Crystal Loon Mills Clean Water Partnership

Work Plan

December 2007

Project Sponsor

City of Lake Crystal

Contributing Sponsors and Cooperators

Blue Earth County Environmental Services
Blue Earth County Pheasants Inc.
Blue Earth County Soil and Water Conservation District
Crystal Valley Co-Op
Department of Natural Resources – Fisheries, Waters, Wildlife
Ducks Unlimited, Inc.
Local Landowners
Minnesota Board of Soil and Water Resources
Minnesota Department of Agriculture
Minnesota Pollution Control Agency
Minnesota River Board
Minnesota State University Mankato – Environmental
Sciences Program
Natural Resources Conservation Service
University of Minnesota Extension Office
U.S. Fish and Wildlife Service
Water Resources Center, Minnesota State University Mankato

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SECTION 1
STATEMENT OF PROBLEMS AND EXSISTING CONDITIONS

A. General Description of the Crystal Loon Mills Lakes Watershed

The Crystal Loon Mills Lakes (CLM) watershed is located in Blue Earth County in south central Minnesota. The CLM system is part of the Minneopa Creek watershed, which is in turn, part of the Middle Minnesota River Basin.

The CLM system consists of two minor subwatersheds [Minnesota Department of Natural Resources (DNR) numbers 28045 and 28046] draining approximately 13,799 acres and includes three lake basins: Crystal Lake (393 acres), Loon Lake (755 acres), and Mills Lake (229 acres) (NLCD 2001, MDNR 2004). There are three public access sites in the system (1 city-owned on Crystal, 1 state-owned on each Loon and Mills MDNR 2004).

Subwatershed 28045 covers 14.8 square miles and is predominantly drained by County Ditch (CD) 56. County Ditch 56 was constructed in 1920 and drains into Crystal Lake. In addition, 75% of the urban residential areas for the City of Lake Crystal are drained into CD 56 through several storm sewers (Proctor et al. 1998).

B. Why the Project is Taking Place

The Clean Water Partnership (CWP) project is taking place to address water quality concerns that were detailed in the Phase 1 Diagnostic Study. The CWP Implementation Project will focus on best management practices (BMPs) and education programs for watershed residents.

There has been significant ongoing concern and interest in the water quality in the CLM system dating back to a 1958 study by Douglas Barr on sedimentation in Crystal Lake. Interest culminated in the 1998 Clean Water Partnership Phase 1 Diagnostic Report. The diagnostic study indicated that the major water quality concern is excess phosphorus from the rural portions of the watershed and a recommendation was made to focus on rural BMPs that would reduce nutrient and sediment transport to the lake, as rural sources contributed approximately 95% of the total phosphorus load.

C. Water Quality Problems

In 2006, Crystal Lake was listed on the 303(d) impaired waters list for excess nutrients. The federal Clean Water Act requires states to publish an updated list of streams and lakes that are not meeting their designated uses because of excess pollutants. The list, published every two years and known as the 303(d) list, is organized by river basin and bodies of water are listed based on violations of water quality standards set by the Environmental Protection Agency (EPA).

The Phase 1 diagnostic study indicated the major water quality concern is excess phosphorus from the rural portions of the watershed. The primary sources of surface water received by Crystal Lake are County Ditch 56 and the outlet of Loon Lake. The diagnostic study found that the major contributor of nutrients and sediment to Crystal Lake was CD 56. Ditch 56 drains approximately 9,472 acres of agricultural land to the southwest of Crystal Lake and then passes through the City of Lake Crystal before it outlets into the lake.

Crystal, Loon, and Mills lakes are considered hypereutrophic, based on the Carlson Trophic Status Index (TSI), due to excess nutrients entering the lake chain from rural and urban sources. A lake's trophic status is determined by considering water quality measurements based on phosphorus content, amount of algae, and water clarity of each lake. Trophic status is an indication of a lake's productivity. Hypereutrophic lakes are typically shallow and rich in nutrients such as phosphorus. The diagnostic study found phosphorus levels from monitored inflows and the lakes themselves to be significantly above recommended standards. The CLM lake chain's hypereutrophic status reflects that the lakes have limited water clarity, are rich in nutrients and subject to numerous algal blooms (Proctor et al. 1998).

Phosphorus is generally the limiting factor in determining the amount of algae and plant growth in a lake. The type, in addition to the amount, of algae in a lake is important. Lakes with very high phosphorus levels tend to have more "blue-green" algae, which are known to form extensive surface scum. During the phase 1 study, blue-green algae were the dominant type of algae found in Loon and Mills Lakes, making up 50-100% of the algae found from June to October 1995. For 1995, at both sample sites on Crystal Lake, percentages of blue-green algae ranged from zero to seventy, with the highest concentrations present during June and early July.

Some forms of blue-green algae are known to produce compounds toxic to wildlife, domestic animals, and humans. In September 2004, Crystal Lake experienced a toxic algae bloom due to very high levels of nutrients. Minnesota Pollution Control Agency (MPCA) staff reported an alarmingly high concentration of microcystis, toxic blue - green algae. Microcystis levels in Crystal Lake, at 7,190 ppb, were almost three and a half times the very high risk level of 2,000 ppb for recreational exposure and vastly higher than the World Health Organization's (WHO) provisional drinking water guideline value of 1.0 ppb. During 2007, microcystis samples collected on Crystal Lake showed concentrations of 3,800 ppb, almost twice the very high risk level.

In addition to problems caused by excess nutrients, the Lake Crystal swimming beach is frequently closed due to high concentrations of fecal coliform bacteria.

D. Suspected and Potential Water Quality Problems

The reoccurrence of toxic algal blooms, high levels of rough fish in the lakes, large amounts of total suspended solids in County Ditch 56 and in Crystal Lake, and

Escherichia coli levels that exceed the MPCA standard are some of the suspected and potential water quality issues for the CLM watershed.

Due to continuing excess nutrient levels and a high possibility for recurrent algae blooms in the CLM lakes chain, there remains the potential of another severe toxic algae bloom like the one that occurred in 2004. Such high levels of toxic algae could pose a health concern for the large number of citizens that use Crystal, Loon, and Mills lakes. In 2007, algae blooms were reported as early in the season as mid-June, and persisted well into the late summer and fall.

DNR surveys conducted on Crystal and Loon lakes in 2006 indicated that spawning conditions were fair to poor on Crystal and fair to good on Loon for popular gamefish. Spawning habitat was best suited for benthic omnivores such as common carp and black bullheads, although good spawning habitat also exists for panfish, especially black crappie. Loon Lake had more emergent vegetative cover which was linked to greater abundance of northern pike, bluegill, and pumpkinseed sunfish but lack of emergent, submergent, and floating leaf vegetation on both lakes greatly limits fisheries potential for northern pike, largemouth bass, and bluegill. Walleye populations, which are primarily maintained through stocking, appeared strong on both lakes. Channel catfish also appeared to be self-sustaining and good spawning habitat may exist on both lakes. Mills Lake was sampled in 2004 and black bullhead accounted for 72% of the fish caught during the sampling period. Despite reclamation in 1998, the fisheries population has been dominated by black bullhead since 2000. Bluegills and black crappies were also present in moderate numbers (MDNR 2007, 2004).

Not only are rough fish, such as carp and bullheads, not as popular with anglers as game fish species, they can also cause water quality problems in lakes where they occur in large numbers. Rough fish reduce water clarity by stirring up the lake bottom – a behavior that inhibits the growth of rooted aquatic vegetation and changes water chemistry. Bioturbation that causes the resuspension of sediments can cause additional exchange of nutrients, including phosphorus, between the sediment and the water column. Rooted aquatic plants can provide natural fish habitat and help counteract algae blooms by stabilizing lake bottom sediments and help protect the sediment surface from wind mixing in shallow lakes, holding settled nutrients in place (Charbonneau 1999).

During the CLM phase 1 study, it was estimated that in 1995 alone, more than 1.3 million pounds of total suspended solids (TSS) entered Crystal Lake through CD 56. Yearly rainfall amounts in the CLM watershed since 2001 from volunteer rain gauge readers are similar to those taken during the 1995-96 study period, so if the 1995 estimate is taken as representative of an average yearly sediment load, then the equivalent of 50 dump truck loads of soil are being carried from CD 56 into Crystal Lake each year.

According to Brach (1989), because sediments impact water clarity, degrade fisheries habitat, and limit the ability of aquatic plants to grow, it is considered to be one of the most damaging pollutants. Other pollutants such as phosphorus, heavy metals, and petroleum products attach to sediments and are carried into lakes, where they accumulate.

In addition, suspended solids are indicative of the amount of erosion occurring in the watershed. Therefore, the presence of sediment pollution is indicative of numerous other potential issues.

Monitoring conducted in 2007 has shown that *E. coli* concentrations at the outlet of CD 56 are all higher than the 126 colony forming units (cfu)/100 mL MPCA standard for safe recreational contact. The geometric mean (a type of average used to dampen the effect of very high or low values) for the 2007 monitoring season through the end of August was 586, nearly five times the standard for safe contact.

E. Economic Significance of the Water of Concern

Crystal, Loon, and Mills Lakes have been the major recreational focal point for watershed residents since the 1800s. The primary historical uses include boating, fishing, swimming, water skiing, and ice-skating. Annual fishing contests are held on the lake system and Fourth of July celebrations on Crystal Lake include a boat parade and water skiing competitions. Other activities held on the lakes include annual Duck Days festivities and community education classes on canoeing.

Local groups, county and state organizations, and concerned citizens have expressed interest in the deteriorating water quality of Crystal and Loon Lakes and at the Minneopa State Park. Poor water quality can have a detrimental impact on recreational activities and lakeshore property values. According to a 2003 study by the Mississippi Headwaters Board and Bemidji State University, higher property prices are paid on lakes with higher water quality. The study looked at thirty seven lakes in the Mississippi River headwaters area and showed that if the water clarity of a lake increased one meter, one could expect a property price increase of between $1.08 (Balsam Lake) and $423.58 (Leech Lake) per frontage foot. Conversely, decreased water clarity and quality had an even more dramatic detrimental effect on property values, lowering property values by between $1.43 (Balsam Lake) and $594.16 (Leech Lake) per frontage foot (Krysel et al. 2003).

The CLM system also makes up one arm of the Minneopa Creek watershed. Minneopa State Park is located approximately five miles downstream from the Crystal Lake outlet and is visited by approximately 106,800 visitors each year. Therefore, water quality issues caused by the CLM system have regional consequences as well. Water quality improvement in the CLM system and upper Minneopa Creek would ultimately help improve water quality at Minneopa State Park and in the Minnesota River proper.

F. Land Use Information

Minnesota is divided into seven ecoregions based on vegetation, soils-geology, and climate. All of south central Minnesota, including the CLM watershed, is located in the Western Corn Belt Plains Ecoregion. The dominant land use in this region is agricultural.

The land use characteristics for the CLM watershed are summarized in Table 1. For land use map and land cover class definitions see Appendix E. CRP cover category (code 89) was estimated using visual survey during summer 2007 field season.

Table 1. Summary of Land Use Characteristics for the CLM Watershed (NLCD 2001- National Land Cover Dataset 2001)

Total Project Area: 13,789Acres (Ac)
Land Cover in the Project Area:

Cover Type	Code	Percentage
CULTIVATED CROPS	82	74.79%
OPEN WATER	11	10.68%
DEVELOPED	21-24	7.92%
WETLANDS	90 & 95	3.43%
DECIDUOUS FOREST	41	0.71%
GRASSLANDS/PASTURE	71	0.10%
CRP/CONSERVATION LAND	89	2.35%
BARREN LAND (Rock/Sand/Clay)	31	0.02%

SECTION 2
STATEMENT OF PROJECT GOALS AND OBJECTIVES

Ultimately, the success of this project will depend on the extent that landowners and citizens of the CLM watershed are willing to implement water quality BMPs. Project goals were set by local, state, and federal agencies and organizations, as well as residents to reduce pollution and improve water quality in an important local resource. During the diagnostic study, priority areas and practices were identified that will provide the greatest environmental impact for the least amount of project funds. Throughout the implementation phase of the project, priority areas and practices will continue to be evaluated and may shift depending on the success of certain BMPs. To provide technical support and help promote the BMPs associated with this project, a steering committee of local, state and federal personnel and area residents has been established for this project.

A. Overall Resource Goals

The overall goal of the CLM CWP project is to promote and implement positive land use changes in the watershed that will improve water quality along with promoting a healthy agricultural and recreation-based local economy.

Water quality and quantity assessment in the CLM watershed was conducted during the Phase 1 diagnostic study. The cooperative and citizen-friendly approach that was utilized during the diagnostic study should facilitate widespread support for the restoration of the watershed through BMPs.

To facilitate progress during the CLM implementation project, three priority areas have been identified: 1) Installing BMPs, 2) educational activities, and 3) continued water quality monitoring. Emphasis will certainly be placed on BMPs that most positively impact water quality such as riparian buffer strips, wetland and shore land restorations, nutrient management, and alternate tile intakes.

The desired environmental outcome of this project is a significant reduction in the total phosphorus (TP) concentrations reaching Crystal Lake. Improvement of wildlife and aquatic habitat, as well as increased suitability for recreational use, will be additional goals of the project, but overall success of the project hinges on significant reductions of TP from the watershed.

