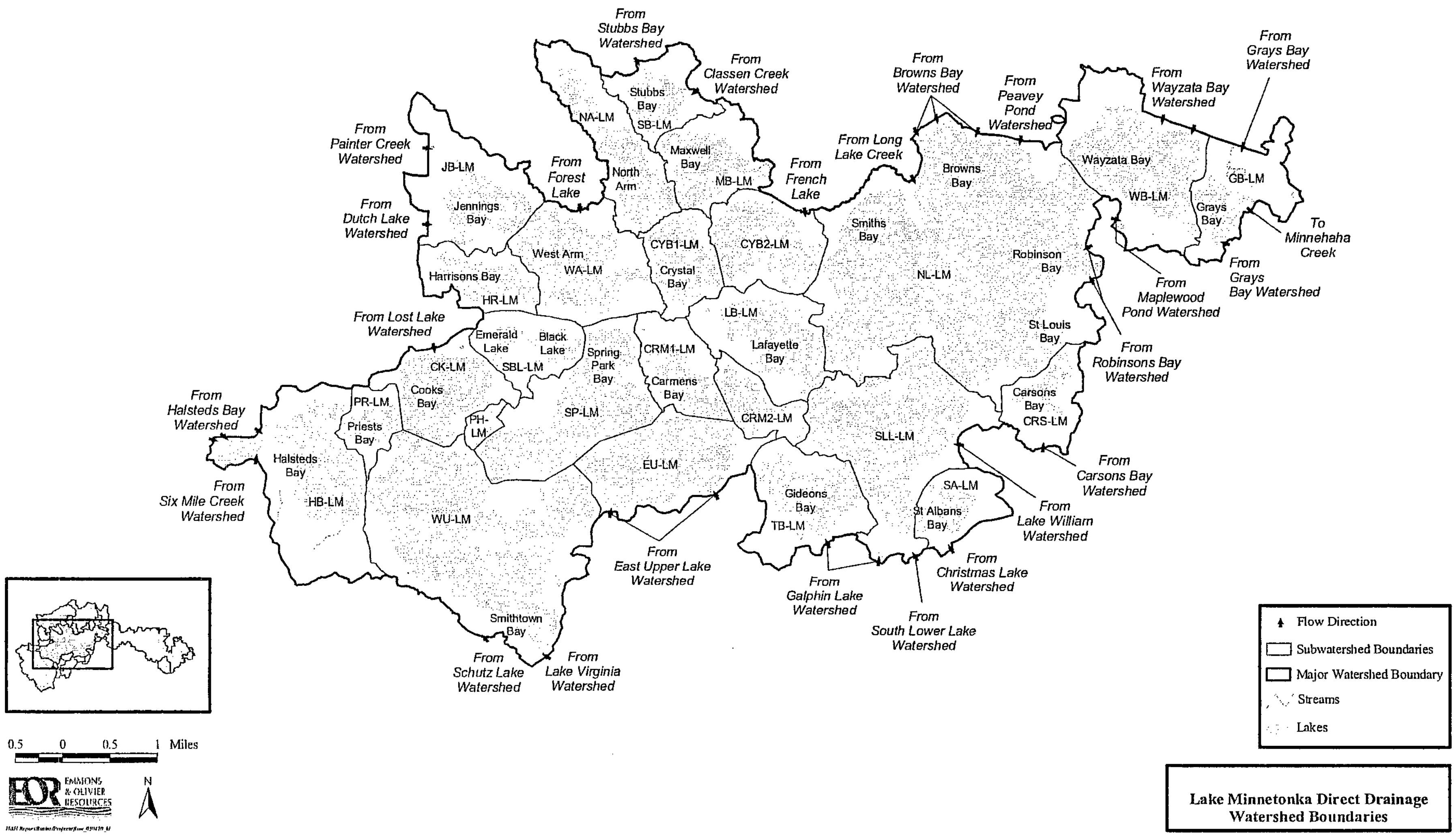
One of the primary reasons the MCWD signed a Federal Cost Sharing Agreement is the pursuit of the restoration of the Minnehaha Creek Corridor from the outlet of the Gray's Bay Dam to the confluence with the Mississippi River. The MCWD and cities all proclaim in their local plans that the preservation and enhancement of this corridor is of the utmost importance to both elected officials and the citizenry of the aforementioned. Activities included are bank stabilization, restoration of a stable base-flow, modifications of storm drains (200+), grit chambers, "green" land use practices, restoration of buffers, recreational trails, connectivity from the "Chain of Lakes" to "Grays Bay", infiltration and ground water sources and sinks, FEMA flood plain mapping and flood damage reduction. This aspect of the Feasibility Study is already in the preliminary phases of design based on sound engineering principles. Additional cultural resources, hazardous-toxic waste phase one assessments and public inputs, NED and NER assessments, soil borings and delineations are the primary missing elements to the proposed Feasibility Study. An additional area of study and development was recommended by the Education and Community Assessment Report and by HDR and that is the development of a TAC/CAC process for the creek corridor.

5.3.4 MULTI-PURPOSE PROJECTS

See Aquatic Ecosystem Restoration.

5.3.5 WATERSHED PLANNING AND MODELING

The MCWD has completed an incredible round of modeling, planning and project preparation. While the H&HPSL and other assessments offer a wide arrange of recommended projects and



Lake Minnetonka Direct Drainage Watershed Boundaries

data, they still have "short-comings" that have been addressed in the External Review/Recommendation Sections of this report. Based on review of all available information, there are several areas of watershed modeling and planning that the Corps should include in the Feasibility Study including:

1. **Lake Minnetonka Circulation Model**
   The lake appears to be an incredible natural filter and assimilant of pollutant loading. However, the western bays of the lake are clearly stressed and not of acceptable quality to local residents. A comprehensive model of sources of loadings, pollutants, and the alternatives of dredging, watershed treatments, ground water inflows and exits and land use changes needs to be completed as a part of this feasibility study. It is recommended that this model be completed as a part of this Feasibility Study. The H&HPLS model and other External Reviews/Recommendations indicate the additional data necessary to complete this Task.

2. **Minnehaha Creek Watershed Model**
   The H&HPSL Model provides a very sound foundation for the MCWD and its quest for watershed information. However, little is understood about the exchanges of surface water and ground water and historic, existing and future base flows within the creek. A model that ties all of these elements together, such as the Corps Geisha Model, is a recommended Watershed Planning study. The review of existing planning studies, models and reports indicates that most of the necessary data for this model exists, however, additional precipitation and water quality monitoring are necessary for a truly accurate watershed model.

5.4 PAINTERS CREEK AND JENNINGS BAY

One of the most complete and project ready reports that HDR reviewed is the Painters Creek/Jennings Bay Feasibility Study. This study, commissioned by the MCWD in 2003, involved an extensive soils chemistry data collection effort, field sampling and summarization of findings. It is recommended that the Corps, in accordance with the request of the MCWD, carry this study forward into the AFB process.

5.4.1 SUMMARY OF PAINTERS CREEK STUDY

The degraded water quality condition of Jennings Bay has resulted from several contributing factors, including dramatic alteration of contributing watershed hydrology, removal of many wetlands and floodplain areas from effective hydrologic contact with water running off of the watershed, and input of wastewater effluent for over 30 years. The Minnehaha Creek Watershed District (MCWD) has recognized the problem linkage and undertaken this *Painter Creek Feasibility Study (PCFS)* to assess the methods available to restore good water quality to Jennings Bay and its tributary area, with primary emphasis on the Painter Creek watershed.

Achieving improved water quality for Jennings Bay (Bay) depends on many factors. The inflow of water from Painter Creek, Dutch Lake Creek and the area directly surrounding the Bay, atmospheric fallout, and the nutrient-rich deposits on the bottom of the Bay all contribute to the water quality problem. Figure 1.1 illustrates Jennings Bay and the area draining to it, along with the communities in the drainage area. Figure 1.2 shows the sub-watersheds within the Painter Creek watershed.

The *Painter Creek Feasibility Study (PCFS)* was initiated by the Minnehaha Creek Watershed District (MCWD) to specifically examine two of the major contributors - Painter Creek and the Bay sediment. Years of data collection and many small projects within the watershed have not answered the question of wetland nutrient behavior to everyone's satisfaction. Speculation on the success of chemically treating the Bay sediments has not to-date resulted in a chemical application project. Clearly, MCWD wants to end the speculation and begin action to improve the water quality of the Bay.

The *PCFS* includes study elements that address many different facets of an action plan. Chapter 2 begins with an evaluation of the institutional measures that are currently in place and used by the MCWD and its partners to manage water within the Painter Creek watershed. The study examines the governance structure, its successes and the recommended changes that would make it more effective. This assessment is critical because many of the assumptions for future development within the watershed that were developed as part of the MCWD's *Hydrologic, Hydraulic and Pollutant Load Study* (*HHPLS*, MCWD, 2003) rely on holding current pollution loads as a base level. That is, it is hoped that development will not increase current loads any further, and that implementation of corrective watershed projects will in fact decrease loads. This chapter also includes a summary of the public input process that was used during the *PCFS*.

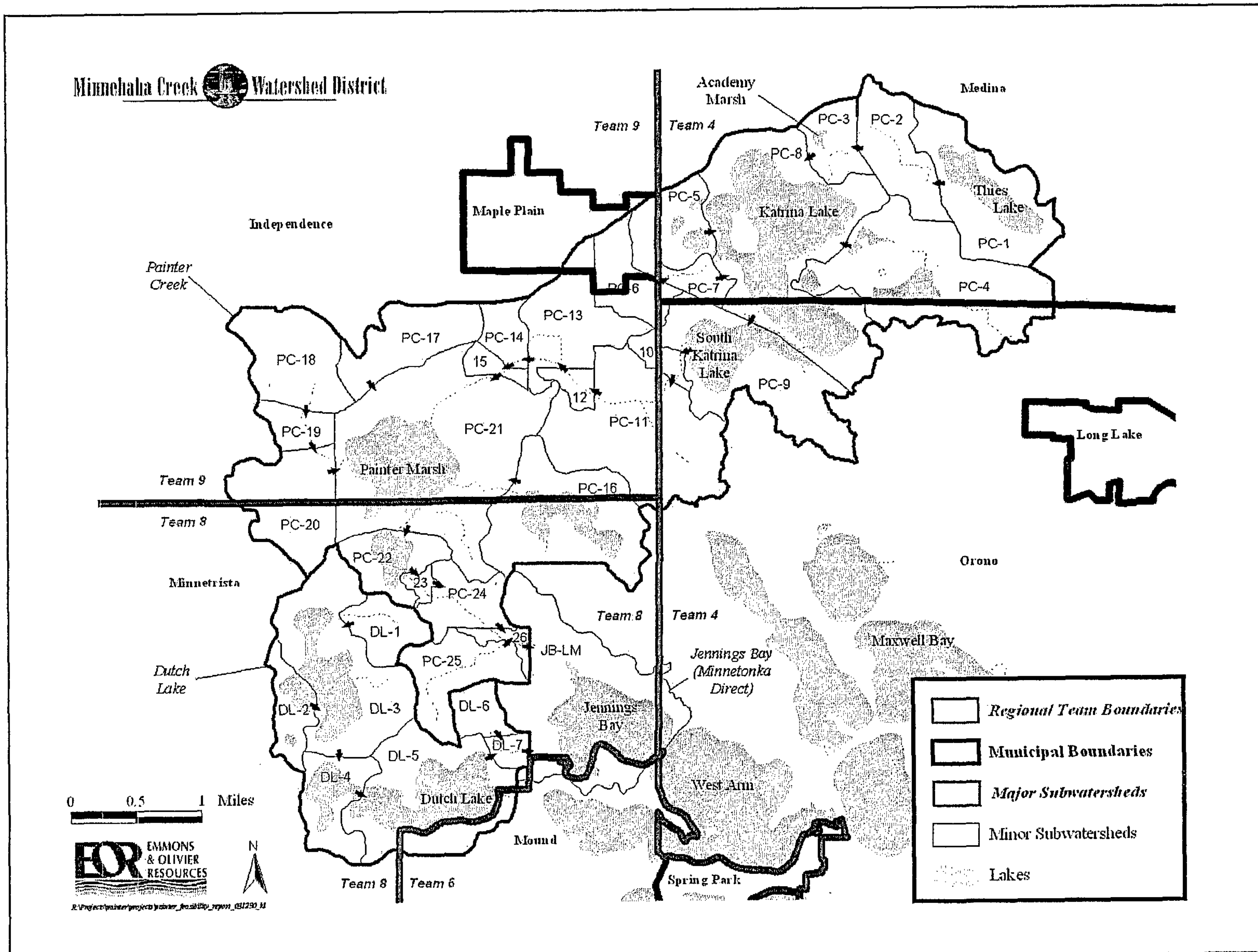
An analysis of the institutional and regulatory tools available to the MCWD has shown that it has all of the available authority it needs to implement effective water management within the District. However, MCWD realizes that it cannot act alone in the watershed. To be successful in properly managing water, the District needs to cooperate with the many municipalities, government agencies, and landowners within the watershed. Joint ventures, shared financial and technical responsibility, and exchange of information and data will be needed to achieve the goals of clean water within the watershed and Jennings Bay. Special emphasis is needed in the future in the sharing of technical information and educational programs with communities within the watershed. Suggestions for program modifications include improving stormwater management coordination with communities, determining wetland functions and roles, and planning corridor development.

The key to successful water management in the future is a collaborative approach, with all affected parties working together to achieve a common goal. Success within the watershed can then be claimed when the goal is achieved. Chapter 3 of this study examines the various goal statements that have been made in the past for the watershed and the Bay and proposes a level agreed upon through input of many parties in the *PCFS* Project Steering Committee. For Jennings Bay, the goal recommended by this study 60 μg/L of total phosphorus as a summertime average near the surface of the bay.

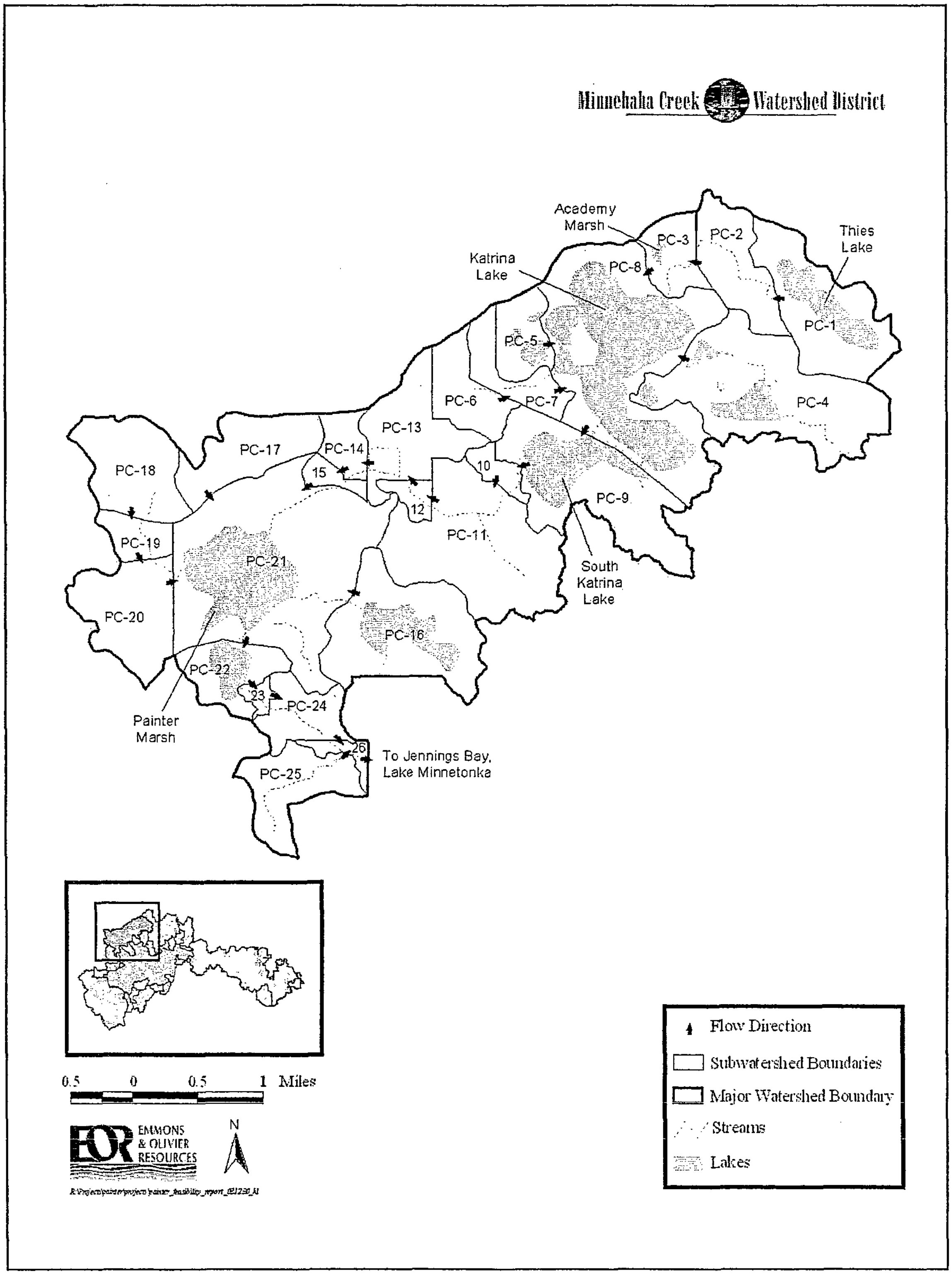
Because of the dramatic hydrologic change that was introduced to the Painter Creek watershed, it seems logical as a first step to try to re-establish contact between the runoff and the soil that was lost when the watershed was largely ditched in the early 1900s. The restoration of a watershed corridor, wetland hydro-period, floodplain/shoreland functions and a meandering channel all are integral parts of a low-cost water quality improvement program. Repair of erosion problems within and tributary to Painter Creek, and mitigation of urban runoff from Maple Plain are also needed to address existing nonpoint sources of pollution. The means to accomplish all of these remedial measures is addressed I the remainder of the report.

Chapter 4 begins the assessment of the role of wetlands in maintaining the integrity of water quality within the watershed. There has been much speculation in the past about whether the large number of wetlands in the watershed help water quality or possibly contribute to its degradation. The "source versus sink" debate for phosphorus clearly needed some in-depth evaluation. The assistance of a member of the MCWD "Expert Panel" convened under the Value Methodology effort of early 2002 was sought to assist the study team in its effort to address this long-standing question. Wetlands with potential to hold more phosphorus, as well as those with a potential to contribute stored phosphorus were identified, and a management program recommended to take advantage of new information on the wetlands.

Jennings Bay Drainage Area, Cities and HHPLS Regional Team Boundaries



Painter Creek Sub-Watersheds



As a result of examining wetland soils, a recommendation is made to re-establish contact between the runoff and the soil that was lost when the watershed was largely ditched in the early 1900s. The restoration of a watershed corridor that would allow such contact, as well as floodplain/shoreland and meandering channel restoration, are the hallmarks of what can potentially be a low-cost water quality improvement program.

Runoff from the City of Maple Plain has been suspected to contribute to water quality problems in Katrina Lake and to severe erosion problems south of the city as the runoff drains down a steep grade to Painter Creek. An assessment of these problems and the role of Maple Plain runoff in Chapter 5 has led to a number of suggested remedial actions that would detain the runoff to the east and south, and repair the erosion and rehabilitate the receiving wetland south of the city.

Chapter 6 of this report explores the basic water quality of the watershed from existing Hydro-Data information and proposes a management approach based on water quality improvements that are expected from improved BMP application and wetland treatment.

The operation of a wastewater treatment plant in Maple Plain from 1951-1986 had a tremendous impact on Jennings Bay and perhaps more of Lake Minnetonka. The Maple Plain plant was one of seven plants draining effluent to Lake Minnetonka during the middle part of the last century. Fortunately, the impacts of these discharges on the lake were realized and eventually all of the wastewater effluent was diverted. However, remnant phosphorus from the wastewater still sits on the bottom of Jennings Bay and exerts a negative impact via release during anaerobic conditions that are typical during the hot summer months. Because the load of phosphorus is so large, the only feasible method to reduce its impact is the application of alum (aluminum sulfate) to chemically tie the phosphorus up in an aluminum complex. Recommendations for the amount of alum to be added and the method for doing so are made in Chapter 7 of this report.

The success of any of the management recommendations made within this report cannot be quantified without a comprehensive data collection program. The current hydro-data monitoring program of the MCWD is assessed to see if it can accomplish proper quantification. The location of stations and the type of information collected is examined and suggestions for improvement made in Chapter 8.

It becomes apparent in examining Painter Creek and Jennings Bay that the *PCFS* and past efforts do not necessarily address all of the possible improvements that are needed. Chapter 9 lists some additional recommended tasks that should be undertaken to help understand the system and improve it.

The final chapter (Chapter 10) concludes the report with a summary of the findings and a list of the recommendations.

5.4.2 FINDINGS OF THE JENNINGS BAY/PAINTERS CREEK REPORT

1) The inflow of water from Painter Creek, Dutch Lake Creek and the area directly surrounding the Bay, atmospheric fallout, and the nutrient-rich deposits on the bottom of the Bay all contribute to the water quality problem.

2) It is a basic premise of this study that development will not increase loads over the current base level any further, and that implementation of corrective watershed projects will in fact decrease loads.

3) Although sufficient institutional and regulatory authority exist with the MCWD, to be successful in properly managing water, the District needs to cooperate with the many municipalities, government agencies, and landowners. Joint ventures, shared financial and technical responsibility, and exchange of information and data will be needed to achieve the goals of clean water within the watershed and Jennings Bay. More participatory input to District programs is needed from communities.

4) Runoff from the City of Maple Plain contributes to water quality problems in Katrina Lake and to severe erosion problems south of the city as the runoff drains down a steep grade to Painter Creek.

5) Because the load of phosphorus in Jennings Bay sediment is so large, the only feasible method to reduce its impact is the application of alum (aluminum sulfate) to chemically tie the phosphorus up in an aluminum complex.

6) The success of any of the management recommendations made within this report cannot be quantified without a comprehensive data collection program.

7) A greenway/corridor approach is desirable if funding is available: partnerships for funding should be pursued with state and federal agencies to supplement the District's wetland restoration fund.

8) The best way to assure coordination of District and community water management is to coordinate through the planning process. However, the Local Surface Water Management Plan adoption process is not complete in the MCWD because two adjacent watershed organizations have not yet adopted a second generation watershed plan. Communities have two years after such adoption to adopt their local plan under the watershed framework.

9) The MCWD Board of Managers has budgeted a significant amount of money specifically dedicated to a land preservation/wetland restoration program for the District. The money will be used to provide incentives to landowners to voluntarily place land in a conservation easement, purchase easements or land, perform restoration projects, and potentially hire a full-time staff person to manage the conservation program.

10) The VM Expert Panel recommended that the MCWD pursue a program to achieve the 60 μg/L level through a watershed load reduction of 25% and a reduction in in-lake internal load of 70% obtainable by an alum treatment. Review of this goal by the public has been generally supported, and even strengthened to 50 μg/L.

11) The PLOAD model was re-calibrated for average conditions to reflect the monitored watershed load from 1996-2002. This updates the *HHPLS* model that was calibrated without the recent data.

12) Public input and Board direction in undertaking the *PCFS* indicate that better use of such natural drainage features as wetlands, floodplains, and green corridors should be pursued. The cost of a natural treatment approach versus many of the structural alternatives available is far less, and could be incorporated into local regulatory and conservation programs. The approach that is proposed is restorative to the condition that used to exist in the watershed.

13) Approximately 30% of the watershed is covered in wetlands and/or standing water, with hydric soils. This acreage has been largely removed from hydrologic contact by ditching and drainage projects.

14) A wetland soil sampling program conducted in response to a VM Expert Panel recommendation indicates that the wetlands in the Painter Creek watershed might hold enough phosphorus to be an integral part of the management solution for reducing the watershed TP load.

15) Detailed wetland soil sampling coordinated with Professor Curtis Richardson (of the VM Expert Panel) at the Duke University Wetland Center found that:

- Several wetlands have the high P sorption capacities;
- The soil properties that best predicted the variability in P sorption are SOM, and Caex, which can be also used as a predictive tool for other, less detailed soil samples;
- The P fractionation data indicate that accretion of organic P (deposition of peat material) is the dominant long-term P storage process, with organic P comprising greater than 60% of the total soil P for each of the 15 detailed cores;
- The high relative pH (all above 6.3) and Ca content of the soils in the wetlands favors the binding of P to Ca, which in turn bonds to negatively charged organic matter and forms an organo-metallic P complex that is likely responsible for initially grabbing P and enabling it to become part of the permanently bound peat. This process is independent of oxygen conditions and will not easily reverse under anoxic conditions;
- Water from the ditches and incised streams could be improved by routing it through wetlands with the highest P sorption potential; and
- Further information that would be informative to the processes involved include soils analysis throughout these wetlands to make sure adequate soils exist throughout, an assessment of the P loads entering the wetlands to see if they will

remove sufficient P from the watershed (see next section), and implementation of a system to transport water across the surface of the wetlands to maximize P removal.

16) Public input during the *HHPLS* identified erosion problems in a tributary of Painter Creek south of Maple Plain. The problem resulted in stream down-cutting and under-cut banks, mass failures of the streambank, overturned trees, deposition of sediment from the bank erosion in the downstream channel and prevention of free flow in the channel causing water to back up onto adjacent property. Erosion problems in this sub-watershed were also identified on two County Roads. The degradation observed in this tributary likely started due to the changes that occurred several decades ago when the area was converted to agricultural land, as well as the other land use changes that have occurred since then. The stream is adjusting to the changes in flow and sediment supplied to the stream from the watershed by down-cutting and widening.

17) Predicting "normal" behavior in Painter Creek is a major challenge because of the extreme variability that occurs in the watershed. The median runoff value from recent watershed runoff data is 6.9 inches

18) The loading data presented for 2002 and 2003 reflect two very wet years, which cannot be considered "normal". Unfortunately, they are the only two years with good Creek data from north to south through the drainage system. The behavioral patterns seen in the data can offer clues to system function during wet years, presumably when "worst case" conditions occur.

19) Phosphorus load does typically increase as Painter Creek passes through Painter Marsh. Sources of this increase potentially include runoff from another approximately 3,500 acres of land, flushing of material from the ditches draining the marsh, and open cattle (about 100) access to the creek and marsh. Management proposals to address this focus on limiting cattle access, watershed runoff management, and flow spreading over the wetland soils to take advantage of its potential phosphorus sorption capacity.

20) The two important nutrient sources that impact water quality in Jennings Bay are external watershed load and internal load from bottom sediments. A control program

for both sources will be needed to effectively improve bay quality. Other factors to consider include inter-bay circulation and atmospheric inputs. Extending internal loading control to West Arm and Harrisons Bay could help reduce the inter-bay load.

21) "Severe nuisance" and "very severe nuisance" Jennings Bay conditions will drop from about current levels of about 90% of the time to about 30% with a shift from the current 100+ μg/L TP to an improved condition of 60 μg/L TP.

22) Factors that need to be considered in implementing a monitoring program and establishing water quality goals, both for Painter Creek and for Jennings Bay, include:

- Documentation of extreme events
- Variable (drought, average and wet) conditions
- Relationship of probabilities and recurrence intervals to goals

23) Monitoring establishes the extent of the problem, provides information to implement solutions, provides credible information that those efforts are effective, and provides for the detection of trends in water quality.

5.5 RECOMMENDATIONS FOR ACTION

1) Contact between the runoff and the soil of many wetlands that was lost when the watershed was largely ditched in the early 1900s should be re-established through a combination of floodplain and corridor restoration, flow spreading, and hydro-period re-introduction.

2) Suggestions for governance program modifications include improving stormwater management interaction with communities, determining wetland functions and roles, and planning corridor development. Also, it was noted that more staff may be needed to perform site inspections to see if conditions of each permit are being met and that communities need continued technical and educational information from the District.

3) In those communities where Local Surface Water Management Plans have not been completed, the local processes contained within Table 2.1 should be used to coordinate water management activities between the District and communities.

4) The MCWD should continue to provide incentives for land preservation/wetland restoration programs.

5) The MCWD should work with communities to establish stringent requirements for infiltration and changes in land use ordinances for new development and redevelopment. It should also consider changes to its permit program that would provide incentives to protect high quality wetlands and habitats while still providing permitting flexibility when dealing with heavily altered habitats.

6) The MCWD should consider using the results of the *HHPLS* models, along with a modified Hydro-Data monitoring program, to begin to prioritize projects based on removal and treatment efficiencies, overall contributions to watershed load reductions and cost per treatment unit.

7) The water quality goal for Jennings Bay should be 60 μg/L for an interim goal, improving to 50 μg/L once the interim goal is achieved.

8) Water from the ditches and incised streams should be routed through wetlands with the highest P sorption potential.

9) A program for restoration of an eroded channel draining to Painter Creek south of Maple Plain should be undertaken at an estimated cost of about $35,400, with the following components:

- Channel debris removal
- Bank toe stabilization
- Bank slope restoration
- Vegetation restoration above the bank-full elevation
- Cross-vane installation at areas were severe bank erosion is occurring

- ❖ Riprap installation to stabilize areas where the tile outlets discharge, as well as where any surface drainage outlets enter the channel
- ❖ Replacement of tile outlets susceptible to breakage

10) Long-term runoff management for the area above should be addressed to include improved detention of runoff from Maple Plain prior to the erosive channel and removal of eroded material from the receiving wetland. Costs for these two items are estimated in the $60,000-100,000 range.

11) County Road 19 ditch repairs should be implemented by Hennepin County.

12) Prior to, or concurrent with, undertaking any construction projects, several actions were recommended as an outcome of the *HHPLS* and VM Expert Panel discussions. Following is a list of those actions:

    - ❖ The installation of a fish gate to control carp in-migration at the mouth of the creek, which should be followed in turn by monitoring natural carp eradication prior to any further efforts at control;
    - ❖ Retrofit of BMP sites identified in Table 6.4 should be exploited when the opportunity is presented;
    - ❖ Guidance for low- and medium-density "Development BMP" suites for BMP recommendations in Table 6.4 should be prepared;
    - ❖ Channel erosion reaches in the watershed should be identified and prioritized in order of control implementation; and
    - ❖ Water quality monitoring needs should be identified to best characterize load behavior as the creek flows through the sub-basin (see Chapter 8).

13) External load reduction to Jennings Bay from Painter Creek sufficient to improve bay water quality can be achieved through a management program that focuses on wetland (hydro-period), floodplain and corridor restoration, control of Maple Plain runoff, implementation of effective future development runoff control, and eroded channel repair. The total cost of this program is estimated at about $2.9 million spread over a period of about 15 years (about 2020).

14) An alum dose for Jennings Bay was determined using three different methods. The estimated alum requirement is 1,000 gallons of alum per lake acre, with the treatment to include the West Arm and Harrison's Bay for a total dosing area of 1,083 acres. It is recommended that rather than applying all the alum at once, that it be applied in three treatments over a span of six years. Before the first lake alum dose, Painters Creek phosphorus reduction projects should be implemented. The total cost of the alum application program is estimated at $1,000,000. A cooperative study with the Three Rivers Park District of internal loading in Jennings Bay should be undertaken to better document current internal load.

15) Continuous flow measurement and flow-weighted water quality samples at the mouth of the Painter Creek watershed are essential. The variable nature of this watershed's runoff-response and water quality behavior indicates that a minimum of 15 samples per year and preferably 25 should be sampled over the entire year, including the Spring melt.

