Benton Lake TMDL Implementation Plan

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September 2013

wq-iw11-15c

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1.0 Introduction

1.1 Purpose

This Implementation Plan (IP) is prepared for the Total Maximum Daily Load (TMDL) study addressing a nutrient impairment in Benton Lake in the Carver Creek watershed in Carver County, Minnesota. The goal of this IP is to provide a plan to meet the TMDL wasteload allocations (WLAs) and load allocations (LAs) quantified in the TMDL needed to meet the state water quality standards. The Benton Lake TMDL for nutrients is being established in accordance with section 303(d) of the Clean Water Act, because the State of Minnesota has determined this water body in the Carver Creek watershed exceeds the state established standards for nutrients.

2.0 TMDL Summary

2.1 Impaired Waters

The MPCA included Benton Lake on the 2002 State of Minnesota 303(d) list of impaired waters (Table 2.1). The lake is impaired for excess nutrients, which inhibit the beneficial use of aquatic recreation.

Table 2.1 303(d) listing information.

LAKE	DNR LAKE #	AFFECTED USE	YEAR LISTED	POLLUTANT OR STRESSOR
Benton	10-0069	Aquatic recreation	2002	Excess nutrients

Benton Lake is a shallow lake, with a maximum depth of approximately 7 feet and a mean depth of 2 feet (Table 3.1). In accordance with lake assessment values, it is hypereutrophic, with a 10-Year summer mean TP concentration of 252 µg/L, chlorophyll-a concentrations of 190 µg/L, and an average Secchi depth of 0.4 meters. Annual averages of TP, chlorophyll-a, and Secchi depth have fluctuated since monitoring data have been collected, and the lake is not currently meeting the MPCA's water quality standards for shallow lakes.

Benton Lake has a direct watershed of 485 acres, including the lake. The indirect watersheds are made up of one shallow lake that flows into Benton Lake via a tributary (Figure 2.1).

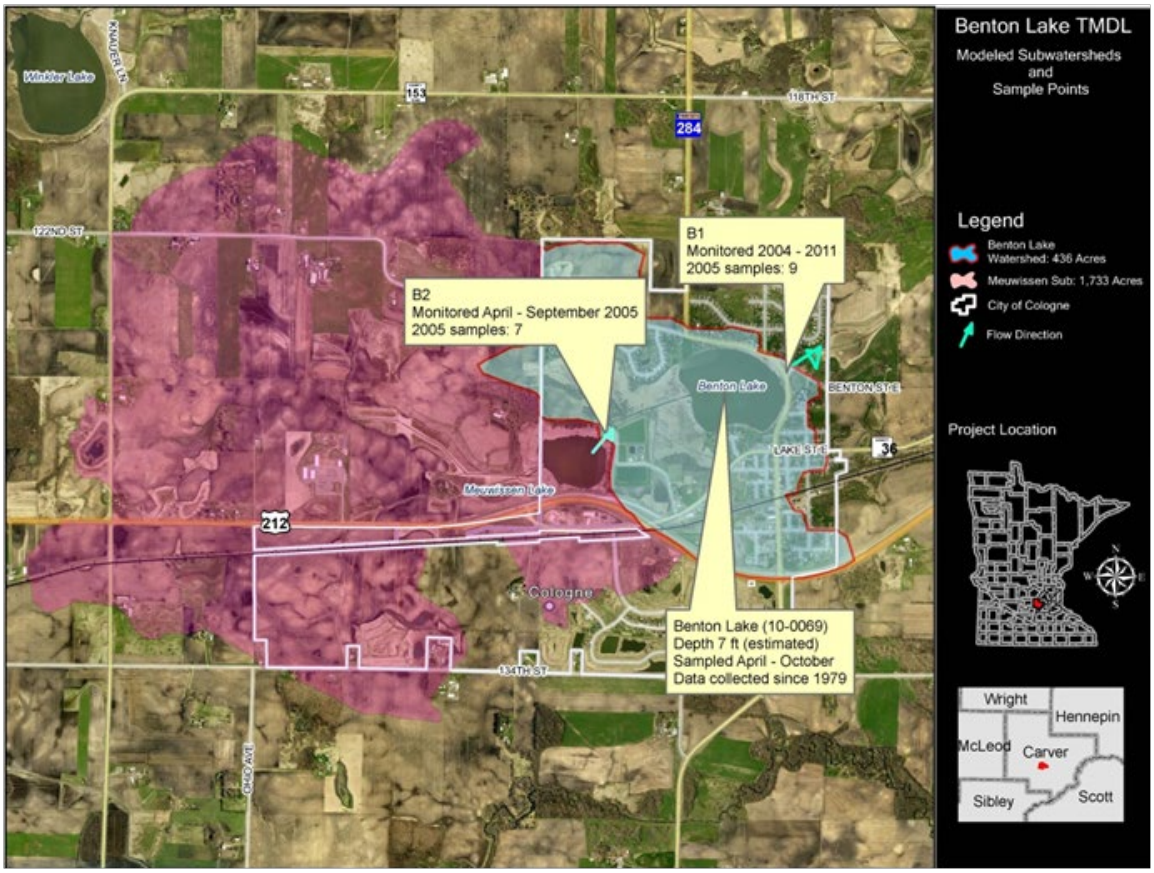


Figure 2.1 Map of Benton Lake watershed and subwatersheds.

2.2 Benton Lake Endpoint

Determining appropriate goals and endpoints for lake water quality is an essential part of the TMDL process. Benton Lake was listed as impaired based on the standards of the North Central Hardwoods Forest (NCHF) ecoregion.

Benton Lake is defined by the MPCA as a shallow lake in the NCHF ecoregion. Maximum depth of the lake is 7 feet with a 100 percent littoral area. Therefore, the final goal for TP will be set at the NCHF shallow lake standard of 60 µg/L.