B. Preliminary Quantitative Goals

The goals of the implementation project are as follows:
1) Reduce nutrient levels in Crystal Lake enough to allow for delisting from the 303(d) Impaired Waters List,
2) Decrease average in-lake phosphorus levels to under 0.1 mg/L or parts per million (ppm),
3) Increase water transparency,
4) Decrease blue-green algae bloom intensity and frequency,
5) Secure a net gain in wetlands and vegetative buffers in the watershed,
6) Promote compliance of all septic systems in the watershed within 10 years and
7) Educate citizens on environmental issues pertaining to the lakes – including rural and urban issues.

C. Information and Education Goals

Landowner and citizen support will be a critical component of a successful project. Through education and information based activities, project partners will strive to increase awareness and adoption of urban and rural water quality BMPs throughout the CLM watershed.

Possible methods of sharing information with watershed residents will include demonstration sites, field tours, public meetings, news releases, presentations, brochures, mass mailings and fact sheets. Target audiences for educational outreach include rural and urban landowners, farmers, school and youth groups, township boards, elected officials, special interest groups, agricultural resource professionals, and the general public.

Education activities and informational materials will emphasize both urban practices to reduce water quality pollutants and land/farm management BMPs.

SECTION 3
PROJECT ORGANIZATION AND OBJECTIVES

A. Project Structure

Due to the large number of contributing partners and considerable amount of resource expertise available to the CLM CWP project, a cooperative approach will be utilized to achieve project goals. Roles and responsibilities of project partners may be revised as necessary for the success of the project and as programs, budgets and personnel may change.

Programs will largely be administered by participating local, state and federal agencies in order to accomplish project goals and objectives. The CLM CWP coordinator, with assistance from the Water Resources Center (WRC) and Minnesota River Board (MRB), will facilitate nearly all aspects of the project – with the intention of reducing the workload on other local agency staff. Contributions from project partners will include 1) promoting, designing, and installing BMPs, 2) Informing watershed residents of project activities, and 3) continued monitoring of watershed for project impacts to water quality and quantity.

Major project partners will meet every six months to serve as a technical advisory committee for discussion of project activities and related issues. The technical committee will work to support and sustain communication among participants and investigate new opportunities for improving project success and assessing results.

B. Contributing Sponsors

The following is a description of activities that contributing sponsors indicated they could perform for the CLM Implementation Project.

<u>City of Lake Crystal</u>:

- Project sponsor
- Fiscal agent of Clean Water Partnership and 319 Grant funds
- Stormwater management plans
- Support urban pollution education
- Support shoreland restoration education
- Assist local and open house coordination
- Assist with implementation plan development

<u>Blue Earth County Environmental Services</u>

- Provide technical support when possible
- Assist with implementation plan development
- GIS data and evaluations
- Septic support
- Water plan management
- Local contacts assistance

- Include project information as applicable in routine communications with land owners and operators
- Work with the City of Lake Crystal Master Planning Committee and subcommittee as part of the County's Greenprint project's priority area focus

Blue Earth County Pheasants Incorporated

- Land conservation incentives ($500/project up to 10 projects or $5,000 total)
- Local contacts
- In-kind services
- General project support

Blue Earth County Soil & Water Conservation District

- Provide technical support
- Assist with implementation plan development
- Fiscal agent for Clean Water Legacy Act funds
- Fiscal reporting for Clean Water Legacy Act funds
- Program enrollment
- Watershed management
- Landowner contacts
- Promote and provide technical support for structural BMPs
- Promote Ag BMPs
- Engineering coordination through Zone 10

Board of Soil and Water Resources

- Project management (CWLA project manager)
- Assist with implementation plan development
- Provide technical support
- Program and policy guidance

CLM Implementation Coordinator

- Develop implementation work plan
- Coordinate the implementation technical team
- Coordinate the implementation activities between all project participants
- Coordinate public meetings
- Coordinate educational activities
- Promote BMPs throughout the watershed
- Prepare annual progress reports
- Fiscal management
- Prepare annual fiscal reports
- Assist with water quality and quantity monitoring
- Assist with analysis and assessment of monitoring data

Ducks Unlimited, Inc.

- Land conservation incentives
- Local contacts
- In-kind services
- General project support

DNR – Fisheries, Water and Wildlife

- Provide technical support
- Assist with implementation plan development
- Agency program enrollment
- Fisheries management
- Cost-share assistance for rain garden installation and shoreline restoration as available

Local Landowners

- Cost-share contribution
- Meeting/planning participation
- Septic upgrades (in-kind contribution plus grant assistance)

Minnesota Department of Agriculture

- Provide technical support
- Assist with implementation plan development
- Priority area land mapping using LiDAR

Minnesota Pollution Control Agency

- Project management (CWP project manager)
- Provide technical support
- Assist with implementation plan development
- Provide survey and monitoring support

MSUM –Environmental Sciences Program

- Provide technical support
- Data analysis
- Historical data perspectives (completed Phase 1 diagnostic)
- Supply, travel and lake sampling assistance
- Use of computers, software and lab equipment assessment completion

Minnesota River Board

- Supervise CLM Implementation Coordinator
- Provide technical support
- Assist with implementation plan development

NRCS

- Assist with implementation plan development
- Promote and provide technical support for structural and vegetative BMPs
- Promote and provide technical support for feedlot improvements (EQIP)
- Program enrollment
- Engineering assistance

US Fish & Wildlife Service

- Provide technical support
- Assist with implementation plan development
- Wetland program enrollment
- In-kind services for wetland restoration projects

Water Resources Center, MSUM

- Hiring and housing project coordinator
- Provide technical support
- Assist with implementation plan development
- Provision of student labor
- Water quality and quantity monitoring
- Analysis and assessment of monitoring data
- Supervise and direct graduate student and associated project

SECTION 4
IDENTIFICATION AND SUMMARY OF PROJECT ACTIVITIES

Program Element 1: Initial Activities

June — September, 2007

Full time coordinator to be hired with the main emphasis on Program Element 1 and development of a relevant work plan. Coordinator will work with various aspects of the CLM CWP project, setting up project systems, and establishing relationships between partner and stakeholder groups. After workplan completion coordinator will work to fulfill the education, monitoring and BMP goals of the project with cooperators.

Cash: $ 16,333
In-kind: $ 3,368

1A – Work plan Development *June –August 2007*
CLM COORDINATOR & TECHNICAL COMMITTEE

Complete detailed work plan and budget for the project.

1B – Committee Organization

July – Sept., 2007
CLM COORDINATOR & TECH COMMITTEE

Meet with technical committee to review work plan, schedule, committee member roles and responsibilities and establish project direction. Communicate with all relevant stakeholder groups regarding project, gathering support and coordinating activities.

1C – Project Research and Planning

Throughout project timeline
CLM COORDINATOR & GRAD ASSISTANT

Coordinator and MSUS staff and students will attend conferences & workshops to gain knowledge and perspectives from other projects and related activities. Continue professional growth through relevant research through magazine subscriptions, journals, books, research forums, organizational memberships and conferences. Meet with project partners and stakeholders to discuss project direction and planning.

Program Element 2: Education and Outreach Activities

Throughout project timeline

Educational and outreach activities are essential to the long-term success of the project. Current and future watershed residents and recreational users must understand why the project is necessary, project goals and activities, and what roles they can play in water and land management. This program element also directs work with students and professional education for staff.

Cash:	$ 2,500
In-kind cash:	$ 5,000
In-kind:	$16,786

2A – Newsletter and Mailings

December 2007 & 2008
CLM COORDINATOR & GRADUATE ASSISTANT

As allowed by project budget, publish an annual newsletter for watershed residents and landowners. Newsletters will inform residents of project related activities, updates, and issues. Send out mailings detailing project goals, up-coming activities, and information regarding BMPs and cost-share programs available to landowners. BMP and cost-share mailings will be targeted to specific stakeholder groups, such as urban residents, lakeshore owners, rural landowners, and recreational users.

2B – Community Activities *Throughout project timeline*
CLM COORDINATOR & TECH ADVISORY COMMITTEE

Explain project goals and activities to area residents at community events and town halls as opportunities arise. Host public meetings to inform and address questions and comments about the project. Provide informational booth at Lake Crystal annual Duck Days events. Provide opportunities for landowners and residents to learn about BMPs and view demonstration sites through tours and field days as appropriate.

2C – Schools and Youth Groups *Throughout project timeline*
CLM COORDINATOR, GRAD ASSISTANT & TECH ADVISORY COMMITTEE

Work with local schools through classroom visits, relevant school field trips, and projects. Participate in festivals and other educational events as opportunities arise. Provide opportunities for college students via internship work. Develop bio-monitoring and water sampling projects with Lake Crystal High School classes, FFA, and 4H groups as opportunities arise and provide classes with adequate training of proper procedures.

Program Element 3: Best Management Practices Promotion and Activities

Throughout project timeline

Promotion and installation of BMPs will be the most important products of the project. Staff will provide opportunities for every watershed producer/landowner to participate in the installation or demonstration of a variety of land management practices suited to their particular property or situation. Although the CLM project coordinator will be the main personnel responsible for implementing this program element, project co-sponsors will be essential to its success. Research and assistance from the Water Resources Center in use of GIS analysis will help define potential areas for consideration. Cooperation between Coordinator, Tech Committee and MSUM Staff and students will provides opportunities to promote and implement practices. Cost-share funds will be available to practice participants for implementation at levels up to 75% as set by the Technical Advisory board. The Advisory board may change the amount of cost-share funds available on a project-by-project basis if it is deemed necessary.

Program Element 3A – Vegetative Practices

Cash:	$ 35,000
In-kind cash:	$ 15,000
In-kind:	$ 20,650

<u>3A-1 – Wetland Restoration</u> *Project years 2 & 3*

CLM COORDINATOR, SWCD, NRCS, FSA, CITY OF LAKE CRYSTAL, DUCKS UNLIMITED & USFWS

Promote enrollment of restorable or farmed wetland acres in federal Continuous Conservation Reserve Program (CCRP) and state cost-share program. Work with project partners to provide easement on and/or purchase of property suitable for wetland restoration adjacent to CD56, in order to divert ditch flow through and/or daylight of tile lines into restored wetland for water treatment. Restored wetland site to be used as demonstration site for project and provide educational opportunities for student classes and clubs.

<u>3A-2 – Buffer Strips</u> *Project years 2 &3*

CLM COORDINATOR, PHEASANTS INC., SWCD & NRCS

Facilitate enrollment of buffer strips with a minimum 2 rod width along entire stretch of CD 56. Buffers installed on side-inlet structures into CD 56 will also be eligible for cost-share funds. Sites not adjacent to CD 56 will be targeted for buffer strip installation as determined by LiDAR priority area mapping conducted by MDA. Project will attempt to utilize current conservation programs such as CCRP, Environmental Quality Incentive Program (EQIP), and Clean Water Legacy Act (CWLA) funding. Project cost-share will be used to supplement conservation programs to cover up to 75% of practice installation. Landowners will be eligible for additional incentive payments of $500.00 per project, up to 10 projects (Pheasants Inc.).

<u>3A-3 – Grassed Waterways</u> *Project years 2 & 3*

CLM COORDINATOR, SWCD & NRCS

Promote and facilitate installation of grassed waterways on areas of significant erosion potential as determined by LiDAR priority area mapping conducted by MDA. Promote grassed waterways leading to side-inlet structures. Project will attempt to utilize current conservation programs such as CCRP, EQIP, and CWLA funding. Project cost-share will be used to supplement conservation programs to cover up to 75% of practice installation.

Program Element 3B – Open Tile Intake Alternatives *Project years 2 &3*
CLM COORDINATOR, SWCD & CITY OF LAKE CRYSTAL

Cost-share will be offered for the following alternatives to open tile intakes:

1) Removal of the intake and replacement with dense pattern tiling
2) Installing a grass buffer around the intake
3) Installation of a slotted riser or "Hickenbottom" intake

Installation of pattern tiling in place of open inlet will be engineered so as not to violate Farmbill or Wetland Conservation Act provisions. The required buffer area for buffered intakes will be determined on a case-by-case basis dependant on drainage area size, slope, soil type and other individual determining factors.

Cash:	$ 10,000
In-kind cash:	$ 5,000
In-kind:	$ 5,000

Program Element 3C – Structural Practices *Project years 2 &3*
CLM COORDINATOR, SWCD, NRCS & CITY OF LAKE CRYSTAL

Promote and facilitate the installation of terraces, water & sediment control basins, tile risers and trash guards. Repairs to existing side-inlet structures and tile outlets may be eligible for cost-share funds on a case by case basis. Cost-share funds will be used to supplement funding for EQIP and state cost-shared projects in order to provide 75% cost-share to the landowner.

Cash:	$ 5,000
In-kind cash:	$ 5,000
In-kind:	$ 20,000

Program Element 3D – Nutrient Management *Project years 2 & 3*
CLM COORDINATOR, NRCS & CRYSTAL VALLEY CO-OP

Work with Crystal Valley Co-Op and Blue Earth Consulting agronomists and crop consultants to promote soil testing, nutrient management planning, and custom-rate nutrient application. Promote producer enrollment in existing EQIP nutrient management programs and University of Minnesota Extension BMP Challenge program. Establish test plots for variable rate application and monitor yield changes and water quality effects.

Cash:	$ 3,000
In-kind:	$ 1,000

Program Element 3E – Non-Crop Land Practices

Cash:	$ 5,000
In-kind cash:	$ 3,000
In-kind:	$ 37,000

<u>3E-1 – Septic Upgrades</u> *Project years 2 & 3*

CLM COORDINATOR, SWCD, BLUE EARTH CO. ENVIRO.SERVICES, CITY OF LAKE CRYSTAL

Support project partners by promoting existing Ag BMP Program available through SWCD and County Low Interest Loans as funds are available, while actively seeking other funding sources for septic system upgrades throughout the watershed. Major preliminary education campaign will focus on those residences that most significantly impact the waters of interest: CD 56, Crystal, Loon, and Mills lakes. Fact sheets with contact information will be dispersed to contractor and real estate agents in addition to landowners.

