Goose Creek Watershed Restoration and Protection Strategy (WRAPS) Report

Lower Saint Croix River Major Watershed

December 2015

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Project Partners

Chisago Soil & Water Conservation District

Emmons & Olivier Resources, Inc.

Minnesota Pollution Control Agency

Pine Soil & Water Conservation District

Chisago County

City of Harris

City of Rush City

City of Rock Creek

Goose Chain of Lakes Association

Minnesota Board of Water and Soil Resources

Minnesota Department of Natural Resources

Pine County

Rush Lake Improvement Association

St. Croix Watershed Research Station

US Department of Agriculture Natural Resource Conservation Service

*** Disclaimer**

The science, analysis and strategy development described in this report began before the accountability provisions were added to the Clean Water Legacy Act in 2013 (MS114D); thus, this report does not address all of those provisions. When this watershed is revisited (according to the 10-year cycle), the information will be updated according to the statutorily required elements of a Watershed Restoration and Protection Strategy Report.

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Key Terms

Assessment Unit Identifier (AUID): The unique water body identifier for each river reach comprised of the USGS eight-digit HUC plus a three-character code unique within each HUC.

Aquatic life impairment: The presence and vitality of aquatic life is indicative of the overall water quality of a stream. A stream is considered impaired for impacts to aquatic life if the fish Index of Biotic Integrity (IBI), macroinvertebrate IBI, dissolved oxygen, turbidity, or certain chemical standards are not met.

Aquatic recreation impairment: Streams are considered impaired for impacts to aquatic recreation if fecal bacteria standards are not met. Lakes are considered impaired for impacts to aquatic recreation if total phosphorus, chlorophyll-a, or Secchi disc depth standards are not met.

Aquatic consumption impairment – Lakes and streams are considered impaired based on fish tissue samples which are analyzed to determine the current levels of a chemical in the aquatic community. These impairments are based on the pollutant type (mercury, PCBs, etc.) which can be toxic to human health if ingested beyond the recommended levels. Guidelines for safe human consumption are issued by the Minnesota Department of Health for how often certain fish can be safely eaten.

Hydrologic Unit Code (HUC): A Hydrologic Unit Code (HUC) is assigned by the USGS for each watershed. HUCs are organized in a nested hierarchy by size. For example, the Saint Croix River Basin is assigned a HUC-4 of 0703 and the Lower Saint Croix Watershed is assigned a HUC-8 of 07030005.

Impairment: Water bodies are listed as impaired if water quality standards are not met for designated uses including: aquatic life, aquatic recreation, and aquatic consumption.

Index of Biotic integrity (IBI): A method for describing water quality using characteristics of aquatic communities, such as the types of fish and invertebrates found in the waterbody. It is expressed as a numerical value between 0 (lowest quality) to 100 (highest quality).

Pollutant: The Clean Water Act Sec. 502(6) describes a pollutant as dredged spoil, solid waste, incinerator residue, sewage, garbage, sewage sludge, munitions, chemical wastes, biological materials, radioactive materials, heat, wrecked or discarded equipment, rock, sand, cellar dirt, and industrial, municipal, and agricultural waste discharged into water. Another way of looking at is, a substance that makes land, water, air, etc., dirty and not safe or suitable to use: something that causes pollution. Example of Pollutants include: Phosphorus, Sediment, Nitrogen, and Temperature.

Protection: This term is used to characterize actions taken in watersheds of waters not known to be impaired to maintain conditions and beneficial uses of the waterbodies.

Restoration: This term is used to characterize actions taken in watersheds of impaired waters to improve conditions, eventually to meet water quality standards and achieve beneficial uses of the waterbodies.

Source (or Pollutant Source): This term is distinguished from ‘stressor’ to mean only those actions, places or entities that deliver/discharge pollutants (e.g., sediment, phosphorus, nitrogen, pathogens).

Stressor (or Biological Stressor): This is a broad term that includes both pollutant sources and non-pollutant sources or factors (e.g., altered hydrology, dams preventing fish passage) that adversely impact aquatic life.

Total Maximum Daily Load (TMDL): A calculation of the maximum amount of a pollutant that may be introduced into a surface water and still ensure that applicable water quality standards for that water are met. A TMDL is the sum of the wasteload allocation for point sources, a load allocation for nonpoint sources and natural background, an allocation for future growth (i.e., reserve capacity), and a margin of safety as defined in the Code of Federal Regulations.

What is the WRAPS Report?

The State of Minnesota has adopted a "watershed approach" to address the state's 80 "major" watersheds (denoted by 8-digit hydrologic unit code or HUC). This watershed approach incorporates **water quality assessment, watershed analysis, civic engagement, planning**, **implementation**, and **measurement of results** into a 10-year cycle that addresses both restoration and protection.

As part of the watershed approach, waters not meeting state standards are still listed as impaired and Total Maximum Daily Load (TMDL) studies are performed, as they have been in the past, but in addition the watershed approach process facilitates a more cost-effective and comprehensive characterization of multiple water bodies and overall watershed health. A key aspect of this effort is to develop and utilize watershed-scale models and other tools to help state agencies, local governments and other watershed stakeholders determine how to best proceed with restoring and protecting lakes and streams. This report summarizes past assessment and diagnostic work and outlines ways to prioritize actions and strategies for continued implementation.

Purpose

- Support local working groups and jointly develop scientifically-supported restoration and protection strategies to be used for subsequent implementation planning
- Summarize Watershed Approach work done to date including the following reports:
  - *Lower St. Croix Watershed Monitoring and Assessment*
  - *Lower St. Croix Watershed Biotic Stressor Identification*
  - *Goose Creek Watershed TMDL*

Scope

- Impacts to aquatic recreation and impacts to aquatic life in streams
- Impacts to aquatic recreation in lakes

Audience

- Local working groups (local governments, SWCDs, watershed management groups, etc.)
- State agencies (MPCA, DNR, BWSR, etc.)

Users' Guide

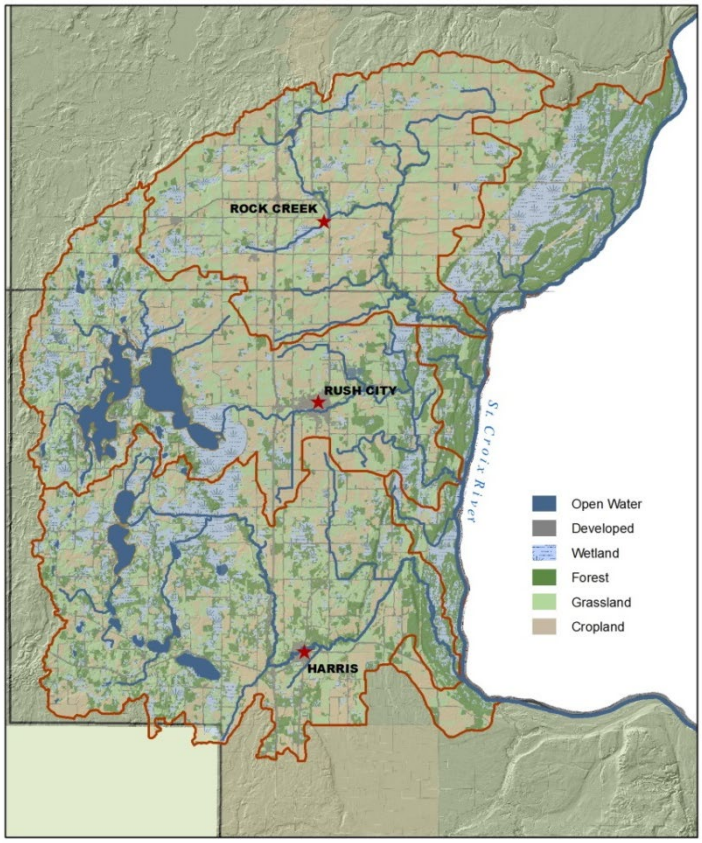
This Watershed Restoration and Protection Strategy (WRAPS) report summarizes past monitoring, water quality assessments, and other water quality studies that have been conducted in the Goose Creek Watershed. In addition, it outlines ways for local groups to prioritize projects that can be implemented in the watershed to improve water quality. The WRAPS report contains a large amount of information. The purpose of the following table is to provide a Quick Reference guide for users to quickly identify what information can be found in each section of the report.