16) Some flow-weighted data should be collected at the outflow of Dutch Lake Creek to document, at least for a period of time, its input to Jennings Bay. Each continuous flow monitoring location should be accompanied by an auto-sampler for flow-weighted water quality data collection.

17) Both the HHPLS and the VM Expert Panel recognized the importance of good intra-lake circulation data to assess water quality in Jennings Bay and the rest of Lake Minnetonka. It is recommended that this type of monitoring be considered as part of the 2004 monitoring effort, possibly as part of the cooperative Three Rivers Park District/MCWD study of internal loading in Jennings Bay, since the inflow or outflow of TP via circulatory patterns is part of the internal load behavior.

18) The MCWD should participate in the development of a comprehensive BATHTUB model for Lake Minnetonka.

19) Focused wetland data collection should begin so that a reliable database on wetland roles in phosphorus reduction can be built once a management program is implemented.

20) Future efforts should be undertaken to address the following needs:

- Carp reduction
- Management of nuisance macrophytes (weeds)
- Circulation within Jennings Bay and its relationship to Lake Minnetonka
- Internal sediment loading
- Additional phosphorus control options if those proposed do not result in the desired load reductions
- Assessment of the impact of wetland treatment practices on biota

Note: As part of the H&HPLS, Appendix G – Painters Creek Optimum Approach, provides a recommended approach to achieve TP reduction in the Painter Creek Watershed.

5.6 SIX MILE CREEK

5.6.1 DESCRIPTION

The Six Mile Creek watershed is one of the more complex watersheds within the MCWD. It is located along the southwestern boundary of the MCWD and within the cities of Minnetrista, St. Bonifacius, and Victoria, Laketown Township, and Watertown Township (Figure IV.D.1-1).

The watershed is approximately 17,000 acres in size (about 27 sq. miles), and includes 66 subwatershed units. Approximately 3,600 acres (~21% of the watershed) are made up of lake and wetland surfaces, which significantly affect the hydrology and water quality behavior of water within the basin.

Lake Pierson, in the southern portion of the watershed, forms the headwaters of Six Mile Creek, which snakes its way north and west through a series of lakes and wetlands before flowing into Halsteds Bay of Lake Minnetonka. Despite its name, Six Mile Creek is approximately 11 miles long from the outlet of Lake Pierson to Halsteds Bay.

The dominant drainage direction of the creek is a northerly direction towards Lake Minnetonka. Pierson Lake, the first in a series of lakes, flows into Marsh Lake and then into Lake Wasserman. Passing through Wasserman, Six Mile Creek flows through a large unnamed wetland, which is also fed by Church Lake and Carl Krey Lake, before flowing into the eastern lobe of Auburn

Lake. Also tributary to the eastern lobe of Auburn is Steiger Lake from the east, and Stone, Zumbra and Sunny Lakes from the northeast. From the eastern lobe of Auburn Lake, flow passes through a shallow constriction into the western lobe of Auburn Lake, then through a series of small wetlands (also referred to as the Valley Watershed in the Carver Park Reserve Water Management Plan) before dropping six feet in elevation to the controlled normal water elevation of Lunsten Lake. Very low grade exists between the Zumbra/Sunny Lake system and the controlling rip-rap weir outletting the Valley Watershed wetlands downstream of Auburn.

The Lunsten Lake outlet represents the second significant control point of Six Mile Creek. In addition to the main stem of Six Mile Creek, Lunsten Lake receives tributary discharge from the Turbid Lake system to its south. The outlet of Lunsten Lake is controlled by a concrete weir structure that delivers discharge to Parley Lake (SMC-47) approximately 4.6 feet in elevation beneath Lunsten Lake. This elevation drop can vary slightly, depending on the elevation of Lake Minnetonka, which can influence the water elevations in the entire lower stretch of Six Mile Creek.

The lower stretch of Six Mile Creek flows through Parley Lake, into Mud Lake, and then through a large wetland (essentially part of Lake Minnetonka) before emptying into the open water portion of Halsteds Bay of Lake Minnetonka. The channel elevation of Six Mile Creek connecting Parley, Mud and Halsteds is lower than the average water elevation of Lake Minnetonka. For this reason, water surface elevations in Lake Minnetonka can have a significant influence on the elevations of Parley and Mud Lakes. Tributary to Mud Lake is drainage from the southern portion of the City of Minnetrista and a large portion of St. Bonifacius.

Land use throughout the watershed is primarily agricultural (about 25%). Residential and commercial land uses within this watershed are primarily confined to the cities of St. Bonifacius and Victoria. Wetlands, forests, woodlands, and grasslands together make up approximately 40% of the landscape. "Natural" areas are primarily confined to the area of Carver Park Reserve (surrounding Lakes Steiger, Auburn, Lunsten, and parts of Zumbra).

Following the same pattern as other developing areas within the MCWD, the biggest percent decreases in 2020 land use are expected for agricultural land and forests/woodlands categories.

The hydrology of the Six Mile Creek watershed contains a few areas of urban development, but is dominated by expansive wetlands, lakes, undeveloped park land and rural areas. Areas of urban residential development include the City of Victoria, City of St. Bonifacius and along the Hwy 7 corridor. The highest density landscape exists in the downtown districts of Victoria and St. Bonifacius. As development proceeds, more parts of the watershed will deliver increasing amounts of runoff. The greatest increases in impervious surfaces are generally predicted to occur in the subwatersheds in and around the Cities of Victoria, St. Bonifacius and parts of Minnetrista along the Hwy 7 corridor.

As Six Mile Creek develops, an opportunity exists not only to protect and maintain resource status, but to make improvements to existing problem areas such as drainage restrictions along Hwy 7 south of St. Bonifacius and water quality problems in Halsteds Bay. The greatest potential for bay improvement exists in areas draining into the lower reaches of Six Mile Creek.

5.6.2 Issue and Recommendation Summary

Some water quantity related problems are expected to result from the development occurring within the watershed. Areas of the watershed predicted to have a more significant impact on water resources resulting from 2020 land use changes include areas in the City of Victoria and along the Hwy 7 corridor. For example, a wetland located in subwatershed SMC-54 on the northern most tip of the watershed is expected to see high water levels increase 0.5 feet for the 100-year storm event, and high water levels in wetlands on the eastern side of the City of Victoria are predicted to increase 0.3-0.4 feet. Several other predicted HWL increases along the Hwy 7 corridor include wetlands showing modeled increases of 0.3 feet. These wetlands contribute to Mud Lake, which is the last of the Six Mile Creek lakes prior to discharge into Halsteds Bay.

Additional impacts to Six Mile Creek include increased erosion and scour potential due to additional discharge and increased velocities associated with 2020 land use changes. An overall increase of about 30 cfs for the 100-year storm event is predicted to discharge into Halsteds Bay by 2020. Many other areas will experience local increases of 10 cfs or greater. Special efforts to minimize sediment transport, especially in the lower reaches of Six Mile Creek, are warranted to avoid exacerbating existing problems in Halsteds Bay.

The Carver Park Reserve represents approximately 25% of the area contributing to Six Mile Creek and ultimately to Halsteds Bay. As such, the District should make collaboration with the Carver Park Reserve a priority. The District could, in collaboration with the Park Management, play a key role in facilitating the development of an up-to-date and more structured water management plan that integrates multiple objectives of the park, county, cities, residents and District. This is especially needed for flow structure renovation. Other quantity related recommendations include:

- Evaluating the Zumbra/Sunny Lake flow/connection system for flood reduction
- Adopting strong volume control standards in all areas draining to landlocked depressions; using low impact development techniques as these areas develop
- Adopting inlet and outlet erosion control measures or energy dissipation designs for identified erosive areas
- Correcting several local flooding problems before 2020 conditions make them worse

Due to both the size of the watershed and its land uses, pollutant loads from the Six Mile Creek watershed are high, contributing to the high nutrient levels in Halsteds Bay. Overall, 2020 pollutant loads in the watershed are expected to increase by 53%, 26% and 32% for TP, TN and TSS, respectively. The highest TP loads (per unit area) in the Six Mile Creek watershed originate from the urbanized portions of the cities of St. Bonifacius and Victoria. The areas of lowest loading rates are in the mostly undeveloped Carver Park Reserve, located surrounding Steiger Lake, Stone Lake, Auburn Lake, and Lunsten Lake. Phosphorus loads in this area are not predicted to substantially increase by 2020.

The water quality of nine lakes within the watershed was evaluated. The lakes range in TP levels from a low of 39 μg/L for Steiger and Pierson, to a high of 85 μg/L for Parley. Many of the lakes relate to each other because they occur in sequence along the creek path. Lakes Wasserman and Parley are listed as impaired waters on the MPCA 303d list.

RT7 recommended new goals for each of the nine lakes, with five of the lakes suggested more stringent than the 1997 MCWD watershed plan. Specific load reductions needed to achieve the lake goals are documented in Table IV.D.5-4.

The Six Mile Creek watershed is the second largest tributary system draining to Lake Minnetonka, excluding Lake Minnetonka itself. The Six Mile Creek watershed is unique in that it contains thirteen lakes and numerous other smaller lakes and wetlands, all of which are generally interconnected with the creek and its tributaries. The Six Mile Creek watershed is also unique in that it contains the largest area of contiguous agricultural land in the District. The often steep to moderately rolling topography, erodible soils, and extensive network of drainage tiles present special challenges, both for existing agricultural land uses, as well as for future residential development.

Specific recommendations for Six Mile Creek and its lakes and wetlands include:

- Preserving landlocked depressions through strict volume control standards as the watershed area develops
- Expanding water quality monitoring sites along Six Mile Creek
- Conducting a tile and ditch inventory of agricultural land
- Implementing a "green corridor" approach for Six Mile Creek and its major tributaries, in cooperation with willing landowners
- Encouraging the use of agricultural, lakeshore, erosion control and urban BMPs, and providing technical assistance related to them
- Evaluating Tellers Road feedlot and the feasibility of wetland treatment system for
- Pierson Lake
- Implementing boat access shoreland demonstration sites to educate lake residents on shoreline BMPs, including buffers
- Implementing feedlot and pasture management plan for Lake Wasserman
- Undertaking an environmental impact analysis of Six Mile Creek dredging before further consideration is given to this proposal
- Improving the drainage system south of Hwy 7 in St. Bonifacius into Mud Lake
- Installing energy dissipation and erosion control at culverts with high pipe velocities
- Installing and/or protecting lake and wetland buffers, especially on steep slopes and areas where shoreline erosion is occurring
- Stabilizing erosive channel reaches
- Working with the City to Victoria to incorporate effective stormwater management into existing and new development
- Constructing various wetland/treatment pond systems
- Preparing a lake management plan for Mud and Turbid Lakes
- Evaluating the need for Turbid and Lunsten Lake feedlot management
- Partnering with private landowners to implement stormwater improvements
- Developing a Six Mile Creek rough fish management plan
- Updating the Carver Park Reserve stormwater management plan
- Developing a showcase LID development in Laketown Township.

These recommendations emerged out of discussions as part of the Regional Team 7 and Regional Team 8 public involvement process. A complete presentation of the recommendations made for this watershed can be found in *Volume III: Public Involvement, Regional Team 7 and Regional Team 8*. This includes information regarding the priority of each issue, who would be responsible for undertaking each suggested management approach, and a recommendation of when the approach should be undertaken.

5.7 LAKE MINNETONKA

5.7.1 DESCRIPTION

The Lake Minnetonka direct drainage area covers approximately 23,330 acres (about 36.5 square miles). This area includes the surface area of the lake itself (approximately 13,980 acres), which covers a little over half of the total area, as well as that area that drains directly into Lake Minnetonka. It contains portions of Orono, Wayzata, Minnetrista, Minnetonka, Shorewood, Woodland, Mound, Deephaven, Minnetonka Beach, Spring Park, Tonka Bay, Excelsior, and Victoria (Figure IV.J.1-1). The direct drainage area includes 26 subwatershed units (Figure IV.J.1-2).

Surface water (in the form of lakes and bays) covers half the total area in the Lake Minnetonka Direct watershed. In remaining areas, land use is dominated by single family residential. Isolated pockets of forest and woodland are common throughout the watershed, covering slightly more than 10 percent of the upland landscape. Commercial and industrial land uses are concentrated along major transportation corridors such as County Road 15 and State Highway 7. Under 2020 land use conditions, losses are expected to occur in the agricultural land and forest/woodlands categories.

5.7.2 ISSUE AND RECOMMENDATION SUMMARY

The hydrology of the direct drainage watershed is influenced primarily by low lying wetlands around the fringe of Lake Minnetonka, Lake Minnetonka itself, and stormwater runoff into the lake from immediately adjacent areas. The Lake Minnetonka Direct Drainage has, therefore, been modeled as one subwatershed, which is internally divided into two areas – the lake itself and the immediately adjacent drainage areas. No specific flooding or structure overtopping is indicated by the model for this watershed. However, structures adjacent to Lake Minnetonka near the HWLs computed for this study are at risk of flooding when large single or multiple storm events and/or prolonged wet periods occur.

The identification of lakeshore erosion areas was conducted primarily at the Regional Team meetings, when participants were asked to locate any known erosion areas on a map of the area represented. The RT 5 and 6 meetings identified several locations of lakeshore erosion. These locations are detailed in *Volume III. Public Involvement, E. Regional Team 5 (Figure III.E-1), and F. Regional Team 6 (Figure III.F-1).* This does not necessarily mean that these are the only erosive locations in Lake Minnetonka; rather, it indicates that the regional team members have only seen these specific problems.

The direct drainage area to Lake Minnetonka is nearly fully developed; therefore, pollutant loads are expected to increase only minimally by the year 2020, with only about a 10% increase in TP, TN and TSS by 2020. The highest TP loads (per unit area) in the Lake Minnetonka direct drainage area originate around Stubbs Bay and Crystal Bay (Figure IV.J.5-1). These areas have less natural areas on the average than the other subwatersheds. The majority of the subwatersheds' loads are not expected to increase by 2020, due to the already fully developed nature of the drainage area.

Water quality goals for 26 of the Lakes Minnetonka bays located within this watershed are recommended in the text. Most recommendations reflect a substantial change from the MCWD's 1997 goals. Without a Lake Minnetonka model, it is difficult to estimate the load reduction necessary to achieve a specified in-lake phosphorus goal. Many of the Lake Minnetonka bays are of relatively good water quality and are at or near their proposed goals; therefore the P loads entering these bays should not be allowed to increase, in order to prevent any degradation in the water quality of the bays.

In addition to the in-lake goal for the bays, specific total phosphorus goals for all of the areas that drain directly into Lake Minnetonka were developed. These were long-term goals designed to achieve a specified total phosphorus flow-weighted mean (FWM) concentration in the runoff.

The average FWM concentration for streams in this ecoregion (North Central Hardwood Forests) is 100 μg/L, and this figure is often used as a standard. However, urban streams on average have greater concentrations of TP, and their FWMs consistently range from 300 to 500 μg/L. Therefore, an intermediate FWM concentration of 150 mg/L was selected. Specific recommendations include:

- Installing a cable skimmer and conducting continuous flow monitoring at Grays Bay Dam
- Retrofitting stormwater improvements into redeveloping urban areas
- Conducting an inventory of natural/constructed stormwater ponds
- Developing a roadway reconstruction stormwater plan that incorporates stormwater management improvements and design into roads as they are maintained, upgraded, or newly constructed
- Working with lakeshore residential development and redevelopment to encourage more low impact approaches
- Drafting language for rules and model ordinances that address shoreline buffers, steep slopes, erosion/sediment control, and bank stabilization within the context of lakeshore redevelopment
- Expanding the District's Water Quality Monitoring Program to lakes and/or tributaries of minor and direct drainage watersheds
- Conducting an analysis of Lake Minnetonka water levels using the new HHPLS tools
- Conducting a Lake Minnetonka shoreline erosion inventory and shoreline stabilization pilot project
- Developing a whole-lake water quality model for Lake Minnetonka
- Controlling carp on Lake Minnetonka tributaries
- Working with other entities to support efforts to minimize boating-related impacts

These recommendations emerged out of discussions as part of the public involvement process for Regional Teams 3, 4, 5, 6, and 8. Additional issues and management recommendations were identified as part of this process. A complete presentation of the recommendations can be found in *Volume III: Public Involvement*, which includes information regarding the priority of each issue, who would be responsible for undertaking each suggested management approach, and a relative recommendation of when the approach should be undertaken.

5.7.3 Lake Minnetonka – Water Quality/Hydrologic Monitoring

Additional data collection should be focused on the direct drainage and minor drainage areas to the lake, since together these represent about 18,500 acres of land draining to the lake. Identification of runoff monitoring sites should become an integral part of the District's overall monitoring program, with watershed-wide coverage occurring as a result of rotating stations based on priority loading and representative site selection. Evaluation of the success of these stations in filling the need should occur after at least two years of monitoring is complete.

Recommendation: Additional water quality monitoring stations should be established for minor watersheds outletting to Lake Minnetonka. In particular, monitoring should be expanded to some of the Minor Watersheds that encompass lake/stream systems such as Classen Creek. The District should also consider adding two continuous monitoring stations on Minnehaha Creek.

5.7.4 Lake Minnetonka – Internal Loading and Intra-Lake Circulation

Internal loading and intra-lake circulation data needs have not been adequately addressed. Some attention is being paid to internal load reduction on Jennings Bay through the Jennings Bay Feasibility Study funded by the District for 2003. However, the relationship of Jennings Bay internal load dynamics to the other bays has not been determined, and a need continues for additional data from other locations around the lake. The need for intra-lake circulation knowledge is paramount, since the movement of water from the upper portion of the lake to the outlet at Grays Bay seems to be a key factor in lake quality determination. For bays experiencing poor water quality (e.g., Jennings, Halsteds), water quality inputs including tributaries and direct runoff from the contributing watershed have been modeled. Outputs out of these bays, however, are poorly understood. The BATHTUB computer model, or a similar model, can be used as a tool to help define this critical behavior.

Recommendation - The District should begin a long-term effort to integrate data collection on watershed loading, internal Lake Minnetonka loading and in-lake circulation for development of a whole-lake model.

5.7.5 Lake Minnetonka – Comprehensive Lake-Wide Model

There are several bays (for example Crystal, Wayzata, and Spring Park) in Lake Minnetonka that are of exceptional quality. The preservation of these bays was identified as a high priority by many study participants. Similarly, there are at least two bays (Jennings and Halsteds) with very poor water quality. The range of water quality conditions within bays of Lake Minnetonka is governed by a number of different factors, including basin morphometry, watershed input, internal loading, and intra-lake circulation. A lake-wide model would take the guesswork out of defining the true source of phosphorus and help to better target Lake Minnetonka Management efforts.

RECOMMENDATION 26

A comprehensive lake wide model should be completed for Lake Minnetonka.

5.7.6 LAKE MINNETONKA - WATER LEVEL FLUCTUATIONS

Users of the lake and residents around Lake Minnetonka stressed the importance of maintaining lake levels at an elevation that allows for recreational uses, yet is not so high as to trigger "nowake" restrictions. The Dam Operation Plan mandates how the outlet control at Grays Bay will be operated to maintain lake levels up to the OHW. In contrast to lake residents, residents of the lower creek prefer a continual release of water from the lake, no matter what the lake level conditions are.

A minimum release of water would assure a continual Minnehaha Creek flow that would result in better water quality and improved biological conditions. Stagnant areas with low dissolved oxygen could be reduced with a continual flow of water. Minimum releases would mean, however, that a change in the current operating procedure for the dam would be needed, since low flow releases do not currently occur when the lake's water level falls below the historic outflow elevation. A low flow release could make up for the historic shallow groundwater seepage that has been lost because of development.

Alteration of the dam operation could also occur on the high flow end, with more water held back from Minnehaha Creek during high water periods. This end of the operation change would result in decreased peaks and flashiness, even though a similar volume might ultimately be released.

A re-evaluation of the Grays Bay operating plan could include input from the HHPLS model results on changing watershed hydrology for both the upper and lower watershed. That is, it could assess the long-term hydrologic changes likely to result as development proceeds. Increased development usually means more runoff, less infiltration and shallow groundwater flow, and flashier runoff conditions. The HHPLS model could be used to determine how these changes will affect water moving into and potentially out of the lake under varying conditions, as well as downstream implications, such as flooding potential and improved operation of the Lake Nokomis flexible weir under variable flow conditions. It could also answer such questions as time of travel from Grays Bay to the Mississippi River under differing flow scenarios and the effects of multiple high flow events (multiple peaks, higher volumes, timing, and event separation). See the "pulse" graph in HHPLS Volume IV, Section L.3.c. Special Subwatershed Issues for more information.

Finally, maintenance of the Grays Bay structure has been raised as an issue. It is difficult to obtain accurate flow measurements over the dam due to frequent clogging and timing of cleaning. During the flow model calibration procedure, it was found that for a particular lake elevation, there could be discrepancy of up to 50% due to restriction caused by debris. Proper maintenance of the structure is essential, and would be even more important in assuring reliability if the operation changed to allow a minimum flow release. See HHPLS Volume IV, Section J.6Lake Minnetonka Direct Drainage, Recommendations for more information regarding debris clogging at the dam.

RECOMMENDATION 27

The Grays Bay dam operating plan should be amended, if possible, to minimize water level fluctuations and improve the in-stream flow regime of Minnehaha Creek. Key Elements of this assessment include:

1) *Using XPSWMM Model, complete water balance analysis of Lake Minnetonka Basin for dry, wet and normal precipitation year conditions.*

2) *Check/reset rating curve (stage-discharge) for Grays Bay Dam*

3) *Evaluate low flow maintenance options for Minnehaha Creek below Grays Bay Dam.*

4) *Evaluate role that upstream storage plays in attenuating lake level bounce.*

5.7.7 LAKE MINNETONKA - EURASIAN WATERMILFOIL

The occurrence of dense stands of Eurasian Watermilfoil (milfoil) in Lake Minnetonka was identified by many as a major problem on the lake. Efforts to control this nuisance aquatic plant were found to be under way in the watershed by the Lake Minnetonka Conservation District (LMCD), the Lake Minnetonka Association (LMA) and the Three Rivers Park District (TRPD).

Since there is so much on-going effort to address this problem, members of the Regional Teams addressing this issue suggested that the District's role should be one of secondary support rather than primary controller. Secondary support would include coordination of water level determination for minimizing milfoil growth, information sharing and distribution, and potential financial support.

RECOMMENDATION 28

The District should support the on-going Eurasian Watermilfoil control programs under way by other agencies.

5.8 LAKE MINNETONKA DIRECT MINOR WATERSHEDS

5.8.1 DESCRIPTION

Nineteen small watersheds are grouped under the term "minor watersheds" for purposes of this report. Some of these represent a group of subwatersheds that drain into the direct drainage areas described in the previous section and in HHPLS Volume IV.J. None of these watersheds contain lakes that were modeled as part of the water quality portion this report.

These minor watersheds are located around Lake Minnetonka, within the cities of Chanhassen, Deephaven, Excelsior, Minnetonka, Minnetrista, Mound, Orono, Shorewood, Tonka Bay, Wayzata, and Woodland (HHPLS Figure IV.K.1-1). The total area covered by these watersheds is approximately 9,176 acres (about 14.3 square miles). Details on the watershed configurations are given in HHPLS Figure IV.K.1-2.

Land use in the minor watersheds changes dramatically from one area to another. Generally, as one moves east through the watershed, land use becomes more intense. In the minor watersheds to the north and west of Lake Minnetonka, land uses are primarily dominated by agriculture and open space, with varying amounts of single family residential land use. The watersheds to the south and east of Lake Minnetonka are generally dominated more by single family residential and commercial land uses. Typical of other developing areas in the MCWD, the biggest change in land use by 2020 will be a gain in single family residential at the cost of agricultural land and forest/woodlands.

The hydrology of this watershed is dominated by runoff from small tributary sub-watersheds into bays of Lake Minnetonka. However, several landlocked drainage basins exist around the lake.

5.8.2 ISSUE AND RECOMMENDATION SUMMARY

Potential increases in both flow and water pollution are expected for the Halsteds Bay and Peavey Lake subwatersheds as they develop over the next 20 years. The landlocked basins and depressions in the minor watersheds area are particularly sensitive to additional stormwater volumes. For this reason, strong volume control standards are recommended in all areas draining to landlocked areas.

As the minor watersheds develop, increases of 16%, 18% and 14% are expected for TP, TN and TSS, respectively, from the changing land uses. Impervious cover is expected to increase only slightly (HHPLS Figure IV.K.2-2). Watershed pollutant loads in the minor watersheds vary, with the highest TP loads (per unit area) originating towards the eastern portion of Lake Minnetonka (HHPLS Figure IV.K.5-1). These areas have less natural areas on the average than the other subwatersheds. The magnitude of the predicted load increases by the year 2020 varies across the area.

There were no lakes modeled for water quality within the minor watersheds area. However, several goals were recommended by the regional teams for lakes in these watersheds. Specific recommendations for the minor watersheds include:

- Retrofitting new stormwater practices into redeveloping urban areas adjacent to Lake
- Minnetonka not presently receiving adequate stormwater management
- Preserving and managing landlocked basins and pockets (maximize infiltration, bounce, and retention)
- Implementing volume control standards in all subwatersheds draining to or containing landlocked depressions
- Placing special emphasis on control of runoff to Halsteds Bay
- Achieving a no net increase in phosphorus loading for new development
- Developing a "Roadway Reconstruction Stormwater Management Plan" for areas adjacent to Lake Minnetonka
- Working with riparian property owners to implement stormwater and shoreline BMPs
- Incorporating the monitoring of lakes and tributaries within minor watersheds into the
- District's water quality monitoring program
- Adopting water quality goals for lakes within minor watersheds
- Conducting an inventory of natural and constructed stormwater ponds

- Maintaining stormwater ponds
- Keeping landlocked basins closed as long as problems do not occur

A complete presentation of the recommendations made for this watershed by the Regional Teams can be found in HHPLS Volume III: Public Involvement. This includes information regarding the priority of each issue, who would be responsible for undertaking each suggested management approach, and a recommendation of when the approach should be undertaken.

5.9 DUTCH LAKE

5.9.1 DESCRIPTION

The Dutch Lake watershed is located along the western boundary of the MCWD and within the Cities of Minnetrista and Mound (Figure IV.B.1-1). The Dutch Lake watershed is 1,888 acres in size (almost three square miles) and includes seven subwatershed units (Figure IV.B.1-2). Flow in the upper part of the Dutch Lake watershed goes through several large wetlands, which eventually outlet into the west side of Dutch Lake. A small stream flows from the northeast corner of Dutch Lake into Jennings Bay of Lake Minnetonka. Wetlands comprise about 20% of the watershed area.

Land use in the north and western portions of the watershed is dominated by agriculture and open space in the form of forests, woodland and wetlands. Moving east through the watershed, land use becomes increasingly dominated by single family residential. As with other urbanizing portions of the Minnehaha Creek watershed, agricultural and forest/woodlands will give way to development over the next 20 years. To protect and enhance the value of the watershed resources, and to minimize further impacts to Jennings Bay, care should be taken to ensure that development impacts are mitigated.

5.9.2 ISSUE AND RECOMMENDATION SUMMARY

The Dutch Lake outlet consists of a poorly maintained culvert which is exposed in a wider channel opening. This culvert frequently washes out. The issue of outlet stability and Dutch Lake fluctuating water levels has been identified in both the City of Minnetrista and City of Mound Surface Water Management Plans. The Metro DNR Waters office stated that work was in progress to address the Dutch Lake outlet with construction of a control dam, but plans are preliminary and no outlet design information is available. Proposed outlet modifications for Dutch Lake should be reviewed to ensure reasonable high water elevations on Dutch Lake, as well as the protection of Dutch Lake creek from potential flow related impacts.

The small creek running from Dutch Lake to Jennings Bay currently experiences erosion at the outlet, and development in the watershed is predicted to increase peak discharge, velocity and volumes received by the creek. To reduce scour potential in the creek, it is important to emphasize both rate and volume control in those developing areas. Local soils and proximity of groundwater may limit the use of volume control practices.

As the Dutch Lake watershed develops, increases of TP, TN and TSS loads generated from the changing land uses are expected to increase by 60%, 35% and 33%, respectively, if measures are not taken to adequately control runoff. The highest current TP loads (per unit area) in the Dutch Lake watershed originate around Dutch Lake and in the area to the northeast of the lake, but the entire watershed is predicted to show increases in phosphorus loading as development proceeds. The quality of Dutch Lake is currently in the transition zone between non-supportive of swimming conditions and marginally supportive. Attention to surface water management techniques, as identified above, will help in moving the lake toward improved quality. The Regional Team process led to a recommended water quality goal of 40 μg/L TP, which is less than the 1997 MCWD goal.

A mix of agricultural, shoreline and urban BMPs are recommended to reduce pollutant loading within this watershed. Specific recommendations include:

- Stabilizing the Dutch Lake outlet (see previous discussion)
- Minimizing sediment transport in Dutch Lake Creek through erosion control at the lake outlet and in the creek, and through peak discharge and potential volume controls as development occurs
- Dissipating energy at the culvert under Game Farm Road
- Implementing a no net increase in phosphorus loading approach for new development to achieve water quality goals
- Completing an in-lake sediment analysis of Dutch Lake and determining the internal loading potential for future management attention
- Evaluating wetland functions with respect to phosphorus source/sink, using the results of the *Painter Creek Feasibility Study*

- Targeting educational efforts and shoreland BMP grants/funding to direct drainage areas of Dutch Lake and targeting residential BMPs within subwatersheds exhibiting the highest per area loading
- Raise Game Farm Road to increase freeboard over the 100-year HWL.

A complete presentation of the recommendations can be found in *Volume III: Public Involvement, Regional Team 8*, which includes information regarding the priority of each issue, who would be responsible for undertaking each suggested management approach, and a recommendation of when the approach should be undertaken.

5.10 LANGDON LAKE

5.10.1 DESCRIPTION

The Langdon Lake watershed is located along the western boundary of the MCWD and within the cities of Minnetrista and Mound (Figure IV.C.1-1). The watershed is 1,055 acres (about 1.6 square miles), and includes five subwatershed units (Figure IV.C.1-2). Langdon Lake (LL-5) is located at the downstream end of the watershed and is the last in a string of water bodies, including Black Lake and Saunders Lake. Langdon Lake outlets directly into Lost Lake before entering Cooks Bay.

Land use in the watershed changes dramatically across the political boundary between the cities of Minnetrista and Mound. Open space in the form of woodlands, forests, grasslands and maintained natural areas dominates the western portion of the watershed in Minnetrista. The eastern part of the watershed is dominated almost entirely by residential land use types. Single family residential land use surrounds Langdon Lake to the south and north. To the east, the lake is surrounded by commercial and institutional land use. As with many other urbanizing areas, agricultural, grassland and forest/woodlands eventually give way to urban uses as the area develops.

The hydrology of the Langdon Lake watershed is influenced by wetlands, lake large lot rural areas found in Minnetrista, and denser urban development predominantly located in the City of Mound. Despite significant capacity restrictions in several locations, drainage eventually makes its way into Langdon Lake at the downstream end of the watershed.

5.10.2 ISSUE AND RECOMMENDATION SUMMARY

Some parts of the watershed are predicted to experience water quantity problems resulting from increased runoff. Peak flows and volumes should be strictly regulated, especially in the portions of the watershed draining directly to the creek, in order to minimize flooding and increased erosion/scour. Special efforts to minimize sediment transport to Langdon Lake are warranted to avoid exacerbating existing problems in Langdon Lake.