The TMDL for Benton Lake has been established with the intent to implement all the appropriate activities that are not considered greater than extraordinary efforts. But these proposed goals will require aggressive action. Upon initial implementation, subsequent monitoring will determine the feasibility in moving to the next level. If all appropriate BMPs and activities have been implemented and the lake still does not meet its goals, Carver County staff will reevaluate the TMDL and work with the MPCA to evaluate whether more appropriate site-specific standards for the lake could be pursued and developed.

2.3 Qualitative Lake Conditions

Inherent in the numerical water quality goals for shallow lakes are desired ecological endpoints. Carver County's management strategies are focused on these endpoints which are restoring the lakes to a diverse, native aquatic plant (macrophyte) dominated state across much of the lake. This type of lake is characterized by low rough fish populations, clearer water, higher wildlife values and positive feedback mechanisms that maintain the lake in this condition (Scheffer 1998). A shift from the algae/invasive macrophyte dominated state to the clear water, native macrophyte dominated state should be a qualitative goal for Benton Lake.

2.4 Summary of TMDL Allocations and Reductions

The Benton Lake TMDL is set for a shallow lake in the NCHF ecoregion of Minnesota with a standard of 60 µg/L phosphorus as a final goal. The selected average precipitation year for the Benton Lake TMDL is 2001. Table 2.2 presents the TMDL and its components.

Table 2.2 TMDL allocations for Benton Lake. Allowable loads to meet the NCHF shallow lake standard of 60 µg/l. MOS is implicit and RC is zero.

Load Units	TMDL	WLA Cologne WWTP	WLA Construction/ Industrial	LA Atmospheric	LA Internal	LA Non-MS4	LA Upstream Lakes
kg/yr	137.4	46.4	0.01	4.0	7.1	11.0	68.8
kg/day	0.38	0.13	0.00003	0.011	0.02	0.03	0.19

Pollutant load modeling was conducted and analyzed on an annual basis to establish this TMDL at a level necessary to attain and maintain applicable water quality standards. Daily wasteload allocations were derived from this analysis. A baseline year of 2005 is to be used for evaluating and crediting loading reductions for this TMDL.

3.0 Public Participation

3.1 Introduction

The County has an excellent track record with inclusive participation of its citizens, as evidenced through the public participation in completion of the Carver County Water Management Plan, approved in 2001. The County has utilized stakeholder meetings, citizen surveys, workshops and permanent citizen advisory committees to gather input from the public and help guide implementation activities. The use of this public participation structure will aid in the development of this and other TMDLs in the County.

3.2 Technical Advisory Committee

The Water, Environment, & Natural Resource Committee (WENR) was established as a permanent advisory committee. The WENR is operated under the County's standard procedures for advisory committees. The WENR works with staff to make recommendations to the County Board on matters relating to watershed planning.

The make-up of the WENR is as follows:

1 County Board Member
1 Soil and Water Conservation District Member
5 citizens – (1 appointed from each commissioner district)
1 City of Chanhassen (appointed by city)
1 City of Chaska (appointed by city)
1 City of Waconia (appointed by city)
1 appointment from all other cities (County Board will appoint)
2 township appointments (County Board will appoint– must be on existing township board.)
4 other County residents (1 from each physical watershed area – County)

The full WENR committee received updates on the TMDL process from its conception in 2004.

As part of the WENR committee, two sub-committees are in place and have held specific discussions on Excess Nutrient TMDLs. These are the Technical sub-committee and the Policy/Finance sub-committee.

TMDL progress, methods, data results and implementation procedures were presented and analyzed at the WENR meetings mentioned above. Committee members commented on carp removal possibilities, sources, internal loading rates, and future monitoring plans. All issues commented on were considered in the development of the Draft TMDL.

3.3 Public Meetings

Stakeholder involvement involved the following components: public survey, public meeting, and personal meetings. The following are general discussions of stakeholder involvement.

Landowners within the Benton Lake watershed were invited to an open house that was held on January 22nd, 2008. During that meeting, 47 were present to learn about the history of Benton Lake, how the City of Cologne's WWTP interacts with the lake, and the impacts of carp on the lake. Leading up to the open house, 350 surveys were mailed to landowners. Of those 350, 53 were filled out and returned. The following is a summary of the user survey and comments received during the meeting:

- Sources that respondents were concerned about were the City of Cologne's WWTP, lawn fertilizers, and rough fish.
- Group has active leaders that want to see improvement of water quality within the lake and are eager to help.
- Respondents would like to see the lake return to a state that allows for swimming, fishing, and boating activities.
- Survey responses indicate the willingness to participate in cost share grants to help with improving water quality.

In addition, an opportunity for public comment on the draft TMDL report was provided via a public notice in the State Register from February 25 to March 27, 2013.

4.0 Recommended Phosphorus Management Strategies

4.1 Lake Strategies

Based on the Benton Lake TMDL, it will be necessary to address the internal and external loading when considering how to manage this lake. As previously stated to meet the goals of the TMDL, a reduction of up to 79 percent in the phosphorus load is needed.

It should be noted that as part of the Carver, Bevens, and Silver Creek TMDL CCWMO is currently implementing a fecal coliform reduction plan that focuses on minimizing runoff and thus reducing fecal coliform (or E. Coli) bacteria numbers. A number of the BMPs targeted and implemented in this plan will provide a cumulative reduction of phosphorus to the lakes within the watershed. With that said, the two main contributors of indicator bacteria are feedlot sources as well as SSTS. Failing SSTS are not mentioned in this plan because we feel they are adequately addressed in the Carver, Bevens, and Silver Creek TMDL Implementation Plan.

To reach the reduction goals CCWMO will be the lead on the implementation of the Benton Lake Excess Nutrient TMDL and will rely largely on its current Water Management Plan which identifies the Carver SWCD as the local agency for implementing BMPs. Although CCWMO will champion the plan, in some instances individual stakeholders will be ultimately responsible for implementing the identified BMPs.