Table 1. WRAPS Report Quick Reference Guide

Section	Title	Description	Pages
Summaries of Past Monitoring and Water Quality Studies			
1	Watershed Background	A brief description of the Goose Creek Watershed.	10
2.1	Water Quality Assessment	A summary of how fishable, swimmable and usable the lakes and streams are in the watershed.	12
2.2	Water Quality Trends	A summary of lakes and streams with improving or declining water quality based on at least 10 years of monitoring data.	14
2.3.1	Stressors of Biological Impairments	A summary of factors that cause fish and invertebrate communities in streams to become unhealthy (also known as stressors).	14
2.3.2	Pollutant sources	A summary of sources of pollutants (such as phosphorus, bacteria or sediment) to lakes and streams, including point sources (such as sewage treatment plants) or non-point sources (such as runoff from the land).	15
2.4	TMDL Summary	A summary of TMDL studies in the watershed. A TMDL is a calculation of how much pollutant a lake or stream can receive before it becomes unfishable, unswimmable, or unusable.	19
Ways to Prioritize Projects to Protect or Restore Water Quality			
2.5	Protection Considerations	A summary of common water quality issues in the watershed.	20
3.1	Civic Engagement	A summary of input meetings with local partners in the watershed on the development of the WRAPS report.	23

1. Watershed Background & Description

The Goose Creek Watershed comprises the northern portion of the Lower St. Croix River Major Watershed (07030005). This watershed is a 10-digit HUC (hydrologic unit code), that is made up of seven 12-digit HUC (sub-watersheds), all of which drain to the St. Croix River. The goal of this WRAPS is to provide locations for best management practices that can be completed to achieve the goals of the TMDL, as well as summarize the work and efforts that have taken place in the watershed.



Goose Creek Watershed Landcover
2006 National Landcover Data
Chisago SWCD

The Goose Creek 10digit watershed is approximately 184 square miles (which includes Rock Creek, Rush Creek, and Goose Creek) and is located mostly in Chisago and Pine counties with less than one square mile in Isanti County. Also included in this report are the areas in northern Chisago County and southern Pine County that drain directly to the St. Croix River. The Chisago County area in Rushseba and North Sunrise Townships is about 13 square miles. The Pine County area in Pine City Township is 23 square miles. The municipalities in the watersheds include: city of Harris, city of Rush City, city of Rock Creek, city of North Branch, Royalton Township, Pine City Township, Nessel Township, Rushseba Township, Fish Lake Township, North Sunrise Township, and North Branch Township.

The Goose Creek WRAPS purpose is to support local working groups and jointly develop scientifically-supported restoration and protection strategies to be used for subsequent implementation planning.

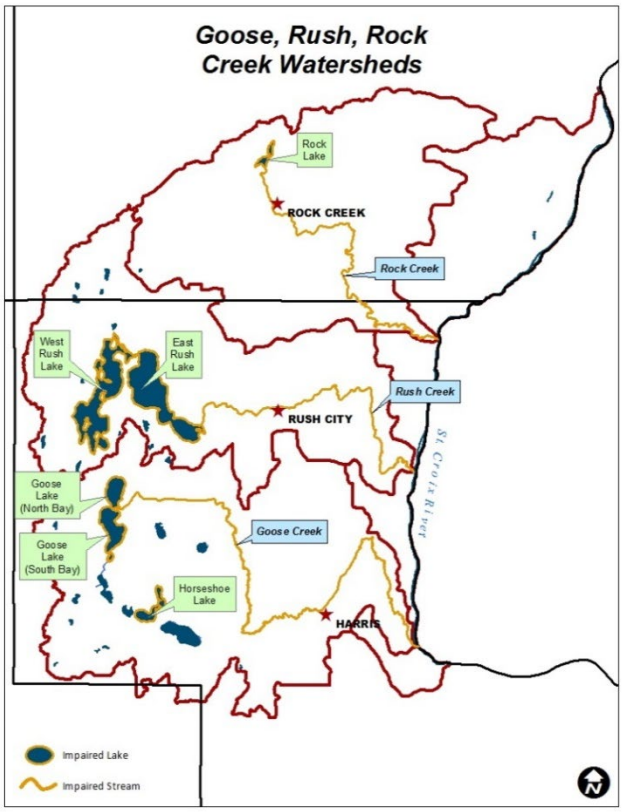
Additional Goose Creek Watershed Resources

Rush Creek Watershed Surface Water Assessment Grant (Chisago SWCD 2009, 2010)
Goose Creek Watershed Surface Water Assessment Grant (Chisago SWCD 2009, 2010)
Rush Lake Clean Water Partnership Project (Steve McComas and Dave Schuler 2002)
Lower St. Croix River Monitoring and Assessment Report (MPCA 2014)
Lower St. Croix River Watershed website: http://www.pca.state.mn.us/enzq104e
Goose Creek Watershed TMDL website: http://www.pca.state.mn.us/hh89xpd
Lower St. Croix Stressor Identification Study (MPCA 2014)

2. Watershed Conditions

Waters within this watershed have been assessed for both pollutants and biological health. Many of the waterbodies have more than one impairment. Some of the smaller lakes have not been assessed due to lack of water quality data, but based on local conditions it is quite possible they too are impaired. Fish Lake, in the Goose Creek Watershed is the best water quality lake within Chisago County.

Over the past few years when uniform water quality monitoring has taken place, the water quality of these lakes appears to be declining slightly each year. Long term monitoring of these lakes will show water quality trends and impacts of installed best management practices.



Affected Use: Pollutant/ Stressor	Lake ID/ AUID	Lake/Stream Name	Subwatershed Size (acres)
Aquatic Recreation: Nutrient/ Eutrophication Biological Indicators (Phosphorus)	13-0083-01	Goose Lake (North Bay)	9,293
	13-0083-02	Goose Lake (South Bay)	7,696
	13-0073-00	Horseshoe Lake	4,279
	58-0117-00	Rock Lake	6,264
	13-0069-02	Rush Lake (West)	15,509
	13-0069-01	Rush Lake (East)	22,557
Aquatic Recreation: *Escherichia coli* *Aquatic Life:* Fish Bioassessments	07030005-510	Goose Creek	44,809
Aquatic Recreation: *Escherichia coli*	07030005-584	Rock Creek	36,141
Aquatic Life: Fish and Macroinvertebrate bioassessments	07030005-509	Rush Creek	36,514

2.1 Water Quality Assessment

This section summarizes impairment assessments for streams and lakes in the Goose Creek Watershed. Waters that are not listed as impaired will be subject to protection efforts (See Section 2.5). Some of the waterbodies in the Goose Creek Watershed are impaired by mercury and PolyChlorinated Biphenyls (PCBs) in fish tissue; however, this report does not cover toxic pollutants. For more information on mercury impairments see the statewide mercury TMDL at: http://www.pca.state.mn.us/wfhy9ef. If you also have concerns about other pollutants and emerging concerns see: http://www.pca.state.mn.us/rkfw3cr.

