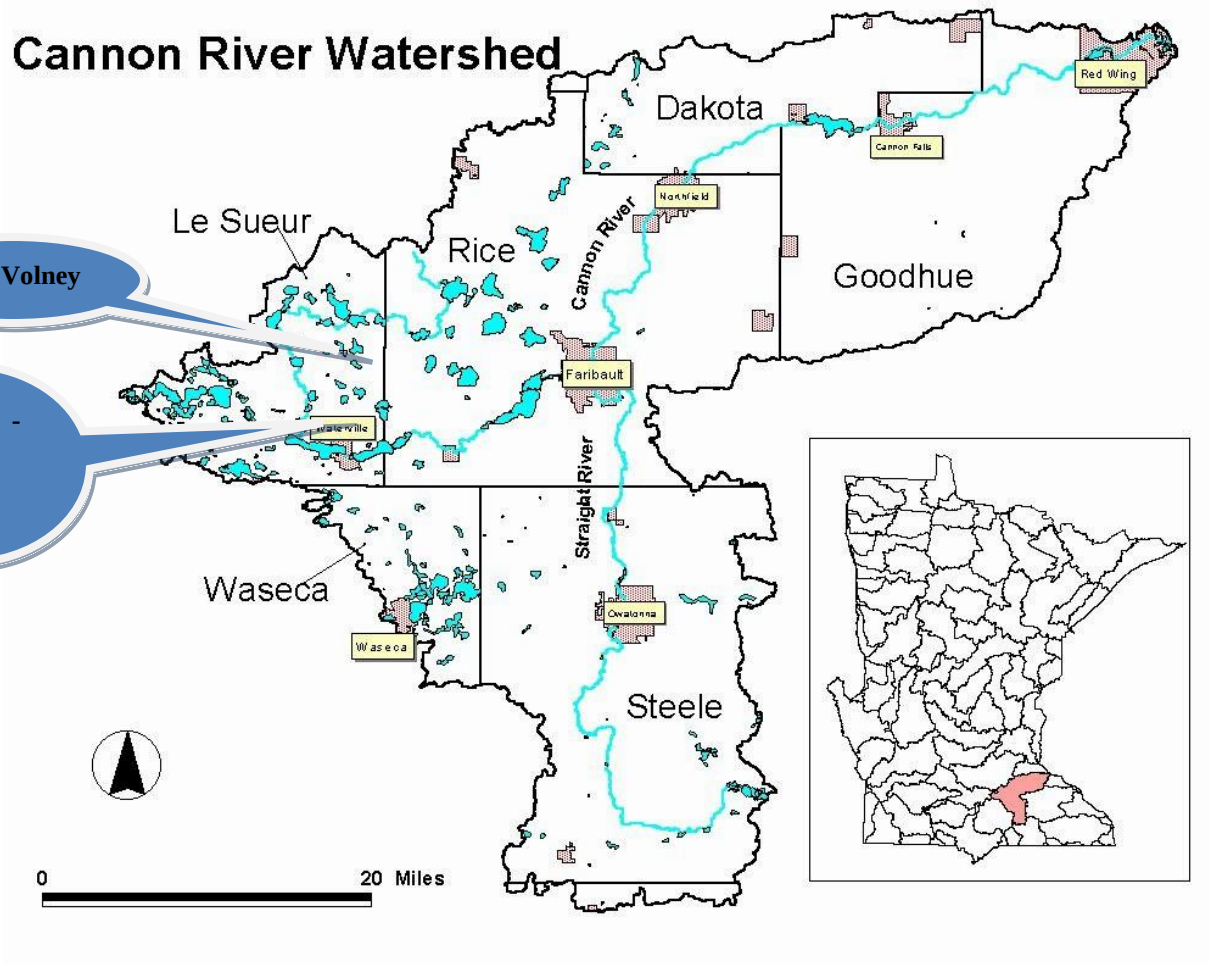

Cannon River TMDL Summary

September, 2008

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Lake Volney Studies

MPCA Lake Assessment Program 1986

Recommendations:

Target mass loading of 1,500 pounds Phosphorus from all sources is proposed- this would require a reduction of about 4,000 pounds P/ year.

Results:

Water quality was collected on 5 occasions from two sites on Lake Volney and from Ditches 1, 2, 12, and the lake outlet over the summers of 1985 and 1986.

Spring Sample obtained April, 1986 showed the lake to be isothermal, however by June the lake had become stratified. Thermocline was found to be between 20-26 feet at this time.

Lake total phosphorous concentrations were very high on all sample dates averaging 160 ug P/L. At that time this concentration of phosphorous was higher than 92% of lakes in a sample of 1028 Minnesota lakes.

Total Nitrogen concentrations averaged 2,040 ug in 1985 and 1986.

Ratio of TN:TP = 13- indicates that either phosphorus or nitrogen can be limiting but most likely phosphorous is the limiting nutrient.

This study locates Ditch #1 as a site on the northeastern corner of the lake as being the site where most of the flow into the lake was coming from as well as the source of many of the nutrients loading in to the lake. I believe the ditch they are referring to is the ditch with the parshall flume located on it.

Probably range of phosphorus reaching Lake Volney is between 2,238 and 7, 568 pounds per year according to computer generated model.

Future of the lake seems bright given the morphometry of the lake, it was estimated that the lake retains 90% of the phosphorous coming into it, which means that the lake will tend to respond quickly to reductions in nutrient loadings

Lake Volney Improvement Project Application for Phase I MPCA Clean Water Partnership Program

Project Applicant Le Sueur County Board of Commissions

Statement of Problem- All prior studies conducted including a fishery survey in 1992, a septic survey, an Agricultural Non-point Source pollution model, and other studies indicate that the lake has been subject to extreme water quality deterioration.

Statement of the Project Goals and Objectives

Overall Resource Goals

- Advance the current understanding of the cause-effect mechanisms relating the watershed landuse practices to lake water quality
- The data gathered during the diagnostic study will enable the project manager and resource committee to develop an information based management plan to assess the magnitude of each pollution source and design realistic control measures
- Define preliminary quantitative goals
- Inform and educate the public especially those within the watershed.

Costs/Budgets of monitoring, who will be responsible for each aspect – parties involved will include MSUM MDNR MPCA

Various letters from people within the watershed describing their interest in the management of Lake Volney- many state that the lake was once very clear and an excellent location for swimming, boating, and fishing that has declined dramatically over the years

Lake Volney Diagnostic Study 1997

Results:

Mass balance shows that 1382 kg of P was delivered to the lake from the watershed and the lake discharged 325 kg of P, retaining 76% or 1057 kg of P. Lake stratification proceeded rapidly through the month of May, oxygen was depleted below 16 meters by the end of the month. Hypolimnetic Fe/P ratios of 3 or greater are required for adequate control of phosphorous during periods of lake turnover, lake Volney's values fall far short of this value.