CCWMO realizes that each of the following tasks relates to corresponding reduction strategies and that the tasks must be completed based on acceptance, staff and funding availability. Hence, this implementation plan's activities will commence upon the availability of funding. To accomplish this, the tentative timelines (listed as follows) were set for each task to correspond with the project goals.

The timelines are defined as: Short Term - 0-7 years from the inception of the plan, Medium Term - 7-15 years from the inception of the plan and Long Term - greater than 15 years or on-going from the inception of the plan.

External Load

Direct runoff from the watershed will decrease the quality of water in the lake. Thus, areas that will be targeted heaviest for implementation will include the lake's watershed and direct inflow.

Internal Load

Internal sources of phosphorus have an impact on water quality and will undoubtedly need to be addressed in this TMDL, knowing that we must first manage external sources of phosphorus. Attacking and controlling external factors first will give us a better opportunity to achieve the goals in the implementation plan and corresponding TMDL. When we are confident that external sources are controlled, internal sources will be attacked and managed adaptively to bring us to the final goal of the TMDL.

4.2 External Loading Reduction Strategies

External loading reduction strategies include a variety of agricultural and urban BMPs. Examples of agricultural BMPs are reduced tillage, buffer strips, nutrient management, manure management, grassed waterways, contour farming, and terraces. Urban BMP examples include stormwater detention basins, street sweeping, rain gardens, shoreline restorations, and enhanced infiltration (e.g., core aeration of grassy areas).

Buffer strips along ditches, streams, wetlands and lakes can reduce nutrient runoff from agricultural cropland. Areas of high erosion potential or wetland restoration identified in each lake's subwatershed will be targeted for these practices.

Areas with the greatest potential to pollute surface water will be targeted for BMP establishment first. In non-regulated MS4 areas, BMP establishment will be on a voluntary basis. State and federal grant monies will be solicited by CCWMO to cost share BMP establishment and incentives if needed.

The interim and final goals for reducing external phosphorus are indicated in Table 5.1.

Table 4.1 Interim and Final external reduction goals for Benton Lake TMDL.

	Current External Load (kg/yr)	Interim Goal (µg/L)	Interim goal load (kg/yr)	% reduction needed	Final Goal (µg/L)	Final Goal Load (kg/yr)	Total % reduction needed
Benton	51	90	17	66	60	11	79

Timeline: Long Term
Estimated total cost of all tasks: $ 5,897,000

4.2.1 Agricultural Cropland Runoff Control and Storage BMPs

Task 1. Identify and prioritize key erosion/restoration areas within the Lake watersheds. Identification will be based on monitoring results, Geographical Information Systems data for vulnerable or erosion-prone soils, and/or visual inspections of field conditions.

1) Responsible Parties: CCWMO, Carver SWCD, NRCS
2) Timeline/scope: Staff will identify restoration areas over a 7 year period.
3) 10-Year Milestone: Completed this task
4) Estimated Cost: $4,000
5) Priority: High

Task 2. Identify and educate landowners through meetings, brochures, Carver County quarterly newspaper (The Citizen), Carver County Website, and various workshops.

1) Responsible Parties: CCWMO, Carver SWCD

2) Timeline/scope:	Staff will identify and educate landowners over a 22 year period.
3) 10-Year Milestone:	50% completed
4) Estimated Cost:	$6,000
5) Priority:	Low

Task 3. Design and implement cropland BMPs to reduce phosphorus inputs to each lake. BMPs will be targeted on land identified as significant contributors of phosphorus and sediment. Agricultural BMPs will be designed and implemented to reduce sediment and nutrients into each lake. Examples could be but are not limited to nutrient management, crop residue management, and other practices utilized by the Carver SWCD and NRCS and identified in the NRCS field handbook available electronically at www.nrcs.usda.gov/technical/efotg/.

1) Responsible Parties:	CCWMO, Carver SWCD, NRCS
2) Timeline/scope:	Over the long term 50% of row crops within the Benton Lake Subwatershed will be targeted for BMPs
3) 10-Year Milestone:	50% completed
4) Estimated Cost:	$50,000
5) Priority:	Low

Task 4. Design and implement practices that will reduce sediment and nutrients into each lake by installing buffer strips, wetland restorations, alternate rock inlets or other water retention devices and/or practices identified by qualified staff.

1) Responsible Parties:	CCWMO, Carver SWCD, NRCS
2) Timeline/scope:	Over the long term wetland restoration will occur on up to 5 percent of all land area within the watershed, up to 5 percent of row cropped area will have controlled drainage, and up to 50% of all ditches will have a minimum buffer of 16.5 feet.
3) 10-Year Milestone:	50% completed
4) Estimated Cost:	$1,250,000
5) Priority:	Low

Task 6. Design and implement practices that will reduce sediment and nutrients into each lake by innovative design technology and practices including but not limited to "bio-reactor run-off structures" to treat tile discharge and in-line ditch sediment control structures along with other technologies as they are identified by qualified staff.

1) Responsible Parties:	CCWMO, Carver SWCD, NRCS
2) Timeline/scope:	Over the long term up to 25 percent of crop land will be routed through these innovative BMPs
3) 10-Year Milestone:	50% completed

4) Estimated Cost: $125,000
5) Priority: Low

4.2.2 Animal Manure/Feedlot Management

Animal manure management and to a lesser extent feedlot run-off will be examined and appropriate measures will be taken to ensure that these activities do not result in a phosphorus load entering each lake. Many of the practices are also outlined in the NRCS field handbook and will be utilized again to control any problem areas that are encountered or previously identified in our modeling.

Task 1. Identify potential areas and contact landowners to inform them of funding and projects that they can initiate to benefit each lake and their properties.

1) Responsible Parties: CCWMO, Carver SWCD
2) Timeline/scope: Staff will identify potential areas over a 22 year period.
3) 10-Year Milestone: 50% completed
4) Estimated Cost: $5,000
5) Priority: Low

Task 2. Identify and educate landowners through meetings, brochures, Carver County quarterly newspaper (The Citizen), Carver County Website, and various workshops.