<u>3E-2 – Shoreland Restorations</u> *Project years 2 & 3*

CLM COORDINATOR, DNR, USFWS, SWCD & CITY OF LAKE CRYSTAL

Work in partnership with City of Lake Crystal to educate local lakeside property owners about erosion and runoff issues associated with altered shorelines and promote shoreland restorations. Utilize education materials published by DNR. Offer cost-share assistance through CWLA funds for up to 75% of installation costs to lakeshore owners wishing to re-vegetate and restore their shorelines. Promote cost-share grants available to landowners through DNR and USFWS. Work to educate citizens about existing county and state shoreland ordinances and explore the passage of new ordinances that will lead to water quality improvement in the CLM watershed.

<u>3E-3 – Residential Stormwater Management</u> *Throughout project timeline*

CLM COORDINATOR, DNR & CITY OF LAKE CRYSTAL

Promote the installation of rain gardens through Town Meeting Initiative Grant to City of Lake Crystal. Cost share will be limited to $200 per landowner and will be available through September 30th, 2007. Continue promotion of rain gardens and rain barrels to catch and treat stormwater runoff after Sept. 30th deadline. Provide cost-share and technical assistance to landowners as available.

Program Element 3F – Technical Support *Throughout project timeline*

CLM COORDINATOR, GRAD ASSISTANT & WRC

This element includes research done by Project Coordinator and WRC staff related to the various target BMPs that will be utilized by the project. Coordinator and MSUM staff will work directly with individuals, stakeholder groups, tech committee members and agency staff to provide needed assistance to promote implementation of BMP projects. It also covers technical assistance to landowners and stakeholders regarding the BMPs listed in the above program elements.

Cash:	$ 63,213
In-kind cash:	$ 5,000
In-kind:	$ 0

<u>Program Element 4: Monitoring</u>

This element will fulfill requirements for the TMDL study on excess nutrients in Crystal Lake. Monitoring prior to BMP implementation will serve as a baseline for measuring the impact of BMPs on water quality in the watershed. It will also include additional monitoring (ditch and aquatic surveys) to further define priority areas. Sampling will be conducted by the Project Coordinator and MSUM students and WRC staff with assistance from MPCA staff.

Cash:	$ 16,550
In-kind:	$ 27,000

Project Element 4A – Water Quality Monitoring *Throughout project timeline*

WATER RESOURCES CENTER, GRAD ASSISTANT, MSUM – ENVIROMENTAL SCIENCE PROGRAM & DNR

Water quality monitoring will be conducted on CD 56 during field monitoring season, approximately April 1st or ice-out through September 30th 2007-2009. Twenty to twenty-five samples will be pulled during the monitoring season. Water monitoring includes: stage readings taken every 15 minutes, flow measurements every six weeks by DNR, phosphorus, ortho-phosphorus, nitrogen, total suspended solids (TSS), T-tube readings, *E. coli*, dissolved oxygen, pH and temperature. Total loads will be calculated for TSS, N, P, and ortho-phosphorus at the end of the year using FLUX. DNR will be collecting flow data through a grant from MPCA.

Crystal, Loon and Mills lakes will be monitored starting in 2008/2009 under the Lake Crystal Nutrient TMDL Study. Phosphorus, chlorophyll-A, and secchi disk data will be collected. MSUM WRC Staff will analyze the data using BATHTUB and the Carlson Trophic Index.

Program Element 4B – Field Surveys *Throughout project timeline*

WATER RESOURCES CENTER, GRAD ASSISTANT, MSUM – ENVIROMENTAL SCIENCE PROGRAM & DNR

Tillage and land-use survey will be completed during initial stages of project in order to provide baseline data to compare to survey data collected during the final project year. Project staff will complete a visual survey of CD 56 and branches to GPS and field verify priority areas identified by LiDAR project. Field survey will also attempt to locate and mark open tile inlets. This element also covers aquatic/lake surveys conducted on Crystal, Loon, and Mills Lakes by DNR as part of their in-kind contribution to the project.

Program Element 5: Data Evaluation and Analysis

MSUM WRC staff will review and analyze data to provide information on watershed practice improvements. This element involves evaluation of the BMPs, monitoring and education activities for both mid-project corrections and management advice from the technical committee. This element also includes required project reporting.

Cash: $ 0
In-kind: $ 34,846

Program Element 5A – Modeling *Throughout project timeline*

CLM COORDINATOR, GRAD ASST, WRC, MDA, TECH ADVISORY COMMITTEE

Compute nutrient and sediment loads and flow weighted mean concentrations for CD 56 using FLUX program according to state/federal and MN River Basin data QA/QC procedures. Compute FLUX and associated analysis for County Road 9 site for TSS, TP, Po4, and No3. Conduct analysis of lake monitoring data for phosphorus, secchi disk, and chlorophyll-A for use in BATHTUB and Carlson Trophic Index. BATHTUB will be used to calculate the % reduction in nutrient loads needed to reach project goals. The Minnesota Phosphorus Source Assessment Tool (PSAT) will also be used to help illustrate areas of potential phosphorus reduction to citizens, as appropriate.

Program Element 5B – Technical Committee Review *Throughout project timeline*

CLM COORDINATOR, GRAD ASST, TECH ADVISORY COMMITTEE

Convene the technical committee as needed for project direction, evaluation of activities, analysis of results and progress towards achievement of goals.

Program Element 5C – GIS *Throughout project timeline*

WRC, MDA, BLUE EARTH CO. ENVIRO. SERVICES, TECH ADVISORY COMMITTEE

GIS data will be used to facilitate targeted education and installation of BMPs, for public meetings to help explain the project, and to produce final products for the project report.

The Blue Earth County Environmental Services Department will be supplying the project with the following maps and accompanying data descriptions: property owners (1 map and 1 list), feedlot permits (1 map and 1 table), manure management (2 maps and CFO reference), county-permitted ISTS (1 map), conservation land (1 map), 2005 land use (1 map and 1 table), public drainage (1 map), crop equivalency rating (1 map), topographic shaded relief (1 map), floodplain (1 map).

Blue Earth County Light Detection and Ranging (LiDAR) GIS data will be used by Adam Birr of MDA to identify areas with the most erosion potential. An erosion map will be created using Digital Elevation Models (DEMs) and Revised Universal Soil Loss Equation (RUSLE) to be used to pin-point areas for BMP implementation. The Stream Power Index (SPI) will also be used to predict where gully erosion will occur, based on topography. High priority areas will be field verified by project staff during a visual survey of CD 56 to assist in determining the feasibility and accuracy of LiDAR in identifying priority areas for future projects.

Program Element 6: Administration

This element involves all duties associated with fiscal management, reporting, communications, office management, housing, insurance, supervision & oversight and overall coordination of the Crystal Loon Mills Implementation project.

Cash: $ 53,904
In-kind: $ 21,480

Program Element 6A – Communications *Throughout project timeline*

CLM COORDINATOR & GRAD ASST.

Project staff will report to the Technical Advisory Committee via regular meetings, emails, and written updates. Participate in partner agency, city council, and sponsor group meetings to update stakeholders on the project as requested. Maintain an email distribution list for interested parties and disperse project updates and items of note on a regular basis or as needed. This element also covers any press releases and media activities.

Program Element 6B – Fiscal Management *Throughout project timeline*
CLM COORDINATOR, WRC, CITY OF LAKE CRYSTAL, BLUE EARTH SWCD

Keep records of time, expenditures and project income as directed by MPCA project staff, as required by City of Lake Crystal as CWP fiscal agent, and Blue Earth SWCD as CWLA fiscal agent. Track in-kind contributions. WRC will be responsible for paying bills and salaries, participating in audits by MPCA and State of Minnesota Auditor, coordinate utilities, rent, overhead costs, insurance, mileage reimbursements, and workers comp as needed.

Project Element 6C – Project Direction *Throughout project timeline*
MRB, MPCA, BWSR, TECH ADVISORY COMMITTEE

Dr. Shannon Fisher will provide supervision and support to project coordinator, graduate assistant, and student workers. MPCA and BWSR project managers will provide supervision and support to Program Coordinator. Project staff will maintain office, laboratory, and field activities as needed. The Technical Advisory Committee will provide oversight for project activities and staff.

Project Element 6D – Office Management *Throughout project timeline*
CLM COORDINATOR, WRC

This activity covers office support for all other program elements and daily management of time & supplies. Also included in this element is the production of project materials, supply purchase, maintenance of internal systems, and contingency planning activities.

Program Element 6E – Reporting *Annually & at project completion*
CLM COORDINATOR, GRAD ASST, SWCD TECH ADVISORY COMMITTEE

Complete biannual progress reports (February 1 and August 1) for CWP as required by MPCA project management. SWCD will complete E-Link reporting as required for CWLA as required for BWSR project management. STORET reporting will also be completed annually. A final report for the project will be written and distributed.

SECTION 5
MILESTONE SCHEDULE

Program Element 1: Initial Activities

Activity	Time Frame	Responsibility
Complete work plan and project budget	June – August 2007	CLM Coordinator & Technical Advisory Committee
Committee organization	July – Sept. 2007	CLM Coordinator & Technical Advisory Committee
Attend conferences & workshops	Ongoing	CLM Coordinator & Graduate Student

Program Element 2: Education and Outreach Activities

Activity	Time Frame	Responsibility
Put together and distribute informational brochures about the project and BMPs available	December 2007 & 2008	CLM Coordinator & Graduate Student
Host public informational meetings, attend community events and town halls as opportunities arise; provide informational booth at Duck Days celebration	Ongoing	CLM Coordinator
Host BMP field days and tours of demonstration sites	Project years 2 & 3	CLM Coordinator & Tech Advisory Committee
Work with local schools and youth groups through classroom visits, field trips, and projects	Ongoing	CLM Coordinator & Graduate Student

Program Element 3: Best Management Practices Promotion and Activities

Activity	Time Frame	Responsibility
Promote and sign-up landowners for vegetative practices through EQIP, state cost-share, & CRP	Project years 2 & 3	CLM Coordinator, SWCD, FSA & NRCS
Promote and sign-up landowners for open tile intake alternatives	Project years 2 & 3	CLM Coordinator & SWCD
Promote and sign-up landowners for structural practices through EQIP & state cost-share	Project years 2 & 3	CLM Coordinator, SWCD, & NRCS
Promote nutrient management planning and custom-rate application; promote enrollment in EQIP and U of M Extension BMP Challenge Program	Project years 2 & 3	CLM Coordinator, SWCD, & NRCS
Promote septic upgrades for non-compliant systems through existing county loan program	Project years 2 & 3	CLM Coordinator & Tech Advisory Committee
Promote and sign up landowners for shoreline restorations through state cost-share	Project years 2 & 3	CLM Coordinator, DNR, SWCD, & City of Lake Crystal
Promote urban and residential stormwater management	Project years 2 & 3	CLM Coordinator & City of Lake Crystal
Research and provide TA to citizens and stakeholders regarding project BMPs	Ongoing	CLM Coordinator & WRC

Program Element 4: Monitoring

Activity	Time Frame	Responsibility
Routine monitoring – CD 56	April – September, 2007-2009	WRC, Grad. Asst., MSUM
Routine monitoring – lakes	April – September, 2008-2009	WRC, Grad. Asst., MSUM, MPCA
Aquatic survey	Every 5 years	DNR
Visual site survey of CD 56 and open tile inlets	Spring 2008	CLM Coordinator, WRC, MSUM

Program Element 5: Data Evaluation and Analysis

Activity	Time Frame	Responsibility
Evaluation of BMPs	Project years 2 & 3	CLM Coordinator, Grad. Asst., WRC, Tech Advisory Committee
Evaluation of monitoring data	Project years 2 & 3	WRC
Tech committee review	As needed	CLM Coordinator, Tech Advisory Committee
GIS analysis and products	Ongoing	CLM Coordinator, WRC, MDA, BEC Enviro. Services

Program Element 6: Administration

Activity	Time Frame	Responsibility
Communications management	Ongoing	CLM Coordinator & Grad. Asst.
Maintain email list and send out project updates	Ongoing	CLM Coordinator
Fiscal management	Ongoing	CLM Coordinator, WRC, City of Lake Crystal, Blue Earth SWCD
Provide support & direction to project staff	Ongoing	Dr. Shannon Fisher, MPCA, BWSR, Tech Advisory Committee
Office support & management	Ongoing	CLM Coordinator, WRC
Project reporting	Annually & biannually	CLM Coordinator, SWCD, WRC

SECTION 6
MONITORING PLAN

A. Purpose of Water Quality/Quantity Monitoring

The purpose of water quality monitoring is to continue to delineate and evaluate water quality problems identified in the Crystal Loon Mills Lakes Restoration Project Diagnostic Study Final Report and to evaluate the effectiveness of the BMPs installed during the implementation project timeline. Monitoring data will be utilized to determine the nutrient, sediment, and *E. coli* concentrations for County Ditch 56. Water quality data will also be used to determine flow volume entering the lake from CD 56. Data will also be entered into the FLUX model to calculate yearly sediment and nutrient loads to Crystal Lake from CD 56. In-lake monitoring data will be collected and used in BATHTUB modeling to develop Carlson TSI.