Sub watershed 7 and 8 (northwest corner of lake) discharged the most nutrients per area while subwatershed 3 (parshall flume site) was by far the largest and dominant source of nutrient loading.

The wetland in subwatershed 3 is acting as a source of P, the wetland receives inflow from streams passing through sites 1 and 2, and more phosphorous is coming out of the wetland than is going into the wetland. The wetland is acting as an anaerobic reactor with chemically reduced forms as outputs similar to lake sediments. The lake and reservoir predictive model BATHTUB was used to simulate both current and future water conditions. The predicted total P is much less than the observed values and is indicative of a missing P contribution. A complete inhibition of sediment P release would reduce mean annual lake concentrations from approximately 170 ug/l to 85 ug/l.

A model simulation was conducted assuming a 30% reduction in the 1995 TP resulting from creating a deeper permanent pool within the wetland, the simulation predicts a further 13% reduction in average lake concentration and a 6% reduction in chlorophyll-a. A separate model run indicated that a combined 50% reduction in watershed loading through BMP's in addition to sediment P control would result in an average lake P concentration of 67 ug /L.

Results of the 1994-95 lake and watershed sampling are included within this report as follows:

During the 1995 lake diagnostic study thirteen sampling stations were located throughout the lake and watershed representing a relatively large tributary flowing from the Northeast, several smaller streams discharging directly to the lake, a single lake station, and the lake outlet. Subwatersheds 1 and 2 drain almost entirely cropland and discharge via ditch systems into subwatershed 3 which contains a large wetland surrounded by agriculture. The wetland outflows into subwatershed 5 and is contained within the ditch past a large swine feedlot, through a drained wetland, and into Lake Volney. Subwatershed 4 is elevated 20-60 feet above the lake and drains via a tile network with surface inlets. Subwatershed 6 is steep and several terraces exist and are currently being constructed. Subwatershed 8 discharges via draintile and road ditch into a short channel that flows through a small constructed pond/wetland within subwatershed 7. Subwatersheds 9 and 10 are croplands equipped with draintile systems, site 13 located at the lake outlet is located in a county park near the beach. Subwatershed 3 is the largest watershed and contains the largest wetland. Subwatershed 3 dominated the flow inputs to the lake; however subwatershed 9 had the largest runoff coefficient at 0.63 which was probably due to the extensive draintile network.

Subwatersheds 7 and 8 discharge the most phosphorus per area; however subwatershed 3 was the dominant source of phosphorus contributing 503 kg. Sites 7-10 contributed the greatest percentage of soluble phosphorus to the lake although the total amount of phosphorus contributed was relatively low with the exception of subwatershed 8 which for its area contributed the most per area as was previously mentioned. Subwatershed 3 also contributes the largest amount of suspended solids to the system.

Water Quality Goals

Variable	Management Objective	1995 Conditions
Total Phosphorus	60-80	170 ppb
Chlorophyll-a	10	26 ppb
N/P Ratio	>16	14
Si/P Ratio	>100	25
OP/TP Ratio	0.10	0.59
Hypolimnetic Fe/TP	>3	0.29
Chl-a/ TP	0.10	0.15

Budget for Proposed Implementation Plan

Index discussing various pollutants and how they are measured.

Lake Volney Water Quality Improvement Project Implementation Plan and Application for Phase II Goals

Outlines project goals and budget- the actual accomplishments for each of these goals was outlined in the 2002-2005 Lake Volney Clean Water Partnership Phase IIB as outlined below in the goals for phase II section.

Lake Volney – Work Plan 1998-2001

Outlines information of budgets, schedule, activities, and responsibilities for the lake Volney watershed- provides information for who is eligible for grants and who is not,

Restates many of the same project goals as before, provides contacts for project managers, lake association members, and others associated with the project.

Lake Volney Clean Water Partnership Work Plan 2002-2005

Restates Project Goals, Provides timeline for accomplishments of each task under the goals.

Summary of projects and monitoring efforts conducted in the past:

Table 1:

Date	Monitoring Effort	Monitoring of	Project Organized by	Phase Associated With
1987	Lake Assessment Project	Lake Water	Lake Assoc. MPCA	I
1991	Septic System Survey	Home ISTS	Lake Assoc. County	I
1991-92	Watershed Assessment (AgNPS)	Land Use/Management	SWCD	I
1992	Lake Water Quality	Lake Water	MPCA	I
1992	Full Lake Survey	Lake Biology	MDNR	I
1995	Phase I CWP Monitoring	Lake Water, Inflow Water, Landuse/Mgt.	County	I
1997	Limited Inflows	Inflow water	County	I
1998	CWP Phase IIA Implementation		County, Lake Assoc.	IIA
1998	Inflow Tributary Sites	Inflow water	county	IIA
1999	Full Lake Survey	Fisheries, aquatic veg, lake water quality	MN DNR	IIA
2002	CWP Phase IIB Implementation		County, Lake Assoc	IIB
2002	Limited Inflows	Inflow	County	IIB
2003	Limited Inflows	Inflow	County	IIB

Lake Volney Improvement Project Final Report Phase IIA and Phase II B Summarized below under Phase II Goals- These are the goals that have been accomplished within the Lake Volney watershed.

Overall Summary

Volney Lake Background

Lake Volney is a relatively small lake at approximately 277 acres, however; the lake is deep with a mean depth of 22.7 feet and a maximum depth of 67 feet. In May of 1995, Le Sueur County received a grant from the MPCA to investigate the impacts of watershed loading to Lake Volney. Monitoring began in the spring of 1995 because of public concerns over the deteriorating quality of the lake. Lake Volney is a dimictic lake, meaning that it has two periods of stratification (summer and winter) and two mixing periods (spring and fall turnover). During summer periods of stratification, the hypolimnion becomes anoxic. During this time phosphorus is released from sediments which allows for the internal fertilization of Volney Lake, this in turn leads to algae blooms which block out light penetration and prevent macrophyte growth.

Lake Volney is situated in a watershed that is comprised of moderate to steep sloping hills which have been cleared for agricultural purposes. Lake Volney's watershed is comprised of a total of 2,278.27 acres, of which agricultural land practices account for 1,574.64 or 69% of the total amount Until the 1980's Lake Volney was considered a favorite swimming location of many residents in Leseur County, however; due to the increased severity and frequency of algal blooms residents no longer use the public beach. The number of people fishing, boating, and enjoying other forms of aquatic recreation on Lake Volney has also dropped significantly over the last 10 years in response to the algal blooms which seem to now plague the lake.

Past Studies

The first study to take place on Lake Volney was conducted by the MPCA in 1986. The Lake Assessment Project was the first effort which attempted to identify why water quality in the lake had begun to deteriorate. The study was also the first to attempt to answer questions posed by concerned citizens and local government. High phosphorus concentrations Le Sueur County conducted Phase I of the Diagnostic and Feasibility study of the lake and watershed in 1995, studies were also taking place in the early 90's which aimed at finding the sources of nutrients. Lakeshore resident septic systems were addressed as well as taking a comprehensive view of Lake Volney's watershed.