Streams

Streams are assessed for aquatic life and aquatic recreation uses. Aquatic life impairments include: fish index of biotic integrity (Fish IBI), macroinvertebrate index of biotic integrity (Invert IBI), dissolved oxygen (DO), turbidity/total suspended solids (TSS), pH, and chlorides. Aquatic recreation use impairments include: *E. coli*. Table 2 summarizes the stream impairment assessment for all sampled individual assessment unit IDs (AUIDs) in the Goose Creek Watershed.

It should also be noted that at the time this watershed was assessed (2009) the MPCA's new River Eutrophication and TSSs standards were not yet established to conduct the necessary assessments. It is expected that once the waters are assessed, any waterbodies identified as impaired or unimpaired would be included in the next WRAPS and TMDL Report.

Table 2. MPCA 2012 Stream Impairment Assessment Summary

Stream Name, Description (AUID)	Aquatic Life Use Assessment								Aquatic Recreation Use Assessment (Bacteria)
	Fish IBI	Invert IBI	Dissolved Oxygen	Turbidity	Chloride	pH	Ammonia	Overall	
Rock Creek, Rock Lake to St. Croix River (07030005-584)	MTS	MTS	MTS	MTS	MTS	MTS	MTS	FS	NS
Rush Creek, Rush Lake to St. Croix River (07030005-509)	EXP	EXS	MTS	MTS	MTS	MTS	MTS	NS	NS
County Ditch 6, Headwaters to Rush River (07030005-680)	NA	--	--	--	--	--	--	NA*	NA
Unnamed Creek, Headwaters to Rush Lake (07030005-695)	NA	--	--	--	--	--	--	NA*	NA
Goose Creek, Headwaters to St. Croix	EXP	MTS	MTS	MTS	MTS	MTS	MTS	NS	NS

Stream Name, Description (AUID)	Aquatic Life Use Assessment								Aquatic Recreation Use Assessment (Bacteria)
	Fish IBI	Invert IBI	Dissolved Oxygen	Turbidity	Chloride	pH	Ammonia	Overall	
River (07030005-510)									
Unnamed Creek, Headwaters to St. Croix River (07030005-729)	--	--	--	MTS	--	--	--	IF	IF
Unnamed Creek, Headwaters to Goose Lake (07030005-741)	--	--	--	MTS	--	--	--	IF	NA

MTS = meets criteria; EXP = exceeds criteria, potential impairment; EXS = exceeds criteria, potential severe impairment; FS = fully supporting (i.e. not impaired); NS = not supporting (i.e. Impaired); IF = insufficient data for assessment; NA = not assessed; NA* = assessment deferred until the adoption of Tiered Aquatic Life Uses due to the AUID being predominantly (>50 percent) channelized or having biological data limited to a station occurring on a channelized portion of the stream

Lakes

Lakes are assessed for aquatic recreation uses based on ecoregion specific water quality standards for total phosphorus (TP), chlorophyll-a (chl-*a*), and secchi transparency depth. To be listed as impaired, a lake must fail to meet water quality standards for TP and either chl-*a* or secchi depth. Table 3 summarizes the lake impairment assessment for all sampled lakes in the Goose Creek Watershed.

Table 3. MPCA 2012 Stream Impairment Assessment Summary

Lake ID	Lake Name	Ecoregion standard	Aquatic Recreation Assessment
58-0117-00	Rock Lake	NCHF, shallow	NS
13-0069-01	East Rush Lake	NCHF, general	NS
13-0069-02	West Rush Lake	NCHF, general	NS
13-0068-00	Fish Lake	NCHF, general	FS
13-0073-00	Horseshoe Lake	NCHF, general	NS
13-0083-01	Goose (North Bay)	NCHF, shallow	NS
13-0083-02	Goose (South Bay)	NCHF, general	NS
13-0074-00	Mandall	NCHF, general	NA
13-0079-00	Rabour	NCHF, general	NA
13-0080-00	Little Horseshoe	NCHF, general	NA

NS = not supporting (i.e. Impaired); FS = fully supporting (i.e. Not Impaired); NA = not assessed

2.2 Water Quality Trends

A seasonal Kendall test for trend using R Statistical Software was used to identify statistically significant trends in water quality. Trends were only reported that had statistical confidence of at least 90% (meaning that there is at least a 90% chance that the data are showing a true trend and at most a 10% chance that the trend is a random result of the data), contained at least 10 years of data, and were missing no more than 75% of the samples from the entire period.

No stream stations had enough water quality data to determine long-term trends for Phosphorus, TSSs, Inorganic nitrogen (nitrate and nitrite), Kjeldahl nitrogen, nor Biochemical Oxygen Demand.

Only East Rush Lake (13-0069-01) had enough data to determine a long-term trend for TP, Chlorophll-*a,* or Secchi transparency depth, with a 98% increase (improvement) in Secchi transparency depth between 1979 and 2012.

2.3 Stressors and Sources

In order to develop appropriate strategies for restoring or protecting waterbodies the stressors and/or sources impacting or threatening them must be identified and evaluated. Biological stressor identification is done for streams with DO, fish, or macroinvertebrate biota impairments and encompasses both evaluation of pollutants and non-pollutant-related factors as potential stressors (e.g., altered hydrology, fish passage, habitat).

2.3.1 Stressors of Biologically-Impaired Stream Reaches

Stressors were identified for two streams in the Goose Creek Watershed with biological impairments, shown in Table 4. The most common stressors are low DO, high phosphorus levels, lack of habitat, altered hydrology, and physical connectivity. Low DO levels are present in the stream headwaters resulting from the low gradient nature of the stream upper watersheds, and the location of impaired lakes with excess nutrients in both stream headwaters (Goose Lake and Rush Lake). Stream eutrophication is a localized stressor in the stream upper reaches with DO and nutrient levels improving in the stream lower reaches. There is also a lack of habitat with low diversity of pools and riffles and the presence of fine sediments in the stream bed resulting from the wide and shallow nature of the streams and predominantly sand substrate. Portions of Goose Creek and its tributaries are extensively channelized resulting in altered hydrology and contributing to the lack of habitat. Several dams and a perched culvert are located along Rush Creek, impeding stream connectivity and fish migration.

Table 4. Stressors to aquatic life in biologically-impaired reaches in the Goose Creek Watershed

Stream AUID	Stream Name, Description	Biological Impairment	Stressors							
			Dissolved Oxygen	Phosphorus	Nitrate	pH	Lack of Habitat	Suspended Sediment	Altered Hydrology	Physical Connectivity
07030005-509	Rush Creek, Rush Lake to St. Croix River	Fish, Invertebrates	£	£			●			●
07030005-510	Goose Creek, Headwaters to St. Croix River	Fish	£	£			●		●	

£ = localized stressor applicable to the upstream portion of the AUID only; ● = stressor applicable to entire AUID

2.3.2 Pollutant sources

Pollutant sources were identified for point and non-point sources in the Goose Creek Watershed. There are two municipal wastewater, one small sanitary sewage system, one Municipal Separate Storm Sewer System (MS4) city, and 10 industrial stormwater point sources (Table 5) (Figure 1). At any one time there can be several construction stormwater activities taking place in these watersheds, which are covered under the Construction Stormwater General Permit. These permits typically only cover the construction period, and once that is complete the permit is closed. The construction stormwater permit does require that any activities that take place near an impaired or special water follow additional measures, which are identified in appendix A of the permit.