B. Summary of Crystal Loon Mills Restoration Project Diagnostic Study by Proctor et al. (1998)

B-1: Overall Water Quality Findings

Water quality data collected during the 1995 and 1996 monitoring season for the Crystal Loon Mills Diagnostic Study indicated that the three lakes had poorer water quality with respect to water clarity, algae (chlorophyll-a) and total phosphorus than regional reference lakes representing the 25-75 percentiles in the Western Cornbelt Plains Ecoregion. Those findings indicated that Crystal, Loon and Mills Lakes were hypereutrophic. This reflects that the lakes had limited water clarity, were nutrient rich and subject to numerous algae blooms.

In 1995 almost 80% of the water entering Crystal Lake came through County Ditch 56. Water enters CD 56 through surface run-off, sub-surface tile drainage systems in the rural areas, and storm sewers in the City of Lake Crystal.

B-2: Phosphorus Levels

During the summer of 1995 the mean total phosphorus (TP) level in Mills Lake was well above the expected range of TP for the Western Cornbelt Plains Ecoregion and was almost twice as high as the summer mean TP level in Loon and Crystal Lakes. The TP levels in Crystal and Loon Lakes were higher than mid-range (25-75) percentiles for lakes in this region. See Table XIII in Appendix C for 1995 lake comparisons based on specific water quality parameters.

In 1995 and 1996, the amount of TP entering Crystal Lake from CD 56 and the City of Lake Crystal was approximately 7,000 pounds and 4,387 pounds respectively. During 1995, the rural watershed contributed 84% of TP and 67% of the phosphate-phosphorus (P-PO4), the type of phosphorus mostly responsible for algal growth, also known as ortho-phosphorus. Land within the Lake Crystal urban area flowing directly into CD 56 contributed approximately 16% TP and 33% P-PO4. In 1996, the rural section of the watershed contributed 90% of the total loading (pound per year) of TP and P-PO4 to CD 56 and Crystal Lake. See Table IV in Appendix C for yearly loading in pounds per year by sampling site for several water quality parameters. CD 56 was responsible for 90 to 95% of the total phosphorus load during 1995 and 1996.

It is not surprising that the rural part of the watershed contributed significantly more phosphorus to CD 56 and Crystal Lake than the urban area of the watershed considering that, when the 1998 study report was written, 88.8% of the land in the watershed was in rural use.

According to 1990 MPCA standards, in order to fully support recreational and aesthetic appearances in Western Cornbelt Plains Ecoregional lakes, TP levels should be less than 40 ug/L. To partially support recreational and aesthetic appearances, levels should be less than 90 ug/L. In 1995, Crystal, Loon and Mills Lakes had a respective TP mean summer averages of 140, 139 and 213.

Based on BATHTUB modeling predictions, a 50% reduction on phosphorus would improve water quality in Crystal Lake enough that the secchi disk and chlorophyll-a readings would just barely fall within the 25-75 percentile reference values for lakes in the Western Cornbelt Plains Ecoregion. Based on information gathered from 1995 and 1996, reductions in phosphorus would have to take place in all portions of the watershed.

<u>B-3: Water Clarity and Algae</u>

The 1995 water clarity levels of Crystal, Loon and Mills Lakes were less than 75% of the reference lakes located in the Western Cornbelt Plains Ecoregion. Water clarity in Loon and Mills Lakes was poorer than in Crystal Lake. Secchi disk and percentage of blue-green algae to total algae by sampling date for Crystal Lake, Loon and Mills Lakes respectively are summarized in Figures 5-8 in Appendix C. Although summer average secchi disk readings are similar for the three lakes, Crystal and Mills Lakes experienced greater fluctuations than Loon Lake. Blue-green algae were the dominant type (50-100%) of algae found in Loon and Mills Lakes for the general period from June to October, 1995. For 1995, at both sample sites on Crystal Lake, percentages of blue-green algae ranged from zero to seventy, with the highest concentrations present during June and early July.

<u>B-4: Total Suspended Solids</u>

In 1995, more than 1.3 million pounds (650 tons) of total suspended solids entered Crystal Lake through County Ditch 56. During the same year, approximately 299,000 pounds of total suspended solids settled to the bottom of CD 56 between County Road 9 and Prince Street. In 1996, the total suspended sediment load to Crystal Lake from CD 56 was 922,385 pounds.

B-5: Nitrogen

Nitrate levels in all three lakes were 10 times higher than the range (25-75 % of the lakes) that would be expected in this region of Minnesota. Crystal Lake had 5 and 20 times more nitrogen as nitrates than Loon and Mills Lakes, respectively.

B-6: Urban verses Rural Loading

The urban contribution to load was determined by subtracting the load at County Road 9 from the Prince Street load results for each water quality parameter. The rural load equaled the load determined at CR 9. The rural part of the watershed is very large and it contributed the largest amount of pollutants to CD 56 on a percent of total load basis. On a pounds per acre basis, the diagnostic study found the urban area of the watershed contributed substantially larger amounts of P-PO4, TP and N-NH3 than the rural area in both 1995 and 1996.

Ongoing review and analysis of the data suggests that the large difference in contribution between the two watersheds was probably due to inaccurate hydrograph data used to calculate nutrient loads. Re-assessment of data available from 1995-1996 for the County Road 9 and Prince Street monitoring sites indicates that on a per acre basis, it is likely that the concentrations of phosphorus coming from the urban and rural portions of the watershed are equal. Therefore, since in 1995-1996 2.7% of the watershed was urban, it is likely that approximately 3% of nutrient loading came from the urban area. See Appendix D for further information on the phosphorus loading re-assessment.

C. Monitoring Site Selection and Description

The sampling site for the rural drainage area is located on County Road 9 at the Lake Crystal city limits. (See Appendix E.) The rural drainage area covers approximately 9,211 acres. The site is located along a straightened length of ditch channel where CR 9 crosses the ditch with two box culverts approximately 6 ft. x 6 ft. Stage level is recorded every 15 minutes on a continuous basis using a SR50 Ultrasonic Transducer that bounces a wave off the water surface to record stage and stage readings are stored with a Campbell CR510 data-logger.

The DNR collects flow measurements at the CR 9 sampling site throughout the year to obtain measurements from all different types of flow (low to high). DNR will conduct 6 to 8 flow measurements per year to develop and maintain the flow rating equation.

Lake sampling sites will be located at two points on Crystal and Loon Lakes and one point on Mills Lake. Sampling sites for lake monitoring will be determined in the spring of 2008.

D. Sampling Frequency and Water Quality Parameters

Water quality data will be collected according to the requirements of the various models used to determine nutrient loading in the lakes and CD 56, as well as to meet the requirements of the simultaneous TMDL study parameters.

Sampling Feature	Sample Site			
	Crystal Lake	Loon Lake	Mills Lake	County Ditch 56 at County Road 9
Water quality parameters	Temperature, dissolved oxygen, TP, chlorophyll-a, Secchi disk transparency, conductivity, TSS, pH, color	Temperature, dissolved oxygen, TP, chlorophyll-a, Secchi disk transparency, conductivity, TSS, pH, color	Temperature, dissolved oxygen, TP, chlorophyll-a, Secchi disk transparency, conductivity, TSS, pH, color	TSS, turbidity, nitrate, TP, P-PO4, total kjeldahl nitrogen, total suspended volatile solids, pH, *E. coli*
# of sample locations	Two	Two	One	One
Duration of sampling	April 1/ice-out to September 30/ice-in and one under-ice sample	April 1/ice-out to September 30/ice-in and one under-ice sample	April 1/ice-out to September 30/ice-in and one under-ice sample	April 1/ice-out to September 30/ice-in
Frequency of lab samples	Bimonthly	Bimonthly	Bimonthly	20-25 over sampling season; collection during rise, peak and fall of storm hydrographs; base flow collected every 10-14 days
Depths of lab sampling	Surface grab	Surface grab	Surface grab	Surface grab
Field profiles	Same frequency of other sample parameters	Same frequency of other sample parameters	Same frequency of other sample parameters	Same frequency of other sample parameters
Fisheries, lake level and macrophyte data	Once during project timeline	Once during project timeline	Once during project timeline	Once during project timeline
Lab analysis	Delivered to MVTL in New Ulm at 4C, within parameter holding time in sterilized bottles provided by MVTL	Delivered to MVTL in New Ulm at 4C, within parameter holding time in sterilized bottles provided by MVTL	Delivered to MVTL in New Ulm at 4C, within parameter holding time in sterilized bottles provided by MVTL	Delivered to MVTL in New Ulm at 4C, within parameter holding time in sterilized bottles provided by MVTL; *E. coli* sample analysis conducted at Minnesota State University Mankato
Sampling Equipment	Fields meters will be used for dissolved oxygen, temperature, pH, and transparency	Fields meters will be used for dissolved oxygen, temperature, pH, and transparency	Fields meters will be used for dissolved oxygen, temperature, pH, and transparency	Fields meters will be used for dissolved oxygen, temperature, pH, and transparency

SECTION 7
WATERSHED ASSESSMENT

A. Physical Description of the Project Area

The CLM watershed is located in Blue Earth County in south central Minnesota. The CLM system is part of the Minneopa Creek watershed, which is in turn, part of the Middle Minnesota River Basin. The CLM system consists of two minor subwatersheds (MDNR numbers 28045 and 28046) draining approximately 13,799 acres and includes three lake basins: Crystal Lake (393 acres), Loon Lake (755 acres), and Mills Lake (229 acres) (NLCD 2001, MDNR 2004). Subwatershed 28045 covers 14.8 square miles and is drained by CD 56. County Ditch 56 was constructed in 1920. Most of the watershed drains through CD 56 into Crystal Lake. In addition, 75% of the urban residential areas for the City of Lake Crystal are drained into CD 56 through several storm sewers (Proctor et al. 1998).

B. Land Use

For land use map and land cover class definitions see Appendix E. CRP cover category (code 89) was estimated using visual survey data collected during summer 2007 field season.

Table 1. Summary of Land Use Characteristics for the CLM Watershed (NLCD 2001)

Total Project Area: 13,789Acres (Ac)
Land Cover in the Project Area:

Cover Type	Code	Percentage
CULTIVATED CROPS	**82**	**74.79%**
OPEN WATER	**11**	**10.68%**
DEVELOPED	**21-24**	**7.92%**
WETLANDS	**90 & 95**	**3.43%**
DECIDUOUS FOREST	**41**	**0.71%**
GRASSLANDS/PASTURE	**71**	**0.10%**
CRP/CONSERVATION LAND	**89**	**2.35%**
BARREN LAND (Rock/Sand/Clay)	**31**	**0.02%**

C. Other Collected Project Data

See Appendix E for watershed area maps showing soils and topography.

D. Modeling

Sediment and nutrient loading will be estimated using the FLUX modeling program. In order to determine loading, FLUX requires both a water quality file containing date, flow and quantitative values for each testing parameter and a second file containing a continuous flow record with daily mean flows for the given monitoring period. FLUX then maps the sampled flow/concentration relationship onto the entire flow record using six different calculation techniques to calculate total mass discharge and the associated error statistics (Kudelka 2004).

The BATHTUB model will be used to determine the trophic status and the nutrient and water budgets for Crystal, Loon and Mills Lakes. The three related parameters used by BATHTUB (water clarity, chlorophyll-a and total phosphorus) determine the lake's Carlson TSI. Algae growth, indicated by chlorophyll-a, is increased by high phosphorus levels. Water clarity, measured by secchi disk, is in turn reduced by the increased algae growth. TSI for lakes in the Western Cornbelt Plains Ecoregion typically range between 55 – 80 (Proctor et al. 1998).

The Minnesota PSAT model, developed by the University of Minnesota, will also be used as an education tool for watershed residents. PSAT is a relative model and is not designed to be used alone, but in the context of other modeling programs. Data gathered and input into the PSAT model is used to analyze relative contribution of sources of P to a lake or stream and then educate the stakeholders about those sources. The PSAT model inputs include: land use acreage, population, condition of septic systems, livestock lots, and permitted dischargers. However, much more detailed data can be entered and the model becomes a more accurate educational tool as more data is entered.

E. Selection of Priority Management Areas

General priority management areas were selected during the Crystal Loon Mills Lakes Phase 1 diagnostic study based on the water quality outcomes of the study and the input of the various stakeholder groups. The County Road 9 and Prince Street (urban) subwatersheds were identified as high priority areas due to the heavy pollutant loads that they contributed to CD 56 and Crystal Lake. Crystal, Loon and Mills Lakes themselves were considered high priority because of shoreline erosion and degradation, internal loading, the presence of rough fish, and direct tile drainage into the lakes.

Additional refining of priority management areas will be completed using Light Detection and Ranging (LiDAR) technology methods currently under development by the Minnesota Department of Agriculture (MDA). Using a system of lasers and sensors to transmit and receive pulses from reflected surfaces, LiDAR technology can create highly accurate digital elevation models (DEMs). By combining DEMs with data from the Revised Universal Soil Loss Equation (RUSLE), it is possible to create an erosion map that can help pin-point specific areas for BMP implementation. LiDAR can also be used in conjunction with the Stream Power Index (SPI) to predict where gully erosion may occur. The SPI uses topographic indices to identify critical source areas at high resolution that may be vulnerable to sediment loss. On-the-ground surveys of the project area will be conducted as a measure of field validation of the LiDAR analysis.