During the 1995 lake diagnostic study thirteen sampling stations were located throughout the lake and watershed representing a relatively large tributary flowing from the Northeast, several smaller streams discharging directly to the lake, a single lake station, and the lake outlet. Subwatersheds 1 and 2 drain almost entirely cropland and discharge via ditch systems into subwatershed 3 which contains a large wetland surrounded by agriculture. The wetland outflows into subwatershed 5 and is contained within the ditch past a large swine feedlot, through a drained wetland, and into Lake Volney. Subwatershed 4 is elevated 20-60 feet above the lake

and drains via a tile network with surface inlets. Subwatershed 6 is steep and several terraces exist and are currently being constructed. Subwatershed 8 discharges via draintile and road ditch into a short channel that flows through a small constructed pond/wetland within subwatershed 7. Subwatersheds 9 and 10 are croplands equipped with draintile systems, site 13 located at the lake outlet is located in a county park near the beach. Subwatershed 3 is the largest watershed and contains the largest wetland. Subwatershed 3 dominated the flow inputs to the lake; however subwatershed 9 had the largest runoff coefficient at 0.63 which was probably due to the extensive draintile network.

Subwatersheds 7 and 8 discharge the most phosphorus per area; however subwatershed 3 was the dominant source of phosphorus contributing 503 kg. Sites 7-10 contributed the greatest percentage of soluble phosphorus to the lake although the total amount of phosphorus contributed was relatively low with the exception of subwatershed 8 which for its area contributed the most per area as was previously mentioned. Subwatershed 3 also contributes the largest amount of suspended solids to the system.

Based upon the findings from these studies, an implementation plan was put into place for Lake Volney. This was labeled as the Lake Volney Improvement Project. There were several goals put into place which together make up the second phase of the effort to help control excess nutrients in Lake Volney. Due to the relatively small size of Lake Volney's Watershed (1906 acres) and given the fact that Volney is a relatively deep lake, Volney has a better than average chance of improving its overall water quality.

Goals for Phase IIA

Goal 1: Coordination of watershed activities that will occur within the Lake Volney watershed

A.) Create and maintain a Resource Committee

On December 21, 1998 a Resource Committee Meeting was held to overview the Phase I results and sequence the major implementation activities during the project term. People talked about how they used to enjoy crystal clear swimming in the past. Lake Volney TP is around 170, without the eternal loading the lake would be around 80ug/l. Rough fish dominate what should be a bass/panfish fishery.

Feb 23rd 1999, Points of interest included

- Cluster Septic Systems on Brockway Beach
- Low Interest loan funds available
- Wetland Survey occurring
- Mach property stabilization likely
- Jerry Scheffert terracing
- Dredging of lake outlet
- Improve fish barrier
- Offer manure/ soil testing

May 22, 2000

- Resource Committee meeting in Le Center – discussed grant payout upon approval of project workplan, points of interest included:
    - Aeration downstream of wetland
    - Dollars available for Rock Inlets
    - Dollars available for soil grid sampling.
    - Secci Disk readings
    - Importance of Meetings/Attendance

- September 19th, 2001 Resource Committee meeting held in Le Center. Review and revision of the project workplan discussed. The main objective of the meeting was to discuss the wetland in subwatershed 3. Talk about 100 year flood elevation planning criteria. Main objective was to stabilize the water elevation in the wetland, thereby reducing phosphorus export to Lake Volney. In the end due to a large amount of turnover within Le Sueur County, wetland restoration goals were not accomplished.

B.) Planning and Zoning and the Soil and Water Conservation District (SWCD) will coordinate watershed activities

- Annual contract established with the Le Sueur County SWCD for a watershed specialist. This individual was responsible for contacting landowners to promote conservation practices and the implementation of BMP's within the watershed.

C.)Administration and follow-up of workplan projects will be done by P +Z. The SWCD will oversee operation and maintenance of BMP's.

- Intern hired to create map themes within Arc View GIS
- Digitize all septic systems that utilized SRF funds
- Digitize CRP acreage, update feedlot inventory, indicator points to represent CWP project sites.
- Staff knowledge of Arc View was very poor, resulted in data that was not useable

D.) Planning and Zoning will administer the SRF loans

- During the phase IIA timeframe, $50,612 was disbursed to the following categories
    - Tillage equipment: $42,612
    - Shoreline Stabilization: $8,000

Goal 2: Reduce Nutrient Loading from the Watershed

Wetland Restoration in Subshed 3

Investigations into the potential for wetland restoration continued during the entire timeframe of the phase IIA study, some of the highlights are as follows:

Alvin Brockway- interested in RIM program for restoration work in lower wetland but ultimately his project was not eligible.

Many studies work done in 1998-99 to study the phosphorus impact of the wetland on lake Volney, in May 1999 a dike was proposed that would be place on Don Gibbs property to hold water back onto the wetland area. Jeff Hedke with BWSR evaluated the survey work done on the large wetland to determine the feasibility of building a pond just south of the wetland outlet on Don Gibb's property. In late Dec. 1999, it was proposed that a buffer was to be installed adjacent to the Picka property. No work was actually ever completed on the wetland, however extensive studies and proposals continued throughout the entire timeframe of the phase IIA project. Valuable information was collected and the ultimate restoration of lake Volney will depend upon the revival of this wetland, given the amount of time and effort put into the research of this wetland, it should not be ignored.

B.) Promote Cluster Septic Systems and up-grade of individual systems

A cluster septic system was pursued on Brockway Beach, however no systems were actually installed. During the phase IIA lifetime, 11 systems were installed, with two other existing systems receiving certificates of compliance.

C.) Promote Manure and Soil Testing, and Implement General Ag BMP's

BMP's Installed:

Alfred Scheffert installed 6 sediment blocks to reduce sediment and nutrient transport in subshed 10.

Tom Gregor installed a terrace/diversion through his yard to divert clean water around his feedlot to prevent feedlot runoff, located in subshed 2.

Dollars for phosphorous program was only taken advantage of by 2 landowners, Tom Gregor was awarded for hauling manure out of the watershed, while The Cooney Brothers were given incentives for installing a terrace

A buffer was installed on "Elmwood Corner" in subshed 10 by Roger Goettl, the purpose of this buffer was to slow water and trap sediment from the rolling agricultural land in this subshed. The Goettl Farm installed two terraces to slow runoff and sediment transport in subshed 4.

A drainage tile broke in subshed 9/10 which caused a severe washout on the Trenda property in May,2000. New tile was installed under the road all the way to the lake.

Dee Soulek located on the North shore of Lake Volney obtained a DNR Waters permit to install rip rap more than 5 feet waterward of the Ordinary High Water Mark to help with erosion issues. The watershed specialist aided in the design of this project and several others, along with follow-up for proper installation.