Multiple structures in the Langdon Lake watershed are in need of maintenance and/or repair. Further evaluation/investigation of the structures controlling Black Lake and Saunders Lake is of particular importance due to the current and predicted future development pressures in the subwatersheds containing these lakes. Alterations or repairs of the structures should be implemented prior to or in conjunction with area development. The issue of structure and berm integrity at the outlets of Black and Saunders Lakes has been identified in the City of Minnetrista SWMP.

As the Langdon Lake watershed develops, increases of 52%, 37% and 50% are expected for TP, TN and TSS, respectively, by the year 2020. The majority of the southwest quadrant of the watershed is predicted to change from vacant/agricultural land to single family residential. The highest current TP loads (per unit area) in the Langdon Lake watershed originate from the eastern portion of the watershed. The lowest loading rates are in the less developed areas of the western portion of the watershed. Phosphorus loads in the northwest corner are not predicted to substantially increase.

Langdon Lake is a shallow lake with a mean depth of 8.3 feet. Historically, TP concentrations in the lake have been extremely high, primarily due to the abandoned Mound Wastewater Treatment Plant, which had a capacity of 1.25 MGD, two to three times higher than the other six wastewater treatment plants that operated on Lake Minnetonka. In 1998, the lake was treated with alum and TP concentrations were reduced. However, Langdon Lake still scores a D+ on the 2000 MCWD report card, and by the year 2020, watershed loading is estimated to increase by 52%, from its current level of about 87 μg/L to 111μg/L. Different lake goals were recommended by Regional Teams 6 and 8. The lake itself is located in RT6, with parts of the watershed located in RT8. RT 6 recommended 70 μg/L, while RT8 recommended 50 μg/L. The MCWD will ultimately work with the communities to decide which level should be the goal.

(More information regarding the RT6 and 8 goal recommendations can be found in *Volume III:Public Involvement, F. Regional Team 6 and H. Regional Team 8.*)

Watershed load reductions are needed for either of the RT-recommended goals to be reached.

Specific recommendations for the watershed include:

- Minimizing erosion and sediment transport in the creek from Saunders to Langdon
- Lake by emphasizing rate and volume control
- Enhancing or replacing the Saunders Lake and Black Lake outlets
- Investigating the continued influence of the Wastewater Treatment Plant on adjacent wetlands and Langdon Lake
- Retrofitting new stormwater practices into redeveloping areas of Mound and achieving a no net increase in phosphorus for new development.
- Developing a "Roadway Reconstruction Stormwater Management Plan" that incorporates stormwater management improvements and design into roads as they are maintained, upgraded, or newly constructed
- Preserving small wetlands as development pressure increases, with special attention to preservation of a healthy hydroperiod and volume control for areas draining all landlocked pockets
- Monitoring of Langdon Lake to assess phosphorus loading to Lake Minnetonka
- Working with Langdon Lake property owners to implement stormwater management and shoreline BMPs
- Properly maintaining drainage culverts

These recommendations emerged out of discussions as part of the Regional Team 6 and Regional Team 8 public involvement process. Additional issues and management recommendations were identified as part of this process. A complete presentation of the recommendations can be found in *Volume III: Public Involvement, Regional Team 6 and Regional Team 8*, which includes information regarding the priority of each issue, who would be responsible for undertaking each suggested management approach, and a recommendation of when the approach should be undertaken.

5.11 LONG LAKE CREEK

5.11.1 DESCRIPTION

The Long Lake Creek watershed is located to the north of Lake Minnetonka and within the cities of Medina, Orono, and Long Lake (Figure IV.E.1-1). The watershed is 8,215 acres in size (about 12.8 sq. miles), and includes 53 subwatershed units. Long Lake is situated approximately in the middle of the basin.

Land use in the watershed varies dramatically, from predominantly row crop agriculture and open space comprised of large wetland complexes and forest land, to high density residential development. The most intense land use in the Long Lake Creek watershed is in the city center of Long Lake along the Hwy 12 corridor. "Natural areas" are common throughout the landscape, with wetlands, forests, woodlands, and grasslands comprising about 48% of the landscape; however, dramatic population growth is expected by the year 2020, resulting in loss of some natural areas, higher runoff and poorer water quality.

5.11.2 ISSUE AND RECOMMENDATION SUMMARY

Areas of the watershed predicted to have a more significant impact on water resources resulting from 2020 land use changes are concentrated in the subwatersheds in the City of Long Lake and along the Hwy. 12 corridor portions of Orono. Peak rate and volume controls should be implemented as this area continues to develop.

Landlocked basins in the subwatershed are particularly sensitive to stormwater volumes. For this reason, strong volume control standards are recommended in all areas draining to landlocked areas and pockets of smaller unconnected wetlands throughout the watershed. It is also recommended that low impact development (LID) techniques be employed as the area develops and that the function of the pocket wetland areas be retained.

Several channel reaches with potentially high velocities occur. It is recommended that inlet and outlet erosion control measures or energy dissipation designs are implemented in these areas. Modeling of the Long Lake Creek watershed predicted that several roads and trails would overtop during larger storm events. There are also a number of roads and trails modeled under existing and proposed conditions that show 100-year water levels close to overtopping the roads and within the freeboard (two feet) required by the District.

Large portions of the northern part of the watershed that are currently undeveloped are slated for rural residential and single family residential land uses by the year 2020. Effective management of runoff from these areas is essential to achieving the recommended Long Lake water quality goal. To achieve the recommended goal of 40-50 μg/L TP for Long Lake, the maximum TP load must remain constant near current levels rather than increase as the subwatersheds upstream of the lake develop.

Before additional alum treatments to Long Lake are considered, the reasons behind the shortlived benefit should be determined. Decisions with respect to the use of alum treatment as a management tool to improve water clarity must also take into account the increased macrophyte growth that follows treatment.

Tanager Lake is located at the bottom of the Long Lake Creek watershed, and flows into Browns Bay of Lake Minnetonka. Tanager is of poor water quality because it essentially serves as a treatment basin for the Long Lake Creek watershed outflow. RT4 recommended a goal of 70 μg/L TP for Tanager, but data are needed to show both current and future water quality. For Browns Bay, currently at a very clean, fully supportive level of 22 μg/L TP, the Team suggested a goal of 20 μg/L TP. Reductions in TP load to attain all of these goals are recommended in the subwatersheds draining to the impacted waterbodies.

Monitoring data and modeling indicate that several stormwater ponds in the Long Lake Creek watershed perform poorly relative to TP removal. Recommendations are made to restore the performance of the ponds to an effective pollutant removal level.

Specific management recommendations for Long Lake Creek include:

- Controlling the volume of water flowing to landlocked basins
- Dissipating energy at critical culverts to prevent further erosion
- Improving the performance of several existing water quality improvement ponds
- Collecting data for Tanager Lake so that a management strategy can be implemented
- Addressing various local drainage and sediment accumulation problems
- Instituting effective runoff controls for Long Lake Creek between the Long Lake outflow and Tanager Lake
- Establishing peak rate and volume control to streams/tributary creeks as the watershed continues to develop
- Monitoring the effectiveness of the new carp gate

A complete presentation of the recommendations made for this watershed by Regional Team 4 can be found in *Volume III: Public Involvement, D. Regional Team 4*. This includes information regarding the priority of each issue, who would be responsible for undertaking each suggested management approach, and a recommendation of when the approach should be undertaken. The majority of the Long Lake Creek watershed is located within RT4. A small segment in the northeastern portion of the watershed is located in RT3; however, due to the relatively small area of the Long Lake Creek watershed within RT3, this team did not deal with Long Lake Creek watershed issues.

5.12 GLEASON LAKE CREEK

5.12.1 DESCRIPTION

Gleason Lake Creek is located in the north-central portion of the MCWD and within the cities of Plymouth, Wayzata, Orono, and Minnetonka (Figure IV.F.1-1). The watershed is 3,765 acres in size (about 5.9 square miles), and includes sixteen subwatershed units including the Hadley Lake drainage. Gleason Lake Creek flows into Gleason Lake from the north, and then out of the Lake on the southwest corner, joining with the Hadley Lake drainage to flow into Wayzata Bay.

The Gleason Lake Creek watershed is dominated almost entirely by single- and multi-family residential land uses. On the whole, the watershed has urbanized and very little open space or natural areas remain, so little change is expected by 2020 in runoff character.

The hydrology of the Gleason Lake Creek watershed is influenced primarily by urban development (high and medium density), lake, and wetland areas. Only a very small area of rural development remains in the northern most tip of the watershed. This northern area is served by Hwy. 55 and is developing very rapidly. It is expected to be converted to commercial and industrial land use in the very near future.

5.12.2 ISSUE AND RECOMMENDATION SUMMARY

Some erosion and high flow problems currently occur in the watershed (Table IV.F.5-1). Peak flows and volumes should be strictly regulated for all new development in the watershed to minimize increased erosion and scour in Gleason Lake Creek and protect the water quality of the resources. Although increased loads are not expected, under current conditions TP loads (per unit area) in the watershed are relatively high, with lower than average loads in the subwatersheds that contain lakes. The Gleason Lake Creek watershed contains a high proportion of single family residential land uses, with some blocks of multi-family land use mixed in. Commercial and highway uses dominate the far northern subwatersheds. TP loads are predicted to remain relatively stable, due to the fact that these watersheds are nearly fully developed already.

Not unexpectedly, Gleason Lake has a very high TP concentration at 121 μg/L, which should not worsen by 2020. This level is far into the non -supportive range for swimmability. RT3 recommends an interim water quality goal of 80 μg/L, and a longer-term goal of 50 μg/L, which would bring the lake into the partially supported range. Hadley, Snyder and Kreatz are all recommended for some data collection to establish current TP levels, followed by a goal determination of 10% less than observed. Load reductions are suggested only for Gleason. Specific recommendations for Gleason Lake Creek include:

- Addressing localized flood control and flow structure problems
- Establishing in-lake water quality goals for all watershed lakes, assuming some data are collected for Hadley, Snyder and Kreatz Lakes
- Continuing the macrophyte evaluation of Gleason Lake
- Undertaking channel and shoreline erosion stabilization and restoration at locations identified in the Gleason Lake Management Plan
- Promoting progressive stormwater management to protect resources in newly developing areas
- Working with Gleason Lake Improvement Association (GLIA) and the cities to reduce pollutant runoff.
- Expanding the water quality monitoring program to address all lakes and better address Gleason Lake Creek inflow to Gleason Lake
- Using the stocking program to maintain a piscivore fishery and maintain a proper ecological fish balance
- Continuing winter-only aeration of Gleason Lake to prevent fish kills
- Dissipating energy at culverts under County Roads 101 and 6
- Minimizing sediment transport
- Continuing the goose management program
- Working with GLIA to implement the results of its Gleason Lake Management Plan

These recommendations emerged out of discussions as part of the Regional Team 3 and Gleason Lake Improvement Association public involvement processes. Additional issues and management recommendations were identified as part of this process. A complete presentation of the recommendations can be found in *Volume III: Public Involvement, Regional Team 3*, which includes information regarding the priority of each issue, who would be responsible for undertaking each suggested management approach, and a recommendation of when the approach should be undertaken.

5.13 SCHUTZ LAKE

5.13.1 DESCRIPTION

The Schutz Lake watershed is located along the southern boundary of the MCWD and within the city of Victoria (Figure IV.G.1-1). The watershed is 969 acres in size (about 1.5 square miles), and includes four subwatershed units, which flow nearly due north into Smithtown Bay of Lake Minnetonka. Schutz Lake is the major hydrologic feature within this watershed.

Land use in the northern part of the Schutz Lake watershed is split fairly evenly between the open space found in Carver Park Reserve and residential land use types found in the east. The southern part of the watershed is dominated by agricultural and residential land uses. Essentially all of the agricultural land and mush of the forest/woodlands will disappear by 2020 as development proceeds.

5.13.2 ISSUE AND RECOMMENDATION SUMMARY

Modeled land use changes associated with predicted 2020 conditions did not produce significant runoff impacts in the Schutz Lake watershed. The greatest flow impacts predicted are in the creek running through the watershed. As this area continues to develop (perhaps beyond 2020) standard peak rate and volume controls should be implemented to ensure the quality of resources are preserved.

Potential channel erosion at the outlet of Schutz Lake and the North Schutz Lake wetland needs to be assessed further. No other quantity related problems were documented.

As the Schutz Lake watershed develops, increases of 46%, 39% and 23% are expected for TP, TN and TSS, respectively. Under current conditions, TP loads (per unit area) in the Schutz Lake watershed are relatively low, with slightly lower loads in the northern subwatershed, the majority of which is located within Carver Park Reserve. TP loads are predicted to increase in the southern portion of the watershed due to a portion of the "vacant/agricultural" land being planned for single family residential land use by the year 2020.

There are no in-lake TP concentration data for Schutz Lake, but modeling indicates that the TP level is approximately 52 μg/L, or slightly within the partially non-supportive range. The RT7 recommendation for a water quality goal for Schutz is 40 μg/L. Specific recommendations for the Schutz Lake watershed include:

- Working with the Schutz Lake homeowners to implement stormwater management practices, such as ponding, infiltration, rain gardens, and riparian buffers
- Incorporating effective stormwater management into reconstruction of roads and other common infrastructure as improvements are made
- Maintaining pollutant loading from new development at predevelopment levels
- Expanding MCWD water quality monitoring program to include Schutz Lake baseline trend information
- Encouraging the use of agricultural BMPs, such as minimum tillage, contour farming, terracing, riparian buffers and vegetative filter strips
- Conducting a tile and ditch inventory to locate and map tile/ditch locations, verify drainage area boundaries, estimate discharge rates, and where appropriate, collect grab samples for water quality analysis
- Installing and/or protecting lake and wetland buffers
- Assessing damaged culverts and channels

These recommendations emerged out of discussions as part of the Regional Team 7 public involvement process. Additional issues and management recommendations were identified as part of this process. A complete presentation of the recommendations can be found in *Volume III: Public Involvement, Regional Team 7*, which includes information regarding the priority of each issue, who would be responsible for undertaking each suggested management approach, and a recommendation of when the approach should be undertaken.

5.14 CHRISTMAS LAKE

5.14.1 DESCRIPTION

The Christmas Lake watershed is located along the southern boundary of the MCWD and within the cities of Chanhassen and Shorewood (HHPLS Figure IV.I.1-1). The watershed is approximately 742 acres in size (about 1.2 square miles), and includes five subwatershed units (HHPLS Figure IV.E.1-2). Christmas Lake is one of the most pristine lakes in the metropolitan area. Surface flows in the Christmas Lake watershed are routed primarily though a system of culverts connecting small depressions. Flows are received by small pocket wetlands (some landlocked on the north and west sides of the watershed) and then Christmas Lake before ultimately discharging into St. Albans Bay.

Because Christmas Lake is the dominant water body at the center of this small watershed, lakes and open water dominate the land use categories, followed by single family residential. Within this residential setting, isolated undeveloped pockets of woodland, forest and other natural areas exist. Land use immediately adjacent to Christmas Lake is primarily single family residential. Very little additional development is expected for the watershed, but some transition from forest/woodland to urban will occur. The most concentrated development of the watershed is along the Highway 7 corridor which runs between Christmas Lake and St. Albans Bay of Lake Minnetonka (HHPLS Figure IV.I.1-1).

5.14.2 ISSUE AND RECOMMENDATION SUMMARY

Although the HHPLS did not predict significant increases in either high water levels or peak discharge for 2020, development flows and volumes should continue to be regulated to ensure continued health of the watershed resources, especially landlocked basins. It is recommended in the HHPLS that low impact development techniques be employed as the area develops and that the function of the landlocked pocket wetland areas be retained. Particular attention to volume control and green space planning will greatly ease that burden.

The Christmas Lake watershed is already fully developed; therefore, pollutant loads are expected to increase only minimally (HHPLS Table IV.I.5-1). Under current conditions, TP loads (per unit area) in the Christmas Lake watershed are relatively low, with a small area of higher loads in the northeast subwatershed. This subwatershed has a higher proportion of single family residential land uses than the other subwatersheds. TP loads are predicted to remain relatively constant.

Current TP levels in Christmas Lake are low at 15 μg/L, well within the fully supportive swimming range. For Christmas Lake, the lake model predicts that in-lake TP concentrations will increase slightly to 17 μg/L from existing to 2020 conditions. Current TP loads to the lake are relatively low, and future development in the watershed is also predicted to be low, leading to predicted stable in-lake TP concentrations.

Christmas Lake has the highest water quality of any lake in the MCWD. This condition is due to a combination of factors including lake morphometry, small watershed to lake ratio, low levels of impervious surfaces, substantial areas of native vegetation, and probable strong groundwater-surface water interaction. The general approach, therefore, is to maintain and protect the existing conditions that, taken together, sustain the high quality of Christmas Lake. Since much of the lake is well buffered by natural vegetation and receives minimal runoff, the recommendations are focused on managing the shoreline buffer, minimizing stormwater runoff and addressing several areas of known erosion. Specific recommendations of the HHPLS for Christmas Lake include:

- Stabilizing the Christmas Lake tributary from the south to prevent further erosion, provide additional storage opportunities and maintain existing landlocked pockets
- Protecting against bluff-line and shoreline erosion
- Controlling stormwater volume, especially in the landlocked portions of the watershed; where possible, stormwater infiltration should be used to lower the rate and volume of stormwater runoff from existing and new development
- Maintaining all landlocked basins

These recommendations emerged out of discussions as part of the Regional Team 5 public involvement process. Additional issues and management recommendations were identified as part of this process. A complete presentation of the recommendations can be found in HHPLS Volume III: Public Involvement, Regional Team 5, which includes information regarding the priority of each issue, who would be responsible for undertaking each suggested management approach, and a recommendation of when the approach should be undertaken.

5.15 LAKE VIRGINIA

5.15.1 DESCRIPTION

The Lake Virginia watershed (including Lake Minnewashta) is located along the southern boundary of the MCWD and within the cities of Victoria, Chanhassen, and Shorewood (Figure IV.H.1-1). The watershed is 3,990 acres in size (about 6.2 square miles), and includes sixteen subwatershed units representing the Lake Minnewashta drainage area, and the portion of the Lake Virginia watershed downstream of Lake Minnewashta). The watershed flows into Smithtown Bay. Figure IV.H.1-2 shows the subwatersheds and their drainage configuration.

Land use north and west of Lake Minnewashta is dominated by single family residential. Lake Minnewashta Regional Park lies to the east of the lake. Within the park, land use is dominated by forest, woodland, wetland and grassland. South of Highway 5, the watershed is also dominated by open space land use types (forest, woodland and wetland). Repeating a common theme in the Minnehaha Creek watershed, much of the agricultural and non-public forest/woodland will change to urbanized uses by 2020.

The hydrology of the Lake Virginia and Lake Minnewashta watershed is influenced by a mixture of rural and urban residential development, lake, and wetland areas. The most concentrated development of the watershed is along the Hwy 7 corridor which runs between Lake Minnewashta and Lake Virginia. As new areas develop, care should be taken to ensure development does not negatively impact the watershed resources.

5.15.2 Issue and Recommendation Summary

Although 2020 conditions do not predict significant increases in either HWLs or peak discharge, development flows and volumes should continue to be regulated to ensure continued health of the watershed resources, especially within the portion of the watershed that is landlocked. Some minor flooding and erosion problems are noted within the watershed.

As the Lake Virginia watershed develops, increases of 21%, 20% and 21% are expected for TP, TN and TSS, respectively, from the changing land uses. Under current conditions, TP loads (per unit area) in the Lake Virginia watershed are relatively low, with one subwatershed in the northeast portion of the watershed having a higher load (Figure IV.I.5-1). This subwatershed contains a higher proportion of single family residential and commercial land uses than the others. TP loads are predicted to increase upstream of Lake Virginia due to a portion of the "vacant/agricultural" land being planned for single family residential land use by the year 2020, with some multi family residential land use as well.

For Lake Minnewashta, the lake model predicts that in-lake TP concentrations will remain at 22 μg/L from existing to 2020 conditions. Current TP loads to the lake are relatively low, and future development in the watershed is also predicted to be low, leading to predicted stable inlake TP concentrations. This level is within the fully supportive range for swimming, thus representing one of the best lakes within the MCWD. RT7 recommends that a new goal of 20 μg/L be adopted.

Lake Virginia is expected to increase from 46 μg/L currently to 52 μg/L by the year 2020 as a result of land use changes (Table IV.H.5-3). These values are both within the partially impaired range. RT7 recommends that a new goal of 40 μg/L be adopted.

In general, the recommendations for this watershed focus on protecting the water quality of Lake Minnewashta by maintaining or slightly reducing phosphorus loads, while seeking to achieve significant load reductions for Lake Virginia. Specific recommendations include:

- Encouraging shoreline buffers, especially where lawns extend to the lake's edge, on steep slopes and where shoreline erosion is occurring
- Implementing boat access shoreline buffer demonstration sites that should include educational signage targeted to residents and nonresidents of the lake
- Retrofitting existing developed areas with stormwater BMPs
- Evaluating outlet and channel repair and maintenance needs
- Maintain predevelopment stormwater volumes in landlocked basins
- Emphasizing rate control to minimize erosion and sediment transport
- Maintaining natural hydroperiod in sensitive wetlands.

Several of these recommendations emerged out of discussions as part of the Regional Team 7 public involvement process. Additional issues and management recommendations were identified as part of this process. A complete presentation of the recommendations can be found in *Volume III: Public Involvement, Regional Team 7*, which includes information regarding the priority of each issue, who would be responsible for undertaking each suggested management approach, and a recommendation of when the approach should be undertaken.

5.16 MINNEHAHA CREEK

5.16.1 Description

This HHPLS report segment addressed the portion of the Minnehaha Creek watershed that is located downstream of Grays Bay dam (HHPLS Figure IV.L.1-1). It is comprised of 30,920 acres (about 48 square miles) in 184 subwatersheds as defined in the HHPLS. The total length of Minnehaha Creek below Grays Bay dam is 21 miles. Thirty-five lakes are located in this portion of the MCWD. This report section also covers several subwatersheds (Wood/Grass Lake, Powderhorn and Mississippi River direct) totaling 2,417 acres (about 3.8 square miles) that are located within the political boundaries of the MCWD, yet are non-contributing to Minnehaha Creek.

5.16.2 Issue and Recommendation Summary

Problems in the "lower" part of the watershed relate to both flow and water quality. High flows have led over the years to several areas where erosion is a concern (see also Stream Assessment Report). Nearly 120 creek sections ranging from 5 to 1000 feet in length were found to have high erosion potential. These areas are particularly problematic because channel erosion deposits material directly into the creek, immediately degrading water quality.

Among the findings of the RT1 and 2 discussions in the development of the HHPLS was the identification of several reaches in the Creek where accumulation of sediment has reduced channel capacity. Identification of these problems areas and potential solutions was a high priority for the RTs.

As the Minnehaha Creek watershed develops, small increases (6-11%) are expected in the pollutant loads (TP, TN and TSS) generated from the changing land uses since impervious cover is expected to increase only slightly. Under current conditions, TP loads (per unit area) in the Minnehaha Creek (lower) watershed are lower in the western portion, with several areas of high pollutant loads throughout the rest of the watershed (Figure IV.L.5-1). TP loads are not predicted to increase substantially by the year 2020.

Of the nine lakes that were modeled in the lower watershed, five (Lake of the Isles, Nokomis, Hiawatha, Powderhorn and Diamond) are on the MPCA 303d "impaired waters" list. The nine modeled lakes range in TP levels from an outstanding value of 21 μg/L to a very poor 172 μg/L for Powderhorn. Most of the lakes are expected to worsen in quality by 2020 because of additional loading. Effective implementation of BMPs to address this increase could reverse this expectation. RT 1 and 2 suggested goals for these lakes and for the creek (80 μg/L), since it does flow into Hiawatha. Specific recommendations of the HHPLS include:

- Revise water quality goals for Minnehaha Creek and the lakes of the Lower Watershed.
- Develop Implementation Plan to improve Minnehaha Creek and Lake Hiawatha, including additional water quality monitoring, a mixing study of Lake Hiawatha, identification of where water quality and flood reduction efforts should be focused and identification of partners that can help to implement
- Creating an annual shoreline stabilization program, with an accompanying grants program and shoreline buffer requirements.
- Implementing flood mitigation policies for flooding along Minnehaha Creek and within neighborhoods that look beyond the boundaries of the creek and balance the hydraulic inter-relationship between the creek and the municipal drainage systems (Policy components recommended in HHPLS Volume IV.L.6.).
- Creating incentives and/or matching grants for property owners (commercial and residential) that are willing to create innovative or infiltration practices to benefit runoff water quality.

- ✦ Strengthening water quality and construction site management requirements for future highway projects.
- ✦ Utilize the H/H Model to better define high water levels for the Chain of Lakes by simulating back-to back 100-year storm events on Chain of Lakes using full range of potential initial conditions.
- ✦ Preserve and manage landlocked basins and subwatershed areas to lower peak flow rates and pollutant loads of local stormwater runoff to Minnehaha Creek.
- ✦ Implement volume control standards in all subwatersheds draining to or containing landlocked depressions.

A complete presentation of the recommendations made for this watershed by Regional Team 1&2 can be found in HHPLS Volume III: Public Involvement, B. Regional Team 1&2. This includes information regarding the priority of each issue, who would be responsible for undertaking each suggested management approach, and a recommendation of when the approach should be undertaken.

6.0 DISCUSSION OF THE PROPOSED INITIAL PROJECT ALTERNATIVES

The MCWD has completed numerous plans, studies and reports aimed at assessing the historic, existing and future conditions of the watershed. The MCWD, for planning purposes, has divided the projects into the Upper Watershed, above Gray's Bay Dam and the Lower Watershed, which is essentially Minnehaha Creek. The MCWD staff has recommended to the Corps that the Feasibility Study focus on these issues.

6.1 LOWER WATERSHED

Aquatic Ecosystem Restoration, Lower Watershed: Recommended actions for the Lower Watershed are listed in the attached *Table IV.L.6-1* of the HHPLS Report. Details on the recommended actions are included in the report in the accompanying text. The recommendations were coordinated through the MCWD Regional Teams 1 and 2 public involvement process. In addition see the recommendations in the HHPLS Volume III (Public Involvement). Recommendations of particular importance to AER are those projects involving shoreline stabilization (Rec. #1), management of landlocked basins (Rec. #3/4), energy dissipation and flow reduction (Rec. #5), and the development of a management plan for both Minnehaha Creek and Lake Hiawatha (Rec. #9).

Any aquatic ecosystem restoration effort along Minnehaha Creek should include a comprehensive look at the existing flow regime of the creek as influenced by both the base flow from Grays Bay Dam as well as the influence of storm sewer surge discharged into the creek. A reevaluation of both of these flow inputs may be critical in maintaining any investment made to restoration of the creek. Such analyses would also fall under the auspices of Recommendations #2, 3, 4, 9, 12, 13 and 16.

The MCWD Minnehaha Creek Stream Assessment report identifies a number of areas of concern and has identified firm recommendations on potential remedies to perceived problems. Recommendations are highlighted in bold type in the attached *Minnehaha Creek Stream Assessment Summary/Conclusions* table. Individual stream reach recommendations are provided which include projects involving the restoration of native buffers, bioengineering of stream banks, repair of stormwater infrastructure, removal of grade controls, and reduction of channelization through the creation of stream meanders.

The MCWD Minnehaha Creek Stream Assessment also identifies areas of poor ecological health through a macorinvertebrate study by stream reach. The purpose of the study was to examine the aquatic macroinvertebrate population over the varying reaches of Minnehaha Creek in addition to correlating population data with habitat and reach features as identified in the Fluvial Geomorphic Assessment. MCWD encourages the USACE to consider the utilization of macroinvertebrate population data in its evaluation of existing habitat function as well as future use in the development of projects using the Habitat Evaluation Procedures (HEP) outlined under USFWS protocol. MCWD is currently working with the University of Minnesota to develop a macroinvertebrate stream monitoring program which will compliment the existing Hydrodata monitoring program by creating a quantified database evaluating the trends in the ecology of the creek. This may be a valuable tool to any AER projects in evaluating the success of the management tools implemented as a result of the USACE/MCWD Feasibility Study.

As stated in the HDR Engineering, Inc. draft Scope of Work Report, the MCWD Functional Assessment of Wetlands Report identifies approximately 767 acres of restorable wetland within MCWD. It should be noted that restorable wetland is defined in this study as areas of partial or fully filled and/or drained basins. As summarized in the attached FAW tables 2.4 and 2.1, wetlands in this study were evaluated by a number of functional metrics which include vegetative diversity, hydrologic regime, flood storage, downstream water quality, wetland water quality, shoreline protection, wildlife, fisheries, recreation/educational value, commercial value, restoration potential, stormwater sensitivity, stormwater treatment, and groundwater interaction. MCWD suggests that some parameters, particularly those of vegetative diversity, wildlife and fisheries may qualify for enhancement of the current functions which could contribute a value to the overall ecosystem through the creation of habitat units (HEP method evaluation). MCWD has a high interest in creating, preserving and enhancing connective systems of greenways and riparian corridors to preserve green/open space, provide recreational opportunities, improve water quality and promote wildlife habitat. The development of such connective systems should be considered a high priority.

6.2 UPPER WATERSHED (IN ORDER OF MCWD PRIORITIZATION)

6.2.1 PAINTERS CREEK WATERSHED (13.5 SQ. MI.)

Painters Creek contributes significant nutrient loading to Lake Minnetonka (into Jennings Bay) in addition to being an important area for ecological habitat within the Minnehaha Creek watershed (Painters Creek is mostly rural).

Recommended actions for Painters Creek Watershed include the attached *Table IV.A.6-1* of the HHPLS Report. Details on the recommended actions are included in the report in the accompanying text. The recommendations were coordinated through the MCWD Regional Team 9 public involvement process. In addition see the recommendations in the HHPLS Volume III (Public Involvement).

It is suggested that the Feasibility Study include analyses of potential Aquatic Ecosystem Restoration involving:

1) The riparian areas of wetlands/lakes within the hydrologic system, for potential restoration efforts and preservation and/or enhancement of native buffering
2) The tributary ditches and streams to the major tributaries for issues related to the management of flow and reduction of sediment loading.
3) Wetland areas identified in the MCWD Functional Assessment of Wetlands which may be successful areas of restoration or enhancement. Areas where connective natural riparian corridors may be established are of particularly high priority.

Recommendations from the HHPLS of particular relevance to AER include stream reach restoration (Rec. #1), surface water runoff management (Rec. #3), development of a corridor management plan (Rec. #4), and energy/flow dissipation (Rec. #9). Similar to the Lower Watershed recommendation, MCWD staff also recommends that wetlands identified in the MCWD Functional Assessment of Wetlands are evaluated under the Feasibility Study for both restorability as well as enhancement.

MCWD is currently working with Emmons Olivier Resources and HDR Engineering, Inc. on developing an improvement project for Painters Creek and Jennings Bay (downstream receiving waterbody). MCWD is also in the process of completing work related to the MCWD Stream

Assessment for Painters Creek. The results of the completed studies should be reexamined and included in the Feasibility Study.

1) Six Mile Creek Watershed (approx. 27 sq. mi.): Six Mile Creek contributes significant nutrient loading to Lake Minnetonka (into Halstead Bay) in addition to being an important area for ecological habitat within the Minnehaha Creek watershed (Six Mile Creek is mostly rural).