SECTION 8
WORKPLAN BUDGETS

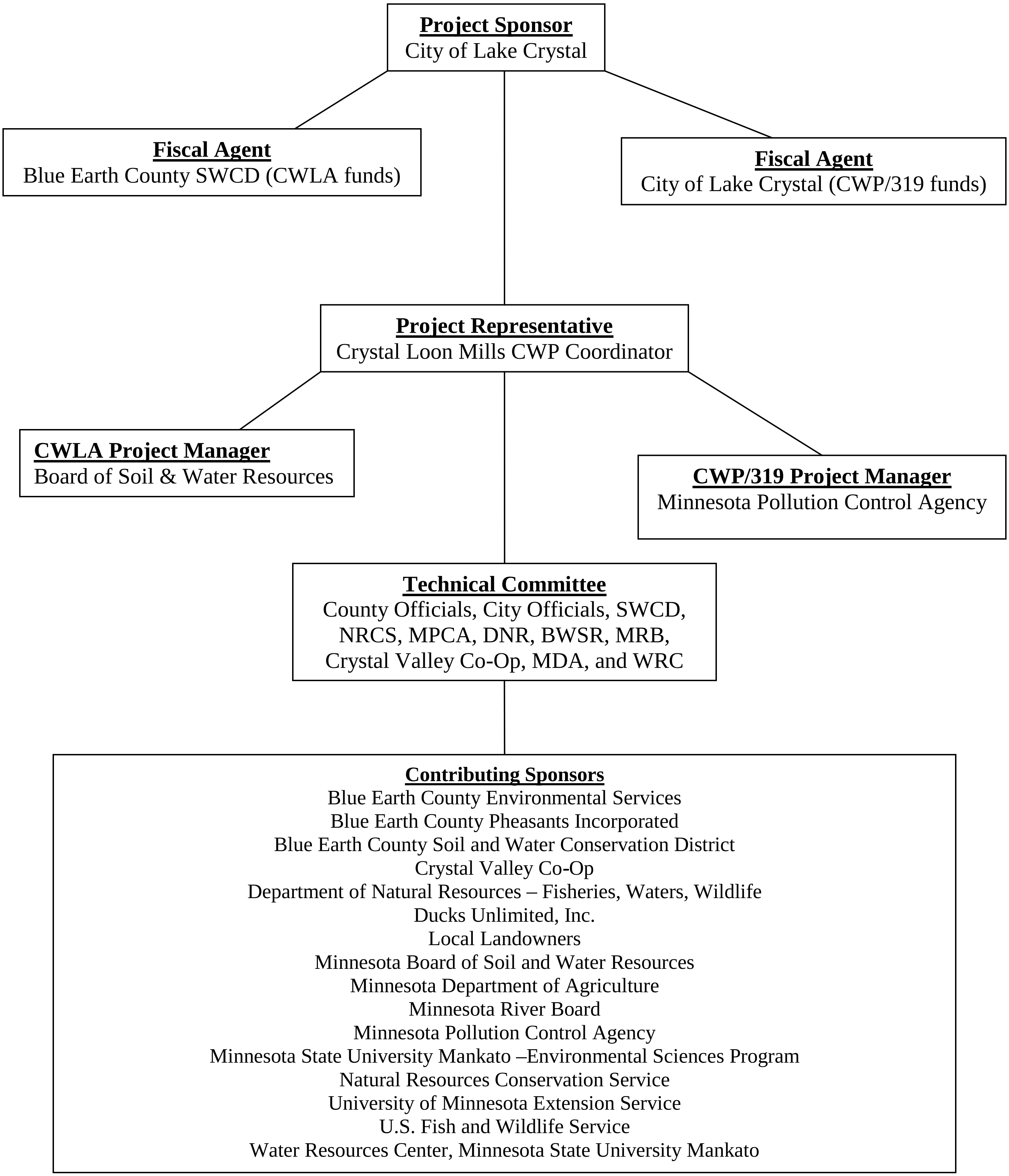
A. Project Support Budget

Project Sponsors	Cash Contribution to Project	In-kind Cash Match	In-kind Contribution	Total Project Support
A. Project Sponsor Contribution				
City of Lake Crystal		$33,000	$12,000	$45,000
B. Local Contributing Sponsors				
1. Blue Earth County Environmental Services			$31,500	$31,500
2. Blue Earth SWCD			$3,000	$3,000
3. BE County Pheasants Incorporated		$5,000		$5,000
4. Landowners			$63,400	$63,400
B. Local Contributing Sponsors Subtotal:		$5,000	$97,900	$102,900
C. State and/or Federal Contributing Sponsors:				
5. Water Resources Center, MSUM			$14,130	$14,130
6. Minnesota River Board			$8,500	$8,500
7. MSUM – Department of Biology, Environmental Science Program			$8,000	$8,000
8. DNR – Fisheries/Waters/Wildlife			$33,600	$33,600
9. NRCS			$7,000	$7,000
10. Board of Soil and Water Resources			$1,000	$1,000
11. US Fish and Wildlife Service			$5,000	$5,000
C. State and/or Federal Contributing Sponsors Subtotal **(not including grant funds)			$77,230	$77,230
TOTAL: All project sponsors (A + B + C)		$38,000	$187,130	$225,130
D. Grant Funds	$210,500			
GRAND TOTALS	Total Cash $210,500	Total In-Kind Cash Match $38,000	Total In-kind Contributions $187,130	Total Project Cost $435,630

B. Itemized Program Element Budget

Element	In-kind Budgeted	Cash Budgeted	In-kind Cash Match Budgeted	Total Budgeted
Element 1: Initial Activities				
1A - Work Plan Development	$2,130.00	$8,069.00	$0.00	**$10,199.00**
1B - Committee Organization	$908.00	$263.00	$0.00	**$1,171.00**
1C - Project Research & Planning	$0.00	$3,212.00	$0.00	**$3,212.00**
1C - Project Research & Planning (meeting/workshop registration & travel)	$330.00	$4,789.00	$0.00	**$5,119.00**
Total Element 1	**$3,368.00**	**$16,333.00**	**$0.00**	**$19,701.00**
Element 2: Education & Outreach				
2A - Newsletter & Mailings	$3,822.00	$1,500.00	$1,667.00	**$6,989.00**
2B - Community Activities	$12,164.00	$750.00	$1,667.00	**$14,581.00**
2C - Schools & Youth Groups	$800.00	$250.00	$1,666.00	**$2,716.00**
Total Element 2	**$16,786.00**	**$2,500.00**	**$5,000.00**	**$24,286.00**
Element 3: BMPs				
3A - Vegetative Practices	$20,650.00	$35,000.00	$15,000.00	**$70,650.00**
3B - Open Tile Intake Alternatives	$5,000.00	$10,000.00	$5,000.00	**$20,000.00**
3C - Structural Practices	$20,000.00	$5,000.00	$5,000.00	**$30,000.00**
3D - Nutrient Management	$1,000.00	$3,000.00	$0.00	**$4,000.00**
3E - Non-crop Land Practices	$37,000.00	$5,000.00	$3,000.00	**$45,000.00**
3F - Technical Support	$0.00	$67,713.00	$5,000.00	**$72,713.00**
Total Element 3	**$83,650.00**	**$125,713.00**	**$33,000.00**	**$242,363.00**
Element 4: Monitoring				
4A - Water Quality Monitoring	$4,500.00	$6,200.00	$0.00	**$10,700.00**
4B - Field Surveys	$22,500.00	$9,300.00	$0.00	**$31,800.00**
Total Element 4	**$27,000.00**	**$15,500.00**	**$0.00**	**$42,500.00**
Element 5: Data Eval & Analysis				
5A- Modeling	$2,133.00	$0.00	$0.00	**$2,133.00**
5B - Technical Committee Review	$12,713.00	$0.00	$0.00	**$12,713.00**
5C - GIS	$20,000.00	$0.00	$0.00	**$20,000.00**
Total Element 5	**$34,846.00**	**$0.00**	**$0.00**	**$34,846.00**
Element 6: Administration				
6A - Communications	$0.00	$23,656.00	$0.00	**$23,656.00**
6B - Fiscal Management	$5,133.00	$10,920.00	$0.00	**$17,253.00**
6C - Project Direction	$13,413.00	$3,800.00	$0.00	**$17,213.00**
6D - Office Management	$2,134.00	$2,500.00	$0.00	**$4,634.00**
6E - Reporting	$800.00	$9,578.00	$0.00	**$10,378.00**
Total Element 6	$21,480.00	$50,454.00	$0.00	**$71.934.00**
ITEMIZED PROGRAM ELEMENT BUDGET				
Total Element 1	**$3,368.00**	**$16,333.00**	**$0.00**	**$19,701.00**
Total Element 2	**$16,786.00**	**$2,500.00**	**$5,000.00**	**$24,286.00**
Total Element 3	**$83,650.00**	**$125,713.00**	**$33,000.00**	**$242,363.00**
Total Element 4	**$27,000.00**	**$15,500.00**	**$0.00**	**$42,500.00**
Total Element 5	**$34,846.00**	**$0.00**	**$0.00**	**$34,846.00**
Total Element 6	**$21,480.00**	**$50,454.00**	**$0.00**	**$71,934.00**
Project Grand Total	**$187,130.00**	**$210,500.00**	**$38,000.00**	**$435,630.00**

Appendix A – Organizational Chart



Appendix B – Project Contact Information

Name	Agency	Phone	Email
Adam Birr	MDA	507-285-7198	adam.birr@state.mn.us
Beth Proctor	MSUM	507-389-5697	bertha.proctor@mnsu.edu
Bill VanRyswyk	MDA	507-389-5772	bill.vanryswyk@state.mn.us
Bob Hobart	MN DNR, Lake Crystal Lakes Committee	507-359-6071	bob.hobart@dnr.state.mn.us
Bob Kaul	Pheasants Inc.	507-359-6000	bob.kaul@dnr.state.mn.us
Chris Hughes	BWSR	507-389-6784	chris.hughes@bwsr.state.mn.us
Craig Austinson	Blue Earth County (BEC)	507-304-4253	craig.austinson@co.blue-earth.mn.us
Darrell Ehlers	Ducks Unlimited	507-726-6937	
Howard Ward	MN DNR	507-389-5464	howard.ward@dnr.state.mn.us
Jerad Bach	BEC SWCD	507-345-4744	jerad.bach@mn.nacdnet.net
Jerry Rollings	Lake Crystal Economic Dev. Committee	507-625-6816	jerry.rollings@minnstarbank.com
Joel Anderson	MN DNR	507-225-3572	joel.anderson@dnr.state.mn.us
Julie Conrad	BEC	507-304-4381	julie.conrad@co.blue-earth.mn.us
Paul Davis	MPCA	507-389-6974	paul.a.davis@state.mn.us
Leo Getsfried	MN DNR	507-389-2151	leo.getsfried@dnr.state.mn.us
Marc Bacigalupi	MN DNR	507-362-4223	marc.bacigalupi@dnr.state.mn.us
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Ryan Braulick	NRCS	507-345-7418	ryan.braulick@mn.usda.gov
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Shannon Fisher	Minnesota River Board	507-389-5492	shannon.fisher@mnsu.edu
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Commissioner Will Purvis	Blue Earth County		will.purvis@co.blue-earth.mn.us

Appendix C – Selected CLM Restoration Diagnostic Study Tables and Figures

Table XIII. Comparison of the 1995 Crystal, Loon and Mills Lakes Summer Mean Average Levels for Specific Water Quality Parameters with Mid Range (25-75th Percentile) Reference Lakes in the Western Cornbelt Plains Ecoregion

Parameter	WCP Ecoregion (25-75%)	Crystal Lake	Loon Lake	Mills Lake
Total Phosphorus ug/l	65-130	140	139	213
Chlorophyll a ug/l	30-80	102	94.4	101
Secchi Disk (M)	0.5-1	0.35	0.27	0.26-0.36
Total Kjeldahl Nitrogen (mg/l)	1.3-2.7	2.50	2.43	3.101
Nitrate-Nitrite-Nitrogen (mg/l)	0.10-0.20	2.82	0.57	0.13
Alkalinity (mg/l)	125-165	140	129	133
TN:TP Ratio	17:1-27:1	38:1	22:1	15:1

Table IV. The 1995 and 1996 FLUX Model Calculated Load in Pounds/Year and by Sampling Site for Several Water Quality Parameters

Parameter	1995 Co Rd 20	1995 Co Rd 9	1995 Prince	1995 CLMO	1996 Co Rd 9	1996 Prince
Flow *	5,820	11,370	11,480	15,575	4,305	4,654
Pounds/Year						
TP	2,490	6,590	6,970	5,462	3,937	4,387
P-PO4	1,410	3,920	4,520	422	2,499	2,664
TSS	378,140	1,656,990	1,357,770	1,426,726	626,200	922,385
TSVS	127,810	438,670	342,570	800,572	------	------
N-NO3	124,820	352,920	333,020	108,428	115,818	124,218
N-NH3	1,370	2,140	2,240	1,602	1,375	1,572
TKN	16,290	26,560	333,020	98,205	19,119	16,385
COD	309,670	582,370	615,540	1,792,011	242,881	302,264

*acre/feet

Table V. Summary of the 1995 and 1996 Load from Urban and Rural Areas in Pounds per Acre for Various Water Quality Parameters

Pounds/Acre	1995 Rural@	1996 Urban^	1996 Rural@	1996 Urban^
TP	0.7	2.63	0.42	3.12
P-PO4	0.42	4.16	0.27	1.14
TSS	177	(-2,073)	66.95	1,983
N-NO3	37.7	(-137.9)	12.38	58.21
N-NH3	0.23	0.69	0.15	1.37
TKN	2.84	9.91	1.72	1.84
COD	62.27	229.87	25.96	412