A grass waterway was created on the Alfred Scheffert property in subshed 10 just prior to the start up of Lake Volney's Phase II Implementation project. The waterway was completed in coordination with the SWCD and cost share funds.

There were also several BMP's that were attempted however they were not installed; these may provide ideas for additional restoration in the future. Some of the attempted BMP's include buffers on the property of Cyril Miller, installation of rock tile inlets, grass waterways, and continuing to monitor for areas of intense erosion and runoff.

D.) Stabilization of Gully and eroding Banks- intermittent drainage channel Subshed 7

On property owned by Harry Mach was a large gully within a wooded ravine that was experiencing a severe erosion problem. Extensive survey work by the NRCS and SWCD lead to the implementation of a grass waterway. Barnett Brothers from Kilkenny, MN cleared the waterway during the fall of 1999, the area was then graded to planned specifications. The waterway outlets to an existing pond through a rip rap outlet, a small sediment basin were constructed above the waterway, and tile intakes were added. All existing tile were hooked into the system for full treatment of runoff water in the sediment basin and ponds. The entire site was seeded and mulched. In September of 2000, the pond was dredged to remove the silt/sediment that had been deposited.

Goal 3: Reduce Lake Sediment Nutrient Recycling

A.) Plan to chemically treat Lake Volney in the near future if wetland restoration and watershed BMP implementation actions do not achieve adequate results. Although the major focus of the project during the Phase IIA timeframe revolved around watershed implementation there was a significant amount of consideration put forth to look at the possibility of treating the lake with an alum compound that would reduce internal recycling. Because internal loading is an extensive source for phosphorus it was determined that the positive effects of this treatment many last for as long as 10-15 years. This would do nothing to reduce external loading which is the ultimate source of the problem, therefore this approach was ruled out. Additional claims to chemically treat surface inflows was also brought into consideration however the use of this process in Minnesota is very limited and the associated cost of equipment and construction was very high. Therefore it was determined that the focus of the future should be based upon reducing nutrients from watershed sources first.

Goal 4:

Public Awareness of Water Quality Issues

1.) Planning and Zoning and Minnesota Extension Services will give and Ag BMP Demonstration- Rock Tile vs. Open Tile demonstration given in Lanesburgh, sponsored by the U of M.

2.) Watershed residents were invited to satellite conferences presented by the U of MN Extension Service on Alternative Systems for ISTS.

3.) Many of the goals designed to increase public awareness fell short of expectations due to a lack of commitment and coordination from various members within the County due a lot of employee turnover. m

Goals for Phase IIB

Goal 1: Coordination of watershed activities that will occur within the Lake Volney watershed

A.) Maintain a Resource Committee, Between January 2003 and March of 2006, residents of Lake Volney and its watershed along with members from various cooperating agencies met 8 times to discuss the progress of the work plan and helped to direct the future undertakings of the project.

B.) Environmental Services and the Soil and Water Conservation District (SWCD) shall be responsible for the coordination of watershed activities. Both Environmental Services and the SWCD relayed any information about the progress for improvement in the watershed to landowners. A summary of what they accomplished is found below,

2002

-One CRP Sign Up
- Clinton Pond
- Wetland project survey work
- Dollars for Phosphorous Project
- One Buffer Sign up
- Grid sampling work
- One presentation to the County board
- Technical meetings w/ water planner

2003

- Continued Buffer Contacts
- Nutrient Insurance Presentations
- Terrace Project Contact
- Presentation to County Board
- Technical and Resource Committee Meetings
- Attended Cannon River Summit CREP meeting
- Grid Sampling

2004

- Biomass meeting
- Cannon River Summit
- Technical meeting
- TMDL training
- Continued Buffer Contracts
- alternative crop meeting
- Nutrient Insurance meeting
- Continued Buffer Contract Work
- Resource Committee meetings
- Volney Outlet Study

2005

- Volney Development meetings
- Technical meetings
- Landowner contacts for blind inlets
- Landowner contact for wetland restoration
- Resource Committee meetings
- Two harvestable buffer projects

C.) Le Sueur County Environmental Services administered and followed up on the work plan projects. The SWCD followed up with landowners on BMP operation and maintenance.

Goal 2: Reduce Watershed Nutrient Loading to the Lake

A.) Watershed Implementation Activities.

Reassessed all wetlands in the watershed to determine the best sites for restoration as well as the potential impacts to farms and homes. Conservation easements, such as RIM and CRP were promoted as applicable. Incentive was paid out on two harvestable buffers along a drainage ditch. Future projects include a wetland restoration and replacement of six open tile intakes with blind inlets.

B.) Promote ISTS (Individual Sewage Treatment Systems) upgrades to further the point-source nutrient reduction. Environmental Services staff promoted ISTS upgrades to ensure compliance with all applicable state and local ordinances. Ensuring ISTS compliance helped to reduce the prevalence of non-point source nutrients. 20 systems were upgraded in the watershed from 2002-2005.

C.) Provide manure and soil testing, and implement BMP's. Environmental Services, the SWCD, and Minnesota Extension Service provided assistance and incentives to landowners for manure and soil testing, as well as BMP implementation relevant to recommendations for nutrient concentrations.

D.) Nutrient Management and Comparison Fields. The project continued conducting demonstration farm plots on existing farm sites within the watershed. The landowner who participated saw the benefit of reducing application rates to university recommendations. The insurance paid the landowner less than $3.00 for the loss in yield using university recommendations. The pilot project of Nutrient BMP Insurance is through a program of the USDA –Risk Management Agency did not continue, the program was not upheld by the agency.

Goal 3: Reduce Lake Sediment Nutrient Recycling:

A.) Lake Management Plan- In coordination with the MDNR, MPCA, develops a comprehensive lake plan by 02/2004 that considered the following factors:

- External nutrient loading from watershed
- Fish Community
- Lake outlet
- Funding options and limitations
- Internal recycling on nutrients
- Aquatic plant community
- Long term use / water quality objectives

Because Lake Volney was put on the impaired waters list, a hold on the lake management plan was put into place. This is due to the fact that we will be using a TMDL for this waterbody.

B.) In Lake Treatment Feasibility- Contracted Blue Waters to conduct an assessment of in-lake treatment options. The MPCA did not approve of using CWP funds for in-lake treatment. Lake was too large and deep for organic carbon amendment; this is a band-aid type fix and would not help the problems associated with excessive nutrient loading.

Goal 4: Public Awareness of Water Quality Issues

A.) Environmental Services will provide information regarding the importance of complying with ISTS (Individual Sewage Treatment Systems) to watershed and lake shore owners.

- Environmental Services educated homeowners regarding ISTS, although a small source pollution, it is an easy source to target as well as a potentially hazardous one.

- Development went in on the north side of Lake Volney; the best available ISTS given soil types was the installation of several mound systems.