None of the point sources require pollutant reductions beyond their current permit conditions or limits to meet the requirements of the Goose Creek Watershed TMDL. However, the Harris Wastewater Treatment Plant (WWTP), Rush City WWTP, and the Shorewood Park Sanitary District did receive phosphorus limits as part of the Lake St. Croix TMDL (see Table A.1 and A.2 of the final TMDL report).

It is also important to note that there are cities within the watershed that do produce urban stormwater, but do not meet the necessary requirements to hold a MS4 Permit.

Non-point sources are summarized by water body and pollutant of concern in Table 6.

Table 5. Point Sources in the Goose Creek Watershed

Point Source			Pollutant reduction needed beyond current permit conditions/limits?	Drains to Waterbody
Name	Permit #	Type		
City of Rush City WWTP	MNG580212	Muni WW	No	Rush Creek
Shorewood Park Sanitary District	MNG580212	Muni WW	No	Rush Creek
Cemstone Products – Rock Creek	MNR0534NB	Indust SW	No	Rock Creek
DKV Demolition Debris Landfill	MNR05344D	Indust SW	No	Rush Creek
Rush City Regional Airport	MNRNE35HY	Indust SW	No	Rush Creek
Plastech Corp	MNR05348Y	Indust SW	No	Rush Creek
Getinge-LaCalhene USA Inc	MNRNE34RC	Indust SW	No	Rush Creek
Horizon Milling – Rush City	MNR0535TT	Indust SW	No	Rush Creek
City of Harris WWTP	MN0050130	Muni WW	No	Goose Creek
North Branch	MS400260	Muni SW	No	Goose Creek
LNE Sandblasting Inc	MNRNE33N4	Indust SW	No	Goose Creek
Knife River Corp N Central N Branch	MNR05347P	Indust SW	No	Goose Creek
Edgewood Machine Inc	MNRNE33BC	Indust SW	No	Goose Creek
Zinpro Corp	MNRNE35BV	Indust SW	No	Goose Creek
Construction Stormwater	Various	Const SW	No	All

Muni WW = Municipal Waste Water; Muni SW = Municipal Storm Water (MS4); Indust SW = Industrial Storm Water; Const SW = Construction Storm Water

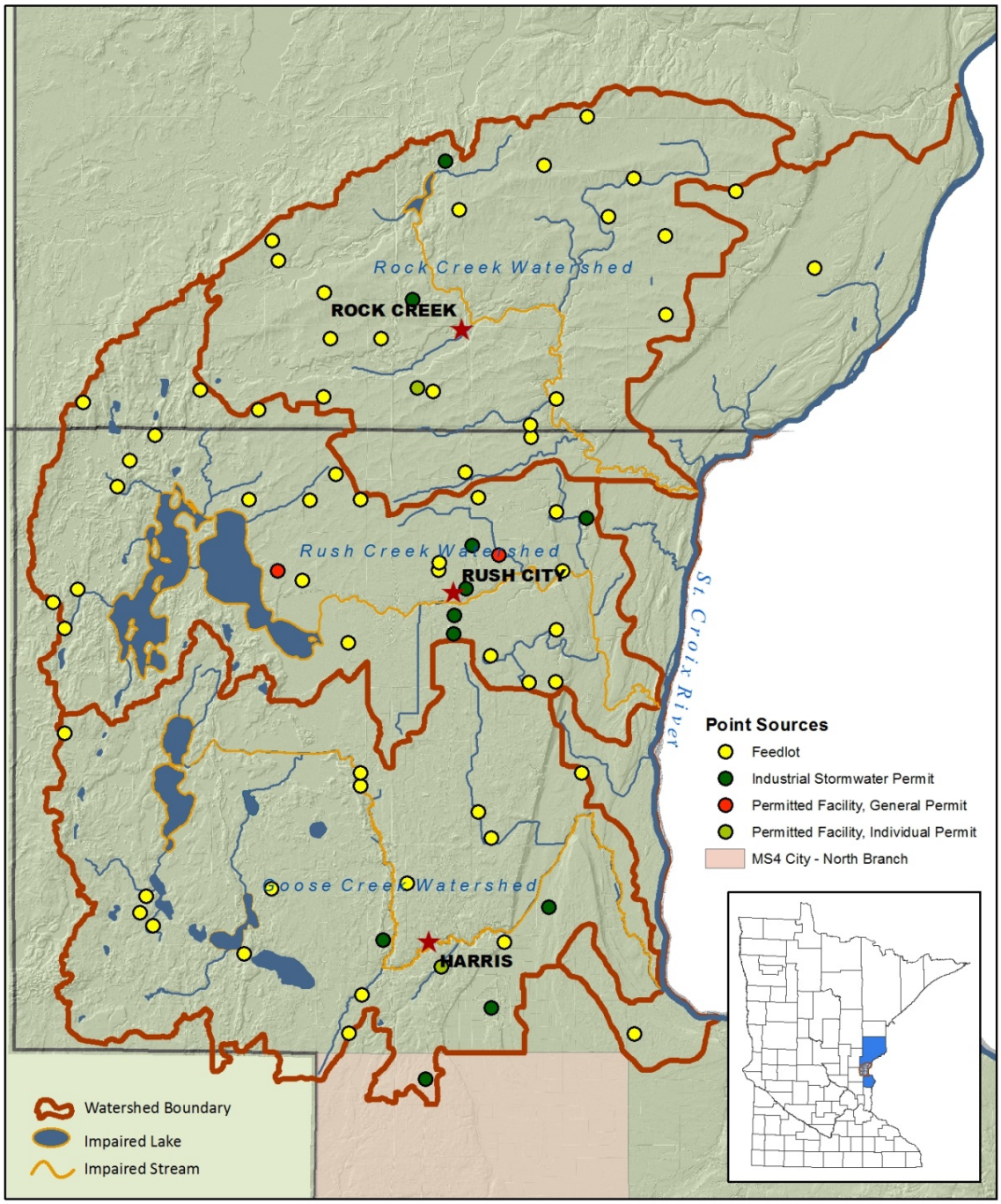


Figure 1. Goose Creek Watershed Point Sources

Table 6. Nonpoint Sources in the Goose Creek Watershed (Relative magnitudes of contributing sources are indicated)

HUC-10 Subwater-shed	Stream/Reach (AUID) or Lake (ID)	Pollutant	Stream Pollutant Sources*							Lake Pollutant Sources*				
			Fertilizer & manure run-off	Livestock overgrazing in riparian	Failing septic systems	Wildlife	Poor riparian vegetation cover	Upland soil erosion	Upstream lake effluent	Upstream lake effluent	Lake sediment P release	Fertilizer & manure run-Off	Failing septic systems	Atmospheric
Goose Creek	Goose Creek	Bacteria	~		™	›								
		Phosphorus	›	›	™			›	~					
	Goose Lake (North Basin)	Phosphorus								›	~	›	™	™
	Goose Lake (South Basin)	Phosphorus								~	›	~	™	™
	Horseshoe Lake	Phosphorus								™	™	~	™	™
	Rabour Lake	Phosphorus								›	™	›	™	™
	Mandall	Phosphorus								›	™	›	™	™
	Little Horseshoe	Phosphorus								›	™	›	™	™
	Fish Lake	Phosphorus								›	™	›	™	™
Rush Creek	Rush Creek	Bacteria	~		™	›								
		Phosphorus	›	›	™			›	~					
	Rush Lake West	Phosphorus									›	~	™	™
	Rush Lake East	Phosphorus								›	›	~	™	™
Rock Creek	Rock Creek	Bacteria	~		™	›								
		Phosphorus	›	›	™			›	~					
	Rock Lake	Phosphorus	›	›	™			›			~	›	™	™

Key: ~ = High › = Moderate ™ = Low

* All sources listed in the table are present in the Goose Creek Watershed; the symbols in the table differentiate the relative ranking of implementation targeting for the more significant sources within each subwatershed.