   Recommended actions for the Six Mile Creek watershed are listed in the attached *Table IV.D.6-1* of the HHPLS Report. Details on the recommended actions are included in the report in the accompanying text. The recommendations were coordinated through the MCWD Regional Team 8 public involvement process. In addition see the recommendations in the HHPLS Volume III (Public Involvement).

   Recommendations from the HHPLS of particular relevance to AER include development of tile inventory/wetland restoration plan (Rec. #3), corridor management plan (Rec. #4), installation of energy/flow dissipation (Rec. #11), establishment of lake and wetland buffers (Rec. #12), stabilization of connective streams (Rec. #13), wetland restoration (Rec. #15), lake restoration (Rec. #16), Turbid Lake/Lunsten Lake corridor restoration (Rec. #26). Similar to the Lower Watershed recommendation, MCWD staff also recommends that wetlands identified in the MCWD Functional Assessment of Wetlands are evaluated under the Feasibility Study for both restorability as well as enhancement. MCWD is also in the process of completing work related to the MCWD Stream Assessment for Six Mile Creek. Information produced from this study and subsequent recommendations will be available in the near future.

   MCWD staff suggests that areas outside of the immediate creek corridor are considered for potential improvements including:

   a. Riparian areas of Turbid Lake, Mud Lake, and other lakes within the hydrologic system, for potential shoreline restoration efforts and preservation and/or enhancement of native buffering
   b. Tributary ditches and streams to the major tributaries for issues related to the management of flow and reduction of sediment loading.

2) Dutch Lake, Lake Minnetonka, Gleason Lake, Long Lake Creek, Christmas Lake, Schutz Lake, Lake Virginia (in order of prioritization): Each of the remaining subwatersheds face varying levels of threats from degradation as a result of development and contain objectives and potential projects identified in the HHPLS Report. Details on the recommended actions are included in the report in the accompanying text. The recommendations were coordinated through the MCWD Regional Teams public involvement process. In addition see the recommendations in the HHPLS Volume III (Public Involvement).

MCWD staff suggests that stream reaches and in/outflows from these watersheds merit additional investigation to the identification of potentially restorable corridors. MCWD has an interest in preserving and enhancing connective systems within these watersheds in much the same manner as the previous MCWD staff comments for Painters, Six Mile and the Minnehaha Creek watersheds.

6.3 SUMMARY

As evidenced from the comments above, one of the primary concerns of MCWD is that the potential improvements to the watershed made in partnership with the USACE are evaluated under a systems-managed approach to watershed management. To clarify, MCWD has a keen interest in not focusing solely on the implementation of Best Management Practices (BMPs) within site-specific areas, but rather the development of a comprehensive system plan which will utilize a host of management tools including BMPs, land (open-space) preservation, promotion of infiltration, ecological enhancement, creation/restoration of riparian corridors and protection of critical areas as tools in managing the overall effects of humans upon water resources within a developing and urbanized watershed. It is also important to MCWD in the context of Aquatic Ecosystem Restoration to gauge the future water quality, stormwater runoff rates, and volumes within the watershed necessary to sustain any such improvements over time.

The MCWD recognizes that local preferences may not fit into the Federal Interest, especially when traditional NED calculations are applied. It may be that a combined NED/NER plan or NER plan will be found to be in the Federal Interest. Given the limitations of time and money, HDR recommends that the Corps proceed with the Feasibility Study and examine potential alternatives in the order proposed by the MCWD.

7.0 OVERALL ASSESSMENT

The MCWD has assembled an incredible wealth of watershed information that is unparalleled by other Minnesota Watershed Districts. There are very reasonable and accurate assessments of hydrology, hydraulics, wetlands, habitat and land use that will form an excellent foundation for the proposed MCWD and U.S. Army Corps of Engineers Feasibility Study (Study). HDR, in accordance with the latest task order has reviewed existing models, plans, studies and reports, summarized them, completed a gap analysis and developed GANTT charts for future actions by the Project Study Team.

The MCWD conducts an annual levy in the amount of three to four million dollars annually. It is unlikely, given the available tax base, that the MCWD will not pass the ability to pay reports for any of the following, proposed watershed Feasibility Studies. This activity should take no more than one day at the study beginning point, mid-point and end-point.

The initial assessments of cultural and historic resources, the social environment, economics of project alternatives, wetlands, habitat units, soils, hydrology and hydraulics is a "paper" exercise that can commence in January 2004. Dependent upon the findings of the various Project Delivery Team members, additional field reconnaissance and studies would commence and be completed in May 2004 after the start of the growing season for this climatic region.

The GANTT charts reflect a combination and blending of local and MCWD goals and objectives, and the Federally mandated planning process. The GANTT charts begin with the assumption that an EIS for the proposed feasibility studies will be required, however, it is quite likely that only a programmatic EA will be required. Overall, the MCWD 509 and Corps Feasibility studies will unite in the September 2004 timeframe with the AFB process of the Corps blending into the project adoption stages of the Minnesota 509 3rd generation watershed planning process. Given this assessment, HDR reviewed potential watershed projects with the objective of "matching" potential projects of local interest with the primary federal outputs of:

- Navigation
- Flood Damage Reduction
- Aquatic Ecosystem Restoration
- Multipurpose Projects
- Watershed Planning

As is apparent upon review of the summaries of the local planning documents, the local units of government within the watershed are also very proactive in dealing with issues of land use and stormwater management. It is recommended that these local units of government be actively engaged in the stakeholder sessions in the event that local projects can be identified that are best suited to Corps Continuing Authorities Programs such as Section 205, 206 and 14.

Appendix A

Summaries of Local Plans, Studies and Reports

US Army Corps
of Engineers ®
St Paul District

Summaries of Local Plans / Studies / Reports

January 30, 2004

Prepared by:

HDR

6190 Golden Hills Dr.
Minneapolis, MN 55416

Summaries of Local Plans / Studies / Reports

US Army Corps of Engineers ®
St Paul District

Prepared for:

United States Army Corps of Engineers St. Paul District

January 30, 2004

Prepared by:

HDR

HDR Engineering, Inc.
6190 Golden Hills Dr.
Minneapolis, MN 55416

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Introduction

The Minnehaha Creek Watershed District (MCWD) is 181 square miles in area and encompasses eight major creeks, 129 lakes and thousands of wetlands. The MCWD contains all or part of 27 cities, three townships and two counties. Where available, HDR Engineering, Inc. (HDR) reviewed existing local plans and reports as a part of this Task Order. Reports reviewed included Flood Area Reports, Storm Water Plans and Wetland Management Plans. Common themes of the various plans include:

- Flood damage reduction and management of storm water for the 10-year and 100-year precipitation events.
- Best management practices for storm water and water quality.
- Wetland management plans in accordance with the Wetland Conservation Act of 1991.
- Identification of priority lakes and wetland resources for protection. Establishment of natural corridors where possible.
- Financing of storm water and related infrastructure.
- Public education and outreach programs to enhance natural resources and water resources management.

For the purposes of this Feasibility Study, the primary areas of federal interest would lie in Navigation, Flood Damage Reduction, Aquatic Ecosystem Restoration, Multipurpose Projects and Watershed Planning. In the area of Navigation, there were no projects identified by local units of government. The most likely project would be making Minnehaha Creek passable from Gray's Bay to Minnehaha Falls. However, it is not likely that changing a couple of bridges and culvert crossings would yield the benefit cost ratio needed for Federal Interest. In the area of Flood Damage Reduction, the City of Minneapolis had by far the most advanced program and the largest identifiable need for mitigation projects. However, the flooding problems in Minneapolis are due primarily to an aging storm water infrastructure system and thus do not "fit" as a high priority Federal Output. The most likely way to address the flooding problems of Minneapolis and other creek corridor municipalities would be through an Aquatic Ecosystem Restoration or Multipurpose Project that attempts to restore the hydrologic regime and natural environment of the corridor and that provides secondary flood damage reduction benefits to the member cities. The cities and counties within the MCWD already have local comprehensive plans that address storm water, land use, wetlands and natural spaces. These plans are approved by the MCWD under the umbrella of the overall watershed plan. The U.S. Army Corps of

Engineers (USACE) planning authorities are best suited to the overall watershed scale and existing MCWD plan rather than on a municipal boundary.

Based on review of USACE planning authorities and guidance and of numerous local plans, it appears that the most likely role for municipal government within this Feasibility Study is in an advisory role to the MCWD as project alternatives are carried forward for consideration. There may be some local projects that are a good fit for one of the Continuing Authorities Programs, such as Section 206. Local governments should be encouraged to bring these forward at MCWD listening sessions. However, for the purposes of watershed-scale projects, the local units of government are in the best position to support projects of interest between the MCWD and the USACE. These project types include whole lake modeling and restoration, creek corridor restoration and large-scale wetland and ecosystem restoration projects.

The local plans that were available for review include the following:

City of Minneapolis 1997 Flood Area Report

PURPOSE

In response to numerous severe storms experienced in the City of Minneapolis this summer, the Department of Public Works studied the resulting flooding and developed a mitigation program. This report presents findings and recommendations of the Minneapolis Public Works, Sewer Design Division for flood mitigation in 39 discrete problem areas of the City. The goal of the recommended Street Flooding Mitigation Program is to provide all areas of the City an equal level of protection from storm water runoff.

THE SUMMER'S STORMS

On July 1, 1997 the City of Minneapolis experienced a series of rainstorms that overburdened the City's storm water drainage system, causing back-ups from the sanitary sewage system, saturation of the soils, and overfilling of lakes and streams. The unusual feature of this storm was that it hit the entire City. The July 1 storm was followed by severe storms on July 11, July 13, July 17, July 22, August 30 and September 16. Many homes and businesses in the City were subjected to repeated water damage. In July 1997, the Minneapolis/St. Paul International Airport recorded a monthly total precipitation of 12.5 inches, second only to the 17.9 inches that fell in July 1987. The 18 days of measurable precipitation in July 1997 set a rainfall frequency record.

IMMEDIATE RESPONSE

On July 20, the Transportation and Public Works Committee of the Minneapolis City Council conducted a flood public hearing for property owners at the Minneapolis National Guard Armory located on Broadway Avenue NE. Tables were set up for residents to gather information on garbage collection, low-interest loans, tree removal, basement pumping and street flooding. Attendees of this meeting filled out flood reports and described their problems to the City Council. At their next meeting, the City Council directed the Department of Public Works to make some immediate improvements to the storm drain system, primarily installation of a remote telemetry system at all storm water and sanitary pump stations, and on-site emergency generation at two storm water pump stations. The Department of Public Works also reassigned street crews to clean-up debris in flood-prone areas, offered free sandbags to residents, pumped excess water from basements and established a flood hotline.

FLOODING ANALYSIS

Calls were logged from residents who called the Minneapolis flood hotline, council members, and Minneapolis Public Works. All of the information was combined into a database of names, addresses, and types of flooding. Four categories of flooding were used: sewage backup, house flooding, garage flooding and area flooding. Flood locations were mapped on the City's geographic information system and correlated with the storm drainage systems. Sewer Design and Sewer Maintenance staff performed field inspections, as well as hydraulic and hydrologic analysis of drainage systems to determine the primary cause of flooding in each area. From this analysis, 39 discrete project areas emerged. Alternatives for mitigation were examined for each of the 39 areas and recommendations proposed for each. The projects were then evaluated for problem frequency, proposal effectiveness, prior commitment, coordination, problem magnitude, effectiveness, and proposal cost. Each project area was assigned a numerical rating which was used for prioritization. The location of the 39 flood study areas are superimposed on a map of ward and neighborhood boundaries. This map follows the cover letter at the front of this report. Seven additional project areas are currently under investigation for inclusion in the Flood Control Program, and are listed in Appendix B.

THE NEXT STEP

As directed by the Mayor, the Department of Public Works is proposing a flood control program. The 39 individual projects have been grouped into three categories:

- Category 1 High Priority / High Bucks
- Category 2 Intermediate Priority / Big Bucks
- Category 3 Intermediate Priority / Low Bucks

Category 3 is already in the 1998-2002 Capital Program. It is recommended that a nine-year flood mitigation program be established with annual funding for 1998-2006. Category 1 and category 3 projects would be programmed 1998-2002, with category 2 projects scheduled in 2002-2006.

FIELD INSPECTIONS

Survey personnel completed final field inspections of each project area. The condition of drainage structures was checked and each site was examined for determination of the problem source. The inspection included the following items:

- Identify all catch basin grates in the area.
- Inspect alley drains and catch basin grates for debris.
- Check for blocked catch basin pots or pipes.
- Inspect main line.
- Check for and inspect sanitary overflows.
- Check for storm damage to storm and sanitary systems.
- Determine if separation is complete.
- Check for erosion problems.
- Check all weirs, diverters, equalizers, or other flow control devices.
- Check if outlet is unrestricted and free of debris.
- Take photos of relevant damage, or other items of interest.
- Visit constituents who had problems.

Any feasible action that could be performed to alleviate or solve the problem, that did not require a major capital expenditure (such as removal of debris from structures), was ordered upon completion of each inspection. Notes and photos from these inspections were then inserted in each project area file.

HYDRAULIC ANALYSIS

For each of the problem areas, the capacity of the existing storm drain pipes was calculated using Manning's formula. This formula for capacity analysis uses pipe material, slope and size to obtain the amount of flow the pipes can handle. Then, the peak runoff for a 10-year frequency storm was computed using the Rational Method. The Rational Method factors the runoff coefficient, the drainage area, and the average local rainfall intensity to estimate the peak runoff. The pipe capacity and the amount of runoff were compared in order to determine if the problem was related to undersized storm drain pipes.

FLOOD CONTROL ALTERNATIVES

Minneapolis Sewer Design staff discussed the project areas and devised several alternatives for each project. The costs of each were estimated and the feasibility of various solutions were examined. The cost/benefit determined the recommended alternative for each project.

FLOOD MITIGATION PRIORITY RANKING

The final step in the analysis phase was an evaluation of each project area and the assignment of a numerical rating. Rating points were assigned based on the same criteria utilized by Minneapolis Public Works in 1981, to rank project proposals for flood mitigation after the severe storms of 1977-78. Seven different point categories contributed to the total score (point ranges follow each category description):

1. *Problem frequency* – frequency of flooding or sewer back-ups (0 to 10).
2. *Proposal effectiveness* – extent to which proposal will alleviate problem (0 to 10).
3. *Prior commitment* – extent proposal continues a previous commitment to a project (0 to 10).
4. *Coordination* – extent proposal could be coordinated with other planned construction(0 to 10).
5. *Problem magnitude* – severity and extent of flooding or sewer back-ups, danger to public health, and property damage (0 to 30).

6. *Effect on tax base* – negative effect if land acquisition required, positive if storm drains are upgraded which would allow for new development (-5 to 5).
7. *Proposal costs* – cost/benefit of project compared to other storm drain projects (0 to 30).

Senior staff members examined each project area along with the respective proposals. Points were assigned jointly in each category based on all available information. Individual project ratings are in the project reports. The ratings were used to prioritize the projects.

INTRODUCTION TO RECOMMENDATIONS

Individual options and recommendations for flood mitigation in the 39 identified project areas are included in this report. Seven additional project areas have been identified, but were found late in the process, and a formal study could not be completed for this report. These areas are described at the end of the project reports and will be incorporated into the City's Street Flooding Mitigation Program.

CAPITAL IMPROVEMENTS

STORM DRAINS

In many of the project areas, recurring flooding has been caused by storm drains which are undersized by current standards. Flood mitigation for these areas entails replacement of existing storm drain pipes with larger and/or additional ones.

FLOOD CONTROL PONDS

Five of the project area recommendations are for the construction of flood control ponds. These ponds are designed to fill with storm runoff during heavy rains, and empty out slowly. This stabilizes the peak flow, allowing the water to drain out over a longer period of time. These ponds are typically used in low lying areas which cannot be easily drained to a receiving lake or stream.

OTHER

Other recommended flood mitigation measures include replacing or upgrading catch basins and catch basin grates, installing additional pumps, and construction of future Combined Sewer Overflow projects.

RECOMMENDATIONS

MAINTENANCE RECOMMENDATIONS

Sewer Maintenance

Five flood control ponds are recommended in the Street Flooding Mitigation Program. An increase in Sewer Maintenance personnel is recommended for routine maintenance (inspection, cleaning, and vegetation maintenance).

Catch Basin Cleaning

A Public Works program to routinely clean leaves and other debris from catch basin grates is recommended.

REGULATORY PRACTICES

Ordinance to Prohibit Existing Rooftop Connections to Sanitary Sewers

Although the Combined Sewer Overflow program is nearly complete, there continues to be a problem of periodic overflows of combined storm water/sewage into the Mississippi River. Investigations have shown that commercial, industrial, and institutional rooftop connections to the sanitary sewers still exist. These connections are causing both overflows to the River and sewage back-ups into basements. A program to prohibit these connections is recommended.

Ponding Requirements for Developments

The increased paving of Minneapolis during the 1950's and 1960's contributed to the flooding that we experience today. A pond in a new development is an effective method to retain water and reduce or eliminate downstream flooding. A Citywide requirement for ponds in flood prone areas is recommended.

HOMEOWNER ASSISTANCE PROGRAMS

Backwater Valve Reimbursement to Prevent Sewage Backups into Basements

In 1989, the Sewer Maintenance budget was used to reimburse the cost of sewer backwater valves to homeowners in sensitive areas. At that time, $100,000 was established, and a maximum of $1,000 was reimbursed per eligible homeowner. Public Works has submitted a decision package in the 1998 budget that reestablishes funding at $150,000, and individual reimbursement of $1,200. It is also recommended that direct payment to plumbers be made in cases of hardship when a homeowner cannot afford the installation costs.

EDUCATIONAL PROGRAMS

Flood Insurance Information

Many residents and homeowner insurance providers are not aware that flood insurance can be purchased for Minneapolis properties that are not in a National Flood Insurance Program designated 500-year floodplain. Callers on the Minneapolis flood hotline and attendees of the citywide flood meeting were informed of the National Flood Insurance Program and provided with a phone number to call for more information.

Flood Prevention

The Federal Emergency Management Agency (FEMA) has published educational materials for homeowners describing flood protection measures such as landscaping techniques that can reduce a property's vulnerability to flooding. An informational handout from FEMA with a publication list of educational materials was distributed at the citywide flood meeting, and to callers to the Minneapolis flood hotline.

1998 - 2006 FLOOD CONTROL PROGRAM

Two flood control projects are currently in the five-year capital improvement programs. It is recommended that five new flood control ponds and 29 new storm drain construction projects be added. It is also recommended that two Combined Sewer Overflow projects, five storm tunnel repair projects and the Hiawatha Avenue storm drain be included in a flood control program. The recommended projects have been organized into three funding categories:

Category 1 High Priority / High Bucks

The top six projects are included in this category. Construction would occur between 1998 and 2002. It will take three to four years to undertake each of these projects, in the following sequence:

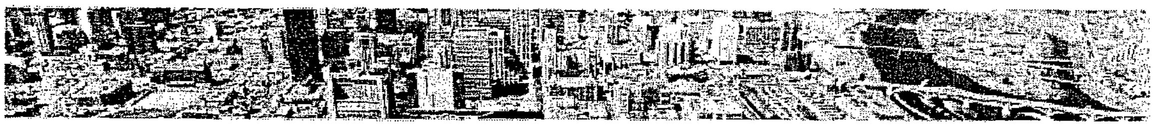
- *Year 1* critical property acquisition (flood pond projects, only)
- *Year 2* non-critical property acquisition and design engineering
- *Year 3* pond and storm drain construction
- *Year 4* pond and storm drain construction (larger projects)

Category 2 ***Intermediate Priority / Big Bucks***

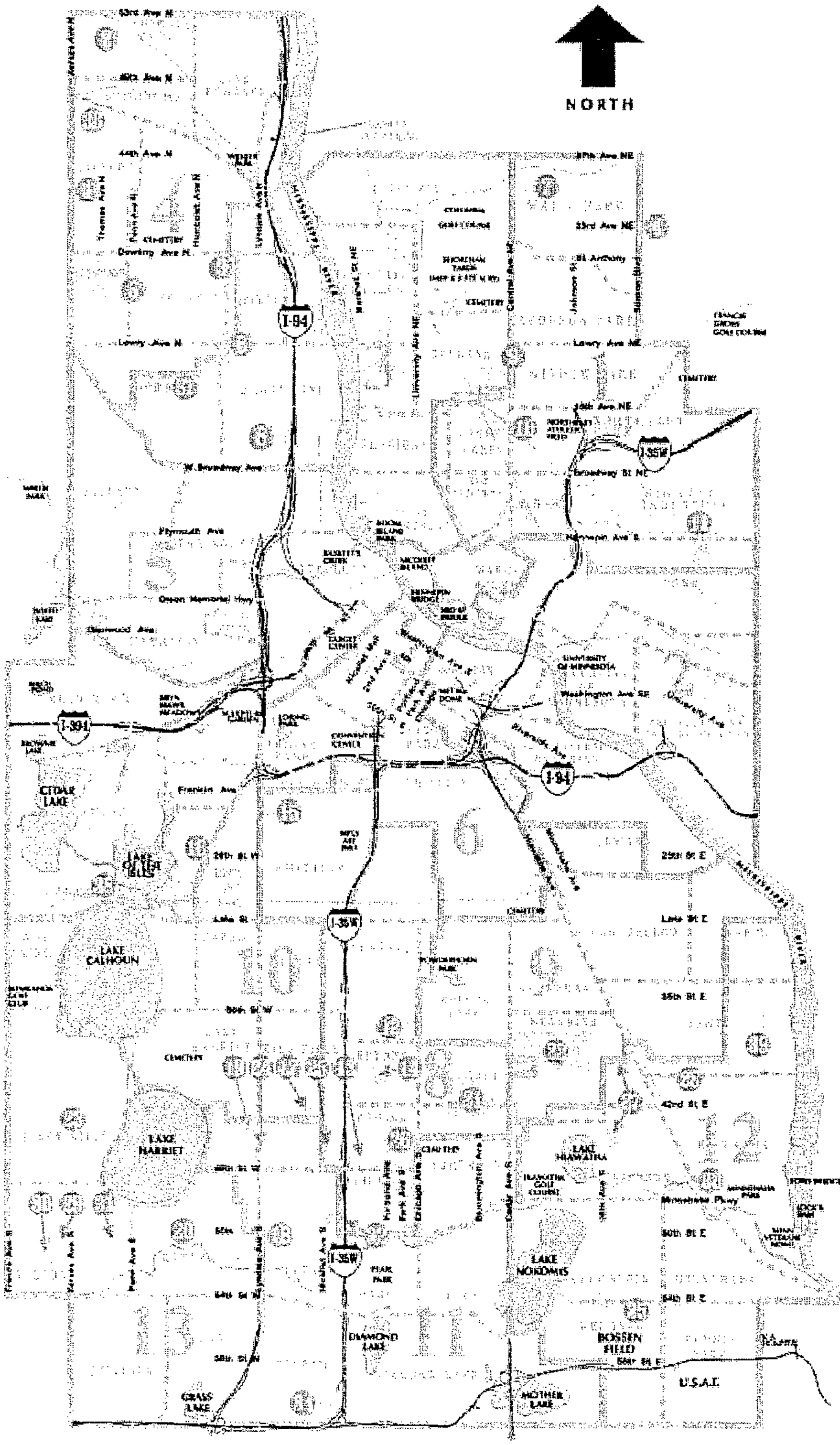
The next four large cost projects, with intermediate priority, are included in this category. Phasing of the projects follows the same sequence as Category 1 projects.

Category 3 ***Intermediate Priority / Low Bucks and Projects currently in the 1998-2002 Capital Program***

These projects are generally under $500,000 in cost and can be programmed into the 1998 - 2002 Capital Improvement Program. Appendix A contains summaries of all the project areas, including recommended project, cost, funding category, funding year and recommended construction year(s).



1997 PROBLEM FLOODING AREAS



Recommended Areas:	Water Outfall:
42ND AVE N & RUSSELL AVE N	20-210B
51ST AVE N & VINCENT AVE N	20-010
37TH & HUMBOLDT AVE N	10-110
33RD & BENJAMIN NE	10-100
35TH AVE N TO DOWLING AVE WASHBURN - MORGAN AVES N	63-010
36TH AVE N TO 33RD AVE N DUPONT TO IRVING AVES N	10-110
35TH AVE & POLK ST NE	10-100
3RD ST N AT 23RD AVE N	10-230
EDISON HIGH SCHOOL AREA	10-180
18TH & QUINCY NE	10-180
TALMAGE & HOOVER NE	10-460Q (10-460R)
3700 BLOCK OF COLUMBUS S	76-010
CLINTON AVE S FROM 45TH TO 46TH STS E	70-330
40TH ST E FROM 4TH TO 5TH AVE S	10-430K
22ND ST W & GARFIELD AVE S	10-430J
26TH ST W & EMERSON AVE S	53-180
43RD ST W & WENTWORTH AVE S	10-430J
50TH & WENTWORTH AVE S	70-285
44TH ST W & ALDRICH AVE S	57-020
MINNEHAHA CREEK - HUMBOLDT TO NEWTON AVES S	70-110, 130, 130, 148
BLOOMINGTON HOLDING POND AREA	78-010
SIBLEY FIELD	78-010
43RD ST W & ABBOTT AVE S	84-060A/B/C
48TH ST W & LYNDALE AVE S	10-430U
48TH ST W - NICOLLET TO 1ST AVE S	10-430U
E 43RD ST TO M'HAHA CREEK PORTLAND TO CHICAGO AVE S	70-350
39TH AVE S & E 44TH ST, 30TH AVE S & E 39TH ST	70-475
E 40TH ST & SNELLING AVE	10-680
50TH TO 51ST STS - ZENITH TO YORK AVES	87-100A/B
51ST ST W & ABBOTT AVE S	87-100A/B/C
50TH TO 51ST STS W & SHERIDAN AVE S	87-070
49TH ST E & STEVENS AVE S	70-330
MINNEHAHA CREEK - 34TH AVE S TO 38TH AVE S	70-536, 548, 856
60TH ST E - NICOLLET TO STEVENS AVES	71-070
54TH ST E & 28TH AVE S	10-720F
VICTORY MEMORIAL PARKWAY & XERXES AVE N	65-010
KNOX-MORGAN AVES N 27TH -29TH AVES N	40-010
DEAN PARKWAY	54-180
46TH AVE S 36TH TO 37TH STS E	10-670

MINNEAPOLIS
DEPARTMENT OF PUBLIC WORKS
OCTOBER 15, 1997
ENGINEERING DESIGN

City of Orono Surface Water Management Plan

This report was prepared in May, 2001 by Bonestroo, Rosene, Anderlik and Associates. It is to serve as a guide for the expansion and development of the surface water system in Orono, and to provide a basis for a consistent approach to lake and wetland protection. It builds upon the surface water plan from 1974. Orono is located to the west of the metro area in Southwestern Hennepin County. Goals and policies were listed in this report. Goals are as follows:

- Provide 100-year flood protection for all residents and structures.
- Promote the reduction of phosphorus loading to waterbodies by regulation, municipal management activities, and public education.
- Monitor water quality and attempt to maintain the water quality of surface waters in the City.
- Equitably finance the construction and maintenance of the surface water management system.
- Involve the public in the City's water quality management efforts.
- Successfully operate the surface water management system.
- Prevent hazardous waste from entering the storm water drainage system.
- Adhere to federal, state, and watershed policies and regulations.

There are three significant aquifers from which groundwater is currently being used – the quaternary (water table) aquifer, the St. Peter aquifer, and the Prairie du Chien-Jordan aquifer. Orono was divided into 18 major drainage districts, and all are within the MCWD. These were then further subdivided into subdistricts. The following issues have been addressed in this report.

- Division of the City into drainage districts and subdistricts based on contour maps, grading pans and natural topography.
- Determination of runoff under ultimate land use conditions.
- Layout and sizing of trunk storm sewers and open channels.
- Determination of storage volumes, high water levels, and peak outflows of all required ponding areas.
- Identification and classification of selected wetlands.
- Development of wetlands management policies to ensure compliance with local, state and federal wetlands regulations.

- Recommendations for education of City residents, staff and development community.
- Estimation of implementation costs, priorities and system financing.

City of Tonka Bay Comprehensive Plan

Tonka Bay is located within the MCWD. It is a fully developed city entirely within the Metropolitan Urban Service Area (MUSA). The City receives metropolitan wastewater service (interceptor 7017 and 6-TB-661, and lift station L19), and flows are treated at the Blue Lake Wastewater Treatment Plant. No metropolitan highways run through the city. Its last complete comprehensive plan was in 1980. The City has several large and small wetlands and lagoons. The City has a natural storm water drainage system. A few locations have culverts under the street. Four storm water ponds are provided. No septic systems are in use in the City. The City's water resource management issues and needs are listed and described below:

- Natural system: Maintaining and protecting the City's natural drainage system is cost-effective and supports the City's vision and goals.
- City's Marina and Lagoon: The City's marina could be expanded to provide lake access for residents not having lakeshore property. The lagoons can be aesthetically and functionally improved.
- Surface Water Quality: Reducing phosphorus and erosion are important, thus this will affect water conditions.

An implementation program was described as follows:

- Regarding phosphorus fertilizer: inform the residents of the ordinance and promote its enforcement.
- Sweep streets and parking lots at least twice a year.
- Adopt Best Management Practices Guide by 2001.
- The City will promote understanding of the phosphorus ordinance and the relationship between clean water and activities of the public.
- Continue to use and apply the adopted floodplain, shoreland and wetland ordinances.

City of Richfield

2020 PLAN

Information from this plan was taken from the City of Richfield website. Various city goals were described, but this summary will look at the environmental goals. The following is a list of the City's environmental goals.

- City staff is accountable for including ecological concerns in all aspects of City planning and activity. Eight strategies were listed. Included are: inventory, restoration, monitoring, water surface management/monitoring, natural resource area integration with parks/greenways and recycling.
- Maximize environmental engineering opportunities. Again, this is related to storm water management and water quality and reduction on man-made systems.
- Restore disturbed ecological systems.
- Provide ecological buffering.
- Ensure ecological management and monitoring.
- Enhance ecological education with the purpose of fostering an understanding of sustainable community development and of protecting Richfield's air, land and water resources.
- Encourage use of native landscaping.

WENCK MEMO 11/8/00

This memo to Glenda Spiotta (MCWD) from Lisa Tilman (Wenck) begins with recommendations and then provides a brief summary of the City of Richfield's Surface Water Management Plan (SWMP) (Wenck File #0185-04-2671). Wenck's recommendations are that the MCWD accept the City of Richfield SWMP upon completion of changes summarized in their report. Wenck's recommendations for the City of Richfield include:

- Include an implementation program and priorities.
- Include a summary of expected plan implementation costs.
- Adopt a floodplain ordinance, a shoreland ordinance, a nonphosphorus fertilizer ordinance, and an erosion control ordinance as planned.
- The Plan should state that the 100-year floodplain storage capacity would be preserved.

- The wetland policies listed in the Plan include a case-by-case assessment of wetland function and value. This should be changed to reference the established wetland management plan and completed function and value assessment.
- The City's wetland buffer requirements should be increased to be at least as restrictive as the District Rule D.
- The City should consider adding other wetlands that show higher function and value levels (such as Galyan's Pond) to the Manage 1 category.
- The City should also include a statement that the District's wetland function and the District will incorporate value assessment results into the plan and policies following completion of the assessment.

WENCK MEMO 4/26/01

This memo was addressed to Glenda Spiotta (MCWD) from Lisa Tilman (Wenck). It relates to changes in Richfield ordinances to conform with MCWD rules. The changes relate to dredging, mitigation and buffers.