B.) Environmental Services, in conjunction with the SWCD and MES will educate landowners of the importance of a healthy watershed. Planning and Zoning, SWCD, and MES educated homeowners through mailings, news releases, and presentations on the importance of a healthy watershed ecosystem. A DNR shore land vegetation grant was written and submitted to the DNR however the project was not funded. Three Shoreland Management workshops were organized in the Upper Cannon for the shoreland owners in Le Sueur County however there was not enough interest and the workshops were cancelled.

C.) Continue monitoring and evaluate the effectiveness of the project. Limited monitoring occurred in Lake Volney and its watershed. In 2005 Lake Volney was monitored 10 times from May-September. Secci Disk readings average 8.8 feet which is equal to a water quality grade of a B. Total phosphorus averaged 87 ug/L which corresponds to a water quality grade of a D while the chlorophyll-a mean of 19.4 ppb fell within the B grade. Overall lake quality for Lake Volney was determined to be a C.

D.) Continue and expand citizen based monitoring program. Several Lake Volney Lake Association members volunteered for the Citizen Lake Monitoring Program (CLMP). Volunteers took Secci disk measurements, lake water levels, and report on conditions of the lake to further compile data on Lake Volney. In 2005, the CLMP report showed that there are no volunteers on Lake Volney. Planning and zoning will continue to promote the CLMP to further the watershed stream monitoring efforts.

Concluding Statement Regarding Success of Phase II :

Although there was substantial turnover amongst employees working on the project as well as a general lack of guidance there were several important steps taken to improving Lake Volney's watershed. Several BMP's were implemented, and a significant amount of information was gained through survey work. Grant dollars were utilized, all for the betterment of the water quality of Lake Volney. Subwatershed 3 which drains subwatersheds 1 and 2 and an expansive wetland has been identified as the major contributor to pollutants entering Lake Volney. This wetland has become a source of nutrients after decades of being inundated with nutrient rich stormwater. Projects proposed to create a deep pool within the wetland that would capture a majority of nutrients have been proposed but complete agreement has not been reached amongst landowners. The remediation of Lake Volney will most likely not see any substantial improvements until the wetland habitat is allowed to be expanded and dredged, thereby allowing the wetland to function as a settling basin for sediments and nutrients.

Future

Currently Lake Volney is listed under section 303 (d) as being an impaired waterbody under the Clean Water Act. Lake Volney is listed under section 303 (d) as being impaired for both nutrient/eutrophication as well as mercury. (Table 1) These pollutants have affected Lake Volney's ability to provide a safe habitat for aquatic recreation and also caused fish and other organisms in the lake to be contaminated with unsafe levels of mercury. Due to the fact that Lake

Volney is listed as being impaired, Lake Volney will undergo a study known as a TMDL (Total Maximum Daily Load). A TMDL study aims to find the maximum amount of a pollutant a water body can receive without violating water quality standards. The TMDL process identifies all sources of pollutants and determines by how much each source must reduce its contribution in order to help meet the standard water quality level desired. The source reduction strategies form the basis of an implementation plan which then must be completed within one year after the U.S EPA approves a TMDL Study. (MPCA) The current project status for Lake Volney is approved, which is defined as: TMDL study approved by U.S. EPA, and project is in implementation phase. (MPCA)

Lake Volney is currently listed as a category 5a waterbody which means that the water body is impaired and is in need of a TMDL study which will help to identify the sources of pollution and suggest a course for remediation of the waterbody. Once studies have been completed which have documented the major sources of pollution within Lake Volney's watershed, steps can be taken to reduce nutrient loading into Lake Volney. The delisting of Lake Volney from the impaired water bodies list will occur when Lake Volney no longer exhibits the characteristics of an impaired waterbody that provided the need for the lake to be placed on the impaired waters list.

Table 1: Lake Volney Impaired Waterbodies Clean Water Act (Section 303 (d))

Reach	Description	Yr	River ID#	Lake or wetland ID#	Affected use	Pollutant or stressor	TMDL Target start	TMDL Target completion	Category
Volney	Lake or Reservoir	02	0704x	40-0033-00	Aquatic recreation	Nutrient/Eutrophication Biological Indicators	2005	2011	5A
Volney	Lake or Reservoir	98	0704x	40-0033-00	Aquatic consumption	Mercury in fish tissue	1998	2011	5A

Jefferson-German Chain Studies

Lake Assessment Program 1990 Jefferson and German Lakes

Water quality collected indicates that German lake is Eutrophic and Jefferson Lake is hypereutrophic, German has a mean total phosphorus of 42 ug/l, while the basins that make up Jefferson Lake have a mean total phosphorus concentration of 114 ug/L. For the North Central Hardwood Forest Ecoregion, 34 percent of the lakes contain concentrations of phosphorus lower than which is present in German lake and 74 percent of the lakes contain lower phosphorus concentrations than Jefferson Lake. This is a reflection of the fact that water quality is much better on German Lake than on Jefferson Lake. During this study the lake levels were significantly below normal in response to a drought which had taken place from 1987 to 1989. Water quality data was collected on May 14, June 14, July 19, August 15, and September 20th at two locations on German Lake and six stations on Jefferson Lake.

Results:

By the June sampling date, thermal stratification was evident on both lakes, however as summer progressed, the stratification became weaker and weaker and by August-September the lakes had become un-stratified as water temperatures were uniform throughout the water column. DO concentrations generally remained above 5 mg/l throughout the water column except in German Lake during the months of July and August when concentrations of DO below 16 feet was less than 5 mg/L. Because these lakes are relatively shallow for their size, stratification is often interrupted by wind, therefore the lakes probably mix at least partially throughout the summer. This mixing combined with low oxygen concentrations can lead to internal fertilization of phosphorus within the water body.

Phosphorus conditions for German averaged 42 ug/L which is lower compared to most lakes within the NCHF ecoregion whose range of values is from (23-50 ug/L). East Jefferson and West Jefferson has high average phosphorus concentrations of 129 and 98 ug/l respectively, once again indicating the difference in water quality between the basins which make up Jefferson Lake compared to German lake. In both Jefferson and German lakes the ratio of phosphorus to nitrogen indicate that phosphorus is the limiting nutrient. Chlorophyll concentrations for the entire Jefferson German chained averaged 49 ug/L however concentrations as high as 426 ug/L were reported on shallow Middle Jefferson Lake. Concentrations greater than 30 ug/L are perceived as a severe nuisance for algal blooms, anything greater than 60 ug/L is considered an extreme nuisance condition.

Phytoplankton samples were collected on four dates over the summer, the phytoplankton community was dominated by the blue-greens which are responsible for forming scum on the lake surface. Secci disk transparency is generally a function of the amount of algae in the water , secci disk transparencies were significantly poorer than the typical range for lakes in the NCHF region; readings taken from the lake averaged between less than 1 foot to just over three feet. Zooplankton samples collected during May through August identified mostly small bodied organisms on most occasions. Large-bodied zooplankton are more preferential because they consume large amounts of algae which can help to improve transparency.