2.4 TMDL Summary

There are six impaired lakes and three impaired streams in the Goose Creek Watershed with completed TMDL studies (Table 7). Table 8 and Table 9 describe the current pollution loadings and load reductions needed for each source or source category to meet water quality standards and goals, including wasteload and load allocations.

Table 7. Completed TMDL studies in the Goose Creek Watershed

Study	Impaired Waters (AUID) – Pollutant	TMDL Report Link
Goose Creek Watershed TMDL	Goose Lake (North Bay, 13-0083-01) – Phosphorus	http://www.pca.state.mn.us/index.php/view-document.html?gid=22245http://www.pca.state.mn.us/qzqha00
	Goose Lake (South Bay, 13-0083-02) – Phosphorus	
	Horseshoe Lake (13-0073-00) – Phosphorus	
	Rock Lake (58-0117-00) – Phosphorus	
	Rush Lake (West, 13-0069-02) – Phosphorus	
	Rush Lake (East, 13-0069-01) – Phosphorus	
	Goose Creek (07030005-510) – *E. coli*	
	Rock Creek (07030005-584) – *E. coli*	
	Rush Creek (07030005-509) – *E. coli*	

Table 8. Allocation summary for completed lake TMDLs in the Goose Creek Watershed

Lake (ID)	Pollutant	Allocations (lbs/year)										Percent Reduction
		Wasteload Allocation			Load Allocation					MOS	RC	
		WWTFs	Construction & Industrial Stormwater	MS4 Communities	Watershed Runoff*	Internal P Release	Upstream Lake Outflow	Failing Septic Systems	Atmospheric Deposition	Margin of Safety	Reserve Capacity	
Goose Lake, North Bay (13-0083-01)	TP	--	0.9	--	236.7	539.5	428.8	0.0	65.5	141.3	--	76%
Goose Lake, South Bay (13-0083-02)	TP	--	0.8	--	616.8	197.6	237.7	0.0	107.8	129.0	--	43%
Horseshoe Lake (13-0073-00)	TP	--	1.0	--	722.8	--	--	0.0	54.0	89.3	--	42%
Rock Lake (58-0117-00)	TP	--	0.2	--	894.9	158.8	--	0.0	19.6	119.3	--	86%
Rush Lake West (13-0069-02)	TP	--	3.0	--	2,341.6	251.1	--	0.0	380.5	330.7	--	56%
Rush Lake East (13-0069-01)	TP	--	2.2	--	1,036.7	609.6	883.4	0.0	357.6	321.0	--	50%

Table 9. Allocation summary for all completed stream TMDLs in the Goose Creek Watershed

Stream/Reach (AUID)	Pollutant	Flow Zone	*E. coli* Allocations (billions organisms/day)					Percent Reduction
			Wasteload Allocation		Load Allocation		Margin of Safety	
			WWTFs	Regulated Stormwater (CSW/ISW/MS4)	Upstream Lake Outflow	Watershed Load		
Goose Creek (07030005-510)	*E. coli*	Very High	0.6	--	88.2	247.8	37.4	0%
		High	0.6	--	29.9	89.9	13.4	3%
		Mid	0.6	--	12.1	26.5	4.3	53%
		Low	0.6	--	5.8	11.7	2.0	45%
		Very Low	0.6	--	2.5	4.7	0.9	0%
Rock Creek (07030005-584)	*E. coli*	Very High	--	--	181.6	753.5	103.9	0%
		High	--	--	31.4	121.2	17.0	82%
		Mid	--	--	10.2	36.9	5.2	61%
		Low	--	--	5.5	13.6	2.7	39%
		Very Low	--	--	3.7	14.4	2.0	0%
Rush Creek (07030005-509)	*E. coli*	Very High	2.0	--	177.4	145.5	36.1	0%
		High	2.0	--	97.7	68.1	18.7	15%
		Mid	2.0	--	50.9	33.5	9.6	0%
		Low	2.0	--	22.8	14.6	4.4	54%
		Very Low	2.0	--	8.1	2.9	1.5	0%

2.5 Protection Considerations

The following is a description of how the items in the table portion of the Subwatershed Implementation Plan figures were calculated. Refer to Section 3 for Subwatershed Implementation Plan figures.

Slope

The average slope of a subwatershed is an indication of the erosive potential of the landscape, with steeper slopes more susceptible to erosion than shallower slopes.

The average slope for each subwatershed was calculated in Arc GIS using 3-meter LiDAR digital elevation model.

Animal Operation Numbers

Animal manure can be sources of nutrients and bacteria if improperly stored or applied to farm fields as fertilizer. A greater number of livestock animals indicate a higher potential for nutrient and bacterial pollution from manure in that subwatershed.

It was determined that for the Goose Creek Watershed and the Direct Drainage to the St. Croix River area that the Minnesota Pollution Control Agency data and GIS shapefiles were not accurate enough to display. Because of this, windshield surveys of animal numbers were used where available. The Chisago SWCD and Pine SWCD completed windshield surveys for portions of the watershed. These surveys were then verified with knowledge of animal operations within the office. Animals within the watershed include: beef cattle, dairy cattle, horse, poultry, and swine. Poultry and swine numbers were converted to animal units.

STEP-L TP/TSS Output

The TP and TSS watershed runoff yields indicate the average TP and TSS pollutant loads transported from the watershed to lakes and streams.

The EPA Spreadsheet Tool for Estimating Pollutant Load (STEP-L; http://it.tetratech-ffx.com/steplweb/) employs simple algorithms to calculate nutrient and sediment loads from different land. For each watershed, the annual nutrient loading was calculated based on the runoff volume and the pollutant concentrations in the runoff water as influenced by factors such as the land use distribution and management practices. The annual sediment load (sheet and rill erosion only) was calculated based on the Universal Soil Loss Equation (USLE) and the sediment delivery ratio.

TMDL TP Runoff Estimation (lb/yr)

TP load estimate from the TMDL for phosphorus reaching the impaired lakes within the whole watershed.

Dominant Hydrologic Soil Group

The dominant hydrologic soil group is an indication of the runoff potential from each subwatershed, with A soils tending to produce less runoff, and therefore pollutant yields, than D soils.

The dominant hydrologic soil group was calculated in ArcGIS for Chisago County and estimated through visual assessment of hardcopy maps for Pine County. Soils are given a classification of A, B, C, or D based on their ability to infiltrate water and potential to have runoff from them. Some soils are classified as A/D soils – these are D soils that, if ditched, would achieve A soil quality. Most of the subwatersheds clearly fit in one hydrologic soil group.

Permitted Wastewater Discharges

While regulated, wastewater treatment facilities are sources of nutrient and bacteria pollutants to downstream water bodies.

Permitted wastewater discharge locations are from the MPCA Municipal Industrial Division database. These locations are discharge permits for wastewater treatment facilities. All permits are through the National Pollutant Discharge Elimination System (NPDES) Permits or NPDES/State Disposal System (SDS) – these could include large dischargers like Rush City's Municipal Wastewater Treatment Facility or smaller systems like a LSTS (large subsurface sewage treatment system).