1) Responsible Parties: CCWMO, Carver SWCD
2) Timeline/scope: Staff will educate landowners over a 22 year period.
3) 10-Year Milestone: 50% completed
4) Estimated Cost: $5,000
5) Priority: Low

Task 3. Work directly with the landowners that have feedlots or land application of manure on their properties. For active feedlots the MINNFARM computer software will be used to identify potential pollution problems. Current NRCS technical practices and standards will be used for feedlot pollution abatement and manure application.

1) Responsible Parties: CCWMO, Carver SWCD
2) Timeline/scope: On an ongoing basis staff will work with landowners to improve manure application management.
3) 10-Year Milestone: 50% completed
4) Estimated Cost: $50,000
5) Priority: Low

4.2.3 Urban/Development Runoff

Improved management of urban runoff, particularly from lakeshore properties and those properties within the each lake's direct watershed will reduce phosphorus loading to the Lake. Urban/developed phosphorus runoff management will include but is not limited to the following components; installation of rain gardens, street sweeping, removal of leaf litter from streets, installation of shoreline buffers, stabilization of eroding lakeshore infiltration/detention ponds, erosion and sediment control and utilizing low impact development techniques. Low impact development techniques refers to using specific practices that mimic natural processes, including infiltration, evapotranspiration, and water retention. These practices are also located close to the source of discharge to minimize size of the project.

Urban development often brings about an increase in impervious surface due to new roads, rooftops, and parking lots.. These surfaces do not let rain water soak into the ground so large amounts of water run into storm sewers which empty into nearby water bodies. In addition, monitoring and modeling has indicated that urban pollutant loads are directly related to watershed imperviousness. CCWMO requires filtration/bio-retention treatment for new development and promotes and encourages reduction in runoff and increased infiltration in re-development and retrofits. CCWMO addresses the use of components such as infiltration ponds, silt fencing and minimization of new impervious surfaces in the County Water Management Plan and Rules. CCWMO will continue to take lead on ensuring preventative measures are installed during construction as well as retrofits and will evaluate increased standards in the update of its Plan and Rules.

In addition to increasing impervious surfaces in urban development, channelization and piping of stormwater commonly occurs. This results in a faster discharge of stormwater to downstream water bodies by collecting all runoff from an area without natural processes to slow down or remove portions of the volume of water.

Task 1.

Utilize Carver County's GIS to identify potential project areas and "hotspots" within the Lakes' subwatersheds. Hotspots are defined as areas that have high potential to deliver phosphorus lakes based on such factors as area of impervious cover and lack of stormwater BMPs. This will be followed up with evaluating and identifying what practices identified above or from the Minnesota Stormwater BMP Manual should be considered. Costs associated with identified projects are not included in the figure below and will be added to this plan at a later time.

1) Responsible Parties:	CCWMO, Carver SWCD, City of Cologne
2) Timeline/scope:	Staff will target hot spots over a 22 year period.
3) 10-Year Milestone:	50% completed
4) Estimated Cost:	$10,000
5) Priority:	Low

Task 2. Identify landowners that either have properties contributing to the impairment or have the potential to reduce the impairment and provide education/outreach through meetings, brochures, Carver County Website, and various workshops.

1) Responsible Parties:	CCWMO, Carver SWCD, City of Cologne
2) Timeline/scope:	Staff will identify and contact landowners over a 22 year period.
3) 10-Year Milestone:	50% completed
4) Estimated Cost:	$5,000
5) Priority:	Low

Task 3. Design and implement urban BMPs to reduce phosphorus inputs to the Lake based on interest of targeted landowners and available monies through the County's Low-Cost Cost Share Program and other grant sources. BMPs including but not limited to rain gardens, shoreline restorations, urban BMPs, and disconnecting impervious surfaces will be designed and implemented to reduce phosphorus inflows into each lake.

1) Responsible Parties:	CCWMO, Carver SWCD, City of Cologne
2) Timeline/scope:	Design and implement projects that are cost effective within the Benton Lake subwatershed over a 22 year period.
3) 10-Year Milestone:	50% completed
4) Estimated Cost:	$350,000
5) Priority:	Low

Task 4. Identify current and future street sweeping schedules that the city has in place and if necessary conduct a load analysis to determine the optimum level of sweeping necessary. If necessary, work with the city to implement a continual spring and fall schedule for sweeping within the subwatersheds. The city has identified this BMP in both the Local Water Management Plan and the SWPPP.

1) Responsible Parties:	CCWMO, Carver SWCD, City of Cologne
2) Timeline/scope:	Staff will review street sweeping schedules over a 15 year period.
3) 10-Year Milestone:	75% completed
4) Estimated Costs:	$12,000
5) Priority:	Medium

Task 5. Identify current and future stormwater pond clean out schedules within the subwatershed to ensure proper operation and maintenance schedules are in place. A maintenance plan is included in the city's Local Water Management Plan. If necessary, work with the city to develop and implement a schedule that will more adequately treat the run-off leaving these areas. In addition, staff will

also identify and retrofit any current stormwater ponds within the subwatersheds that could be updated to current standards.

1) Responsible Parties:	CCWMO, Carver SWCD, City of Cologne
2) Timeline/scope:	Staff will identify pond clean out schedules over a 15 year period.
3) 10-Year Milestone:	75% completed
4) Estimated Costs:	$100,000
5) Priority:	Medium

Task 6. All currently undeveloped land within the Watershed will be required to meet current and any amended stormwater standards including volume reduction and runoff treatment. Review and updates of both the CCWMO plan and ordinances will include the pollutant reduction methods needed for the Benton Lake TMDL. The city plan and SWPPP will need to be updated to meet any revised CCWMO plans and ordinances. Additional LID practices will be encouraged during the site design and review process. Costs will focus on the development and evaluation of CCWMO plan, ordinances, city plan, and SWPPP. Incentives will be considered in order to promote these practices.