TSI values for German lake for total phosphorus, chlorophyll, and Secci disk transparency are 57, 60 and 66, with a mean of 61. This TSI value is higher (more eutrophic) than 56 percent of the lake's assessed in this ecoregion, based on these TSI values German lake is considered to be eutrophic. TSI values for Jefferson lake for the same categories mentioned above for German lake are 70, 74,71, 71, 69 and 62 with a mean of 69.5. Jefferson Lake's TSI value is higher, more eutrophic than that found in approximately 80 percent of lakes within the NCHF region, based on these TSI values, Jefferson lake is considered to be hypereutrophic.

Jefferson-German Lake Complex Restoration Project Diagnostic Study 1994

Report begins with background data that has been described before, primarily highlighting the fact that the watershed is comprised mostly of agriculture, shallow morphometry, and problems associated with eutrophication

Results of study:

West Jefferson:

- Most of the lake became stratified by the end of May, 1993 and remained stratified until the end of August. Some shallower areas remained un-stratified due to the mixing effects of wind.
- Nitrogen levels were at their highest levels in May and June, yet remained at lower levels from July throughout the rest of the year. Phosphorus levels peaked on June 22, 1993, most likely a result of the die-off of Potamegeton Crispus (Curly-Leaf Pondweed) and subsequent release of nutrients. Sediment cores taken from the lake indicate high levels of both nitrogen and phosphorus within the samples, the impact of these sediments on internal fertilization of the lake may be quite large.
- Northern Pike and Walleye net catches were low in all years except 1992 when they were considered average. Panfish numbers remained around the average for lakes in this region while black bullhead and common carp numbers were high.

Middle Jefferson:

- Very little stratification due to the large wind fetch and shallow depth of the lake. Except during periods of extremely calm winds which allowed for temporary stratification often resulting in anoxic conditions and subsequent release of phosphorus.
- Very little seasonal variability in nutrient concentrations, mean TP concentrations for the lake average 160 ug/l while NH3-N concentrations averaged 43 ug/l.
- Inflow from West Jefferson accounted for 61 percent of the volume entering Middle Jeff, while the small ditch from subwatershed 14 accounted for only 4.7 percent. The monitored ditch in subwatershed 14 contributed 66.6 % of the TP and 29.3% of the TN. Middle Jefferson provided a similar fishery to West Jefferson, with high levels of rough fish and average levels of northern pike, walleye, and panfish.

Swedes Bay

- Very little stratification due to the large wind fetch and shallow depth of the lake. Except during periods of extremely calm winds which allowed for temporary stratification often resulting in anoxic conditions and subsequent release of phosphorus.
- Short anoxic periods seemed to lead to increases in nutrient concentrations with TP concentrations averaging 112 ug/l and NH3-Nconcentrations averaging 27 ug/L. Site 23 located in the center of the Swedes Bay basin exhibited much higher nutrient concentrations than did Site 24 located in northern section of Swedes Bay, this may be

indicating a large source of nutrients entering the lake near Site 23. (This site is in between two inflows from subwatersheds 9 and 11.) Subwatershed 9 has some of the steepest slopes in the watershed, therefore some of the most severe erosion. Total suspended solids are greater here than any other subwateshed. At site 11 which is comprised of subwatersheds 10 and 11, 7.31 HM^3 (volume of water) was contributed directly to the lake basin, accounting for 61% of the total inflow to the lake basin. Site 11 contributes 38.7 percent of the TPP and 74.1 percent of the TN. Site 9 which is comprised of subwatersheds 7, 8, and 9 added a total contribution of 2.43 Hm^3 or about 20 percent of the volume for the lake basin. Site 9 contributes 55.1 percent of the TPP and 17.3 percent of the TN.

- No northern pike or walleye were sampled in any fisheries surveys conducted on the lake, both panfish and rough fish showed up in average numbers during all surveys.

East Jefferson:

- Weak stratification occurred as early as June 8th, signs of sediment contributions to internal loading were evidenced during periods of anoxia.
- Concentrations of nutrients seemed to increase throughout the year, most likely as result of the senescence of P. Crispus and subsequent nutrient release.
- TP concentrations averaged 83 ug/ L while NH3-N concentrations averaged 76 ug/l. Fed by outlets from Middle Jeff and Swedes Bay, compared with other lakes the watersheds that drain to East Jefferson have large portions of land that is either forested as well as a couple of larger wetlands. This would suggest that lakeshed does not contribute large sediment and TP concentrations into the lake.
- Northern Pike and Walleye levels were consistently average while both roughfish and panfish exhibited certain years where catch rate was high amongst many years where catch rates were average for the region.

German Lake

- Inflow from East Jefferson and Site 1 which comprises subwatersheds 1,3,4, and 5. Inflow from East Jefferson provides largest input of volume to the basin at around 68 percent of the total input to the German Lake basin. Inflow site 1 contributed 3.94 HM^3 or 17 percent of the total input.
- Site 1 also contributes 42.6 and 23.6 percent of the TPP and TN respectively. Wetlands in the area have helped to remove some pollutants from entering the lake at of 1993, however with an increase in nutrient levels, the wetlands may no longer be able to continue to filter out all of the excess nutrients as well as it had in the past. Erosion in subwatershed 4 and livestock waste in 4 and 5 appear to be the main sources of pollution into German lake. The outlet of the Jefferson-German Chain can be found on German Lake, 35.5 % of the TPP and 62.4 % of the TN are exported out of the chain at this location.

Jefferson German Lake Complex Restoration Plan, Application for Clean Water Partnership Phase II Grant.

Based upon information found during diagnostic study, provides goals for the future, both long and short term.

Includes budget for each goal, including the personnel who will be responsible for each task.

Aquatic Vegetation of German Lake Le Sueur County, Minnesota 2004

Curly-leaf Pondweed dominates the plant community, found in 48 percent of the survey sites. One of few species found deeper than five feet, 75 percent of sites from 6-10 feet had Curly-leaf. Eurasian watermilfoil also found in the lake, first noticed in 2002. Twenty-two native species were recorded but only a few occurred in more than five percent of the sample sites: Muskgrass (Chara sp.), Coontail (Ceratophyllum demersum), and narrow-leaf pondweed (Potamogeton freisii). 18 percent of sites had native species only, 35% had no vegetation present, 31% had only curly leaf pondweed, and 16% had both curly leaf and native species. Curly leaf has been in the lake during all prior plant surveys dating back to 1982. The plant community is fairly diverse for this ecoregion however a trend towards increasing the percentage of non-native species has been observed with more and more area of the lake in curly-leaf.