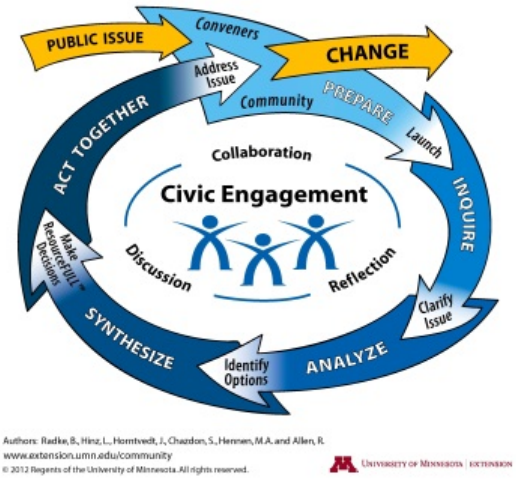
3. Prioritizing and Implementing Restoration and Protection

The Clean Water Legacy Act (CWLA) requires that WRAPS reports summarize priority areas for targeting actions to improve water quality, identify point sources and identify nonpoint sources of pollution with sufficient specificity to prioritize and geographically locate watershed restoration and protection actions. In addition, the CWLA requires including an implementation table of strategies and actions that are capable of cumulatively achieving needed pollution load reductions for point and nonpoint sources.

This section of the report provides the results of such prioritization and strategy development. Because much of the nonpoint source strategies outlined in this section rely on voluntary implementation by landowners, land users and residents of the watershed it is imperative to create social capital (trust, networks and positive relationships) with those who will be needed to voluntarily implement best management practices. Thus, effective ongoing civic engagement is fully a part of the overall plan for moving forward.

3.1 Civic Engagement

Many key partners have been brought together to make this WRAPS report a useable document that will ultimately help us to meet the goals of the Goose Creek Watershed and the Direct Drainage to the St. Croix River. These groups include: Chisago SWCD, Pine SWCD, Chisago County, DNR (Fisheries and Eco/Waters), MPCA, city of Harris, city of Rush City, USDA NRCS, Goose Chain of Lakes Association, and Rush Lake Improvement Association. These groups have collaborated with the Chisago SWCD to provide comments and additions specific to their subwatersheds. This collaboration will prove to be pivotal in applying for funding in the future to complete projects in each constituent's jurisdiction.



Accomplishments

- Farmer Focus Group – A group of local agricultural producers gather with staff from the SWCD and NRCS to discuss solutions to common problems the producers have concerning water quality. This includes discussing barriers to implementing practices.
- Both lake associations within this watershed are very active and have provided input and assistance during this process. The SWCD provides regular updates to these groups.

Future Plans

- The SWCDs will continue to apply for Clean Water Fund grants to implement the projects identified in the watershed.
- Complete further inventories throughout the watershed for restorable wetland locations, gully stabilizations, stormwater retrofit BMP locations, streambank corridors, etc.

- Increase education opportunities for urban and rural landowners to provide more information about best management practices for all locations.
- Determine locations and protections strategies for high quality natural communities and areas of high biological significance.
- The SWCDs will continue to work with local, state, and federal partners to promote, and encourage best management practices within the watershed.

Continuing to build momentum for water quality projects, water quality improvement, and water quality protection will be important in the future. These groups and activities will benefit the individual bodies of water and the watershed as a whole.

Public Notice for Comments

A formal 30 day public notice period for the Goose Creek Watershed TMDL Report and WRAPS Report was held from November 2nd, 2015 through December 4th, 2015.

3.2 Targeting of Geographic Areas

The following section describes the specific tools that were used by the Goose Creek Watershed stakeholders to identify, locate and prioritize watershed restoration and protection actions. The specific tools that were used are described in the following table. The figures and tables that follow summarize the conclusions from each of the tools. Follow-up field reconnaissance will be the next part of the process to validate the identified areas potentially needing work.

Priority areas are the headwater portions of the sub-watersheds (lakes) and then move downstream toward the St. Croix River. It is likely that priority work will occur around the lakes, which are the headwaters of these watersheds; with the pollutants of priority concern being Phosphorus and Sediment. Reducing these pollutants can also help in reducing E. coli in the watershed, as well as help with reductions to Lake St. Croix.

Tool	Description	How can the tool be used?	Notes	Link to Information and data
Subwatershed Stormwater Retrofit Assessments	Identifying small catchments, pollution reduction, appropriate best management practices, and associated costs to make the best bang for the buck water quality improvements (Figure 2 and Figure 3).	A cost-benefit analysis of identified best management practices will help local decision makers identify the best projects that should be completed to achieve the largest pollution reductions.	Rush Creek and the east side of East Rush Lake have been completed – more will be completed as time and funding allow.	*Figure 2 and Figure 3*
Lake St. Croix Prioritization Map	Using multiple GIS layers like Phosphorus Export, Sediment Yield, Recreation, High Priority Terrestrial and Aquatic Habitat areas, and excluding non-contributing areas throughout the St. Croix basin where prioritized based on a weighted approach Figure 4.	[The map and information can help target restoration and protection activities throughout the St. Croix Basin (MN) by identifying priority which can benefit the entire basin and Lake St. Croix.	The Rush Creek and Goose Creek Sub-watersheds were identified as priority based on the final mapping. This information along with the other mapping in this project will help to prioritize local issues, as well as downstream issues.	*Figure 4 and* Report .
Lake Implementation Project Tables	Potential phosphorus load reductions to major lakes were calculated from the management of cropland, developed land covers (urban), feedlots, and septic systems in the direct drainage area of each lake (located downstream of an upstream lake) based on the assumptions listed in Table 10.	These tables illustrate the potential magnitude of phosphorus reduction that can be achieved from the implementation of different types of BMPs relative to the total load reductions needed to achieve in-lake water quality goals. Potential locations of BMPs are shown before the Lake Implementation Project Tables in Section 3.3.		*Refer to Section 3.3 and Table 10*
Subwatershed BMP Maps	Maps and GIS shapefiles have been created for the entire watershed to determine locations for potential Best Management Practices (BMPs). These potential BMPs include: gully stabilizations, grassed waterways, field streambank buffers, lake shoreline buffers, animal operation projects, etc.	These maps and shapefiles will help local decision makers to identify potential locations for projects outlined in the Restoration and Protection Strategy Summary and Impaired Lake Load Reduction tables in Section 3.3. In the future, we would like to complete intensive assessments of where urban stormwater BMPs could be located.	These maps, by no means, point out all of the potential projects, and many identified locations for BMPs may not be an issue. Further analysis is needed for pollution reduction calculations by installing these BMPs.	*Refer to Section 3.3*
Protection Consideration Maps	The Priority Consideration Maps in this document are designed to put many layers of information that is relevant to water quality and water use in one location. These figures include a map and a table for each of the seven subwatersheds used throughout the WRAPS Report.	Local water resource professionals, city staff, watershed staff, and stakeholder groups can use these figures and tables in a variety of ways. The intention of these resources is that locals will be able to use the figures and tables while planning for future development, future projects, and other natural resource planning.	These maps visually show the connections between recreation, water quality, invasive species, public land, and downstream waters. The tables on the right side of the figure show important facts about the subwatershed. These items are defined in Section 2.5 Priority Consideration Figure Methodology.	*Refer to Section 3.3*

Figure 2. Subwatershed BMP Map Example 1

Rush Creek Watershed – Site # 108

Project Description

The area that drains to this agricultural drainage ditch is a 95.9 acre row crop field. The ditch runs through the middle of the entire field.