CITY OF RICHFIELD COMPREHENSIVE SURFACE WATER MANAGEMENT PLAN

The sections addressing water quality, recreation, fish and wildlife, public participation, information/education, public ditch system, groundwater, wetlands and erosion were copied from the compete SWMP. Goals and policies are described for each of these sections.

City of Excelsior Local Water Management Plan

Excelsior adopted the MCWD Water Resources Management Plan. Their storm water management goal is:

- Improve both the treatment and the rate of storm water flowing from private property in an effort to improve water body quality and to minimize surface flooding and erosion.

Natural Environment goals are defined as follows:

- Ensure that community development is compatible with features of the natural environment and is accommodated without destroying environmental features and natural amenities.

- Provide protection for wooded areas, natural wildlife habitats, floodplains, storm drainage areas and wetlands to insure against loss of significant community amenities.
- Protect ground water and soil from contamination and pollution resulting from urban or agricultural uses and correct problems where necessary.
- Reorganize limiting soil features and significant slopes with respect to urban development stability.

City of Chanhassen Comprehensive Plan 1998

The city has made three significant changes to the comprehensive plan since its adoption in 1991. These are as follows:

- Storm Water Management Plan (1994). This plan guides the water quantity and quality issues in the city. The plan puts special emphasis on preserving and enhancing DNR-protected wetlands, plans for future development and growth to reduce public capital expenditures. It recommends rates of runoff to minimize flooding, erosion and sedimentation from surface flow.
- Highway 5 Corridor Study (1995). This plan recommends certain land use changes along this corridor. The purpose of the plan is to protect creek corridors, wetlands and significant stands of mature trees, to promote high-quality architectural and site designs, to create a unified, harmonious and high quality visual environment and to foster a positive community image for the City of Chanhassen.
- Bluff Creek Watershed Plan (1997). This plan recommends land uses in the Bluff Creek Watershed and the southern area of the city. The goals are to protect, restore and enhance the natural resource, to create a continuous greenway along the creek from the Minnesota River to Lake Minnewashta, to manage upstream development for ecological protection through development options, such as mixed or cluster development easements or alternative zoning and education and awareness of the watershed.

In 1993, the city adopted a Comprehensive Sewer Policy Plan and a Water Supply and Distribution Plan. These are being updated as part of the 1998 Comprehensive Plan. It was noted that one problem affecting the Chanhassen sewer system was infiltration and inflow. Chanhassen is using a variety of methods to address these problems. These methods include the following:

- The Downtown Redevelopment Project included sanitary sewer line replacement and establishment of a new storm sewer system.
- The City Council adopted Ordinance No. 5 that prohibits the discharge into the sanitary sewer system of any surface or sub-surface waters.
- Sump pumps are required to have an outside discharge, and private property sump pump inspections are occurring.
- Over 40,000 lineal feet has been televised to locate system defects.
- Maintenance staff has increased.
- Construct drainage improvements necessitated by the recent sump pump inspection program.

Chanhassen's existing sanitary sewer system contains 29 lift stations, three interceptors, and one treatment plant. There are eight existing wells in Chanhassen. City well #1 has been abandoned.

City of Minnetonka Water Quality Management Policy Draft (5/6/96)

This report is divided into two parts: objectives/strategies in establishing a water quality policy and the review process/requirements/standards for construction activities. Projected uses and goals for each of the City's wetlands and major water bodies have been identified. The City intends to use regional watershed management wherever possible to attain the water quality goals for the watershed. BMPs will be required on construction sites, and the City intends to review plans for construction activities in accordance with this policy.

Water Resources Management Plan City of Minnetonka (1/99)

This report was prepared by Barr. Currently 96% of the city is developed, but because of early water management efforts of the city, natural areas have been preserved from development. In 1982 the city developed a "first generation" plan that established an integrated storm water management system. Since then, additional emphasis has been placed on the preservation and enhancement of wetlands and water quality. Water quality concerns have led to inclusion of more storage than would be required for flood protection alone. This plan takes the previous storm water management efforts further by integrating flood control with wetland and water quality needs. Water resources are managed by balancing conflicting needs so the whole system is optimized for public benefit. Priority water bodies are protected through classification and regional management whereby some water bodies are used to protect other higher quality ones.

Section 2 of the plan presents general and physical information that relates to the City's water resources. Section 3 describes surface water resources. It presents the wetland, water quality, and flood control management plans. Section 4 presents the city's water resource goals and policies. Sections 5 through 8 present detailed inventory data and management plans for each of the four major watersheds. Section 9 summarizes water resource problem areas and presents the program for implementation of goals and management plans.

City of Long Lake Water Resources Management Plan (Draft) (12/01)

This city is located in Hennepin County on the south shore of Long Lake. It is entirely within the MCWD, with a generally southerly surface water flow direction towards Lake Minnetonka. In 1998 the City was divided into seven distinct subwatersheds for the original Draft WRMP. In 1997, the Long Lake Ravine subwatershed was modeled by the MCWD. At that time, the MCWD had proposed to expand an existing wetland complex west of Industrial Blvd. to serve as a storm water detention and treatment basin. A key component of this plan relates to several regional storm water treatment ponds that MNDOT will construct as part of the Highway 12 realignment project. Anticipated future land use changes include the development of the remaining undeveloped property in the eastern portion of the City, realignment of Highway 12, and redevelopment of the downtown area.

Golden Valley Comprehensive Water Resources Plan

The City of Golden Valley is located almost entirely within the Bassett Creek Watershed, with the far southeastern corner being located in the Minnehaha Creek Watershed District. Hydrological data collected confirmed that there are no serious storm water infrastructure needs for the city. The purpose of this plan is to provide a guide and reference for managing water resources within the City of Golden Valley. This plan will assist with policy decisions, water resource management, implementation priorities, regulatory program references, and capital improvement budgeting for water resource issues.

This plan is divided into two main sections. Section 1, Water Resource Management, contains information about proposed management programs, a summary of existing programs, objectives, policies, a management plan, and implementation priorities. Also included are a capital improvement plan and a storm water utility fee analysis. Section 2, Water Resource System, provides analysis of the storm water system. The plan references four main drainage districts. These are Bassett Creek, Medicine Lake, Minnehaha Creek, and Sweeney Lake Districts. These districts are then further divided into subdistricts. The appendix contains information including subdistrict descriptions, hydrological data, wetland information and water quality data. A complete water resource inventory was done for each district.

Several ponds along Laurel Avenue were monitored for pollutant loadings and flow during several storm events. The water quality modeling and monitoring data indicates that the existing storm water pond network is effective at removing nutrients in some areas, while other areas could be improved.

Golden Valley Surface Water Management Planning Committee (SWAMP) (10/98)

This committee was formed in August 1997. It was established to set priorities and goals for surface water management for the City of Golden Valley. Golden Valley has many programs in place to deal with water quality issues. They include: sediment removal program, installation of sump catch basins, street sweeping and the implementation of BMPs. The following are improvement needs and strategies for improving water quality in Bassett Creek.

- Adopt an erosion and sediment control ordinance.
- Reduce sedimentation.
- Reduce road runoff.
- Reduce impervious pavement.
- Increase public awareness.
- Implement stream bank stabilization.
- Add storm water ponds.
- Develop a catch basin cleaning schedule.
- Create ponds for nutrient reduction.
- Construct sediment catching manholes.

The following are improvement needs and strategies for improving water quality in lakes and ponds.

- Construct regional detention/nutrient removal basins.
- Increase public awareness
- Enforce existing ordinances.
- Improve specific areas (Centennial Pond, Rice Lake, and Sweeney Lake).
- Work in a combined effort with other cities and organizations.
- Increase/implement pond bank stabilization program.

- Reduce imperviousness.
- Develop some ponds with the goal of growing vegetation to use up nutrients.
- Construct sediment catching manholes.

The following are improvement needs and implementation strategies for erosion and sediment control.

- Adopt new ordinances.
- Develop a fringe of native and naturally existing shoreline vegetation.
- Educate and inform the public.
- Clean all sump catch basins.
- Improve street sweeping.
- Minimize tree removal.

The following are improvement needs and implementation strategies for wetlands.

- Adopt a wetland ordinance.
- Coordinate with other agencies to protect and preserve wetlands in Golden Valley.
- Maximize buffer zones around wetlands.
- Adopt a wetland inventory map.
- Increase public education.
- Excavate wetlands that have become filled to clean out sand and other manmade deposits.

The following are improvement needs and implementation strategies for flood control.

- Regulate new development.
- Increase public awareness.
- Examine all culverts for leaves and debris.
- Reduce and avoid large tracts of impervious pavement.
- Build all new buildings above the 100-year high watermark.
- Update MSA storm sewer map.
- Increase flood prevention measures in problem areas (Brookview Park walking paths, Toledo/Minnaga Bend, golf course flooding)

The following are improvement needs and implementation strategies for aesthetics and recreation.

- Increase recreation opportunities on Bassett Creek.
- Increase attractiveness of ponds and lakes.
- Construct new holding ponds.
- Increase public awareness.
- Create multiple use ponds.

Water Resources Management Plan, City of Plymouth (12/99)

The city lies within four watersheds that are further subdivided into 39 subwatersheds. Within the 39 subwatersheds, 310 individual drainage areas and 918 individual ponds/wetlands have been identified. Each subwatershed is tributary to one of the City's eight major lakes, one of several other significant water bodies or creeks, or directly to an adjacent community.

The four watersheds are as follows:

- Elm Creek: Drains the mostly undeveloped northwestern corner of Plymouth. When this area begins to develop, the drainage plans for Plymouth and Medina will have to be coordinated.
- Shingle Creek: Drains the north central and northeastern part of Plymouth.
- Bassett Creek: Discharges southeasterly through Golden Valley and Minneapolis to the Mississippi River. Medicine Lake is found in this watershed.
- Minnehaha Creek: Is located in the southwestern portion of Plymouth. The major lakes in the basin are Gleason Lake and Mooney Lake. This part discharges south into Minnetonka and Wayzata, and westerly into Medina

The four main purposes of this plan are to:

- Update the 1980 Storm Drainage Plan
- Address water quality concerns.

- Meet the rules of the Watershed Management Organizations (WMO) that require local city plans be completed in conformance with regional watershed plans.
- Meet the requirements of the Metropolitan Council which requires that a Water Resource Management Plan be included as part of a City's Comprehensive Plan.

There are seven major elements of this management plan:

- Ranking of eight major water bodies (Bass, Pike, Schmidt, Pomerleau, Parkers, Medicine, Gleason, and Mooney Lakes).
- Land and water resources inventory.
- Ten city-wide goal-driven implementation plans.
- Nine specific water-body-driven action plans.
- Individual treatment capacity analysis for 39 subwatersheds.
- Preservation of exceptional wetland resources.
- Prioritization of recommended improvements.

Differences between this plan and the 1980 plan include the following. Past efforts to manage water resources have focused primarily on storm water quantity. Major storm drainage improvements were first undertaken in the mid 1960s. The initial plan was subsequently updated with the 1973 storm drainage plan, which presented an overall layout of major drainage facilities in Plymouth, including storm sewer, ponding areas and major drainage ways. The City revised the 1973 plan in 1980. The 1980 revisions were based on recent platting and development proposals, storm drainage improvements and the Land Use Guide Plan. The plan provided information on storm sewer and open channel sizes, storm water flows, pond storage volumes and water levels and detailed cost analysis. The 1980 plan relied heavily on the use of natural storage for the purpose of flood control.

Storm Drainage Plan – City of Plymouth

Major storm drainage improvements were first undertaken in the mid 1960s. Facilities were constructed within the south Parkers Lake Area, the Beacon Height Areas and the Garland Lane and 14th Avenue area. In 1973, a Storm Drainage Plan was prepared for the entire City of Plymouth. It presented an overall layout of major drainage facilities in Plymouth including storm sewers, ponding areas, and major natural drainage ways. The 1980 Storm Drainage Plan provides information on storm sewer and open channel sizes, storm water flows, and pond storage volumes and water levels. The following items have been reviewed and updated and form the basis for the 1980 Storm Drainage Plan:

- Subdivision of the City into watershed, major drainage districts and subdistricts.
- General routing of storm sewers and open channels.
- Design flows for all proposed facilities
- Type, tributary area, storage capacity and water levels of all proposed ponding areas.
- Estimated construction costs of the storm drainage system and a cost allocation on an equivalent area basis.

Natural Resources Restoration and Management Plan, City of Minnetonka (1996)

This report summarizes the restoration and management plan for the selected natural resource areas within the city. The study focused on the five largest parks and three creek corridors in the city (Big Willow Park, Lone Lake Park, Purgatory Park, Civic Center Park, Meadow Park, Minnehaha Creek Corridor, Purgatory Creek Corridor and Nine Mile Creek Corridor)

The primary objective of this study was to evaluate the existing ecological condition of selected natural resources, and to design a management plan that will contribute to site restoration. Site characteristics are individually described in this report.

Storm Water Management Plan, City of Wayzata (1988)

This report presents an analysis of the existing storm water management facilities in the City of Wayzata. The work necessary to upgrade existing systems to acceptable standards of safety, capacity, and aesthetics were identified. It is divided into five study areas (drainage districts). This report discussed the following: land use, design storm event , drainage patterns, and wetland inventory and analysis. The various drainage districts that were covered in this report are as follows: Holdridge, Lasalle Basin, Gleason Creek, Downtown, and Peavey Pond. Hydrologic methods were covered in this report as well.

City of St. Louis Park Comprehensive Water Resources Management Plan (8/01)

This plan has been developed to provide the City of St. Louis Park with direction concerning the administration and implementation of all water resource activities within the City. It will be implemented through the year 2005, at which time this plan will be updated. It incorporates the approaches and direction provided in the programs and documents listed above into a comprehensive plan that can be consistently applied across the City. Section III of this plan provides an inventory of land and water resources within the City that includes the following:

- The location of wetlands within the City that are identified by the MN DNR as protected waters, and wetlands which were identified by the USFWS in their National Wetland Inventory.
- Extensive discussion concerning recognized drainage problems within the City. This discussion includes a description and breakdown of flood problem areas into areas that have been improved through capital improvements, areas which are to be addressed through the capital improvement plan, areas which were investigated and where no corrective action is required and areas which will require further investigation.
- The location of possible pollutant sources within the City. A map is also included which shows the location of all sites as recognized by the MPCA.

Section IV outlines water resource management goals and policies. They are listed in the report. Section V provides an assessment of the existing and potential water resource related problems. These are listed in the report. Section VI discusses financial considerations. Section VII outlines implementation priorities and develops an implementation program. Section VII discusses the procedures to be followed in the event this plan is amended.

A hydrologic summary for the subwatersheds is included. Storm water management guidelines for new development or redevelopment are described. Site specific and general BMP are provided in this report.

Wetland Management Plan, City of St. Louis Park

There are approximately 38 wetlands within the City. All known National Wetland Inventory (NWI) wetlands within the City were evaluated with the exception of those areas where permission to access was denied or where it could not be accessed. Most of the wetlands receive directed storm water. Little space is available to pretreat storm water prior to discharge to wetlands. However, as areas redevelop, pretreatment will be provided. This WMP is to provide a means for the City to manage its wetlands. It provides guidelines for wetland management and assistance with the Wetland Conservation Act. Approximately 36 wetlands were evaluated. Wetland types 2, 3, 4, and 5 are represented within the City. All of the wetlands show signs of impact by storm water or other disturbance. Nearly all of the wetlands receive direct storm water from the storm sewer system. There is very little opportunity to provide treatment for storm water adjacent to many of these wetlands due to the fully developed nature of the City. Retrofitting the storm sewer system is not feasible or cost-effective. The City has placed wetlands into Manage I or Manage II classifications. Manage I wetlands are of higher quality, special purpose and are located primarily on public land. These wetlands include Westwood Lake, Bass Lake and Meadowbrook Lake. The remainder of the wetlands have been placed in the Manage II category.

Manage I wetlands will be managed as follows:

- A 20-foot minimum buffer around the perimeter of wetlands will be implemented, where feasible, by eliminating mowing activities. Wider buffer widths will be implemented in accordance with Watershed District standards if wetlands are proposed to be impacted by filling or draining.
- Perimeter storm water treatment systems will be allowed where upstream treatment cannot be provided. Grit chamber systems will be constructed upon redevelopment if a perimeter system cannot be constructed. Maintenance to remove accumulated sediment is anticipated to occur on an "as-needed" basis.

Manage II wetland will be managed as follows:

- Continue to utilize wetlands for storm water management as wetlands are used in their present condition.
- A 10-foot minimum buffer around the perimeter of wetlands will be encouraged through public education efforts. Wider buffer widths will be implemented in accordance with Watershed District standards if wetlands are proposed to be impacted by filling or draining.

Appendix B

Identification and Description of In-Kind Services

Identification & Description of In-Kind Services
MCWD Feasibility Study
December 3, 2003

A table in the main report (referenced to the Gantt Chart) would be helpful. Each sub-task/task and milestone should include the identification of the proposed in-kind services that the non-federal sponsor will provide (when applicable to a task). A short description of the in-kind service as well as its monetary value will should be included.

The MCWD and U.S. Army Corps of Engineers (Corps) entered into a Feasibility Cost Sharing Agreement in January 2003. At the time this agreement was signed, the total study cost was estimated to be approximately $1,000,000 with 50 percent of the costs being assessed to the Corps and 50 percent to the MCWD. Because the MCWD is very active and had a number of projects and activities in-place that would provide meaningful data and inputs for the Corps study activities, it was proposed that the MCWD provide all in-kind services to fulfill the required match. The original inkind services breakdown as identified in the Corps Project Study Plan dated November 2002 was:

PSP Work Tasks	Task Description from November 2002 Project Study Plan	MCWD	USACE
Task A	Collect, Compile and Evaluate Existing Plans, Studies and Reports	$10,000 Management Planning General	$10,000
Task B	Design GIS-Based Decision Making Model: Scenario-Based Model of Landuse	$125,000 Hydro Data Monitoring	$125,000
Task C	Water Quality and Environmental Systems Modeling	$135,000 H&H Study	$135,000
Task D	USACE Project Study Plan Formulation and Feasibility Report	$150,000 H&H Study	$150,000
Task E	Adopt Project Management and Public Involvement / Communication Plan	$30,000 Education/Communication	$30,000
	Estimated Totals	**$500,000**	**$500,000**

The project schedule has slipped from the original projections and it is proposed that the projects that are used by the MCWD be changed slightly from the original submission. The projects that are proposed to be used as inkind match and qualifying expenditures between February 1, 2003 and November 2003 are as follows:

MCWD Project #	Project Title	Expenditures to Year-to-Date
4320	H&HPLS Model	$152,023
4321	Hydrodatabase	$304,527
4513	Jennings Bay/Painter Creek	$86,965
4516	Functional Assessment of Wetlands	$19,688
4528	Creek Stabilization Phase II	$120,078
4966	Education & Communications Plan	$69,712
		$612,993

The projects recommended for inkind match are all summarized in the MCWD study report. The projects will provide information on:

- Hydrology and Hydraulics
- Soils and geology
- Groundwater
- Precipitation
- Water Quality Data
- Water resources trophic status
- Demographics and parcel information
- Wetland acreages and conditions
- Habitat
- Recreation
- Landuse and Land cover data
- Watershed GIS data layers
- Flood Insurance Rate Maps
- Proposed project locations
- Stream miles, reaches and conditions
- Lakes

All of these pieces of information can be meaningfully used and input into the Corps Feasibility Study process.

The Corps Project Study Plan, dated November 2002, identified eighteen major Feasibility Study Tasks with numerous subtasks. Preliminary cost estimates for each task were developed and are summarized in both the overall project GANTT chart and in the following table. At the time the cost estimates were developed, a number of the major projects completed by the MCWD including the H&HPLS model, the Education and Communications Plan and Audit, and the Functional Assessment of Wetlands were not available as study tools. With the development of this new and improved information, data and summary of the watershed condition, it is quite likely that the cost estimates for some of the Feasibility Study Tasks, especially those in the Engineering Appendix, will come down. It is also likely, given the high level of stakeholder involvement that will be required by the MCWD, that the cost estimate for public participation processes will increase. At this point in time, the original study estimate of $930,000 with a $70,000 contingency appears to be reasonable. It is recommended that Project Delivery Team members refine the cost estimates for their respective disciplines once the initial data assessments have been completed and it becomes more clear how much work will be required to complete each task.

MCWD Feasibility Study Proposed In-Kind Services Match

Feasibility Study Work Tasks USACE PSP - November 2002	USACE Cost Estimate PSP November 2002 Total Costs	Required In-kind Match	Proposed MCWD In-kind December 2003
Engineering Appendix	$402,000	$201,000	Creek Stabilization $120,078 Hydrodatabase $80,922
Surveying and Mapping	$291,000	$145,500	Included Above
Engineering and Design Analysis	$111,000	$55,500	Included Above
Socioeconomic Studies/Report	$77,000	$38,500	Hydrodatabase $18,500 Hydrologic Model $20,000
Economic Analysis Report	$50,000	$25,000	Hydrodatabase $20,000 Hydrologic Model $5,000
Real Estate Analysis/Documents	$23,000	$11,500	Hydrodatabase $11,500
Environmental Studies/Reports	$104,000	$52,000	Jennings Bay $32,312 Wetlands Assess. $19,688
HTRW Studies/Reports	$6,000	$3,000	Hydrodatabase $3,000
Cultural Resources Report	$8,000	$4,000	Hydrologic Model $4,000
Cost Estimates	$20,000	$10,000	Hydrodatabase $10,000
Public Involvement Documents	$40,000	$20,000	Education $20,000
Plan Formulation and Evaluation Report	$114,000	$57,000	Education $15,000 Hydrologic Model $15,000 Hydrodatabase $27,000
Alternative Formulation Briefing	$20,000	$10,000	Hydrodatabase $10,000
Draft Report Documentation	$22,000	$11,000	Education $11,000
Final Report Documentation	$28,000	$14,000	Hydrologic Model $14,000
Washington Level Report Approval	Other Funding Sources	Not applicable	Not Applicable
Management Documents	$25,000	$12,500	Education $12,500
Design Agreement	$16,000	$8,000	Hydrologic Model $8,000

The previous table attempts to attribute local in-kind match to existing Feasibility Study costs by Task as they are known today. The proposed breakdown leaves approximately $200,000 in matching in-kind funds of the MCWD uncommitted to the project and available as a contingency fund.

Appendix C

USACE Feasibility Phase Milestone Gantt Chart

ID	Task Name	Duration	Start	Finish
1	**Start of Project**	0 days	Wed 10/1/03	Wed 10/
2	Scope of Work Report	58 days	Wed 10/1/03	Fri 12/1
3	Project Management Plan	25 days	Mon 12/22/03	Fri 1/2
4	Public and Interagency Workshops for EIS Scoping (Assume EIS Needed)	14 days	Mon 2/9/04	Thu 2/2
5	PDT Identify Alternatives	24 days	Mon 1/26/04	Thu 2/2
6	Revise PMP to Reflect Alternatives; Send Report to MVD and HQUSACE	0 days	Thu 2/26/04	Thu 2/2
7	MVD and HQUSACE Review DRAFT	10 days	Mon 3/1/04	Fri 3/1
8	**FS Meeting with HQUSACE and MVD**	23 days	Mon 3/15/04	Wed 4/1
9	Receive MVD FSM Guidance Memorandum and Comments	10 days	Thu 4/15/04	Wed 4/2
10	Distribute PMP/Project Infomration to Public and Agencies	0 days	Wed 4/28/04	Wed 4/2
11	Publish EIS Notice of Intent (NOI) in the Federal Register	24 days	Thu 4/29/04	Tue 6/
12	Public and Interagency Meetings	0 days	Tue 6/1/04	Tue 6/
13	Memorandum of Record for Meetings	0 days	Tue 6/22/04	Tue 6/2
14	PDT Refine Alternatives	14 days	Wed 6/23/04	Mon 7/1
15	Alt. Screen Letter Report (ALSR) sent to MVD and HQUSACE	0 days	Mon 7/12/04	Mon 7/1
16	Receive comments on ASLR and Develop Preliminary Draft Feasibility and EIS Report	34 days	Tue 7/13/04	Fri 8/2
17	Independent Technical Review and Legal Certification of Preliminary Draft Feasibility and EIS Report	34 days	Tue 7/13/04	Fri 8/2
18	**Alternative Formulation Briefing (AFB) with HQUSACE/MVD**	0 days	Mon 9/27/04	Mon 9/2
19	HQUSACE/MVD Develop and AFB Guidance Memorandum	12 days	Mon 9/27/04	Tue 10/1
20	HQUSACE/MV Distribute PGM	0 days	Tue 10/12/04	Tue 10/1
21	PDT Incorporate Comments	11 days	Wed 10/13/04	Wed 10/2
22	Draft Feasibility and EIS Report	11 days	Wed 10/13/04	Wed 10/2

Project: REVISED Draft 11^6 Date: Mon 2/2/04	Task	Progress	Summary	
	Split	Milestone	Project Summary	

2

USACE Feasibility Phase Milestones - MCWD Watershed Studies

)uration	Start	Finish
0 days	Wed 10/1/03	Wed 10/1/03
58 days	Wed 10/1/03	Fri 12/19/03
25 days	Mon 12/22/03	Fri 1/23/04
14 days	Mon 2/9/04	Thu 2/26/04
24 days	Mon 1/26/04	Thu 2/26/04
0 days	Thu 2/26/04	Thu 2/26/04
10 days	Mon 3/1/04	Fri 3/12/04
23 days	Mon 3/15/04	Wed 4/14/04
10 days	Thu 4/15/04	Wed 4/28/04
0 days	Wed 4/28/04	Wed 4/28/04
24 days	Thu 4/29/04	Tue 6/1/04
0 days	Tue 6/1/04	Tue 6/1/04
0 days	Tue 6/22/04	Tue 6/22/04
14 days	Wed 6/23/04	Mon 7/12/04
0 days	Mon 7/12/04	Mon 7/12/04
34 days	Tue 7/13/04	Fri 8/27/04
34 days	Tue 7/13/04	Fri 8/27/04
0 days	Mon 9/27/04	Mon 9/27/04
12 days	Mon 9/27/04	Tue 10/12/04
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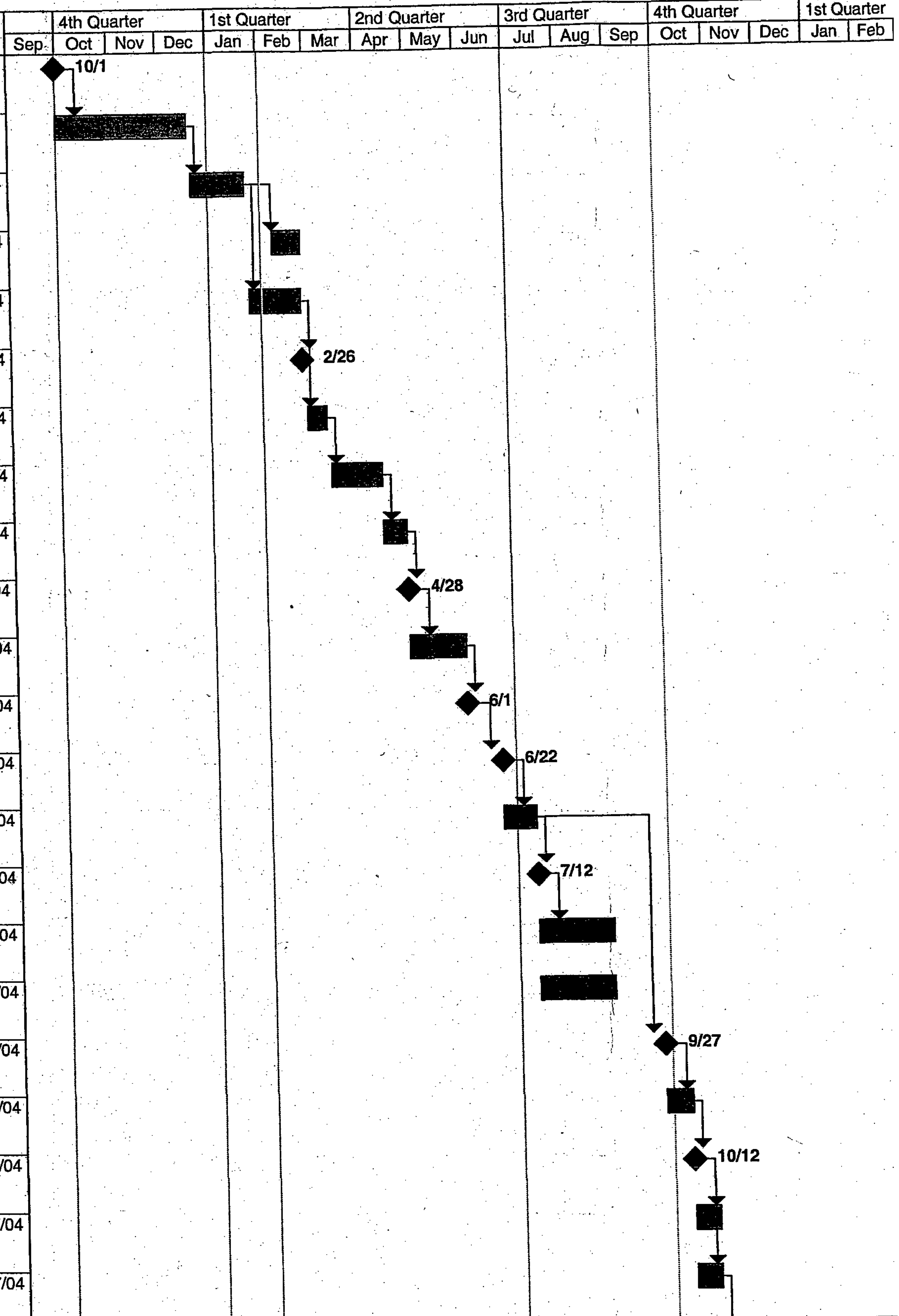
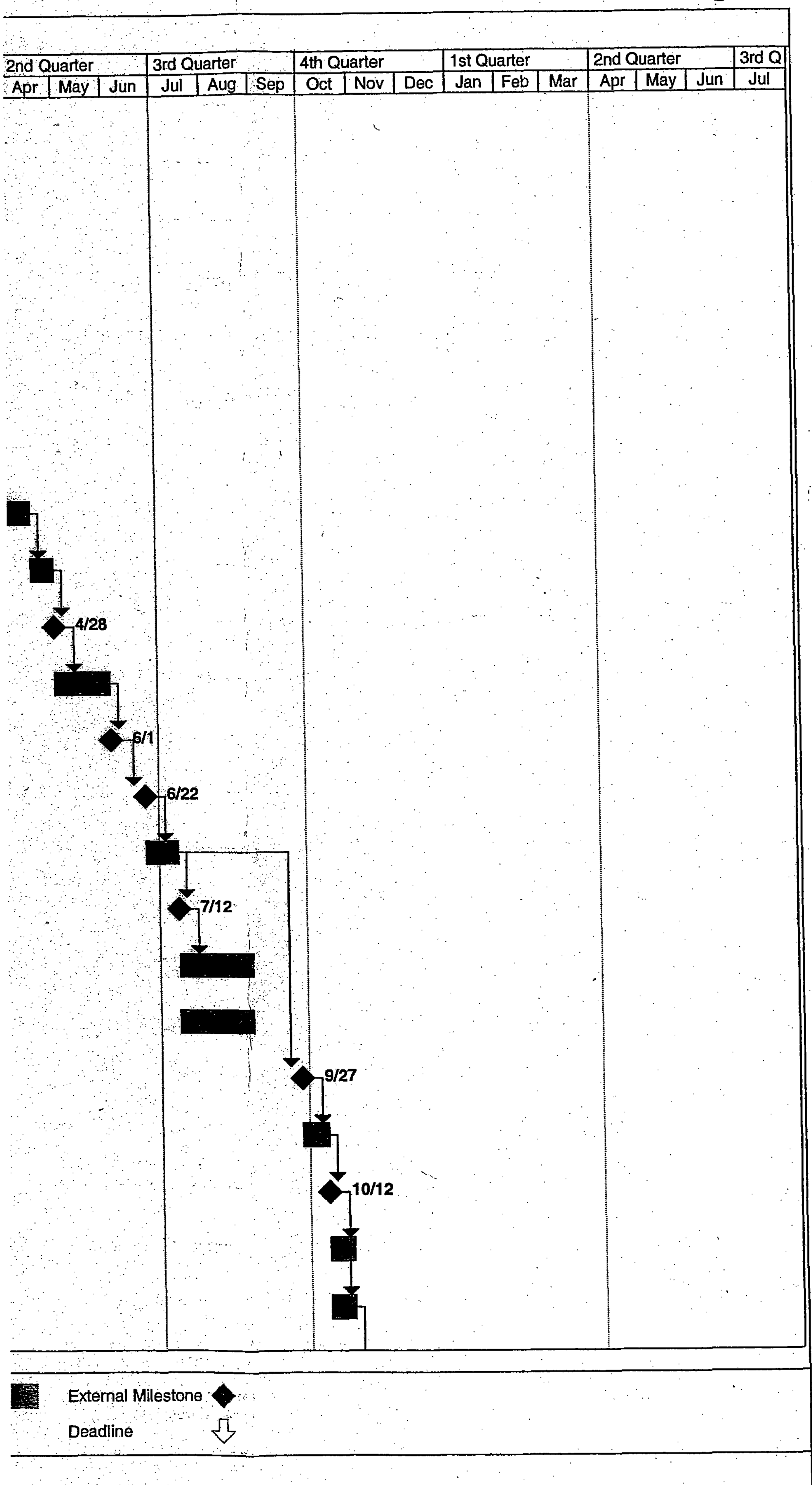
11 days	Wed 10/13/04	Wed 10/27/04