Jefferson German Lakes CWP Phase IIA/B Final Report

See Goals Sections Below

Jefferson-German Chain Background

The Jefferson-German Chain consists of 5 interconnected lake basins that comprise a total surface area of more than 3000 acres. German lake with a surface area of 899 acres is the largest lake on the chain. At more than 3000 acres, the Jefferson German Chain is the largest lake system in south central Minnesota; however at 17,000 acres the watershed that drains into this system of lakes is relatively small and dominated by agricultural land use. Both German and Jefferson Lake (comprised of West Jefferson, Middle Jefferson, East Jefferson, and Swedes Bay) are relatively shallow; 81% of Jefferson Lake is within the littoral zone while 58% of German lake falls within the littoral area. The Jefferson-German Chain has a large watershed at a total acreage of 15,311.7 acres. Agriculture accounts for 6,314.07 acres or about 41.2 percent of the total acreage. This chain has the highest shoreline development index in the area, despite the fact that their water quality is worse than 70 to 90 percent of the monitored lakes within the region. The landscape is mostly comprised of rolling to steeply sloping with interspersed poorly draining swales and sloughs. Historically most of the watershed was covered with hardwoods, however upon settlement the land has been cleared for agricultural use. The water quality of this chain has

been degraded by man's activities over a period of decades leading to the first studies being done on the lake by concerned citizens as early as 1973.

Past Studies

Concerned citizens began tracking secci transparency as early as 1973, however it wasn't until 1990 when the first comprehensive study of the lake began. A lake assessment project conducted by the MPCA in 1990 was the first attempt to identify sources of degradation to the water body. Shortly thereafter watershed assessment and ISTS (Individual Sewage Treatment System) work began. In 1993 Le Sueur County conducted an intense, comprehensive Phase I Diagnostic and Feasibility study of the lake and watershed in 1993. The project objectives were to quantify runoff and nutrient loading from the local watersheds, assess the cause-effect relationships relating watershed land use practices and stream runoff characteristics, provide water budgets and mass nutrient balances for the lake system, and determine methods for improving the water quality of the lake chain. Based upon the results of this study, an implementation plan was set into place to reduce nutrient loading which developed into the Jefferson-German Lakes Water Quality Improvement Project (PhaseIIA).

Goals for Phase II

1995-1998 (IIA)

Goal 1: Reduce Pollutant Loading Through the Implementation of Best Management Practices

Hire Watershed Specialist

Watershed specialist has been a key component in educating and promoting BMP'S to watershed residents. Individual was responsible for contacting landowners to promote conservation practices, and to convey the availability of other set aside programs provided through the SWCD/ NRCS/ FSA offices. Individual is critical to the long term success of the overall project.

Treat Three Priority Feedlots

A Legislative Committee on Minnesota Resources (LCMR) Challenge Grant was obtained through the Board of Water and Soil Resources (BWSR) to complement the implementation actions of this Clean Water Partnership. Three feedlots were identified in the diagnostic phase of the CWP project as having either feedlot runoff problems or concerns regarding manure management (Subwatersheds 4, 14, 9) Two of these sites received corrective action as a result of funding through the challenge grant. The operator of the third site never became involved. Implementation of BMP's at subwatershed 9 included construction of a clean water diversion and a ditch bank diversion which will allow sediment and nutrients to settle out and/or be removed prior to the water reaching a nearby wetland. Livestock is diverted by fencing and

livestock were rotated through a system of cells which allowed for re-vegetation of non-foraged areas. A layer of crushed rock was installed around the existing watering facility to stabilize the high traffic area, reduce sediment, and to facilitate manure removal. Implementation at the second site in subwatershed 14 centered on the abandoning of all outside lots, they were replaced with a total confinement building with concrete pit manure storage under the barn. The operator also replaced a spray irrigation manure handling system with purchase of injection equipment through the SWCD Ag BMP loan program.

On the property of owner Frank Brown- challenge dollars were used to establish a tree barrier along a ravine to prevent erosion on this property.

On the property of owner John Kluntz- dollars from the Challenge Grant were used to fill in an earthen basin and CWP monies were used to reestablish the vegetation in this area.

Target Highly Erodible Lands

Watershed specialist met with several landowners for the design of terraces on their steeply rolling property. In 1998, Steve Krenik utilized $3,500 in state cost share dollars to install his terrace. Noel Quiram, located in section nine of Eylsian Township utilized $2,200 in cost share dollars to install a terrace on his property. Jim Scheurer, a landowner in section 16 of Elysian township also installed two terraces in 1998 using state cost share dollars.

Dollars for Phosphorus Project

In 1997, the dollars for phosphorus pilot project was created to reduce phosphorus losses from agricultural land in the Jefferson-German, Washington, and Lake Volney watersheds. In 1998 a total of 9 producers enrolled in the program, with 7 producers participating in 1999.

Major Changes-Minor Watersheds

In 1998, Joe Schimmel, PCA, introduced the concept which allowed technical staff to meet with any producer in the Ag., community, discuss their operation, and suggest alternatives for nutrient management, pesticide application, tillage options and any other improvement that would benefit water quality. A significant amount of time was contributed to this project by staff, however no progress ever occurred.

Goal 2: Increase Public Awareness of Water Quality Issues

Public Information

Public Water Planner's Conferences were held in 1996 to discuss everything from septic systems to watershed planning and shoreline restoration. Some important discussions that took place included using prairie vegetation in landscaping the shoreline. The Jefferson German watershed project was mentioned on a website created by the University of Minnesota, staff at the University mentioned that is was a good project accomplishing impressive implementation.

Workshops were held for watershed residents on September 13th, 1997. During the meeting speakers from the MNDNR, University of Minnesota, Forestry, and other departments gave information to participants to help them in planning landscape activities on their own properties.

Demonstration Projects

In 1996 and 1997 the Krenik farm served as the MES demonstration project for agricultural BMP's for the Jefferson-German watersheds projects. The Baker's Bay cluster research site in the Washington watershed served as a demonstration site for both watersheds.

Goal 3: Improve Coordination of Watershed Activities

Initiate landowner contacts

Le Sueur County has designated two people, the project representative and an assistant, from the Environmental Services Department to administer the Lake Jefferson-German Clean Water Partnership Project. The Watershed Resource Committee works alongside the project representative and assistant to help implement the work plan goals. This committee is made up of 10 members from different agencies and residents within the watershed.

Maintain Citizen Steering Committee

Four meetings were held during the Phase IIA timeframe. The purpose of this committee was to assist in the implementation of the project work plan and help direct future implementation goals.

Goal 4: Evaluate the Project's Effectiveness

Develop and Implement a watershed wide water quality monitoring program

Consulting environmental engineer to provide technical data-inflows, in lake, modeling and reporting.

Contacts were established between Le Sueur County and Dave Shuler, and Mankato State University in August of 95. Dave Shuler was to provide hydrological monitoring of in-flows, data analysis and report generation, while Mankato State University was to provide water chemistry analysis on the inflow samples.