1) Responsible Parties:	CCWMO, Carver SWCD, City of Cologne
2) Timeline/scope:	Staff will review and update plans to meet new TMDL goals over a 22 year period.
3) 10-Year Milestone:	50% completed
4) Estimated Costs:	$25,000
5) Priority:	Low

Task 7. As the City of Cologne continues to expand, efforts will need to be undertaken to ensure that the wastewater treatment facility's permitted load of 46.4 kilograms per year is not exceeded. The following are various options that the City of Cologne may choose to advance:

Upgraded Treatment Facility – Using the estimated population for 2030 of 9,440 and the WLA of 46.4 kg/year, the Cologne WWTF would need to produce an average effluent phosphorus concentration of 0.05 mg/l. This level of treatment is only feasible with the addition of tertiary treatment (membrane filtration) to the WWTF. We would anticipate the addition of membrane filtration at the Cologne WWTF would cost in the neighborhood of $5 million which would include the membrane filters, building, piping, electrical upgrades, and other process upgrades necessary for phosphorus removal and the inclusion of membrane filters at the facility.

Spray Irrigation- Utilizing spray irrigation for the WWTF would require installation of a pumping station, irrigation equipment, and over 20,000 feet of forcemain. In addition, the use of spray irrigation would require

land acquisition of roughly 500 acres. The equipment and infrastructure improvements needed for spray irrigation would likely cost $4 to 5 million without even considering the land acquisition costs.

New Discharge Location- A new discharge location may be an option, but there are many unknowns at this point to where they would be able to discharge and what limits would be established for the new discharge point. As a starting point Bevens Creek has been identified as a possible discharge location. This would require construction of a new lift station and approximately 7,000 feet of forcemain. Anticipated costs for this addition would between $2.0 million and $2.5 million. Other upgrades at the WWTF may also be necessary depending on the limits established for a new discharge location.

Regionalization – At this time there are no plans for Metropolitan Council to extend their collection system out to Cologne. Regionalization would likely take collaboration with other nearby communities to establish another regional Metropolitan Council Treatment Facility. The costs associated with this option would include a new lift station and forcemain and a buy-in to the new facility. At this time is it not possible to assign any specific costs with this option.

1) Responsible Parties:	City of Cologne
2) Timeline/scope:	City staff will lead efforts to ensure that WWTF does not exceed WLA of 46.4 kilograms per year.
3) 10-Year Milestone:	Ongoing compliance with permit
4) Estimated Costs:	$5,000,000
5) Priority:	Low

4.3 Internal Loading Reduction Strategies

Based on monitoring and modeling results and meetings all parties involved have determined that controlling and reducing internal loading of phosphorus will play a major role in meeting the determined reductions. Internal phosphorus loading could be reduced by the implementation of the following methods: fish barrier, rough fish control, establishment of native vegetation, and establishment of native fish species. Furthermore, reductions to the external load will aid in diluting and flushing out of the nutrient rich sediments in each lake and will minimize future internal loading.

A fish barrier on the outlet of Benton Lake will be constructed in the fall of 2013. The purpose would be to prevent carp from migrating from the lake to Carver Creek. This is the first phase of a multi-phase project, with removal of rough fish and a drawdown of the lake as the final phases of the project.

Native aquatic plants would promote improved water quality by minimizing re-circulation of bottom sediments, competing with algae for nutrients, and providing habitat for zooplankton (which eat algae). CCWMO and Carver SWCD will pursue a

partnership with the MDNR to reduce the invasive species currently present and establish a healthy native aquatic plant population in the lake less.

The interim and final goals for the reducing internal phosphorus are indicated below:

Table 4.2 Interim and Final internal reduction goals for Benton Lake TMDL.

	Current Internal Load (kg/yr)	Interim Goal (µg/L)	Interim goal load (kg/yr)	% reduction needed	Final Goal (µg/L)	Final Goal Load (kg/yr)	Total % reduction needed
Benton	237	90	80	66	60	7	97

Timeline/scope: Long Term
Estimated total cost of all tasks: $420,000

4.3.1 In-Lake Strategies

Task 1. Identify fish barrier sites and the possibility of rough fish removal success. If fish removal is deemed beneficial begin a program to adequately address the goal of the TMDL.

1) Responsible Parties	CCWMO, MDNR
2) Timeline/scope:	Staff will identify a fish barrier site over a 5 year period.
3) 10-Year Milestone:	Completed this task
4) Estimated Cost:	$15,000
5) Priority:	High

Task 2. Chemical or mechanical removal of invasive aquatic plant species and replace with diverse native aquatic plant species.

1) Responsible Parties	CCWMO, Carver SWCD, MDNR
2) Timeline/scope:	Projects to remove invasive aquatic plant species will take place over a 22 year period.
3) 10-Year Milestone:	50% completed
4) Estimated Cost:	$80,000
5) Priority:	Low

Task 3. Determine the feasibility of drawing down the lakes or other viable mechanical options (aeration, barley straw, dredging, iron filings, etc.) to reduce phosphorus loading. Implement if feasible and funding is available.

1) Responsible Parties	CCWMO, Carver SWCD, MDNR
2) Timeline/scope:	Staff will complete the feasibility study by 2045.
3) 10-Year Milestone:	50% completed
4) Estimated Cost:	$150,000
5) Priority:	Low

Task 4. Benton Lake is shallow and has accumulated several feet of nutrient-laden sediment. To cost effectively implement several of the practices outline above it may be necessary to explore innovative ways to remove this material. Dredging, vacuuming or other options will be explored and undertaken if proven to be cost effective.