@ Load at Co Rd 9/ 9,353 acres (acres in Co Rd 9 and Co Rd 20 subwatersheds)
^(Prince load - Co Rd 9 load)/144 acres

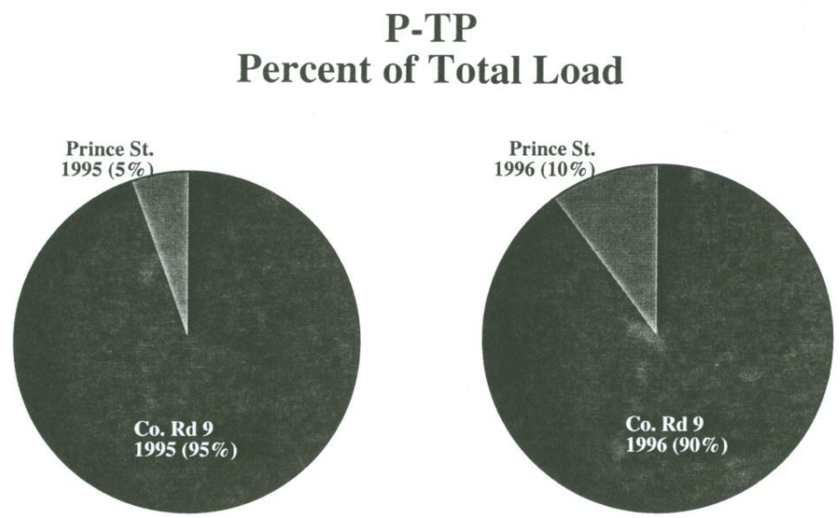


Figure 1. Total Phosphorus contributions to CD 56 by watershed from Executive Summary Report

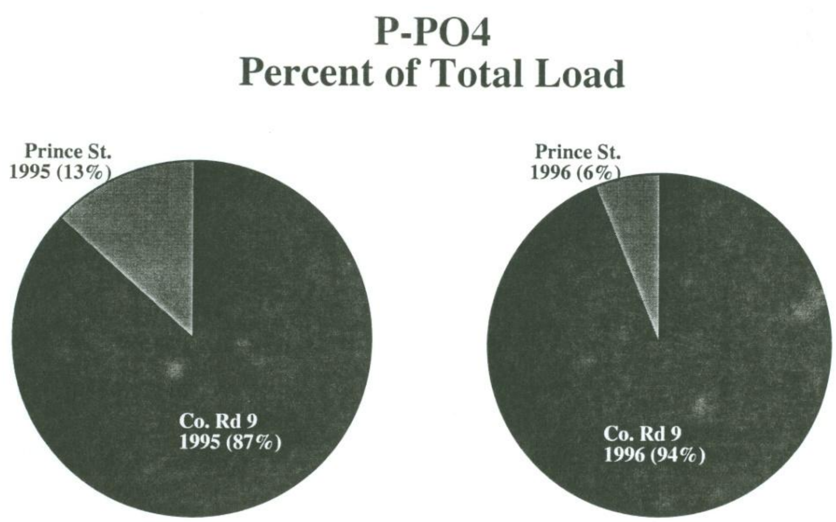


Figure 2. Ortho-phosphorus contributions to CD 56 by watershed from Executive Summary Report

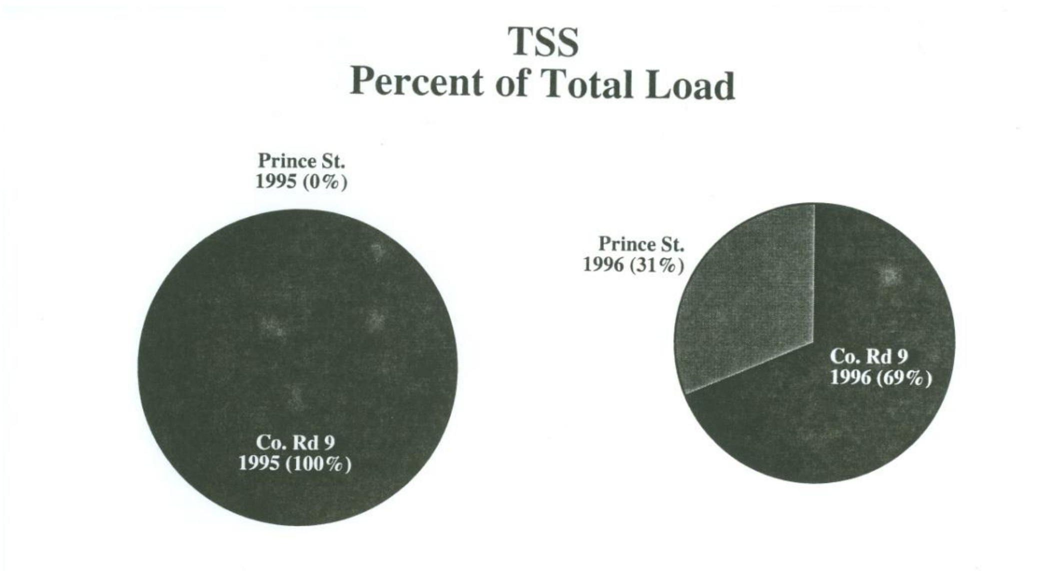


Figure 3. Total Suspended Solids contributions to CD 56 by watershed from Executive Summary Report

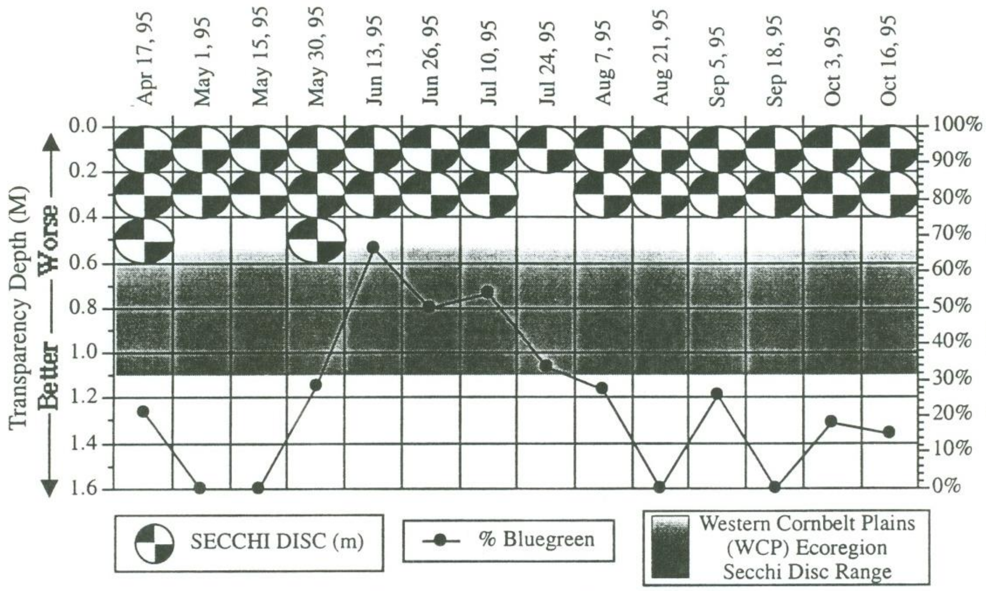


Figure 5. Lake Crystal Site 1, 1995 Secchi Disc Transparency Compared to Percentage of Bluegreen Algae.

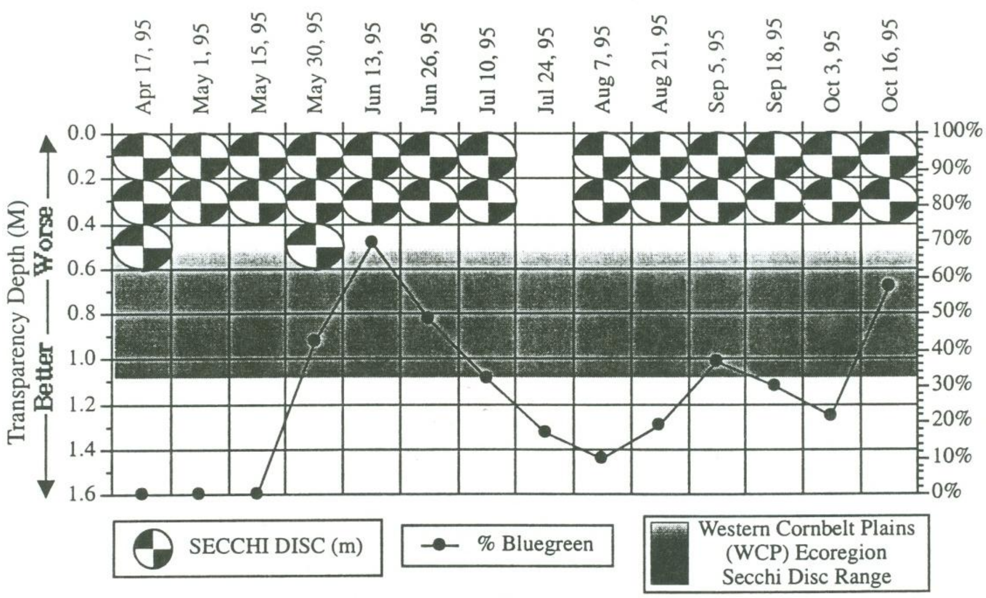


Figure 6. Lake Crystal Site 2, 1995 Secchi Disc Transparency Compared to Percentage of Bluegreen Algae.

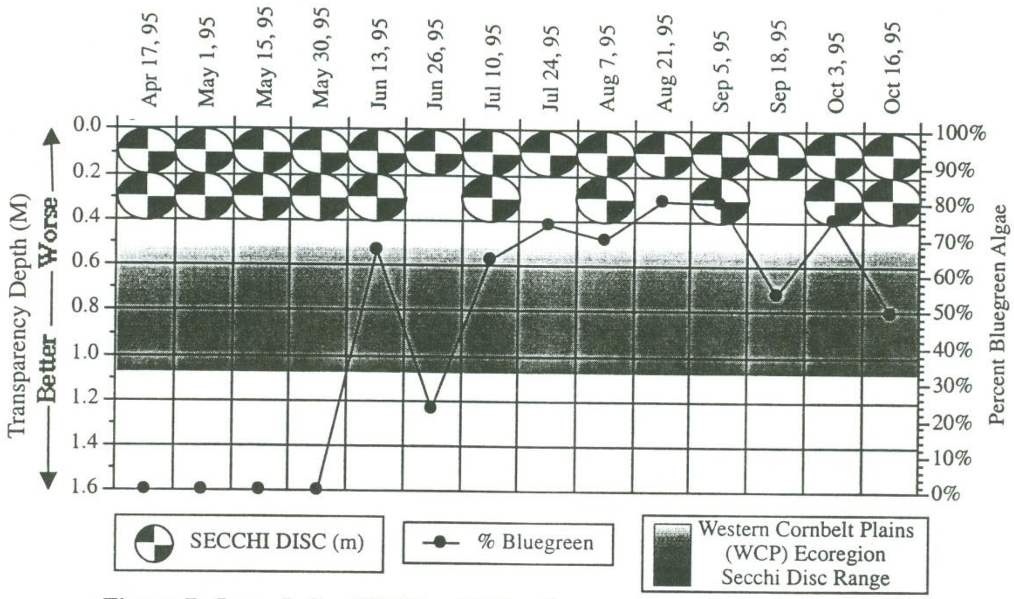


Figure 7. Loon Lake, 1995 Secchi Disc Transparency Compared to Percentage of Bluegreen Algae.