1995 summary:

Loadings much reduced from 1993, however the reduction appeared to be a result of lower flow regimes rather than implementation practices to date. A reversal of lake chain flow direction was again evident in 1995 as it was observed in 1994, especially between West Jefferson and Middle Jefferson. Site 13 experienced an increase in phosphorus concentrations during the season and had become a significant driving force for the lake chain water quality. The wetland above Site 1

had significantly reduced TSS and TP loads received from the upstream Site 4, appeared to be a leading candidate for restoration practices.

1996 summary:

Once again reductions in loading in the watershed were indicative of lower flow regimes rather than implementation practices to date when compared to 1993. The observed increase in phosphorus concentrations at Site 13 during 1994-1996 indicated that Middle Jefferson has very large phosphorus concentrations and is a significant driving force for West Jefferson water quality. Concentrations of phosphorus were reduced at site 14 with the exception of 1996, however this was more than likely a result of extreme storm events. Sealed manure containment systems have been installed within the feedlot and future conditions should show a reduction of nutrient loading at this site. Modifications have also been made at the feedlot above Site 9, in conjunction with Site 14 loading reductions, should reduce nutrient concentrations within the Swede's Bay and Middle Jefferson Lakes.

1997 Summary

Sites 9 and 14 are the major watershed loading sources and the magnitude is proportional to the seasonal flow regimes.

Middle Jefferson drives the water quality conditions to the adjacent lakes, West Jefferson and East Jefferson, depending on flow direction.

The water quality of the two terminal lakes, German and West Jefferson, is highly dependent on the flow direction of the system.

1998-2004 (IIB)

Goal 1: Reduce Pollutant Loading Through the Implementation of Best Management Practices

Watershed specialist has been a key component in educating and promoting BMP'S to watershed residents. Individual was responsible for contacting landowners to promote conservation practices, and to convey the availability of other set aside programs provided through the SWCD/ NRCS/ FSA offices. Individual is critical to the long term success of the overall project

Treat Three Priority Feedlots:

During the first phase, corrections were made to the feedlots in 9 and 14. The feedlot is subwatershed 4 is no longer operational. Follow up monitoring in subshed 14 indicates that pollution from the feedlot is still occurring. High rate of employee turnover prevented any additional follow up from occurring, additional follow up in necessary to fully address the phosphorus problems in this subwatershed.

Target Highly Erodible Land in 4 priority subwatershesd for BMP installation.

The watershed specialist worked with landowners to promote buffer strips and set aside programs. In 2001, Wayne Quiram installed three terraces in section 32 of Cordova Township, utilizing state cost share dollars. Jim Scheurer also took advantage of the cost share program, installing six additional terraces in section 16.

Dollars for phosphorus program continued, those producers that received cost share dollars in 1998 or 1999 continued to enroll in the program, funds were provided by the 319 NPS Program.

Upgrade Non-Complying Individual Sewage Treatment Systems

2000 37 systems installed, $22,163.66 utilized for ISTS upgrades/installations

2001 27 systems installed, $17,000 utilized

2002 34 systems installed, $23,807 utilized

2003 35 systems installed, $15,000 utilized

2004 34 systems installed SRF no longer available.

Goal 2: Increase Public Awareness of Water Quality Issues

Lake shore owners were given ID cards and management information regarding both Curly-Leaf Pondweed and Eurasian Watermilfoil in response to the concern on the part of lakeshore owners over these invasive species. Two workshops were held in 2001 and 2002, these meetings were meant to help homeowners find information about the life cycle and management of both Curly-Leaf and Eurasian Watermilfoil.

Goal 3: Improve Coordination of Watershed Activities

Maintain a Citizen's Steering Committee

May 15th, 2000 – Committee was held to re-introduce the watershed specialist and identify a project schedule, work plan was also discussed.

February 3, 2003- Shoreline workshops to help educate homeowners was suggested

- Upland Ag BMPS- SWCD taking the lead on landowner contacts and promotion of programs.

Overall there were not as many meetings as there should have been due to a large amount of turnover in staff members, continued meetings with input from all agencies involved is vital.

Goal 4: Evaluate the Project's Effectiveness

Volunteers continued to take measurements during the phase IIB timeframe from inflows to the German-Jefferson Chain, Site 14 continues to contribute a large amount of nutrients into Middle Jefferson Lake.

Continued work on feedlots occurred in the watershed, the Watershed Resource Committee was re-established. No vegetations survey were conducted by MSUM, due to employee turnover. (I will be responsible for conducting surveys for the upcoming two field seasons.)

Future

Currently the Jefferson-German Chain is listed under section 303 (d) as being an impaired waterbody under the Clean Water Act. The Jefferson-German Chain is listed under section 303 (d) as being impaired for excess nutrients/eutrophication. These pollutants have affected Jefferson/German's ability to provide a safe habitat for aquatic recreation and also caused fish and other organisms in the lake to live in a severely degraded habitat. Due to the fact that the Jefferson-German Chain is listed as being impaired, it will undergo a study known as a TMDL (Total Maximum Daily Load). A TMDL study aims to find the maximum amount of a pollutant a water body can receive without violating water quality standards. The TMDL process identifies all sources of pollutants and determines by how much each source must reduce its contribution in order to help meet the standard water quality level desired. The source reduction strategies form the basis of an implementation plan which then must be completed within one year after the U.S EPA approves a TMDL Study. (MPCA) The current project status for the Jefferson-German Chain is approved, which is defined as: TMDL study approved by U.S. EPA, and project is in implementation phase. (MPCA) The Jefferson German Chain is a relatively shallow lake, especially given its size. Due to a large wind fetch and shallow morphometry the remediation of the lake will only take place if significant efforts to reduce nutrient loading within the watershed take place. The nature of the lake lends itself to being susceptible to internal nutrient loading, given the amount of nutrients within the lake, methods to control in- lake fertilization will eventually have to take place once inputs from the watershed are under control.

Reach	Description	Yr	River ID#	Lake or wetland ID#	Affected use	Pollutant or stressor	TMDL Target start	TMDL Target completion	Category
German	Lake or Reservoir	08	0704x	40-0063-00	Aquatic recreation	Nutrient/Eutrophication Biological Indicators	2016	2020	5C
East Jefferson	Lake or Reservoir	08	0704x	40-0092-01	Aquatic recreation	Nutrient/Eutrophication Biological Indicators	2016	2020	5C
West Jefferson	Lake or Reservoir	08	0704x	40-0092-02	Aquatic recreation	Nutrient/Eutrophication Biological Indicators	2016	2020	5C
Swede's Bay	Lake or Reservoir	08	0704x	40-0092-03	Aquatic recreation	Nutrient/Eutrophication Biological Indicators	2016	2020	5C
Middle Jefferson	Lake or Reservoir	08	0704x	40-0092-04	Aquatic recreation	Nutrient/Eutrophication Biological Indicators	2016	2020	5C