BMP Recommendation

A 50 foot or greater filter strip should be installed along the agricultural drainage ditch. Habitat value could be increased more with a wider filter strip (up to 220 feet).

CATCHMENT SUMMARY	
Watershed Acres	95.9
Current Land Cover	Row Crop
Number of Landowners	1
TP Reduction (lb/yr)	63.1
TSS Reduction (ton/yr)	39.8
Estimated Cost	$6,060.00
Cost/lb-TP	$9.60
Existing Habitat	1
Proposed Habitat	2
MODEL INPUTS	
Dominant Soil Type	292 (Loam)
Slopes > 6%	no

BEST MANAGEMENT PRACTICE SUMMARY						
Practice Type	TP (lb/yr)	TSS (ton/yr)	Length (feet)	Watershed Size (Acres)	Average Watershed Slope	Distance to Surface Water (feet)
Filter Strip	63.1	39.8	6420	95.9	1.7 %	0

Figure 3. Subwatershed BMP Map Example 2

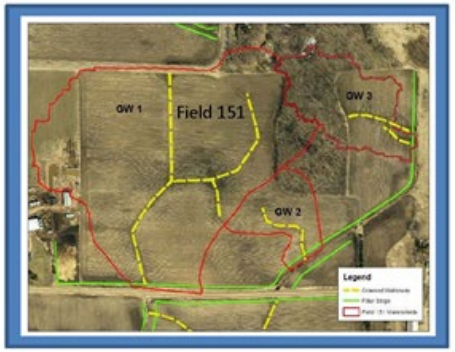
Rush Lake Watershed-Field 151

Project Description

This is a large agricultural field of about 46 acres. It is planted in a corn-soybean rotation. There is a large concentrated flow path running through the field and a drainage ditch runs alongside the field. The concentrated flow area drains to the ditch, which flows through more agricultural fields, pastures, and empties into Rush Lake.

BMP Recommendation

The concentrated flow areas should be converted to a grassed waterway. A 50-foot filter strip should be installed along the drainage ditch.



Catchment Summary	
Field Acres	45.6
Current Cover	Corn/Beans
# of Landowners	1
Removed TP (Lb/yr)	197
Removed TSS (Ton/yr)	182
Estimated Cost	$23,911
Cost/Lb TP	$121
Model Inputs	
Soil Type	346;292;75
Slopes >6%	No

Practice	Removed TP (Lb/yr)	Removed TSS (Ton/yr)	Watershed Size (Acres)	Average Watershed Slope	Distance to Surface Water (Feet)	Length (Feet)	Estimated Cost	Cost/Lb TP
GW 1	109	109	35.8	1.1	0'	2,525'	$12,411	$114
GW 2	27	27	4.3	2	0'	500'	$3,805	$141
GW 3	19	19	7.4	1.9	0'	576'	$4,128	$217
Practice	**Removed TP (Lb/yr)**	**Removed TSS (Ton/yr)**	**Existing Filter Strip (Feet)**			**Area (Acres)**	**Estimated Cost**	**Cost/Lb TP**
Filter Strip	42	27	<5'			3.7	$3,567	$85

Table 10. Impaired lake phosphorus load reduction data sources and assumptions

Implementation Category	Example Activities	Phosphorus Load	Assumed Removal Efficiency[1]	Assumed Implementation Rate
Filter Strips, Shoreline Buffers	Filter strips and shoreline buffers are areas of dense vegetation, typically native grasses or long-rooted plants that reduce runoff velocities, provide settling of particulates, enhance infiltration, and increase vegetative phosphorus uptake.	GIS aerial imagery was used to identify shorelines, riparian corridors and large, isolated agricultural fields with little or no buffering. Phosphorus load treated by the biofilters based on an area-weighted fraction of the total watershed assuming a treated area of total biofilter length by 100 feet of width.	50%	100%
Cropland Management	Conservation tillage, nutrient management planning, cover crops, and other agricultural BMPs	Area-weighted STEP-L modeled load by the percent of cultivated crops land cover (NLCD 2006)	50%	10%
Urban Management	Rain gardens and turfgrass management	Rain gardens were assumed to receive an average of 1 pound of phosphorus per year. Phosphorus loads treated through turfgrass management was based on an area-weighted fraction of the total watershed load assuming 0.125 acres of managed turf per parcel.	0.5 lb P/yr per rain garden 80% (turfgrass management)	10% (rain gardens) 25% (turfgrass management)
Animal Operation BMPs	Manure management and rotational grazing	Phosphorus load from animal operations based on the total number of registered cattle and dairy cow animal units and phosphorus production assumptions in MPCA 2004.	75%	100%
Septic System Management	Upgrade failing shoreline septic systems and replace ITPHSS	Phosphorus load from shoreline and upland septic systems based on assumptions in MPCA 2004, county average % failing rates from MPCA 2012 SSTS Annual Report, and county SSTS inventory	0.45 lb/yr per person (shoreline) 0.64 lb/yr per person (upland)	100%
Gully Stabilization	Stabilize soil erosion from potential gullies. Gullies are identified using stream power index, hillshade, and aerial photos to note places of concentrated flow, then if those places of concentrated flow correspond with the DEM hillshade the aerial photos are looked at to determine if there are changes in that location over the years by changes in farming, etc.	Phosphorus load from potential gullies identified from GIS aerial imagery based on approximately 1 lb phosphorus per year lost through erosion of approximately 1 ton of soil per gully per year	1 lb P per ton of soil stabilized per year	100%
In-lake Management	Lake sediment alum treatment, or aquatic plant and fisheries management for a clear water state	Internal phosphorus load treated through in-lake management estimated from BATHTUB model results for the TMDL study	75%	100%

[1] Derived from the Minnesota Stormwater Manual (http://stormwater.pca.state.mn.us/index.php/Main_Page) and the Agricultural BMP Handbook for Minnesota (http://www.mda.state.mn.us/protecting/cleanwaterfund/research/agbmphandbook.aspx)