Summary		External Tasks	External Milestone
Project Summary		External Milestone	Deadline

3


2nd Quarter
Apr May Jun
3rd Quarter
Jul Aug Sep
4th Quarter
Oct Nov Dec
1st Quarter
Jan Feb Mar
2nd Quarter
Apr May Jun
3rd Q
Jul
4/28
6/1
6/22
7/12
9/27
10/12
External Milestone
Deadline

USACE Feasibility Phase Milesto

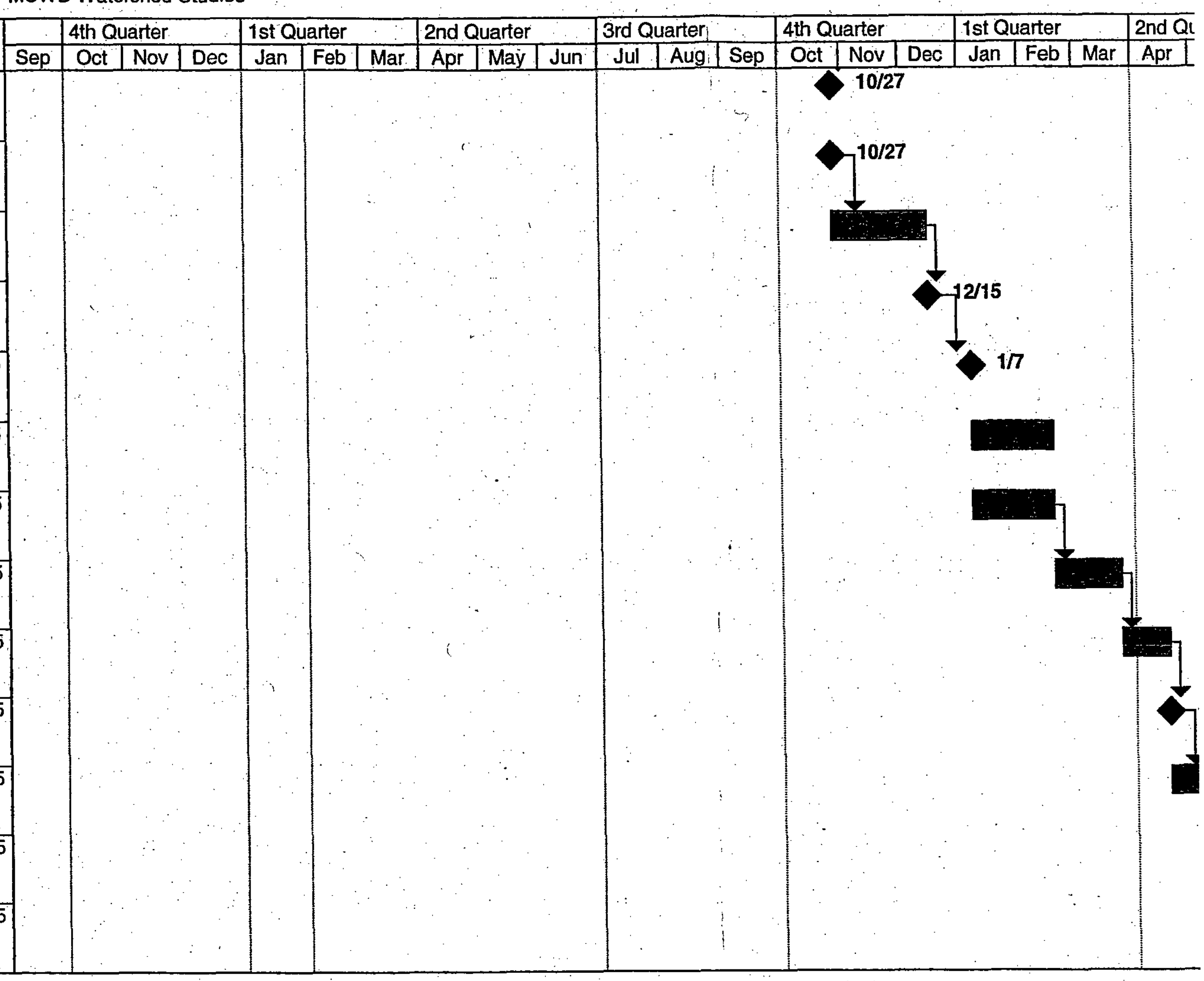
ID	Task Name	Duration	Start	Finish
23	Distribute Draft Feasibility and EIS Report	0 days	Wed 10/27/04	Wed 10/2
24	Publish EIS Notice of Availibility in Federal Register; Send Draft EIS to EPA	0 days	Wed 10/27/04	Wed 10/2
25	Public/Agency Review of Feasibility EA/EIS Report	35 days	Thu 10/28/04	Wed 12/1
26	Public/Agency Review Comments Due-Meeting	0 days	Wed 12/15/04	Wed 12/1
27	Memorandum of Record on Public/Agency Meetings	0 days	Fri 1/7/05	Fri 1/
28	PDT Incorporate Comments and Develop Final Feasibility and EIS Report	30 days	Fri 1/7/05	Thu 2/1
29	Incorporate ITR Comments and Prepare FINAL Feasiblity Report and EIS	30 days	Fri 1/7/05	Thu 2/1
30	Public/Agency Review of Final EIS	25 days	Fri 2/18/05	Thu 3/2
31	Respond to Public/Agency Review Comments	17 days	Fri 3/25/05	Mon 4/1
32	Transmit FINAL Feasibility Report and FINAL EIS (and unsigned Record of Decision) to HQUSACE and MVD	0 days	Mon 4/18/05	Mon 4/1
33	Division Commander Issues Public Notice	30 days	Tue 4/19/05	Mon 5/3
34	Transmit FINAL Feasibility Report and FINAL EIS to Deputy, Assistant Secretary of Army(ASA)	0 days	Fri 6/10/05	Fri 6/1
35	Submit FINAL Feasibility Report and FINAL EIS to ASA, Washington Level Decision and Congressional Autho	0 days	Fri 6/10/05	Fri 6/1

Project: REVISED Draft 11^6 Date: Mon 2/2/04	Task	Progress	Summary	
	Split	Milestone	Project Summary	

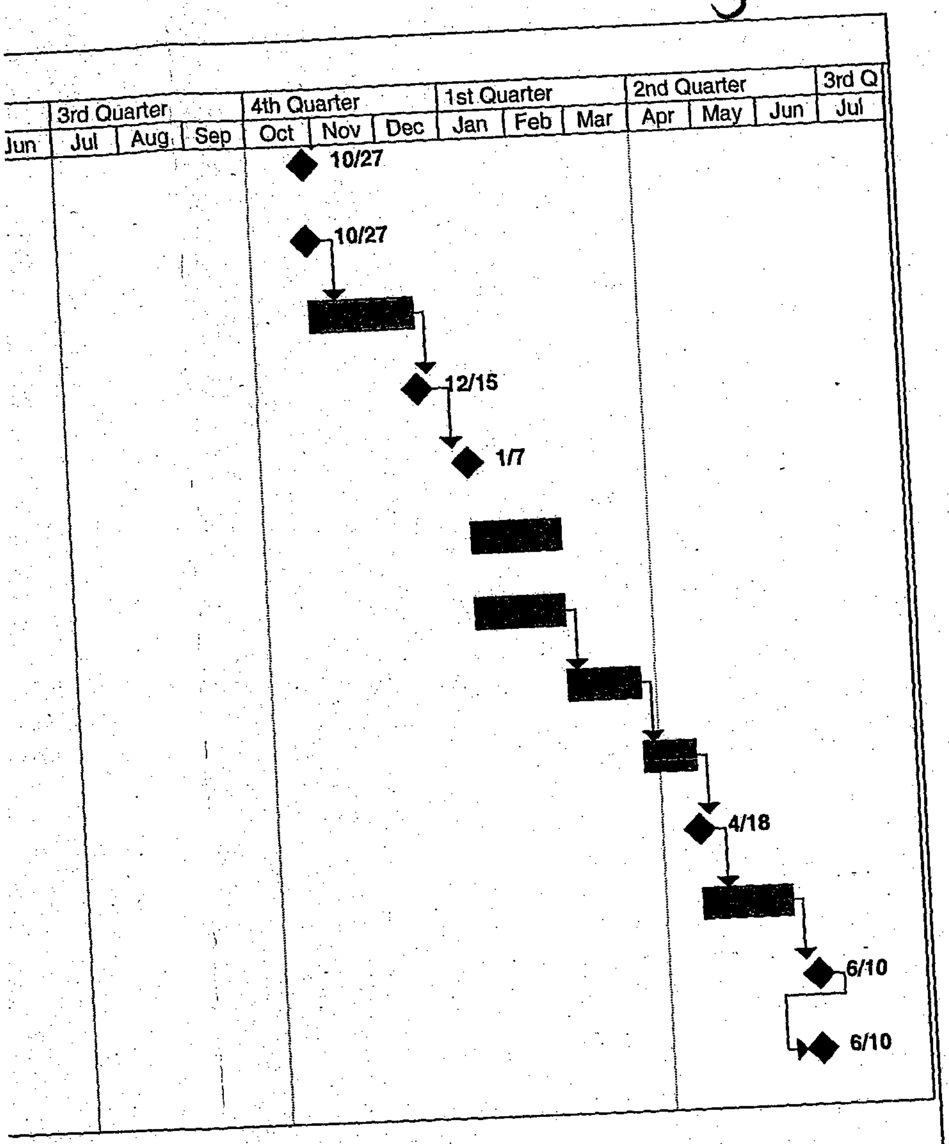
2

'easibility Phase Milestones - MCWD Watershed Studies

Start	Finish
d 10/27/04	Wed 10/27/04
d 10/27/04	Wed 10/27/04
u 10/28/04	Wed 12/15/04
d 12/15/04	Wed 12/15/04
Fri 1/7/05	Fri 1/7/05
Fri 1/7/05	Thu 2/17/05
Fri 1/7/05	Thu 2/17/05
Fri 2/18/05	Thu 3/24/05
Fri 3/25/05	Mon 4/18/05
lon 4/18/05	Mon 4/18/05
'ue 4/19/05	Mon 5/30/05
Fri 6/10/05	Fri 6/10/05
Fri 6/10/05	Fri 6/10/05



nary | External Tasks | External Milestone
ct Summary | External Milestone | Deadline



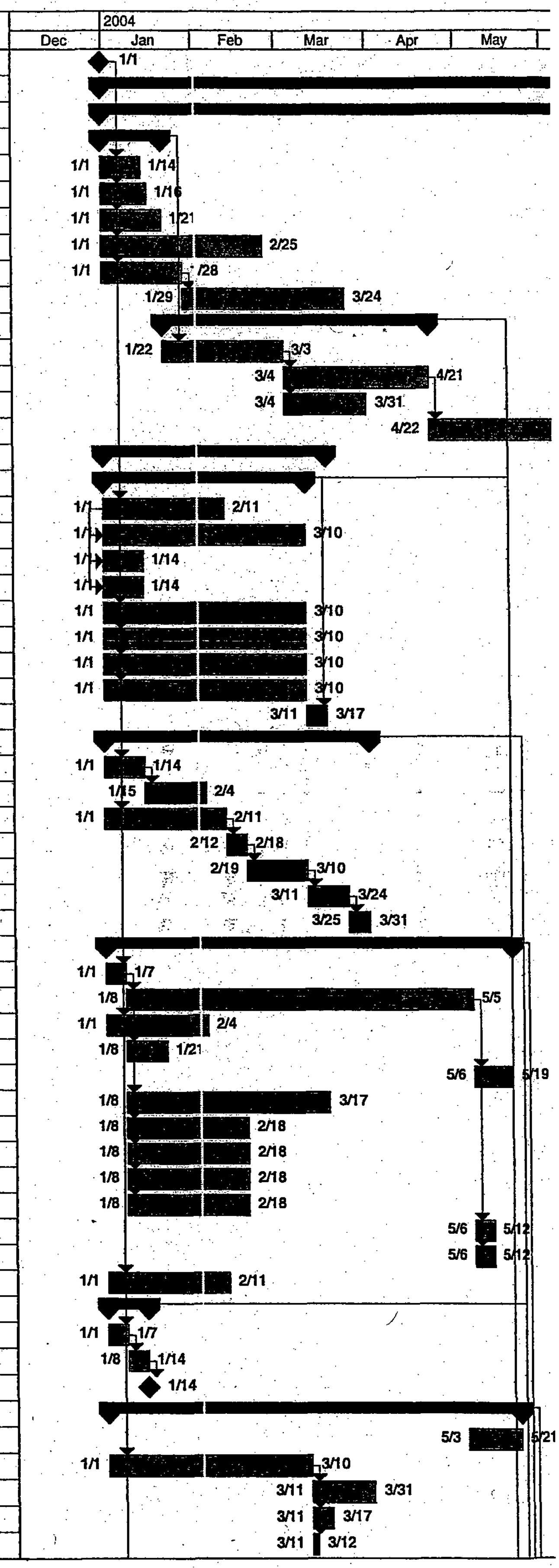
External Milestone ◆

Deadline ⇩

Appendix D

Sub-Products and Major Tasks Gantt Chart

ID	Task Name
1	Start of Project
2	**Product J - Feasibility Report**
3	**Sub-Product JA - Engineering Appendix ($402,000)**
4	**Major Task JAA - Surveying and Mapping ($291,000)**
5	*Task JAAA - Topographic Mapping*
6	*Task JAAB - Water Surface Profiles and Cross-Sections*
7	*Task JAAC - Geographic Information Systems*
8	Major Task JAB - Hydrology and Hydraulic Studies/Reports
9	Major Task JAC - Geotechnical Studies/Reports
10	Major Task JAD - Site Development Analysis/Report
11	**Major Task JAE - Engineering and Design Analysis ($111,000)**
12	*Task JAEA - Preliminary Design*
13	*Task JAEB - Detailed Design*
14	*Task JAEC - Design Appendix*
15	Major Task JAG - Internal Technical Review & VE Study
16	**Sub-Product JB - Socioeconomic Studies/Report ($77,000)**
17	Major Task JBA - Economic Analysis/Report
18	*Task JBAA - NED Analysis for Flood Damage Reduction Features*
19	*Task JBAB - CE/ICA Analysis for Ecosystem Restoration Features*
20	*Task JBAC - Identification of the NED/NER Plan*
21	*Task JBAD - Seperable Cost - Remaining Benefit Analysis*
22	Major Task JBB - Social Studies/Report
23	Major Task JBC - Institutional Studies/Report
24	Major Task JBD - Ability to Pay Report
25	Major Task JBE - Financial Analysis Report
26	Major Task JBF - Internal Technical Review
27	**Sub-Product JC - Real Estate Analysis/Documents ($23,000)**
28	Major Task JCA - Real Estate Supplement/Plan
29	Major Task JCB - Gross Apprisal/Report
30	Major Task JCC - Preliminary Real Estate Acqusition Maps
31	Major Task JCD - Physical Takings Analysis
32	Major Task JCE - Preliminary Attorney's Opinion of Compensability
33	Major Taak JCF - Rights of Entry
34	Major Task JCG - Internal Technical Review
35	**Sub-Product JD - Environmental Studies/Reports ($104,000)**
36	Major Task JDA - Minutes of Scoping Meetings
37	Major Task JDC - Environmental Impact Statement
38	Major Task JDD - Coordination Documents with Other Agencies
39	Major Task JDE - Environmental Resource Inventory Report
40	Major Task JDF - Mitigation Analysis Report
41	Major Task JDG - Endangered Species Analysis
42	Major Task JDH - Section 404(b)(1) Analysis Report
43	Major Task JDI - 401 State Water Quality Certification
44	Major Task JDJ - Record of Decision (ROD)
45	Major Task JDN - Other Environmental Documents
46	Major Task JDO - Conceptual Restoration Plans
47	Major Task JDP - Internal Technical Review
48	Sub-Project JE - Fish and Wildlife Coordination Act Report
49	**Sub-Project JF - HTRW Studies/Report ($6,000)**
50	Major Task JFA - HTRW Preliminary Assessment Report
51	Major Task JFB - HTRW Site Inspection Report
52	Major Task JFC - HTRW Remedial Investigation Study/Report
53	**Sub-Product JG - Cultural Resources Report ($8,000)**
54	Major Task JGA - Site Survey Field Report
55	Major Task JGB - Data Collection and Analysis/Report
56	Major Task JGC - Mitigation Plan Report
57	Major Task JGD - Memorandum of Agreement
58	Major Task JGG - Internal Technical Review



Project:
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Task | Milestone | Rolled Up Task | Rolled Up Progress
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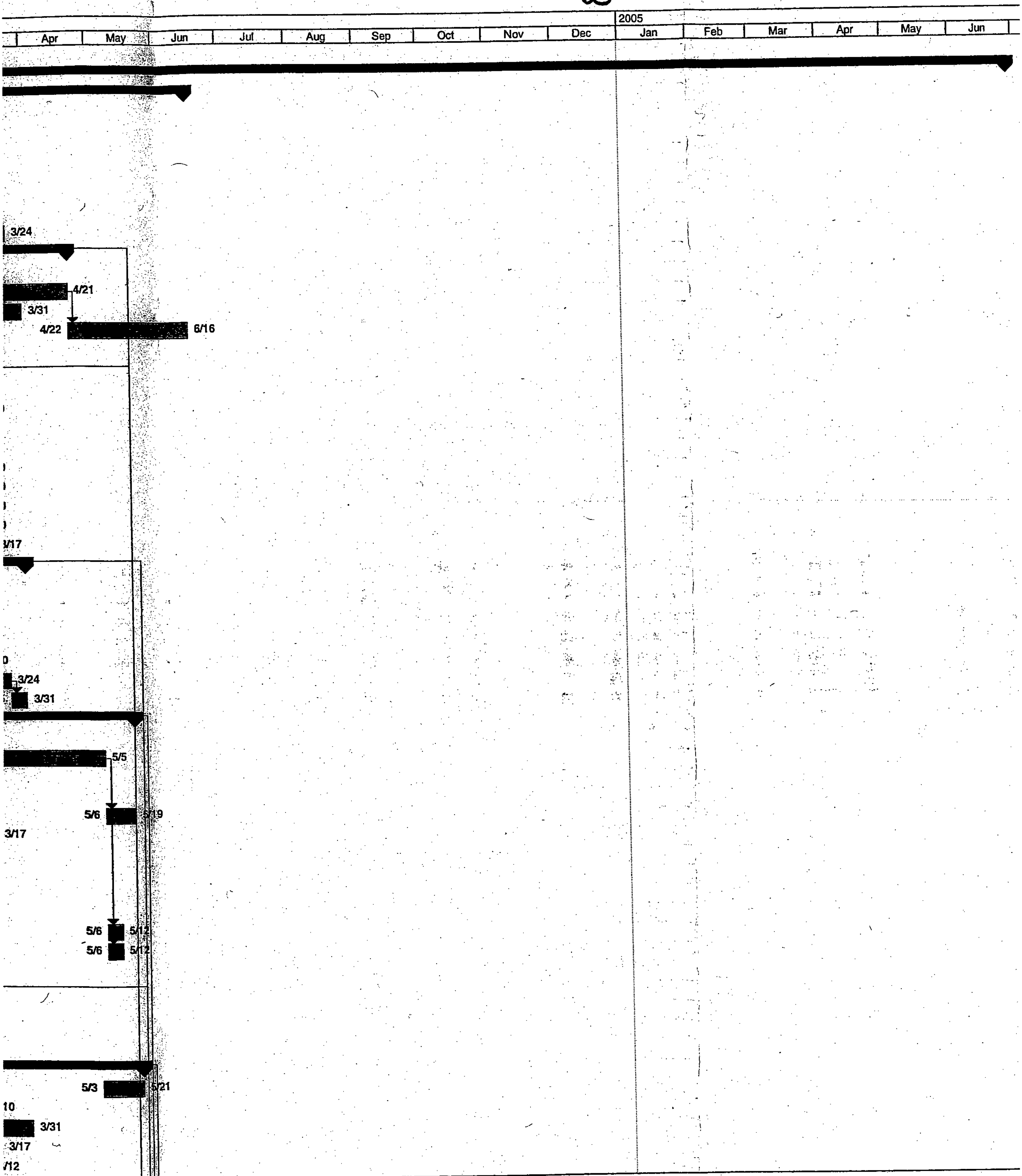

Rolled Up Progress
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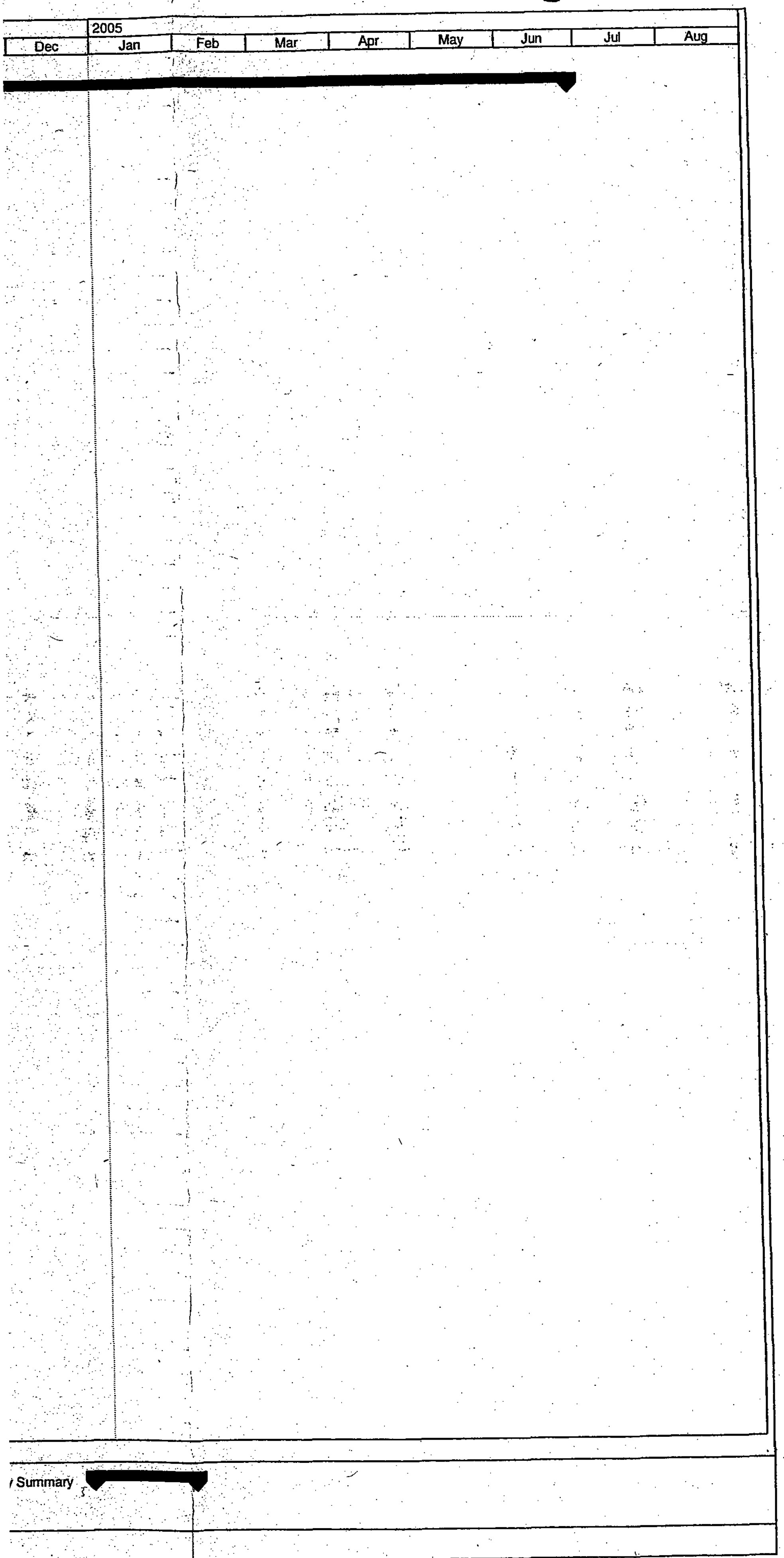
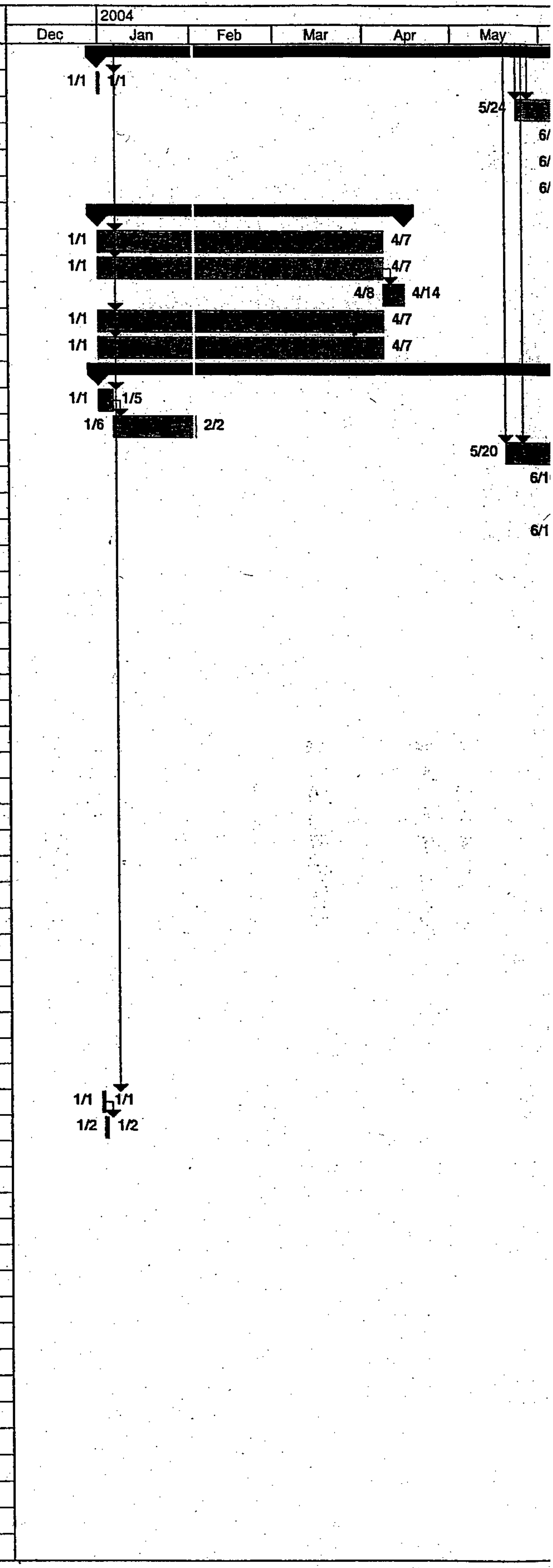


ID		Task Name
59		**Sub-Product JH - Cost Estimates ($20,000)**
60		Major Task JHB - PED Cost Estimate
61		Major Task JHC - Project Cost Estimate
62		Major Task JHD - OMRR&R Cost Estimate
63		Major Task JHE - Baseline Fully Funded Cost Estimate
64		Major Task JHF - Internal Technical Review
65		**Sub-Product JI - Public Involvement Documents ($40,000)**
66		Major Task JIA - Notices and Public Meetings
67		Major Task JIB - Minutes of Public Meeting(s)
68		Major Task JIC - Public Comments Report
69		Major Task JID - Newsletters
70		Major Task JIE - Other Public Involvement Documents
71		**Sub-Product JJ - Plan Formulation and Evaluation Report ($114,000)**
72		Major Task JJA - District Coordination Meeting
73		Major Task JJB - Establish Without Project Conditions
74		Major Task JJC - Preliminary Formulation and Screening of Alternatives
75		Major Task JJD - Detailed Evaluation
76		Major Task JJE - Plan Formulation Management and Report
77		Major Task JJF - Internal Technical Review
78		**Sub-Product JQ - Alternative Formulation Briefing ($20,000)**
79		Major Task JQA - AFB Project Documentation
80		Major Task JQB - AFB Technical Review Documents
81		Major Task JQC - AFB Policy Compliance Review Documents
82		Major Task JQD - AFB Guidane Memorandum
83		**Sub-Product JK - Draft Report Documentation ($22,000)**
84		Major Task JKA - Draft Feasibility Report and NEPA Document
85		Major Task JKB - Public Review Comments
86		Major Task JKC - Project Guidance Memorandum (PGM)
87		Major Task JKE - Technical Review Documents
88		Major Task JKF - Policy Compliance Review Documents
89		**Sub-Product JL - Final Report Documentation ($28,000)**
90		Major Task JLA - Division Commanders Notice
91		Major Task JLB - All Other Final Feasibility Report Documents
92		Major Task JLC - Final Feasibility Report and NEPA Document
93		Major Task JLD - Technical Review Documents
94		**Sub-Product JM - Washington Level Report Approval (OTHER)**
95		Major Task JMA - Policy Compliance Review Documents
96		Major Task JMB - Chief Engineer's Report
97		Major Task JMC - OMB Letter to ASA (CW)
98		Major Task JME - State & Agency Review and NEPA Document Filing Letters
99		**Sub-Product JN - All Other Feasibility Studies/Investigations**
100		**Sub-Product JO - Damages Assessed AE Contractors**
101		**Sub-Product JP - Management Documents ($25,000)**
102		Major Task JPA - A-E Contract Documents
103		Major Task JPB - Coordination Documents
104		Major Task JPC - Study Funds Control Documents
105		Major Task JPD - Trip Reports
106		Major Task JPE - Minutes of Technical Review Conference (TRC)
107		Major Task JPF - All Other Management Documents
108		
109		**Product L - Project Management Plan, Phase 2 ($18,000)**
110		
111		**Product Q - Design Agreement ($16,000)**
112		Major Task QAA - PED Cost Sharing Initial Draft Design Agreement - Initial Draft
113		Major Task QAB - PED Cost Sharing Design Agreement - Deviation Report
114		Major Task QAC - Federal/Non-Federal Allocation of Funds Table
115		Major Task QAD - PED Cost Sharing Design Agreement - Certification of Legal Review
116		Major Task QAE - PED Cost Sharing Agreement - Checklist