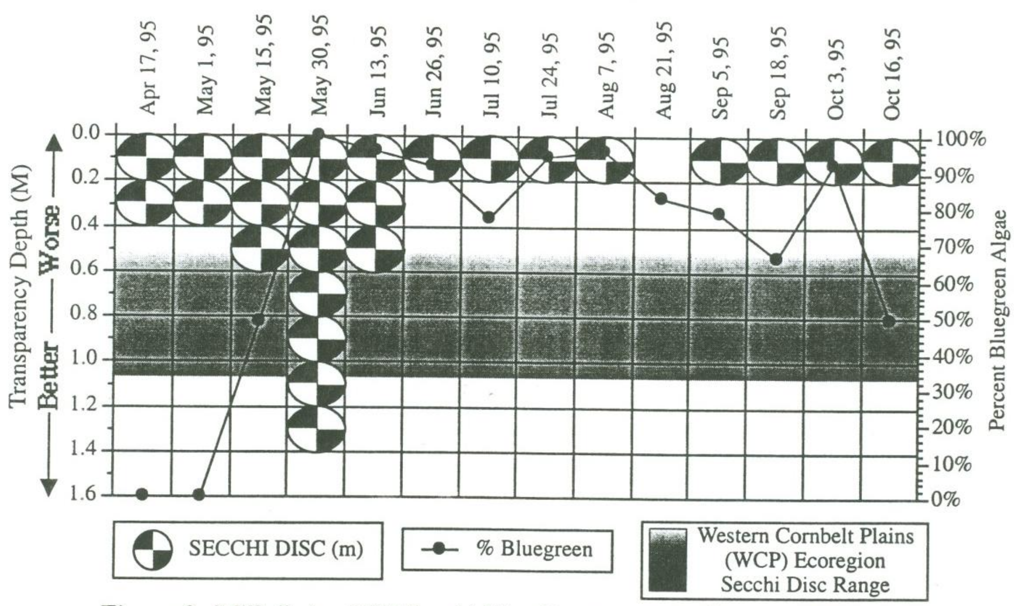
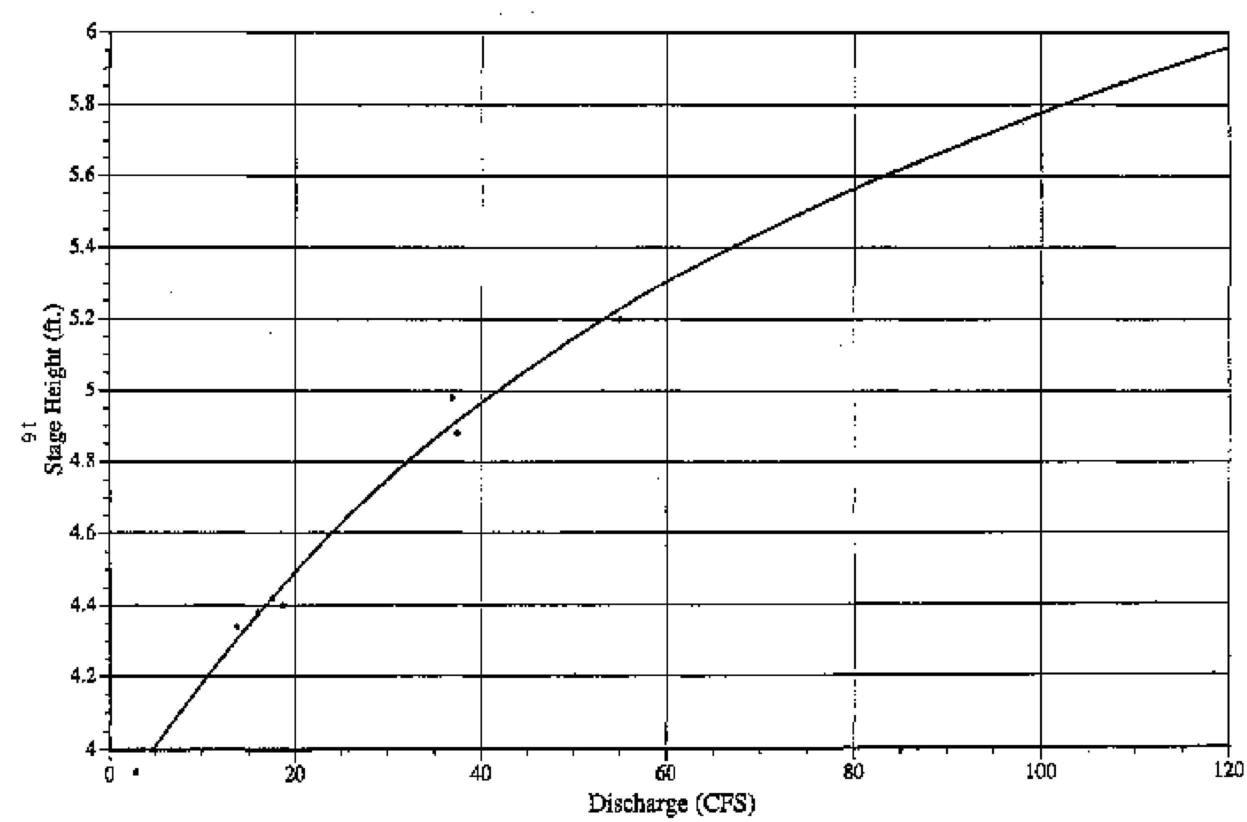
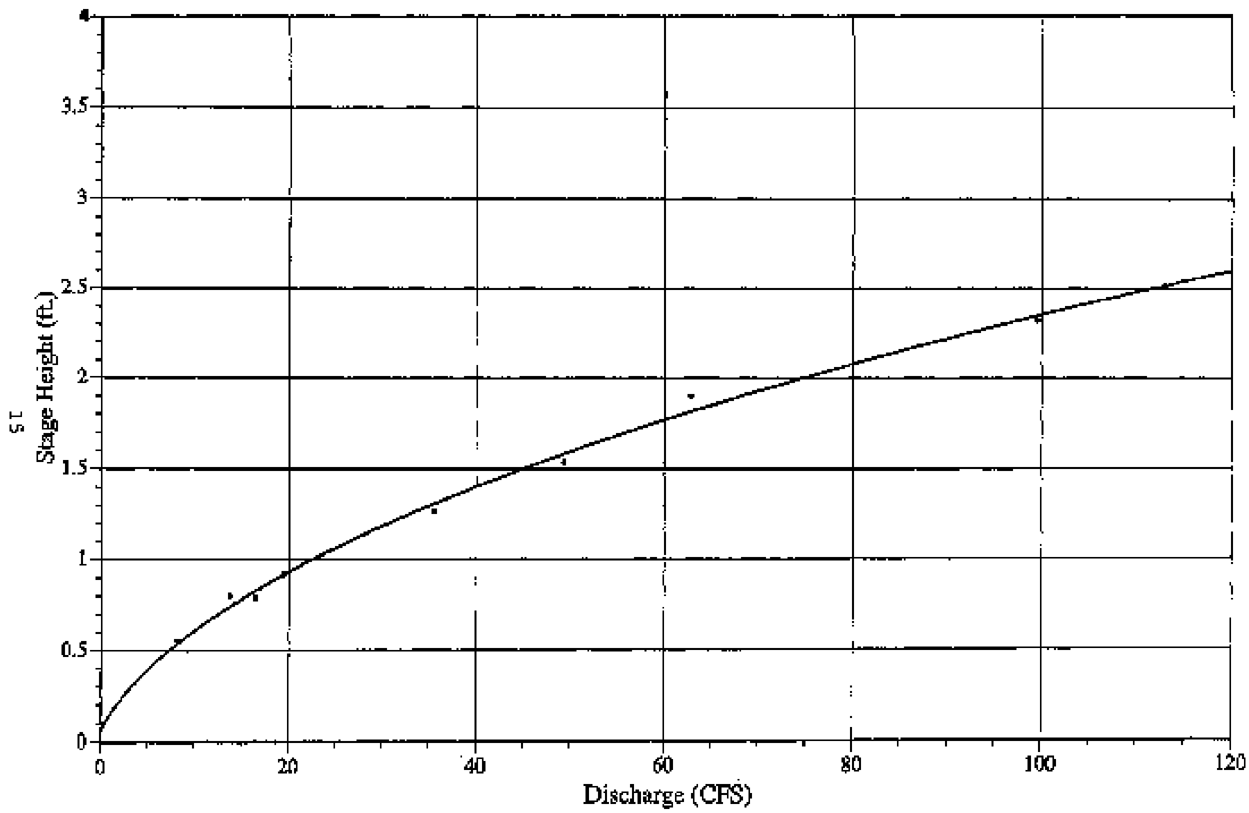


Figure 8. Mills Lake, 1995 Secchi Disc Transparency Compared to Percentage of Bluegreen Algae.



f(y) = 4.427E-1y^3 + 1.321E + 1y^2 + 8.906E + 0*y
R0^2 = .9961

Figure 5. Rating Curve for County Road 9 (from pg. 15)



f(y) = 4.427E-1y^3 + 1.321E+1y^2 + 8.906E+0*y
R0^2 = .9961

Figure 5. Rating Curve for County Road 9.

Appendix D – Re-Assessment of Crystal Loon Mills Diagnostic Study Phosphorus Loads

This spreadsheet provides a re-assessment of phosphorus loads calculated originally in the Crystal Mills Loon Diagnostic Report (Nov. 1998). In September 2007, while reviewing the diagnostic report it became apparent that the flow data shown on pages 18 and 19 of the report did not match.
The graphs showed a much greater quantity of flow at Prince St. as compared to CR 9, despite the sites being within a few blocks of each other. While greater flow quantities may occur at Prince Street immediately following storms, during non-storm periods the two sites should have comparable flow, which the charts contradicted. According to the diagnostic report, the watershed upstream of CR 9 was 9,353 acres. The additional drainage between CR 9 and Prince Street is another 144 acres. Thus, upstream of CR 9 represented 98.5% of the watershed at Prince Street.

According to the diagnostic study, in 1995, CR 9 upstream contributed 95% of the TP load and 90% in 1996. This meant that the small Prince Street sampleshed had TP yields that were around 4 to 8 times higher than the rural areas.

The steps to assess if there was a significant difference in TP loading between urban vs. rural areas of the watershed were the following.

1.) Obtained copies of all the stage and water quality data for Prince Street and CR 9 for 1995/1996.
    This data was pasted into the last eight tabs of this spreadsheet.
2.) For each year stage values were pasted for each site into the two assessment worksheets.
3.) Rating charts on pages 15 and 16 of the diagnostic report *(Appendix C, pgs. 38-39 of this report)* were used to recreate the rating equations. I was unable to find a spreadsheet with the actual values, so I had to interpret from the charts. See below.

<u>Table 1. CR 9 Rating - Derived from Page 15 of Diagnostic Report</u>

Flow = 22.508*stage^1.7454

Stage	Discharge
0.55	8
0.8	13
0.8	17
0.9	19
1.25	35
1.55	50
1.9	63
2.3	99
2.5	112

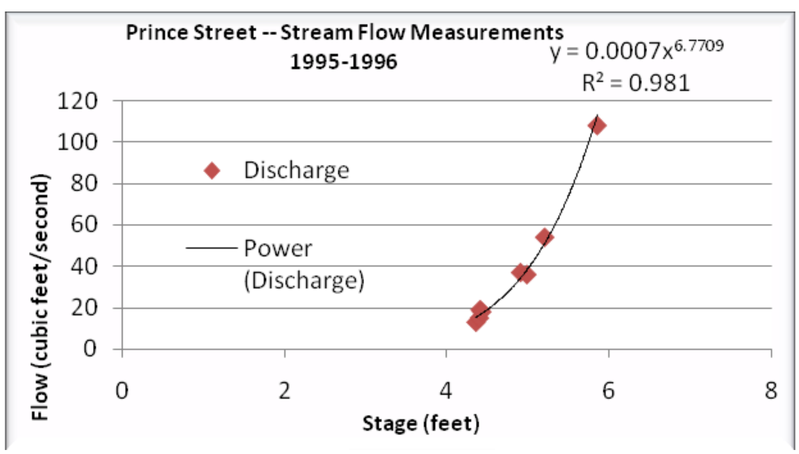
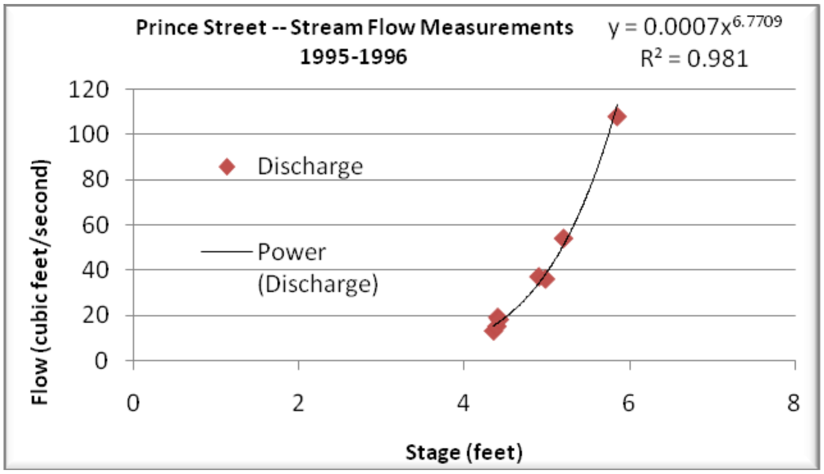


Table 2. Prince St Ratings - Derived from Page 16 of Lake Crystal Diagnostic Report

Flow = 7E-05*stage^8.1949

Stage	Discharge
4.35	13
4.39	15
4.4	19
4.42	18
4.9	37
4.98	36
5.2	54
5.85	108



4.) Using the ratings equations, stages were converted to flow. I was unable to find the 15 minute or daily flow values, so this analysis is solely for dates when samples were collected. There were 25 dates in 1995 and 32 dates in 1996.
5.) Multiplied sample concentration by flow for each sample date to calculate TP load.
6.) TP Load for all sample dates for each year were added together at the Prince Street site and CR 9 site.

	TP Load			Rural %	Urban %
Year	CR 9	Prince St.	Prince St. *	Total Load	Total Load
1995	95.8	92.9	89.1	103.2%	-3.23%
1996	275.5	280.4	304.0	98.2%	1.75%

* Used CR 9 flow values but Prince St. WQ data

7.) Assuming that 1.5% of the Prince Street watershed is urban and estimates in 1996 are that around 1.7% of the TP load was from the urban areas it may be that TP concentrations from both urban and rural areas are equal. Monitoring of storm sewers during the phase I diagnostic study did show some high TP concentrations, but at very low small time durations.

Source of Over-estimation of TP Loads from Urban Areas

It is likely the primary cause of overestimation of TP loads from Lake Crystal is due to inaccurate hydrograph data used to calculate loads. It may be that continuous changes in lake level could have affected the stage flow relationship of the Prince Street rating equation. Or it could also be that an inadequate number of high flow measurements were taken and the upper portion of the rating equations was inaccurate. This is especially apparent when looking at the 1996 data during the highest flow periods, as peak stages exceeded peak flow measurements.

2nd Assessment Procedure

The other quick review method of determining if significant TP loads were coming from the urban area was to compare the average TP concentration at Prince Street to CR9.