1) Responsible Parties	CCWMO, Carver SWCD, MDNR
2) Timeline/scope:	Staff will research innovative ways to remove sediment from Benton Lake and will undertake such projects if deemed cost effective over a 22 year period.
3) 10-Year Milestone:	50% completed
4) Estimated Cost:	$150,000
5) Priority:	Low

Task 5. Ongoing monitoring of all Lakes as outlined in section 6.5**.**

1) Responsible Parties:	CCWMO
2) Timeline/scope:	Yearly monitoring by staff and/or volunteers will continue on an annual basis through 2045.
3) 10-Year Milestone:	50% completed
4) Estimated Costs:	$25,000
5) Priority:	Low

4.4 Project Timeline and Measurable Milestones

4.4.1 Timeline

The first priority of the implementation plan will be to address each of the short term goals identified in the external and internal reduction strategies, followed by medium and long term goals. Many of the tasks involved in implementing these goals will overlap and complement one another while others may not need to be completed after initial assessment or pertinent information is made available. Each task will ultimately be completed as resources and opportunities present themselves, which could allow some long and medium term tasks to be completed sooner rather than later. Many of the tasks identified as "Long Term" may actually start immediately but will be ongoing throughout the life of the project and perhaps beyond.

4.4.2 Measurable Milestones

As noted above, our measureable milestone will be ultimately bringing Benton Lake into compliance with state water quality standards by 2045. Along the way our first milestone will be measured in-lake phosphorus concentration at 90 µg/L by the year 2030 and long term positive trend indicating that changes being made are working.

As we progress through implementation and it appears that our completed tasks are not providing enough treatment to reach our interim and final goals we would utilize Bathtub (as outlined in the Benton Lake Excess Nutrient TMDL) with up to date data and land use

information to identify new hot spots and problem areas that may not have been previously addressed. If discrepancies are identified, the implementation plan will be updated.

5.0 Prioritization of BMPs and Location

Implementation activities throughout the Benton Lake watershed should be based upon a methodology that allows for targeting certain "hot spots", instead of a scattershot approach that is common when relying on voluntary participation. Sections 5.1 through 5.2 summarizes the approach that CCWMO Staff will take in selecting these areas.

5.1 Environmental Benefits Index

The Minnesota Board of Water and Soil Resources and the University of Minnesota developed the Environmental Benefits Index (EBI) dataset through funding from the Minnesota Environment and Natural Resources Trust Fund as recommended by the Legislative-Citizen Commission on Minnesota Resources. This dataset covers the majority of Minnesota, with gaps due to the lack of source data.

The dataset is a compilation of three different sources, each scored from 0-100, in 30-meter resolution raster data files. Combining these scores results in a raster dataset that highlights areas that have highly erodible soils, steep slopes, large catchment areas, proximity to surface waters, and good quality of habitat. (Minnesota Board of Water and Soil Resources, 2011)

The first source estimates the potential for soil erosion based upon the USDA Soil Survey Geographic Database and portions of the Universal Soil Loss Equation. Low scores show low probability of erosion, while high scores predict that soil will erode. (Minnesota Board of Water and Soil Resources, 2011)

The second dataset is a combination of a stream power index model and proximity to surface waters. A stream power index models how much force a stream has which causes erosion on the stream bed and banks. Calculations use functions of water volume as a function of catchment area and slope of the stream. Low scores translate to a low stream power index and/or greater distance away from a water body. High scores are the result of a high stream power index and/or near proximity to a water body. (Minnesota Board of Water and Soil Resources, 2011)

The last dataset estimates terrestrial and aquatic habitat quality. This source is a combination of information from the Minnesota Statewide Conservation and Preservation Plan, Minnesota GAP analysis, Sites of Biodiversity Significance, and others. Higher scores indicate higher quality of habitat. (Minnesota Board of Water and Soil Resources, 2011)

An appropriate way to prioritize using this index is to focus on the land areas with the highest EBI scores (e.g., the top five percent). This gives local partners a way to identify areas that are potentially impacting water quality. CCWMO staff will use this tool as a desktop application as a way to prioritize key areas within Bevens Creek watershed for further investigation. As with any such index once candidate areas are identified the next step is to field-validate the information. Some areas may already be under appropriate

land management and not need improvement. (Minnesota Pollution Control Agency, 2012)

5.2 Subwatershed Assessment

Carver County Soil and Water Conservation District under took a study reviewing subwatersheds within the City of Cologne to help understand pollutant loads and assess stormwater retrofit opportunities. This study provides recommendations to improve treatment of stormwater that are centered around a cost effective approach to reducing phosphorus entering Benton Lake.

Steps that are completed in this assessment are:

1) Identify and prioritize subwatersheds that contribute the greatest to water quality degradation of high priority water resources.
2) Map BMP retrofit potential within neighborhoods of the highest priority subwatersheds utilizing the "Urban Stormwater Retrofit Practices" manual (Schueler, 2007).
3) Design retrofits, primarily involving decentralized rain gardens, neighborhood-scale infiltration basins, vegetative swales, grit separators, and multi-chamber treatment trains.
4) Manage installation
5) Calculate pollutant removal consistent with state and federal stormwater mandates and the modeling done for the non-degradation report.

6.0 Regulatory and Non-Regulatory Controls

6.1 Introduction

When establishing a TMDL, reasonable assurances must be provided demonstrating the ability to reach and maintain water quality endpoints. Several factors control reasonable assurances, including a thorough knowledge of the ability to implement BMPs, as well as the overall effectiveness of the BMPs. Carver County is positioned to implement the TMDL and ultimately achieve water quality standards.

6.2 Carver County

The Carver County Board of Commissioners (County Board), acting as the Water Management Authority for the former Bevens Creek (includes Silver Creek), Carver Creek, West Chaska Creek, East Chaska Creek, and South Fork Crow River watershed management organization areas, has established the "Carver County Water Resource Management Organization" (CCWMO). The purpose of establishing the CCWMO is to fulfill the County's water management responsibilities under Minnesota Statute and Rule. The County chose this structure because it will provide a framework for water resource management as follows:

- Provides a sufficient economic base to operate a viable program.
- Avoids duplication of effort by government agencies.
- Avoids creation of a new bureaucracy by integrating water management into existing County departments and related agencies.
- Establishes a framework for cooperation and coordination of water management efforts among all of the affected governments, agencies, and other interested parties.
- Establishes consistent water resource management goals and standards for at least 80 percent of the county.