Project: Date: Mon 2/2/04	Task		Milestone		Rolled Up Task	Rolled Up Progress
	Progress		Summary		Rolled Up Milestone	Split

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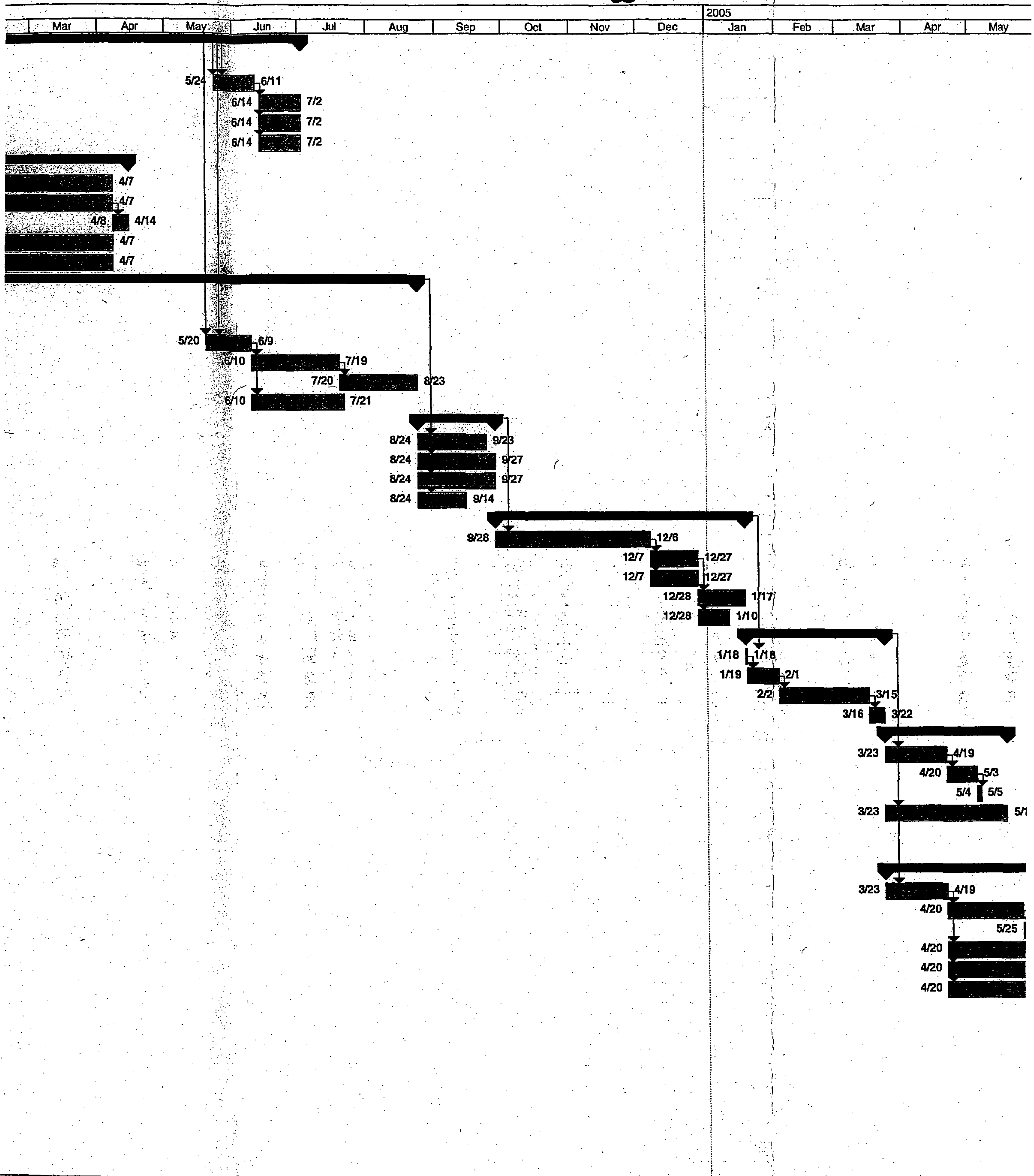

	Rolled Up Progress		External Tasks		Group By Summary
◇	Split		Project Summary		

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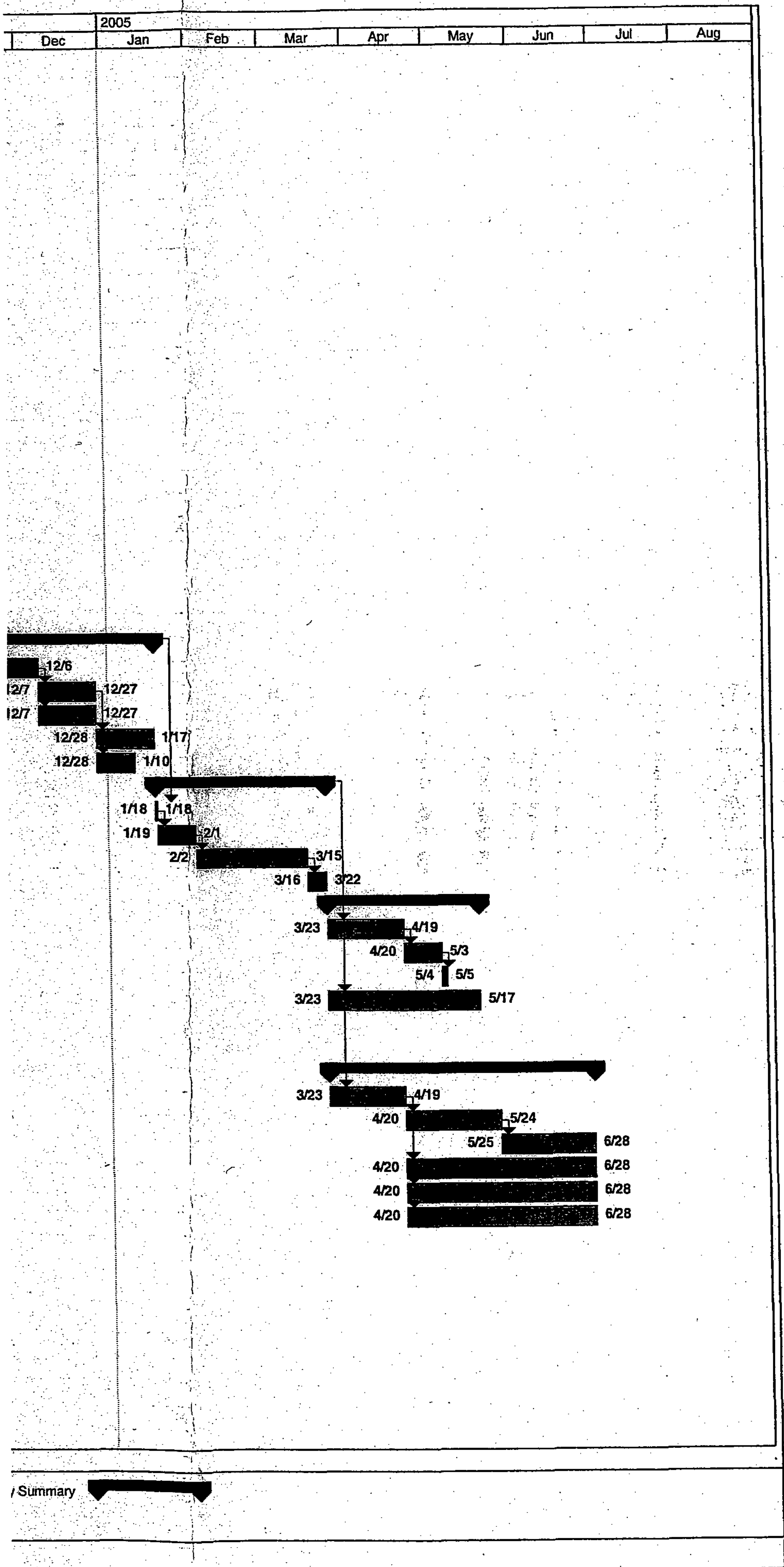
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Summary

2 **Product J - Feasibility Report**
This product includes all activities leading to approval of the final Feasibility Report and National Environmental Environmental Policy Act (NEPA) compliance document by Headquarters, USACE, an
3 **Sub-Product JA - Engineering Appendix ($402,000)**
Supports the alternative analysis and the recommended plan as shown in the Feasibility Report prepared to a level of detail necessary to develop a defensible baseline cost estimate.
4 **Major Task JAA - Surveying and Mapping ($291,000)**
Aerial photography and topography is required for civil and hydraulic design, ecological assessments, and cost estimating.
5 **Task JAAA - Topographic Mapping**
An existing HSGC Digital Elevation Model (DEM) will be utilized to provide topographic coverage of the basin, with potential LIDAR data possible.
6 **Task JAAB - Water Surface Profiles and Cross-Sections**
New survey cross-sections will be surveyed at five potential project sites.
7 **Task JAAC - Geographic Information Systems**
GIS modeling will be used to assist the study team in assesing problems, formulating and evaluating solutions, and presenting study findings.
Use RRBDIN GIS to support studies and incorporate new information.
9 **Major Task JAC - Geotechnical Studies/Reports**
Needed to determine the site conditions and constraints for flood damage reduction measures and ecosystem restoration measures.

Includes potential:
a. Standard Penetration Test
b. FieldPermeability Test
c. Grain Size
d. Atterburg Limits
e. Falling Head Permeability
f. Direct Shear
10 **Major Task JAD - Site Development Analysis/Report**
Required for projects in which sites for detailed analysis and design cannot be selected based on an initial field inspection or evaluation of existing data, and additional investigations and possibly mo
11 **Major Task JAE - Engineering and Design Analysis ($111,000)**
Designs for all flood control and ecosystem restoration measures.
12 **Task JAEA - Preliminary Design**
Prepared for approximately 3 alternatives for ecosystem restoration and 4 alternatives for the flood control portions of potential sites.
13 **Task JAEB - Detailed Design**
Prepared for 1 project alternative and 2 plan scales per each flood control and ecosystem restoration plan on each of the 5 sites.

Included:
a. Design and Drawing of Flood Control Alternatives
b. Design and Drawing of Ecosystem Restoration / Enhancement Feature
c. Input to PMP and QA/QC
14 **Task JAEC - Design Appendix**
Incorporated as Appendix to the Feasibility report.
15 **Major Task JAG - Internal Technical Review & VE Study**
Internal Technical Review by District to meet requirements of QA/QC process. A value engineering study wil be conducted on the final design.
17 **Major Task JBA - Economic Analysis/Report**
1. An NED analysis for flood damage reduction features
2. A cost effectiveness and incremental cost analysis for ecosystem restoration
3. Identifiation of the NED/NER plan
4. A seperable cost-remaining benefit (SCRB) analysis.
18 **Task JBAA - NED Analysis for Flood Damage Reduction Features**
a. First floor elevations or other points of zero damage with topo mapping (up to 10 variables)
b. Crop damage analysis using CACFDAS
c. Estimate flood damages using HEC-FDA for without project conditions, and flood damage reduction benefits for various alternatives

Estimate benefit categories of:
1. Inundation reduction benefits
2. Location and intensification of benefits
3. Savings in flood proofing costs
4. Advanced bridge & utility replacement
5. Transportation cost savings
6. Emergency cost savings
7. Employment benefits
19 **Task JBAB - CE/ICA Analysis for Ecosystem Restoration Features**
Evaluate benefits and costs of ecosystem restoration features and up to 3 project sites.
20 **Task JBAC - Identification of the NED/NER Plan**
Optimize seperately using NED and NER procedures.
21 **Task JBAD - Seperable Cost - Remaining Benefit Analysis**
Economics staff to conduct SCRB analysis using cost data from Major Task JHC
22 **Major Task JBB - Social Studies/Report**
Impacts to include:
a. Income distribution
b. Employment distribution
c. Population distribution and composition
d. Fiscal condition of State and local governments
e. Quality of community life
f. Life, health, and safety factors
g. Displacement
h. Long-term productivity
i. Energy requirements and conservation
23 **Major Task JBC - Institutional Studies/Report**
Identify the juristictions, concerns, and authorities of the non-Federal sponsor(s) and to determine the level of interest of agencies and organizations that may be involved with study.
24 **Major Task JBD - Ability to Pay Report**
Determines local sponsor's eligibility ro reduce their cost sharing responsibilities based on local economic conditions.
25 **Major Task JBE - Financial Analysis Report**
Preparation of the non-Federal sponsor(s)'s statement of financial capability, their preliminary financing plan, and the District Commander's assessment of their financial capability.
26 **Major Task JBF - Internal Technical Review**
Internal Technical Review by District to meet the requirements of the QA/QC process.
27 **Sub-Product JC - Real Estate Analysis/Documents ($23,000)**
All written real estate memoranda, opinions, reports, and other documents will be prepared as required on a project-by-project basis.
28 **Major Task JCA - Real Estate Supplement/Plan**
Prepared as Appendix to Feasibility Report outlining minimum real estate requirements.
29 **Major Task JCB - Gross Apprisal/Report**
a. Detailed accounting of property ownership
b. Property evaluation for possible easment rights or acqusition of impacted lands
c. Preparation of Gross Appraisal
d. Assessment of project LERRD requirements for up to 5 project sites.
Major Task JCC - Preliminary Real Estate Acqusition Maps
Real Estate Division to prepare initial set of maps and drawings the delineate the real estate acqusition lines for ingress and egress and off-site borrow areas.
31 **Major Task JCD - Physical Takings Analysis**
Written legal opinion as to whether flooding will be induce by the construction, operation, or maintenance of the proposed flood damage reduction projects or the ecosystem restoration projects.

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:ument by Headquarters, USACE, and the Office of the Assistant Secretary of the Army (Civil Works).

seline cost estimate.

tional investigations and possibly more detailed analysis is required.

involved with study.

inancial capability.

ecosystem restoration projects.

32 **Major Task JCE - Preliminary Attorney's Opinion of Compensability**
Legal opinion on whether provision of a substitute facility is required under the 5th Amendment as compensation for a facility/utility being acquired for the project.
33 **Major Taak JCF - Rights of Entry**
Obtain rights of entry for various studies (environmental, HTRW, cultural assessments, surveys, exploration, etc...)
34 **Major Task JCG - Internal Technical Review**
Internal Technical Review by District to meet the requirements of the QA/QC process.
35 **Sub-Product JD - Environmental Studies/Reports ($104,000)**
Studies will be performed with the NEPA laws, statutes, Exective Orders, and regulations.

A NEPA document will be prepared to accompany the Feasibility Report.

36 **Major Task JDA - Minutes of Scoping Meetings**
Formal record of discussions with the public and resource agencies that define the environmental concems related to the evaluation of project alternatives and the selection of the recommended plan
37 **Major Task JDC - Environmental Impact Statement**
Evaluation of the impacts of project alternatives on the human environment.
38 **Major Task JDD - Coordination Documents with Other Agencies**
Letters, meeting records, etc... will be prepared that document the correspondence and dialogue between agencies regarding the proposed project.
39 **Major Task JDE - Environmental Resource Inventory Report**
Inventory through literature review and field reconnaissance. Including:

a. Land use
b. Air quality
c. Noise
d. Geology
e. Soils
f. Water quality
g. Water resources
h. Vegitation
i. Wildlife
j. Fisheries
j. Recreation
k. Socio-economic characteristics
l. Federal and state threatened and endangered species
m. Other species of special concem
n. Critical habitats
o. Historic properties
p. Toxic or hazardous materials
q. Wetlands
r. Other appropriate topics

40 **Major Task JDF - Mitigation Analysis Report**
Detailed evaluation of possible actions that would offset unavoidable impacts associated with the proposed project. Additional tasks include:

a. Wetland delineation / report preparation
b. Indentification of existing hydrological conditions
c. Topographic mapping
d. Inventory the existing biological and ecological resources using HEP

41 **Major Task JDG - Endangered Species Analysis**
District to initiate informal consultation with the USFWS and the Natural Heritage Program to assess the presence of Federal and/or state threatened or endangered flora and fauna.
42 **Major Task JDH - Section 404(b)(1) Analysis Report**
Analysis of any water quality impacts associated with the placement of fill material in water.
43 **Major Task JDI - 401 State Water Quality Certification**
Coordination with the State of Minnesota to ensure the proposed actions will not result in a violation of state water quality criteria.
44 **Major Task JDJ - Record of Decision (ROD)**
Report providing a history of actions taken to evaluate project impacts and list and described all compliance actions to be taken.
45 **Major Task JDN - Other Environmental Documents**
Quantify the ecological outputs of ecosystem restoration plans and plan scales in order to assist in the evaluation and prioritization of potential restoration features.
46 **Major Task JDO - Conceptual Restoration Plans**
Team ecologists to provide input to plan formulators and engineering design members in the design of ecosystem restoration measures.
47 **Major Task JDP - Internal Technical Review**
Internal Technical Review performed by the District to meet the requirements of the QA/QC Process.
48 **Sub-Project JE - Fish and Wildlife Coordination Act Report**
Report by the USFWS to document the environmental studies required by the Fish and Wildlife Coordination Act.
49 **Sub-Project JF - HTRW Studies/Report ($6,000)**
Report describing any hazardous/toxic/radiological waste (HTRW) occurances within or nearby the project area. Includes:

a. Determination of nature and extent of contamination
b. Qualitative analysis of impacts in the absence of response actions
c. Preliminary identification of potential source areas, contaminant release mechanisms, exposure routes, potentially exposed populations
d. Determination of non-numerical risk or potential adverse health effects for the identified potential receptors
e. Evaluation of the environmental consequences of all storage, use generation, and disposal on the property

50 **Major Task JFA - HTRW Preliminary Assessment Report**
Report on existing and past land uses based on a review of historical records and other public documentation for up to 5 project sites.
51 **Major Task JFB - HTRW Site Inspection Report**
HTRW specialist to provide an account of the HTRW investigation.

If no HTRW problems - clearly document in the feasibility report.

If HTRW potential, regulatory agencys to be notified, and the alternative will be modified or dropped from consideration.

52 **Major Task JFC - HTRW Remedial Investigation Study/Report**
Not expected to be required.
53 **Sub-Product JG - Cultural Resources Report ($8,000)**
A sampling survey strategy will be used and will provide for the efficient planning of any further cultural resource investigations needed.
54 **Major Task JGA - Site Survey Field Report**
Field Report to provide information on cultural resources necessary to assist in plan formulation and evaluation.
55 **Major Task JGB - Data Collection and Analysis/Report**
A brief description of the identified and predicted historic properties, which would be impacted by the alternative plans that will be included in the Feasibility Report and NEPA document.
56 **Major Task JGC - Mitigation Plan Report**
Document the need for mitigating any adverse effects on historic properties listed or eligible for listing on the National Register of Historic Places, and will include the cost estimates for mitigation or
57 **Major Task JGD - Memorandum of Agreement**
If the identification of historic properties and project impacts cannot be accomplished in a timely manner for consideration in a NEPA document or Feasibility Report, a Memorandum of Agreement (

It is not expected this task will be required.

58 **Major Task JGG - Internal Technical Review**
Internal Technical Review by the District to meet the requirements of the QA/QC process.
59 **Sub-Product JH - Cost Estimates ($20,000)**
Cost estimates will be provided in the Civil Works Breakdown Structure (CWBS) format. Estimates will include Federal and non-Federal costs for:

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ion of the recommended plan.

: and fauna.

EPA document.

t estimates for mitigation or other treatment of historic properties affected by the project.

emorandum of Agreement (MOA) can be developed between the District, SHPO, the Advisory Council on Historic Preservation, and other parties.

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eservation, and other parties.

a. Construction
b. Real estate
c. Engineering and design
d. Construction management
e. Environmental
f. Cultural Resources
g. HTRW investigations and remediation
h. Operation and maintenance, replacement, repairs, and rehabilitation

60 **Major Task JHB - PED Cost Estimate**
PED Cost Estimate to include all Federal costs for preconstruction, engineering and design from the date of the Division Commander's Notice to the award of the Federal construction contract.

61 **Major Task JHC - Project Cost Estimate**
Prepared using a phased approach:

Preliminary, reconnaissance level cost estimates will be prepared for up to 3 variation on up to 3 project features with 2 to 3 scales of restoration.

Detailed feasibility level cost estimates will be prepared for up to five project features, and three scales per feature.

62 **Major Task JHD - OMRR&R Cost Estimate**
All deliverables associated with the preparation of the OMRR&R cost estimates.

63 **Major Task JHE - Baseline Fully Funded Cost Estimate**
Prepared based on project cost estimate developed in Task JHC.

64 **Major Task JHF - Internal Technical Review**
Internal Technical Review performed by the Distric to meet the requirements of the QA/QC Process.

65 **Sub-Product JI - Public Involvement Documents ($40,000)**
Public involvement activities may include a public meeting and agency meetings held during the feasibility study. Coordination with state and local agencies will be initiated immediately and will be m

66 **Major Task JIA - Notices and Public Meetings**
Letters, notices, newspaper articles, and radio announcements will be used to inform the public of meetings, workshops and hearings. Seperate public involvement requirements will be needed for e

a. Watershed Management Plan
b. Water Quality Management Plan
c. Flood Fighting Database
d. Flood Damage Reduction/Ecosystem Restoration Projects

67 **Major Task JIB - Minutes of Public Meeting(s)**
Verbal record and written transcripts of the public meeting(s) will be developed and mainatined on file at the District.

68 **Major Task JIC - Public Comments Report**
A brief summary of the comments received during and after the public meetings and workshops will be prepared and kept on file at the District.

69 **Major Task JID - Newsletters**
Newsletters will be distributed twice a year throughout the study.

70 **Major Task JIE - Other Public Involvement Documents**
The results ofthe public involvement program will be documented in a Public and Agency Coordination Appendix to the Feasibility Report.

71 **Sub-Product JJ - Plan Formulation and Evaluation Report ($114,000)**
Steps in the plan formulation process include:

1. Identify specific problems and oppurtunities that will be addressed in the study
2. Existing and future without project conditions will be identified, analyzed and forecast
3. Formulate alternative plans that adress the planning objectives
4. Alternative project plans will be evaluated for effectiveness, efficiency, completeness and acceptibility.
5. Compare alternative plans
6. Select a joint NED/NER plan

72 **Major Task JJA - District Coordination Meeting**
Meeting with all study team members, including non-Federal sponsor(s), shortly after the initiation of the feasibility phase.

73 **Major Task JJB - Establish Without Project Conditions**
Without project conditions will be developed and refined in the early stages of the Feasibility Study based on environmental, hydrologic, institutional and socioeconomic input.

74 **Major Task JJC - Preliminary Formulation and Screening of Alternatives**
Project planner will lead the team in identifying and screening alternatives for the flood control and ecosystem restoration features.

75 **Major Task JJD - Detailed Evaluation**
Consideration of technical feasibility, economic feasibility, environmental impact, real estate acqusition, and views of the sponsor.

76 **Major Task JJE - Plan Formulation Management and Report**
Includes activities such as planning team meetings, upward reporting, preparation of study management documents, coordination with the local sponsor and other agencies, and integration of all tec

77 **Major Task JJF - Internal Technical Review**
Internal Technical Review by the District to meet the requirements of the QA/QC Process.

78 **Sub-Product JQ - Alternative Formulation Briefing ($20,000)**
A checkpoint conference will be scheduled midway through the formulation effort, to ensure the Corps and non-Federal sponsor(s) focus their resources on alternatives that are in the Federal interes

79 **Major Task JQA - AFB Project Documentation**
Background material of the AFR will be sent to MVD at least 2 weeks prior to the conference. Without-project condiitons hydrology must be approved by the Division prior to the conference.

80 **Major Task JQB - AFB Technical Review Documents**
Technical review documents will be prepared by the District that document the QC process on all data and studies used to reach the conculsions presented inthe AFB documentation. This is a key

81 **Major Task JQC - AFB Policy Compliance Review Documents**
Policy compliance review documents will be prepared by HQUSACE.

82 **Major Task JQD - AFB Guidane Memorandum**
Prepared by HQUSACE documenting directions provided to the District for completion of the feasibility study.

83 **Sub-Product JK - Draft Report Documentation ($22,000)**
The contents of the Draft Feasibility Report are summarized as follows:

1. Concise main report summarizing the study's technical findings, conclusions and recommendations
2. A draft NEPA document
3. Technical appendicies presenting the detailed backup and results of individual work tasks
4. An appendix containing the sponsor's financial capability statement and preliminary financing plan
5. Other supporting documentation including the Watershed Managment Plan and Flood Fighting information database
6. QC report documenting the results of the Internal Technical Review process

84 **Major Task JKA - Draft Feasibility Report and NEPA Document**
Assembling, writing, editing, typing, drafting, reviewing, reproducing, and distribution of the Draft Feasibility Report and Draft NEPA document.

85 **Major Task JKB - Public Review Comments**
Reviewing and preparation of responses to letters received from agencies and the public in response to the Draft Feasibility Report and Draft NEPA document.

86 **Major Task JKC - Project Guidance Memorandum (PGM)**
Directive guidance prepared by HQUSACE for the work accomplished to obtain approval of the Final Feasibility Report.

87 **Major Task JKE - Technical Review Documents**
A QC report documenting the results on the Internal Technical Review will be provided to MVD with the Draft Feasibility Report.

88 **Major Task JKF - Policy Compliance Review Documents**
Policy compliance review documents will be preared by HQUSACE.

89 **Sub-Product JL - Final Report Documentation ($28,000)**
1. Conduct review board meetings
2. Revise Draft Feasibility Report in response to MVD and HQUSACE comments
3. Modify the Draft Feasibility Report in reponse to agency and public comments
4. Prepare draft Final Feasibility Report for internal/sponsor review
5. Coordinate with non-Federal sponsor(s) and internal District elements
6. Reproduce and distribute Final Feasibility Report

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Federal construction contract.

›e initiated immediately and will be maintained throughout the study process.

ent requirements will be needed for each of the elements of:

›nomic input:

er agencies, and integration of all technical investigations.

natives that are in the Federal interest, and to obtain approval from HQUSACE to release the Feasibility Report for concurrent review by the Corps and the public. This will be an Alternative Formulation Briefing

ision prior to the conference.

› AFB documentation. This is a key point in the QA/QC process.

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eview by the Corps and the public. This will be an Alternative Formulation Briefing (AFB).

90 **Major Task JLA - Division Commanders Notice**
Public notice will indicate that the report has been submitted for Washington Level Review
91 **Major Task JLB - All Other Final Feasibility Report Documents**
Document the preliminary findings of each study as well as existing conditions, studies and modeling results that have led to the preliminary findings.
92 **Major Task JLC - Final Feasibility Report and NEPA Document**
1. Conduct review board meetings
2. Revise Draft Feasibility Report in response to MVD and HQUSACE comments
3. Modify the Draft Feasibility Report in reponse to agency and public comments
4. Prepare draft Final Feasibility Report for internal/sponsor review
5. Coordinate with non-Federal sponsor(s) and internal District elements
6. Reproduce and distribute Final Feasibility Report

93 **Major Task JLD - Technical Review Documents**
Technical review documents prepared by the District documenting the QC process on the Final Feasibility Report and NEPA documents.
94 **Sub-Product JM - Washington Level Report Approval (OTHER)**
Includes all activities necessary for submittal of the Final Feasibility Report to Congress after completion of all levels of review.
95 **Major Task JMA - Policy Compliance Review Documents**
A written assessment of the final Feasibility Report will be prepared by HQUSACE, Civil Works Directorate, Policy Division, to document the Feasibility Report's compliance with current policy.
96 **Major Task JMB - Chief Engineer's Report**
Brief summary of the Feasibility Report (signed by Chief of Engineers) sent to Assistant Secretary of the Army for Civil Works (ASA(CW))
97 **Major Task JMC - OMB Letter to ASA (CW)**
A letter prepared from OMB to ASA(CW) expressing the Administration's position regarding transmitting the report to Congress for authorization.
98 **Major Task JME - State & Agency Review and NEPA Document Filing Letters**
Letters from appropriate State and Federal regulatory agencies will be obtained by the District and included in the Final NEPA document.
99 **Sub-Product JN - All Other Feasibility Studies/Investigations**
No additional feasibility studies/investigations will be required.
100 **Sub-Product JO - Damages Assessed AE Contractors**
Documents that determine and assess the liability for inadequate A-E efforts will be prepared, if required.
101 **Sub-Product JP - Management Documents ($25,000)**
Includes all of the documents related to the management of the Feasibility Report, including A-E contract administration and in-house control.
102 **Major Task JPA - A-E Contract Documents**
Preparation and negotiation, award and contract administration documents for the utilization of A-E contractors to complete and/or assist with Feasibility Phase products
103 **Major Task JPB - Coordination Documents**
a. Copies of letter exchanged with the local sponsor that affect study costs, scopes/schedules
b. Official correspondence with higher authority on similar subjects
c. Internal memoranda which bear on significant study elements
d. Any other correspondence with affects significant aspects of the study
104 **Major Task JPC - Study Funds Control Documents**
Includes preparation and management of internal funds control documents for the allocation and management of the Feasibility Study.
105 **Major Task JPD - Trip Reports**
Written trip reports will document study area visits, meetings with the non-Federal sponsor(s) aand other trips affecting the scope, cost, or schedule of the Feasibility Report.
106 **Major Task JPE - Minutes of Technical Review Conference (TRC)**
Minutes will be prepared on the results of the TRC.
107 **Major Task JPF - All Other Management Documents**
No additional managment documents are anticipated.
109 **Product L - Project Management Plan, Phase 2 ($18,000)**
The PMP will be prepared based on the recommended projects. The draft PMP will address the development of additional products and detailed plans for successful management and completion o
111 **Product Q - Design Agreement ($16,000)**
Includes:

1. Applicable PED cost sharing agreement for a flood damage reduction project
2. Federal / non-Federal allocation of funds table
3. Design Agreement deviation report
4. Certification of legal review
5. MSC review comments
112 **Major Task QAA - PED Cost Sharing Initial Draft Design Agreement - Initial Draft**
Legally binding agreement that sets forth the terms and conditions of the relationship between the Federal government and the non-Federal sponsor for the preparation of a Design Documentation F
113 **Major Task QAB - PED Cost Sharing Design Agreement - Deviation Report**
Outlines the deviations of the PED cost sharing Design Agreement from the standard model PED agreement.
114 **Major Task QAC - Federal/Non-Federal Allocation of Funds Table**
Includes allocation of funds for each feature, programmed by FY, for the non-Federal sponsor and the Federal government.
115 **Major Task QAD - PED Cost Sharing Design Agreement - Certification of Legal Review**
A brief memorandum for record certifies tha the District Counsel has reviewed the Initial Draft PCA Design Agreement for legal sufficiency.
116 **Major Task QAE - PED Cost Sharing Agreement - Checklist**
An endorsement will be attached to the Draft PCA that contains the MVD review comments on the PCA.

mpliance with current policy.