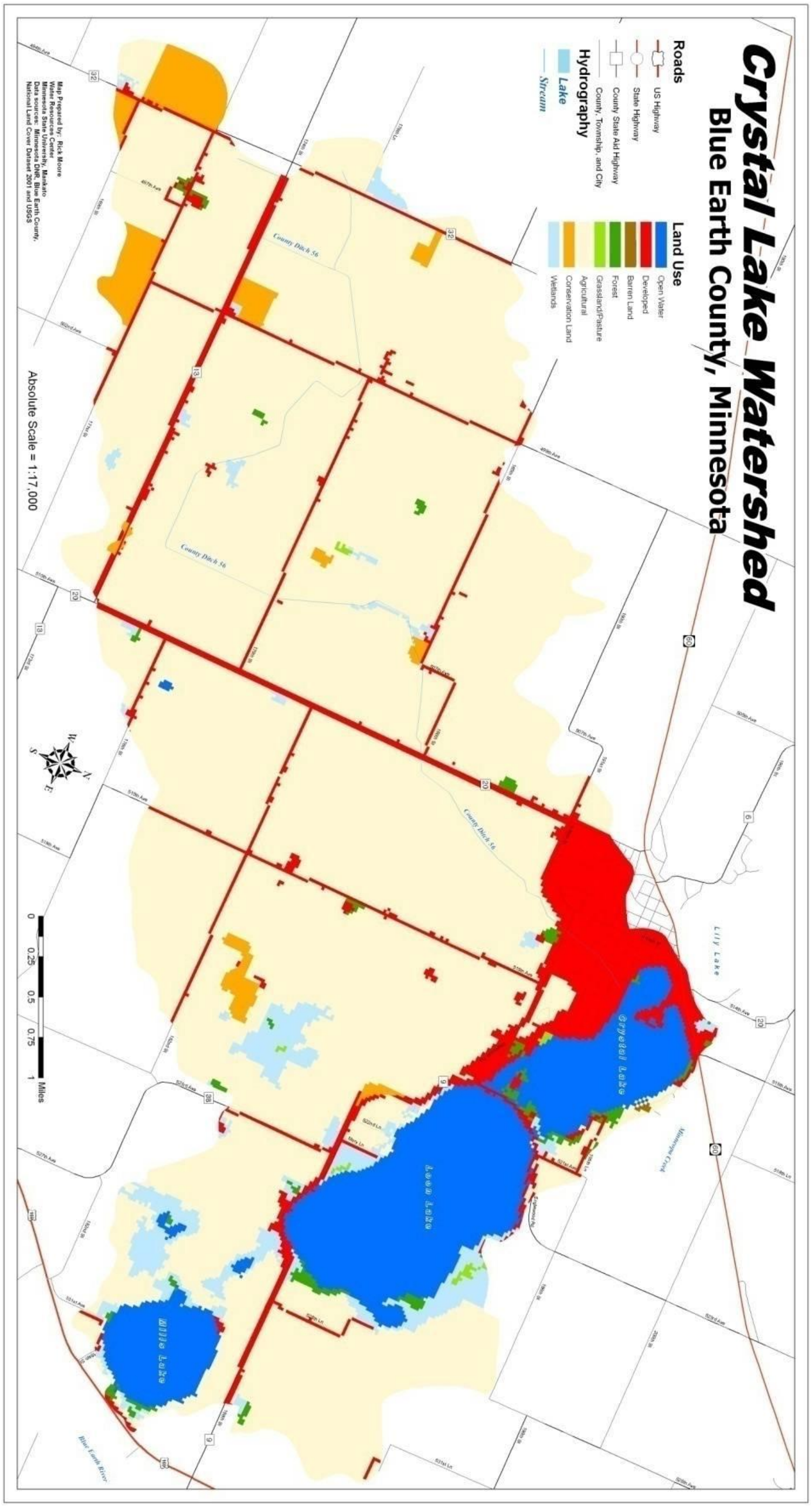
Year	Site	**TSS**	**NO3**	**PO4**	**TP**
1995	CR9	74.6	9.64	0.171	0.277
	Prince St.	61.3	9.50	0.184	0.278
1996	CR9	47.4	7.62	0.152	0.236
	Prince St.	60.9	7.24	0.157	0.258

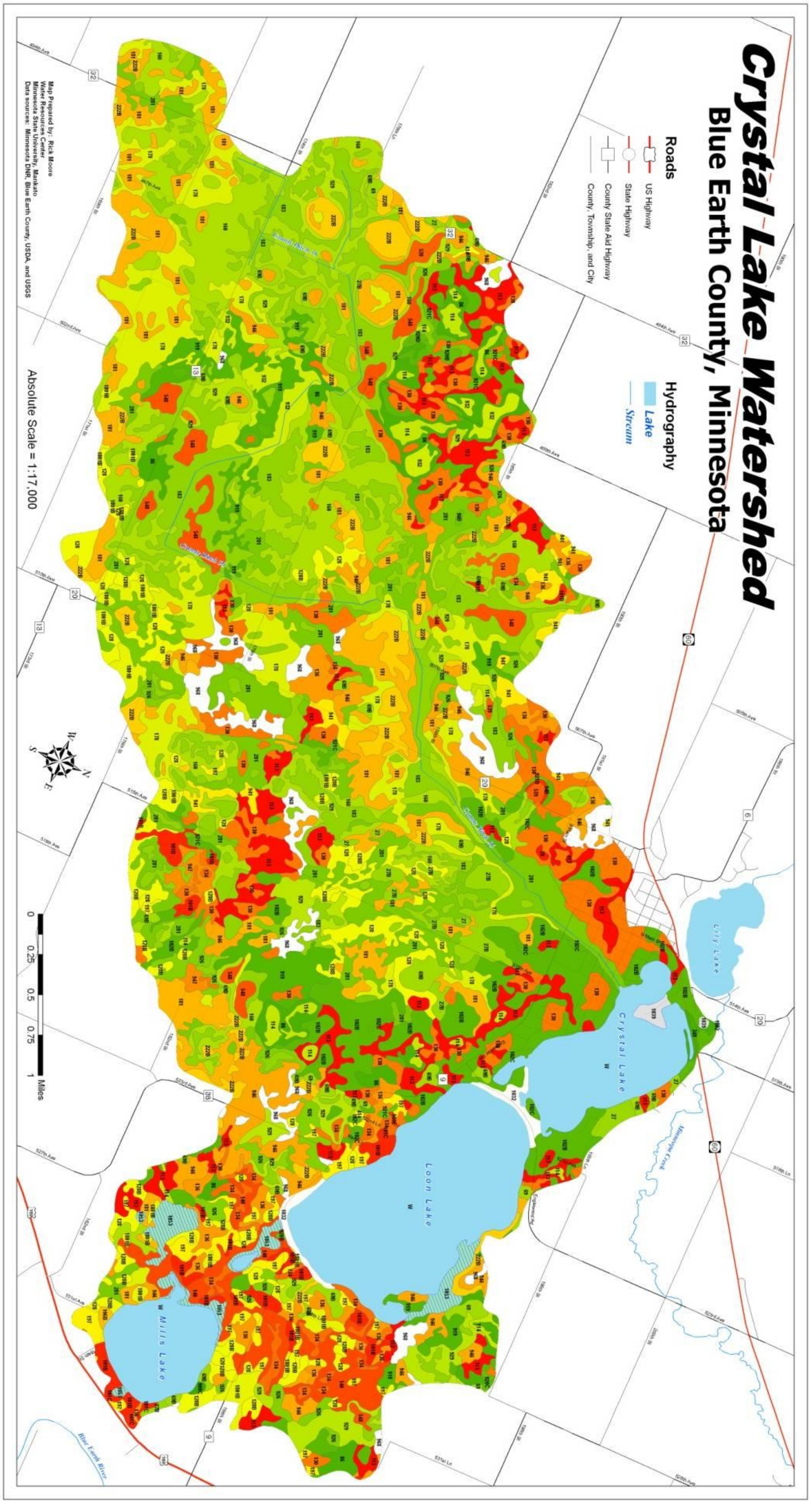
In 1995 there does not appear to be a difference in TP concentration from upstream to downstream.

In 1996 there did appear to be an increase in average concentration from upstream to downstream, however the difference usually occurred during low flows, when little loading takes place.

Assessment Conducted by: Scott Matteson
Water Resources Center, MN State University Mankato
September 6th, 2007

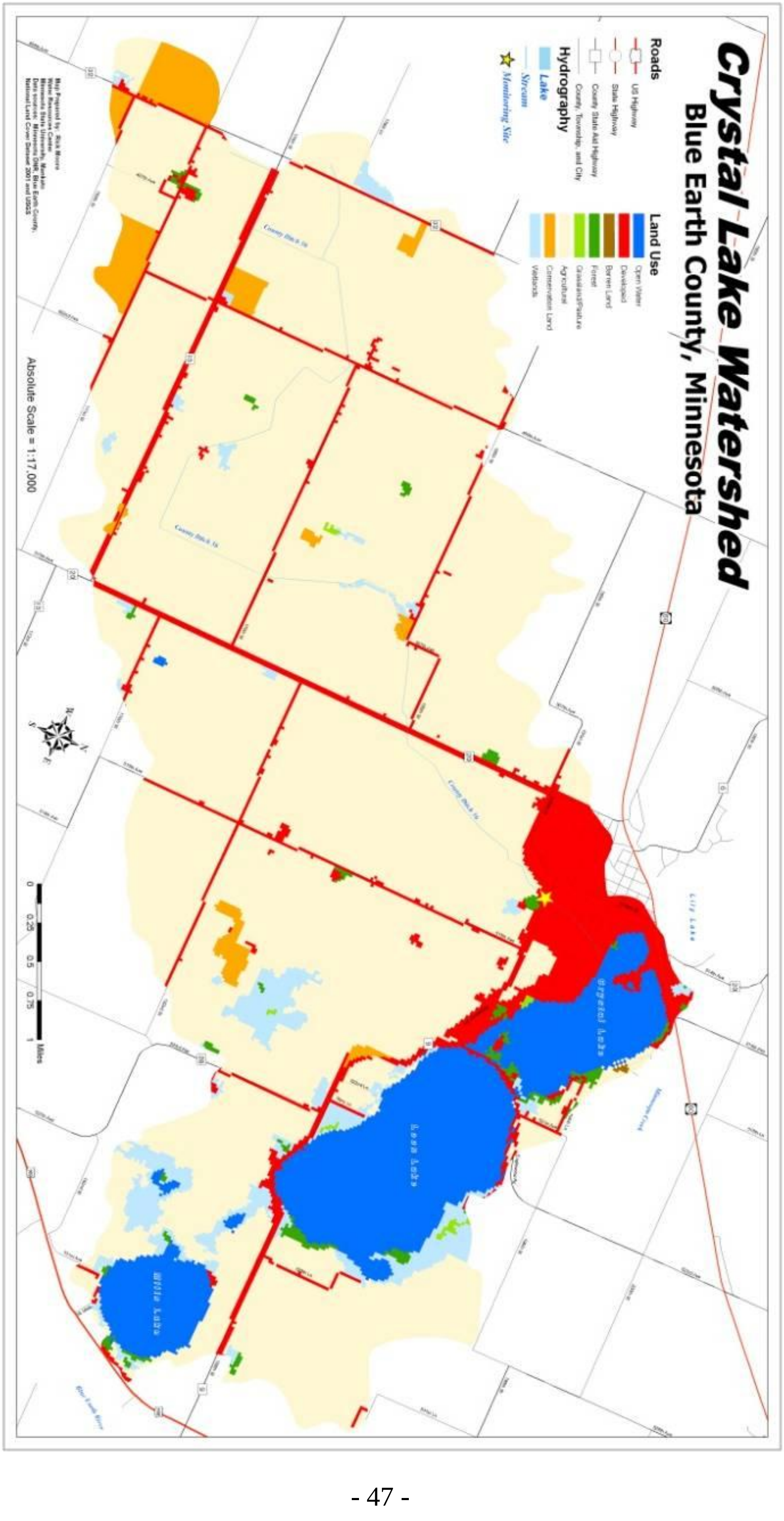
Appendix E – Lake Crystal Watershed Land Use, Soils, Topographic and Monitoring Site Map





Crystal Lake Watershed
Blue Earth County, Minnesota
Roads
US Highway
State Highway
County State Aid Highway
County, Township, and City
Hydrography
Lake
Stream
Absolute Scale = 1:17,000
0 0.25 0.5 0.75 1 Miles
Map Prepared by: Rick Moore
Water Resources Center
Minnesota State University, Mankato
Data sources: Minnesota DNR, Blue Earth County, USDA, and USGS
Lily Lake
Crystal Lake
Loon Lake
Mills Lake

Lake Crystal Watershed
Blue Earth County, Minnesota
Roads
US Highway
State Highway
County State Aid Highway
County, Township, and City
Hydrography
Lake
Stream
Elevation
Contour (Feet)
Index
Intermediate
Absolute Scale = 1:17,000
0
0.25
0.5
0.75
1
Miles
Lake Crystal
Loon Lake


Crystal Lake Watershed
Blue Earth County, Minnesota
Roads
US Highway
State Highway
County State Aid Highway
County, Township, and City
Hydrography
Lake
Stream
Monitoring Site
Land Use
Open Water
Developed
Barren Land
Forest
Grassland/Pasture
Agricultural
Conservation Land
Wetlands
Map Prepared by: Rick Moore
Water Resources Center
Minnesota State University, Mankato
Data sources: Minnesota DNR, Blue Earth County,
National Land Cover Dataset 2001 and USGS
Absolute Scale = 1:17,000
0
0.25
0.5
0.75
1
Miles
Crystal Lake
Loon Lake
Mills Lake

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Appendix G – Quality Assurance Plan

(See attached)