The County Board is the "governing body" of the CCWMO for surface water management and the entire county for groundwater management. In function and responsibility the County Board is essentially equivalent to a joint powers board or a watershed district board of managers.

In order to fulfill legislative requirements or surface and groundwater, Carver County developed a Water Management Plan that was adopted in 2001. The goal of the Plan is to protect, preserve and manage the county's surface and groundwater systems in the midst of rapid growth and intensive agricultural activity. The plan presents sustainable and equitable methods to reach that goal by providing guidance and specific standards for decision-makers, residents, landowners, educators, and implementing staff at the local level. Within the Water Management Plan, there are twelve priority areas the county has identified needing immediate and continued action. These include: Subsurface Sewage Treatment Systems (SSTS), Feedlots, Construction Site Erosion and Sediment Control, Stormwater Management, Land Use Practices for Urban and Rural Areas, Water Quality Assessment, Wetland Management, Groundwater, Natural Resource Management, Education, Total Maximum Daily Loads (TMDLs), and Solid Waste.

Multiple county departments help implement the CCMWO plan. The Carver County Board of Commissioners is the governing board. The Water, Environment, and Natural Resources (WENR) Committee acts as the citizen advisory board and the Planning & Water Management department are responsible for administration, implementation and coordination. Implementation is also the responsibility of Environmental Services, University of Minnesota Extension, and the Carver Soil & Water Conservation District (SWCD).

The County is uniquely qualified through its zoning and land use powers to implement corrective actions to achieve TMDL goals. The County has stable funding for water management each year, but will likely need assistance for full TMDL implementation in a reasonable time frame, and will continue its baseline-monitoring program. Carver County has established a stable source of funding through a watershed levy in the CCWMO taxing district (adopted 2001). This levy allows for consistent funding for staff, monitoring, and engineering costs, as well as on the ground projects.
The County has also been very successful in obtaining grant funding from local, state and federal sources due to its organizational structure.

Carver County recognizes the importance of the natural resources within its boundaries, and seeks to manage those resources to attain the following goals:

1. Protect, preserve, and manage natural surface and groundwater storage and retention systems.
2. Effectively and efficiently manage public capital expenditures needed to correct flooding and water quality problems.
3. Identify and plan for means to effectively protect and improve surface and groundwater quality.
4. Establish more uniform local policies and official controls for surface and groundwater management.
5. Prevent erosion of soil into surface water systems.
6. Promote groundwater recharge.
7. Protect and enhance fish and wildlife habitat and water recreational facilities.
8. Secure the other benefits associated with the proper management of surface and ground water.

Water management involves the following County agencies: Carver County Land and Water Services Division; Carver County Extension; and the Carver Soil and Water Conservation District (SWCD). The County Land and Water Services Division is responsible for administration of the water plan and coordinating implementation. Other departments and agencies will be called upon to perform water management duties that fall within their area of responsibility. These responsibilities may change as the need arises. The key entities meet regularly as part of the Joint Agency Meeting (JAM) process to coordinate priorities, activities, and funding.

6.3 Regulatory Approach

6.3.1 Watershed Rules

Water Management Rules establish standards and specifications for the common elements relating to watershed resource management including: Water Quantity; Water Quality; Natural Resource Protection; Erosion and Sediment Control; Wetland Protection; Shoreland Management; and Floodplain Management. Of particular benefit to nutrient TMDL reduction strategies are the stormwater management and infiltration standards which are required of new development in the CCWMO. The complete water management rules are contained in the Carver County Code, Section 153. The Rules will be evaluated, updated and enforced along with the watershed plan to address TMDLs where needed.

6.3.2 NPDES Permits

The MPCA issues National Pollutant Discharge Elimination System (NPDES) permits for both non-point and point source discharges into waters of the state. MPCA also issues State Disposal System (SDS) permits that also regulate discharge to water bodies of the state. Permits for industrial, construction, or stormwater activities are issued as a combined NPDES/SDS permit. These permits have both general and specific limits on pollutants that are based on water quality standards. Permits regulate discharges with the goals of protecting public health, aquatic life, and aquatic recreation, and assuring that every facility treats wastewater. There are a wide range of NDPES/SDS permits that the MPCA issues covering a range of activities in the state of Minnesota, below are three permit programs that permits that affect the water quality of area lakes.

The Industrial NPDES Permit Program regulates both the wastewater discharges to lakes, streams, wetlands, and other surface waters; and the construction and maintenance of the wastewater treatment disposal systems. These permits establish specific limits and requirements to protect Minnesota's surface and ground water quality. (MPCA 2009)

Another permit program covers stormwater from construction activities. This program targets construction sites to ensure that proper erosion control measures are installed to reduce the amount of sediment that leaves the construction site. EPA estimates that between 20 to 150 tons of soil per acre is lost due to stormwater runoff every year, thus proving that this program is vital in helping to protect surface waters in Minnesota. This permit covers construction activities that are over an acre in size; or less than one acre of activity if it is a part of a larger common plan of development or sale that is greater than one acre; or less than one acre but the MPCA determines that the activity poses a risk to water resources. (MPCA 2013)

MS4s that have been designated by the MCPA for permit coverage under Minn. R. ch. 7090 are required to obtain a NPDES/SDS stormwater permit. The stormwater Program for MS4s is designed to reduce the amount of sediment and pollution that enters surface and ground water from storm sewer systems to the maximum extent practicable.

Currently, the City of Cologne does not have enough residents to be considered an MS4 community, and as such does not have an MS4 permit to regulate stormwater discharges to Benton Lake.

More information about permits, water quality data, and other MPCA programs can be found on the agency's Web site: http://www.pca.state.mn.us/water.