›ducts

ity Report.

sful management and completion of the projects.

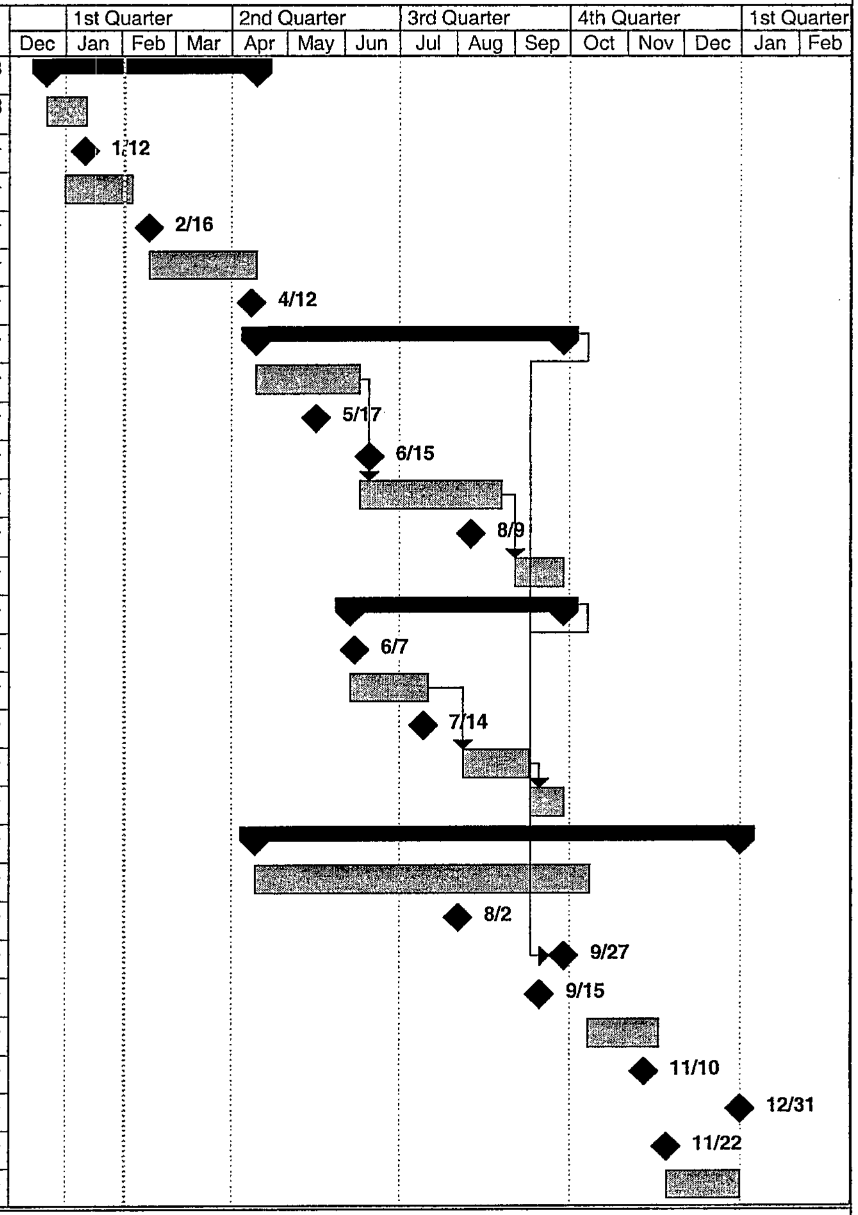
ation of a Design Documentation Report and Plans and Specifications.

Appendix E

Minnehaha Creek Watershed 509 Plan Gantt Chart

Minnehaha Creek Watershed District 509 Plan

ID		Task Name	Duration	Start
1		**Preliminary Planning (includes SOWR, prelim. Alternatives)**	**83 days**	**Mon 12/22/03**
2		MCWD Develop Communications Plan	16 days	Mon 12/22/03
3		Meeting: TAC/CAC/PDT	0 days	Mon 1/12/04
4		Revision of Watershed Goals (PDT Input)	27 days	Thu 1/1/04
5		Meeting: TAC/CAC/PDT	0 days	Mon 2/16/04
6		Develop Plan Adoption Process (PDT Input)	43 days	Mon 2/16/04
7		Meeting: TAC/CAC/PDT	0 days	Mon 4/12/04
8		**Lower Watershed Plan Development**	**118.13 days**	**Wed 4/14/04**
9		Watershed Analysis (PDT Input)	40 days	Wed 4/14/04
10		Meeting: TAC/CAC/PDT	0 days	Mon 5/17/04
11		Meeting: TAC/CAC/PDT	0 days	Tue 6/15/04
12		Stakeholder Meetings	55 days	Wed 6/9/04
13		Meeting: TAC/CAC/PDT	0 days	Mon 8/9/04
14		Board Approval	18 days	Thu 9/2/04
15		**Upper Watershed Plan Development**	**81.13 days**	**Fri 6/4/04**
16		Meeting: TAC/CAC/PDT	0 days	Mon 6/7/04
17		Watershed Analysis (PDT Input)	30 days	Fri 6/4/04
18		Meeting: SMT	0 days	Wed 7/14/04
19		Subwatershed Management Teams(SMT)(MCWD Board)	26 days	Wed 8/4/04
20		Board Approval	12 days	Fri 9/10/04
21		**509 3rd Generation Plan Creation**	**188 days**	**Wed 4/14/04**
22		Updated Information Compilation	129 days	Wed 4/14/04
23		Meeting: TAC/CAC/PDT	0 days	Mon 8/2/04
24		Major Project Summary (AFB Completion) (NED/NER)	0 days	Mon 9/27/04
25		Meeting: TAC/CAC/PDT	0 days	Wed 9/15/04
26		Subwatershed Mgmnt Plans-Assimilation	28 days	Mon 10/11/04
27		Meeting: TAC/CAC/PDT	0 days	Wed 11/10/04
28		PROJECT END	0 days	Fri 12/31/04
29		Meeting: SMT	0 days	Mon 11/22/04
30		Approval Process (MCWD Board)	30 days	Mon 11/22/04



Project:
Date: Mon 2/2/04

Task		Milestone		External Tasks		Deadline	
Split		Summary		External Milestone			
Progress		Project Summary		External Milestone			

Mon 2/2/04

4 Revision of Watershed Goals (PDT Input)

1. Draft Goals
2. Board Discussion
3. Revise Per Discussion

6 Develop Plan Adoption Process (PDT Input)

1. Lower Watershed
    a. Organize stakeholder group
    b. Organize Technical Advisory Group (includes PDT)
    c. Identify meeting locations
    d. Create meeting agendas
2. Upper Watershed
    a. Organize Manager subwatershed management teams
    b. Organize Technical Advisory Group (includes PDT)
    c. Create meeting agendas
3. Cumulative Plan
    a. Develop Lower and Upper Watershed plans
    b. Initiate Regulatory Rules revisions
    c. Collect updated statistical information (Section IV)
    d. Review Plan with District Cities, Regulatory Agencies

9 Watershed Analysis (PDT Input)

1. Review existing conditions
    a. Identify information gaps
        i. XP-SWMM Model
        ii. Functional assessment of wetlands
        iii. Surface water nutrient loading
        iv. Stream assessment data
        v. GSSA Model
    b. Identify problem areas
        i. H&H Study
        ii. Stream assessment data
        iii. Historical information
    c. Investigate potential solutions
        i. Proposed Capital Improvements Program
        ii. H&H Study recommendations
        iii. Generate additional ideas
2. Evaluate Proposed Conditions
    a. Identify information gaps
    b. Identify problem areas
    c. Review proposed recommendations
3. Technical Advisory Group
    a. Organize material for distribution
    b. Review recommendations
    c. Discuss options/opinions
    d. Define recommended objectives
    e. Develop target nutrient loads/runoff rates
    f. Create formal recommended management strategies/report

12 Stakeholder Meetings

1. Primer on watershed issues/management
2. Review of Technical Advisory Group recommendations
3. Discussion
4. Amendments/revisions to recommendations
5. Creation of report

14 Board Approval

1. Review of management team report
2. Discussion
3. Amendments/revisions
4. Adoption

17 Watershed Analysis (PDT Input)

1. Review existing conditions
    a. Identify information gaps
        i. XP-SWMM Model
        ii. Functional assessment of wetlands
        iii. Surface water nutrient loading
        iv. Stream assessment data
        v. GSSA Model
    b. Identify problem areas
        i. H&H Study
        ii. Stream assessment data
        iii. Historical information
    c. Investigate potential solutions
        i. Proposed Capital Improvements Program
        ii. H&H Study recommendations
        iii. Generate additional ideas
2. Evaluate Proposed Conditions
    a. Identify information gaps
    b. Identify problem areas
    c. Review proposed recommendations
3. Technical Advisory Group
    a. Organize material for distribution
    b. Review recommendations
    c. Discuss options/opinions
    d. Define recommended objectives
    e. Develop target nutrient loads/runoff rates
    f. Create formal recommended management strategies/report

19 Subwatershed Management Teams(SMT)(MCWD Board)

1. Review of subwatershed issues
2. Review of Technical Advisory Group recommendations
3. Discussion
4. Amendments/revisions to recommendations
5. Creation of report

20 Board Approval

1. Review of stakeholder report

2. Discussion
3. Amendments/revisions
4. Adoption

22 Updated Information Compilation

a. Climatological
b. Demographic
c. Geologic
d. Soils
e. Minnesota Land Classification System Survey
f. Land use trends
g. Transportation systems
h. Utility systems
i. Environmental hazards
j. Surface water inventories
k. Groundwater aquifers

24 Major Project Summary (AFB Completion) (NED/NER)

a. H&H
b. Functional assessment of wetlands
c. Education/communications strategic audit
d. Stream assessment
e. Regulatory Rules revisions
f. Coincides with AFB

26 Subwatershed Mgmnt Plans-Assimilation

a. Overarching watershed goals
b. Lower watershed (Minnehaha Creek)
c. Christmas Lake
d. Lake Minnetonka Direct
e. Dutch Lake
f. Gleason Lake Creek/Hadley Lake
g. Lake Virginia (Minnewashta)
h. Langdon Lake
i. Long Lake Creek
j. Painter Creek
k. Schutz Lake
l. Six Mile Creek

30 Approval Process (MCWD Board)

a. Review by Citizens Advisory Committee
b. Review with MCWD Board
c. Release to review agencies/general public for comment
d. Board review of comments
e. MCWD Board discussion/revision
f. Release for final comments
g. MCWD Board adoption

Appendix F

Painters Creek Aptimum Approach

Appendix G. "Optimum" Approach to Achieve TP Reduction in the Painter Creek Watershed

GOAL

Achieve greater than 25% reduction in TP load from the Painter Creek watershed as part of achieving 60 µg/l TP in Jennings Bay (adopted in-lake goal, WD Board action 4/18/02)

OBJECTIVE

Propose series of BMPs to reduce TP according to the goal stated above.

PRE-BMP STUDIES

Prior to undertaking any construction projects, it is recommended that some pre-implementation studies be done to:

1) Document the phosphorus content of sediment throughout the watershed, focusing on a set of "typical" wetland soils – Painter Marsh, South Katrina Wetland, and Katrina Lake; translate findings into BMP strategies pertaining to wetland use
2) Evaluate the location and number of carp prior to any eradication efforts; installation of the gate at the mouth of the creek should proceed before any eradication begins
3) Explore the possibility for retrofit opportunities at BMP Sites #4 and #9, and outlet of PC-5
4) Assemble low- and medium-density "Development BMPs" suite for BMP recommendations for #3, 12 and 15
5) Identify channel erosion reaches and prioritize order of control implementation
6) Identify water quality monitoring needs to best characterize load behavior as the Creek flows through the sub-basin

BMP APPROACH

Start at the head of the basin and work down to the mouth, suggesting BMPs for consideration and assigning anticipated water quality improvements associated with the BMPs.

Table IV.Appendix.4-1
Optional BMP Applications (not a cumulative list)

Application # (priority tier for action)	Description (subwatersheds addressed)	Assumed TP Removal Effectiveness (subject to verification with field data)	Element and Estimated Cost	Cost Summary**
1 (1st)	Wetland treatment system, with detention and flow spreader; discharge to wetland west of Katrina Lake (PC 5-7; DA = 509 acres)	50%	-5 acre detention pond -Flow spreader -Wetland use/easement	-$800,000 to $1,600,000 -$2,000 - $20,000
2 (2nd)	Work with Three River Park District on Baker Park runoff management (PC 8)	NQ*	-Dedicated staff time	$0
3 (2nd)	Incorporate "Development BMPs" suite into newly developing areas through 2020 (PC 1-3)	Hold at current levels through 2020	-Staff time through permitting and plan reviews	$0 – cost through reviews
4 (2nd)	Retrofit sub-basin outflow with small detention and flow spreader for outlet to eastern Katrina wetland (PC 4; DA = 758 acres)	25%	-Retrofit basin (max. 7 acre) -Flow spreader -Wetland use/easement	-$1,200,000 to $2,400,000 max. -$5,000 $20,000
5 (2nd)	In-lake controls for Katrina Lake, including carp control and possible chemical addition for internal TP (PC 8)	10%	-Carp eradication -Internal load evaluation	-$5,000 study
6 (1st – joint with #7)	Alter South Katrina Wetland to maximize water/vegetative contact through such means as ditch plugging/re-routing, floodplain re-establishment (PC 1-9; So. Katrina Wetland = 97 acres; DA = 3780 acres)	33% in combination with Application #7	-38 acre (1%) alteration to floodplain/wetland corridor	-$456,000 to $760,000 plus $20,000 to plug ditch

Application # (priority tier for action)	Description (subwatersheds addressed)	Assumed TP Removal Effectiveness (subject to verification with field data)	Element and Estimated Cost	Cost Summary**
7 (1st – joint with #6)	Install small detention pond to settle inflow from PC 9 (PC 9; DA = 300 acres)	See above	-3 acre detention pond	-$480,000 to $960,000
8 (1st)	Connect Carlson Site to Painter Creek channel and route water through wetland system, taking advantage of storage and vegetative treatment (PC 1-11)	25%	-Connect system to creek -Monitoring program for 1-year pre- and 2-year post-connection	-$160,000 for grading and diversion -$30,000 monitoring
9 (1st)	Reduce erosive flow peaks from Maple Plain using temporary storage in the City (PC 13; need to determine DA from Maple Plain, including added area; estimate of 60 acres)	50% in combination with Application #10	-~1-acre detention pond or retrofit at apartment complex; focus on bounce control	-$165,000 to $370,000 for pond with fixed weir control structure
10 (1st)	Stabilize erosive ditches that drain Maple Plain runoff along Co. Rds. 19 and 83 (PC 13)	See above	-Identify problem reaches -Install series of stabilization structures -Streambank stabilization	-$15,000 -function of above survey results -$500/lin.ft.
11 (1st)	Develop "Potato Farm" site into structured wetland treatment system to treat inflow from Maple Plain and Painter Creek main channel (PC 1-12; DA = 4944 acres)	25%	-40 acre alteration into wetland system	-$480,000 to $800,000
12 (1st)	Incorporate "Development BMPs" suite into newly developing areas through 2020 (PC 16)	Hold at current levels through 2020	-Staff time through permitting and plan reviews	$0 – cost through reviews

Application # (priority tier for action)	Description (subwatersheds addressed)	Assumed TP Removal Effectiveness (subject to verification with field data)	Element and Estimated Cost	Cost Summary**
13 (2nd)	Install small detention pond and flow spreader at western inflow to Painter Marsh to increase vegetative contact (PC 18-20; DA = 807 acres)	33%	-8 acre detention pond -Flow spreader -Wetland use/easement	-\$1,280,000 to \$2,560,000 -\$10,000 -\$20,000
14 (1st)	Alter Painter Marsh to make more effective use of vegetation and floodplain by such things a ditch plugging and corridor establishment (PC 1-21; Painter Marsh = 265 acres; DA = 8276 acres)	25%	-80 acre alteration to floodplain/wetland corridor	\$960,000 to \$1,600,000
15 (1st)	Incorporate "Development BMPs" suite into newly developing areas through 2020; install permeable weirs in channel to slow water and allow for vegetative contact in channel wetlands; possible later addition of detention/wetland system (PC 25)	15%	-Staff time through permitting and plan reviews -3 "permeable weirs" -No detention at this time	\$150,000 for weirs
16 (1st)	Install flexible carp gate at mouth of Painter Creek	NQ	-Install carp gate	\$30,000 to \$75,000
Summary		Cumulative 60%		

* NQ = Not quantifiable at this time

** Unit cost assumptions (costs include vegetation, but not landscaping costs):

- All wetland/floodplain alteration estimates are based on Carlson Site cost of \$12,000/acre for all elements (land easement, planting, detention) to max. cost of \$20,000/acre with significant engineering, design and inspection.
- Vegetated detention basin \$40,000 - 80,000 per acre-foot of storage; variation based on presence/absence of site constraints, including land costs
- Flow spreader (10-ft. wide vegetative) \$20 per lin. ft.
- Outlet control structure (weir, access hole, etc.) \$50,000
- Streambank stabilization (bio-engineered, with fabric and limited rip-rap) \$500 per lin. ft.

Minnehaha Creek Watershed District

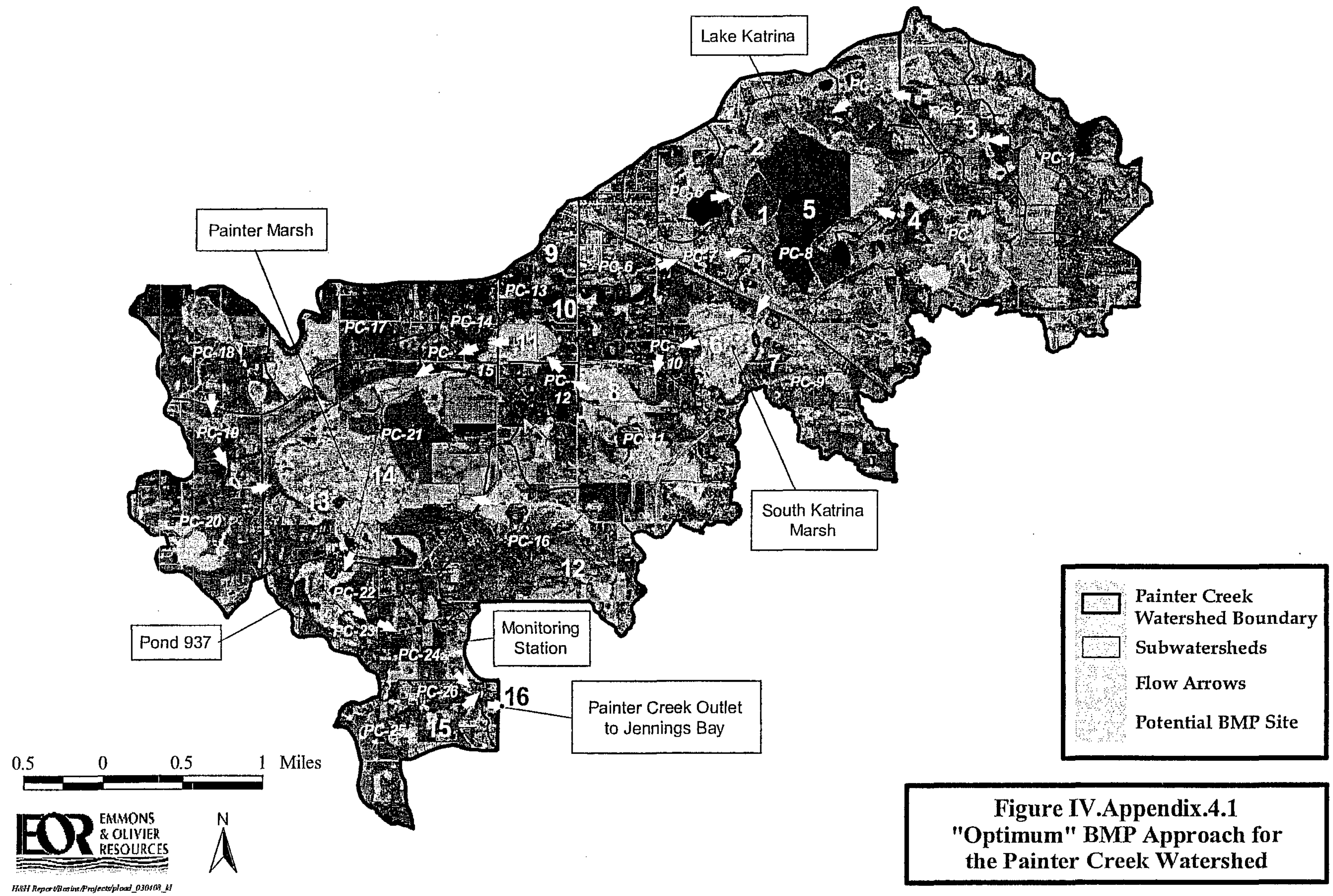


Figure IV.Appendix.4.1
"Optimum" BMP Approach for the Painter Creek Watershed

ELEMENTS BY SUB-BASIN

Sub-Area 1: Katrina Lake

Sub-basins covered: PC-1 through PC-8

Table IV.Appendix.4-2
Sub-Area 1 Pre-BMP Modeled Loads

Sub Basin	TP Load (lbs./yr)	
	Current	2020
PC-1	37	75
PC-2	19	56
PC-3	4	5
PC-4	106	128
PC-5	6	7
PC-6	91	99
PC-7	67	70
PC-8	135	141
Total	465	581

Scenarios:

1) Capture runoff from PC-5 through 7 at the wetland area on the western edge of Katrina Lake. Develop a surface water management wetland system with a flow spreader for release over the wetland vegetation between the installed system and the lake **[Map location #1]**. Work with Hennepin Parks ("Three Rivers") on park management to minimize and treat runoff from park **[Map location #2]**. Assume an overall TP reduction of 50%

   Calculations: Current load = 164 lbs. * 0.5 = 82 lbs.
   2020 = 176 lbs. * 0.5 = 88 lbs.

2) PC-1 through 3 **[Map location #3]** will be developing 2020 and the load increasing substantially. Incorporate "Development BMPs" suite developed by Watershed District as standard for runoff control from newly developing areas. Hold TP levels at current loads.

   Calculations: Current load = 60 lbs.
   2020 = 136 – 60 = 76 lb. reduction by keeping conditions

3) Control load from PC-4 by possible retrofit at outflow of sub-basin prior to outlet to Katrina Lake **[Map location #4]**. Focus on outlet control to spread flow over wetland area east of lake. Assume 25% TP reduction.

   Calculations: Current load = 106 * 0.75 = 80 lbs.
   2020 = 128 * 0.75 = 96 lbs.

4) In-lake controls for Katrina **[Map location #5]**, including carp control and work with Hennepin Parks on park runoff management. Assume a TP reduction of 10% with carp control program.

   Calculations: Current load = 135 * 0.9 = 122 lbs.
   2020 = 141 * 0.9 = 127 lbs.

Table IV.Appendix.4-3
Sub-Area 1 Post-BMP Loads

Sub-Basin	TP Load (lbs.)	
	Current (pre-BMPs)	**2020 (pre-BMPs)**
PC-5 through 7	82 (164)	88 (176)
PC-1 through 3	60 (60)	60 (136)
PC-4	80 (106)	96 (128)
PC-8	122 (135)	127 (141)
Total outflow load from PC-8 at Katrina Lake	344 (465)	371 (581)
Cumulative load reduction	121	210

Sub-Area 2: South Katrina Wetland

Sub-basins covered: PC1 through 9

Table IV.Appendix.4-4
Sub-Area 2 Pre-BMP Modeled Loads

Sub Basin	TP Load (lbs.)	
	Current	**2020**
PC-1 through 8	465	581
PC-9	166	216
Total	631	797

Scenarios:

1) Reduce TP load entering Sub-Area 2 according to above scenarios. Alter South Katrina Wetland **[Map location #6]** to better treat inflows by plugging ditch, allowing floodplain re-establishment, spreading water over wetland vegetation. Install a small detention pond on the east side **[Map location #7]** of the wetland to treat the inflow from the east part of PC-9. Experimental, but assume TP load reduction of 33%.

   Calculations: Current load = (344 + 166) * 0.67 = 342 lbs.
   2020 = (371 + 216) * 0.67 = 393 lbs.

Table IV.Appendix.4-5
Sub-Area 2 Post-BMP Modeled Loads

Sub Basin	TP Load (lbs.)	
	Current (pre-BMPs)	2020 (pre-BMPs)
Total outflow load from PC-18 at South Katrina Wetland	342 (631)	393 (797)
Cumulative load reduction	289	404

Sub-Area 3: Carlson Site Outflow

Sub-basins covered: PC-1 through 11

Table IV.Appendix.4-6
Sub-Area 3 Pre-BMP Modeled Loads

Sub Basin	TP Load (lbs.)	
	Current	2020
PC-1 through 9	631	797
PC-10	23	31
PC-11	159	209
Total	813	1037

Scenarios:

1) Reduce TP loads entering Sub-Area 3 according to above scenarios. Connect Carlson Site to Painter Creek main channel and route water through improved wetland treatment system **[Map location #8]**, using the natural wetland and available detention storage. Assume a TP load reduction of 25% because of its unproven ability and small size relative to the drainage area in the creek.

   Calculations: Current load = (342 + 23 + 159) * 0.75 = 393 lbs.
   2020 = (393 + 31 + 209) * 0.75 = 475 lbs.

Table IV.Appendix.4-7
Sub-Area 3 Post-BMP Modeled Loads

Sub Basin	TP Load (lbs.)	
	Current (pre-BMPs)	2020 (pre-BMPs)
Total outflow load from PC-11 at Carlson Site	393 (813)	475 (1037)
Cumulative load reduction	420	562

Sub-Area 4: "Potato Farm" Site

Sub-basins covered: PC-1 through 13

Table IV.Appendix.4-8
Sub-Area 4 Pre-BMP Modeled Loads

Sub Basin	TP Load (lbs.)	
	Current	**2020**
PC-1 through 11	813	1037
PC-12	14	21
PC-13	99	126
Total	926	1184

Scenarios:

1) Reduce TP loads entering Sub-Area 4 according to above scenarios. Capture runoff from developed area of Maple Plain **[Map location #9]** prior to reaching the ditches along Co. Roads 19 and 83. Look for temporary storage to cut erosive peak flows.
2) Stabilize erosive ditches along Co. Roads 19 and 83 **[Map location #10]** with check dams and/or bank stabilization.
3) Develop "Potato Farm" site **[Map location #11]** to further treat pre-settled Maple Plain runoff and route Painter Creek through new treatment system.
4) Assume a 50% reduction for PC-13 TP load and 25% for PC-12 and upstream loads
   Calculations: Current load = [(393 + 14) * 0.75] + (99 * 0.5) = 369 lbs.
   2020 = [(475 + 21) * 0.75] + (126 * 0.5) = 435 lbs.

Table IV.Appendix.4-9
Sub-Area 4 Post-BMP Modeled Loads

Sub Basin	TP Load (lbs.)	
	Current (pre-BMPs)	**2020 (pre-BMPs)**
Total outflow load from PC-13 at "Potato Farm" Site	369 (926)	435 (1184)
Cumulative load reduction	557	749

Sub-Area 5: Painter Marsh

Sub-basins covered: PC-1 through 21

Table IV.Appendix.4-10
Sub-Area 5 Pre-BMP Modeled Loads

Sub Basin	TP Load (lbs.)	
	Current	2020
PC-1 through 13	926	1184
PC-14	16	25
PC-15	15	18
PC-16	95	137
PC-17	40	55
PC-18	38	43
PC-19	21	21
PC-20	62	81
PC-21	251	302
Total	1464	1866

Scenarios:

1) Reduce TP loads entering Sub-Area 5 according to above scenarios. Maintain current load from PC-16 **[Map location #12]** through application of "Development BMPs" suite developed by Watershed District as standard for runoff control from newly developing areas.
2) Capture PC-18 through 20 at inflow point to Painter Marsh west side **[Map location #13]**. Install small detention pond and level spreader to spread outflow over wetland vegetation. Assume TP load reduction of 33%.
3) Alter Painter Marsh **[Map location #14]** to make effective use of wetland vegetation and soil, assuming soils tests indicate it will work. Plug ditch and spread flow over wetland. Allow floodplain to work. Assume TP load reduction of 25% for PC-21, PC-16 and PC-13 through 15.

   Calculations: Current load = (121 * 0.67) + (746 * 0.75) = 641 lbs.
   2020 = (145 * 0.67) + (971 * 0.75) = 825 lbs.

Table IV.Appendix.4-11
Sub-Area 5 Post-BMP Modeled Loads

Sub Basin	TP Load (lbs.)	
	Current (pre-BMPs)	2020 (pre-BMPs)
Total outflow load from Painter Marsh at PC-21	641 (1464)	825 (1866)
Cumulative load reduction	823	1041

Sub-Area 6: Painter Creek Outlet

Sub-basins covered: PC-1 through 26

Table IV.Appendix.4-12
Sub-Area 6 Pre-BMP Modeled Loads

Sub Basin	TP Load (lbs.)	
	Current	2020
PC-1 through 21	1464	1866
PC-22	33	49
PC-23	5	8
PC-24	28	52
PC-25	37	85
PC-26	23	27
Total	1590	2087

Scenarios:

1) Reduce TP loads entering Sub-Area 6 according to above scenarios. Reduce high load inflow from PC-25 **[Map location #15]** by applying "Development BMPs" suite developed by Watershed District as standard for runoff control from newly developing areas to hold future loading down. Install permeable weirs in the channel to slow flow from numerous wetlands and allow water to contact vegetation. Assume 15% TP load reduction. Possible addition of detention/wetland system at mouth if needed in the future.

   Calculations: Current load = 641 + 89 + (37 * 0.85) = 761 lbs.
   2020 = 825 + 136 + (85 * 0.85) = 1033 lbs.

2) Install flexible carp gate at mouth of sub-watershed **[Map location #16]**.

Table IV.Appendix.4-13
Sub-Area 6 Post-BMP Modeled Loads

Sub Basin	TP Load (lbs.)	
	Current (pre-BMPs)	2020 (pre-BMPs)
Total outflow load from Painter Creek at PC-26	761 (1590)	1033 (2087)
Cumulative load reduction	829	1054

SUMMARY

Application of an optimum suite of BMPs and assumption that the wetlands can act as an annual sink of phosphorus, have led to a total reduction in TP loading of about 50% if all BMPs proposed were implemented under this theoretical design exercise – a condition which is not recommended. Rather, the Regional Team suggests a priority order of implementation according to the "management approach" priorities adopted in April 2002. This approach, for example, would seek ways to take advantage of the extensive wetland system in the Painter Creek watershed, and rely on the application of a "Development BMPs" suite, which must be developed by the Watershed District as a standard for runoff control from newly developing areas to hold future loading down.

Although the wetland character of the sub-basin seems to indicate better use of wetlands, prior to application of watershed-wide wetland treatment, some basic data collection (ex. soils) and a pilot effectiveness test (ex. the Carlson Site) should occur. This is to assure that the wetlands are in fact annual sinks for phosphorus.

Piecing together a watershed management program to reduce phosphorus by 25% to achieve the District's goal for Jennings Bay seems feasible, given the optimum BMP exercise shown above.