6.4 Non-Regulatory Approaches

6.4.1 Education

The implementation of this Plan relies on three overall categories of activities: Regulation, Incentives, and Education. For most issues, all three means must be part of an implementation program.

The County has taken the approach that regulation is only a supplement to a strong education and incentive based program to create an environment of low risk. Understanding the risk through education can go a long way in preventing problems. In addition, education, in many cases, can be a simpler, less costly and more community-friendly way of achieving goals and policies. Education efforts can provide the framework for more of a "grass roots" community plan implementation, while regulation and incentives traditionally follow a more "top-down" approach. It is recognized, however, that education by itself will not always meet intended goals, has certain limitations, and is characteristically more of a long-term approach. To this end, Carver County created the Environmental Education Coordinator position in 2000. This position has principal responsibility for development and implementation of the water education work plan.

Several issues associated with the water plan were identified as having a higher priority for educational efforts. These were identified through discussions with the advisory committees, based on ease of immediate implementation and knowledge of current problem areas and existing programs. The higher priority objectives are not organized in any particular order. The approach to implement the Benton Lake TMDL will mimic the education strategy of the water plan. Each source reduction strategy will need an educational component, and will be prioritized based on the number of landowners, type of source, and coordination with existing programs.

6.4.2 Incentives

Many of the existing programs on which the water management plan relies are incentive-based programs offered through the County and the Carver SWCD. Some examples include: state and federal cost share funds directed at conservation tillage, crop nutrient management, rock inlets, conservation buffers, and low interest loan programs for SSTS upgrades. Reducing nutrient sources will need to rely on a similar strategy of incorporating incentives into implementing practices on the ground. After the approval of the TMDL by the EPA and the County enters the implementation phase, it is anticipated that we will apply for monies to assist landowners in the application of BMPs identified in the Implementation Plan.

6.5 Effectiveness Monitoring

Regular bi-weekly (April – October) in lake monitoring of Benton Lake will continue as identified in the Water Plan and will be conducted at least every other year in order to adequately asses water quality trends in each lake. In-lake collection includes collection of water column profiles (temperature, dissolved oxygen) and discrete water sample collection from the surface including phosphorus, Secchi dish depths, total nitrogen, and chlorophyll-a. However, after implementation of nutrient reduction strategies a stepped-up approach of monitoring will be conducted including integrated depth sampling as well as in-let and outlet sampling to gain an even better handle on how well the implementation plan is working. Adaptive management relies on the County conducting additional monitoring as BMPs are implemented in order to determine if the implementation measures are effective and how effective they are. A sediment core of each lake will be taken providing funding exists, the information extracted from the core will help us to more accurately target the needs of each lake and contributing watershed as well as give us an overall goal for our Adaptive management strategies.

Additional areas that may be monitored include; hypolimnetic sampling to aid in determining internal load reductions, sampling at the lake inlets/outlets during the spring when flow is highest, additional samples in strategic areas, and land use change monitoring. Inflow/outflow monitoring will be initiated during and after implementation of the TMDL to quantify external load reductions as will hypolimnetic sampling. Automated stream samplers will be established at the primary outflow where continuous flow data is needed and composite samples collected during rainfall runoff events. Samples will be analyzed for total phosphorus, total nitrogen and total suspended solids. The flow and water quality data will be used to estimate phosphorus loading to the lake to confirm the TMDL reductions.

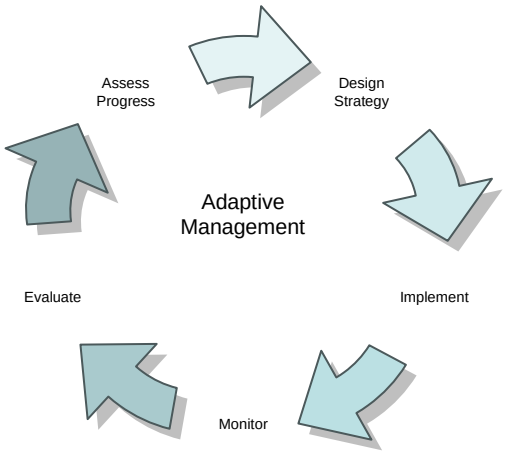
Furthermore, assessment of the stormwater discharge may be monitored to better grasp the nutrient loads caused by runoff from surrounding land. This monitoring will assist in evaluating the success of projects and identify changes needed in management strategies. Revision of management and monitoring strategies will occur as needed.

7.0 Adaptive Management

The phosphorus allocations represented in this TMDL represent aggressive goals; consequently, implementation will be conducted using adaptive management principles. These principals are a systematic process for continually improving management policies and practices by learning from the outcomes of previously employed policies and practices. In active adaptive management, managers design practices so as to discriminate between alternative models, and thus reveal the "best" management action. This sometimes involves testing practices that differ from "normal", in order to determine how indicators will respond over a range of conditions. In passive adaptive management, managers select the "best" management option, assuming that the model on which the predictions are based is correct. Both passive and active adaptive management require careful implementation, monitoring, evaluation of results, and adjustment of objectives and practices. Active adaptive management usually allows more reliable interpretation of results, and leads to more rapid learning.

The criteria outlined in Section 4.0 of the implementation plan will rely on monitoring for measuring our progress towards active adaptive management, while some passive adaptive management will be tracked through modeling efforts. Adaptive management is appropriate because it is difficult to predict the phosphorus reduction that will occur from implementing strategies with the scarcity of information available to demonstrate expected reductions. Limited reduction research is available for BMPs at this time, but this is expected to change in the next several years as state agencies and local experience provide more accurate reduction data. The County has and will continue to look at viable tools that will help to predict and measure the actual reductions that installation of a particular BMP may have.

Future technological advances may alter the specific course of actions detailed here. Continued targeted monitoring based on a project work plan and “course corrections” responding to monitoring results are the most appropriate strategy for attaining the water quality goals established in this TMDL.



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