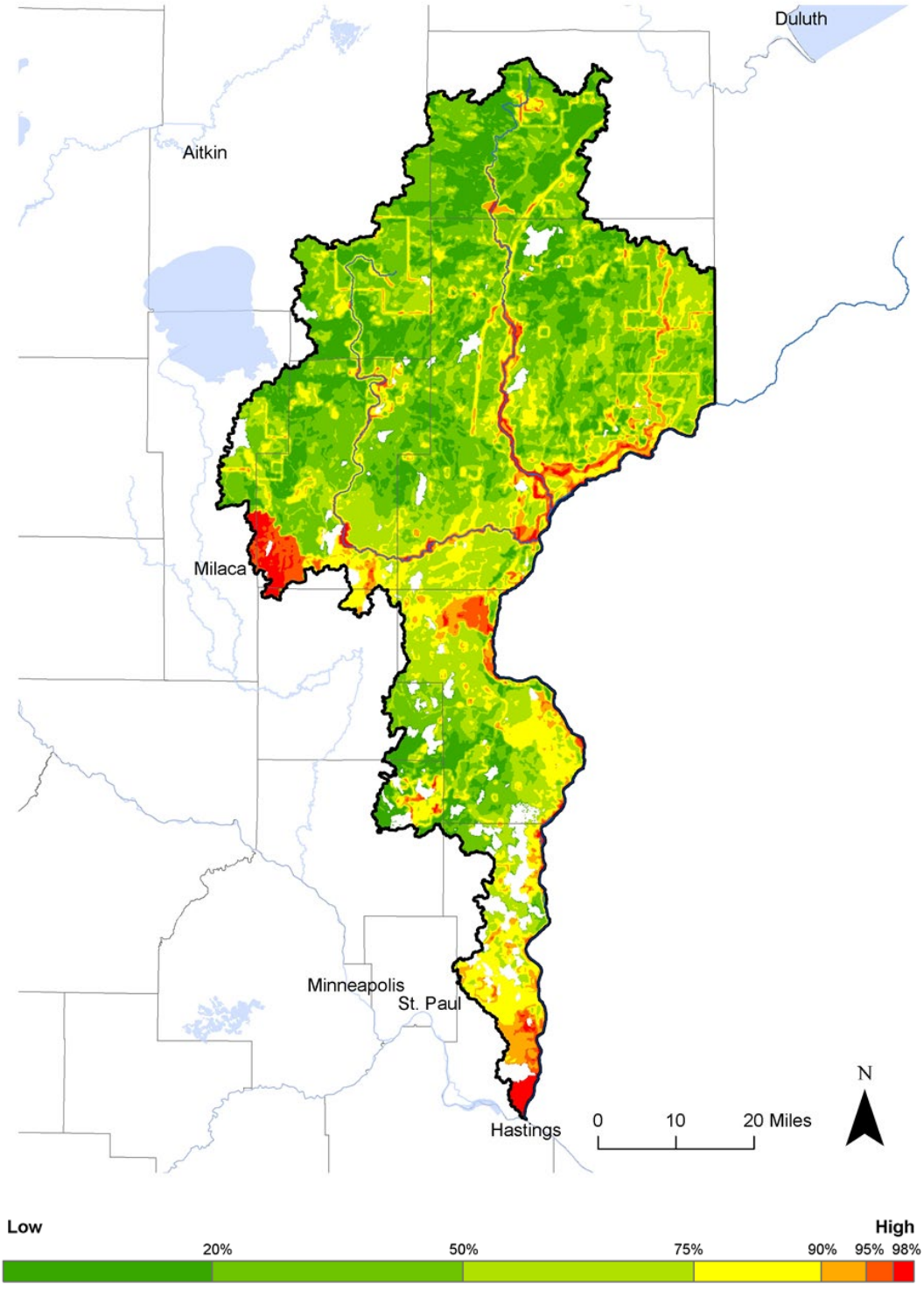


Figure 4. St. Croix River Basin Prioritization Map

3.3 Restoration & Protection Strategies

This section provides detailed tables identifying restoration and protection strategies for individual lakes and streams that restore or protect water quality. Strategies are listed for each individual water body and grouped into 5 tables for each subwatershed of the Goose Creek Watershed (Strategy table subwatersheds are listed in Table 11 and shown in Figure 5). The subwatersheds are based on 7 HUC 12s in the Goose Creek Watershed, with the Goose Creek and Goose Lake HUC 12s, and the Rush Creek and Rush Lake HUC 12s combined into a Goose subwatershed and a Rush subwatershed. These tables include the following information:

- County location
- Water quality conditions and goals
- Strategies (see Table 28 below for complete list of strategies and implementation tools)
- Estimate scale of adoption needed for each strategy to result in measurable improvements in water quality
- Governmental units with primary responsibility
- Estimated timeline for full implementation of strategy
- Interim 10-year milestones for implementation of strategy

Specific strategies have been developed to restore the impaired waters within the watershed and for protecting the quality of the waters within the watershed that are not impaired. The subwatershed-based implementation strategy and action tables in this section outline the strategies and actions that are capable of cumulatively achieving the needed pollution load reductions for point and non-point sources. The tables were developed by thoroughly reviewing the specific conditions affecting each of the waters and collecting input from watershed stakeholders. For the impaired lakes detailed implementation plans are included that describe the in-lake and watershed improvements that are needed to meet the goal of the TMDL. The analysis includes a specific BMP selection and siting based on the specific nature of each of the waters and watersheds. The lake implementation project tables are included following the appropriate subwatershed proposed implementation strategies and actions tables.

Subwatershed BMP maps are created using a process is called Subwatershed Retrofit Assessment in which many layers of GIS data compiled together to identify gullies, feedlots, buffers needed, erodible areas, etc. Points are placed on the maps in locations that may benefit from a water quality project. Field verification and landowner participation is then needed to install the project. More information about this and full documents with more details are available at http://chisagoswcd.org/assessments/.

Section Contents (organized by subwatershed):

- Priority Consideration Map
- Proposed Implementation Strategies and Action Table
- Subwatershed Potential BMP Maps
- Lake Implementation Project Table

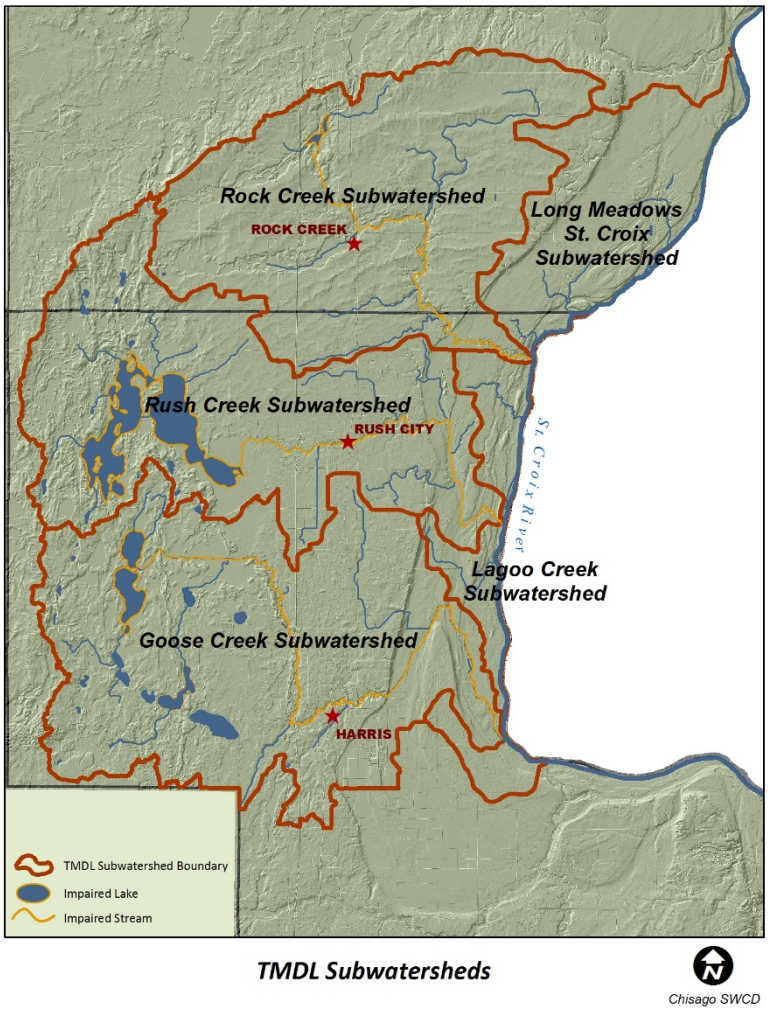


Figure 5. Implementation Strategies and Actions Table Subwatersheds

Table 11. Implementation Strategies and Actions Table Subwatersheds

HUC 8/ HUC 10	(0703000502-XX) HUC 12 Name	Table Sub-watersheds
07030005 **Lower St. Croix**/ 0703000502 **Goose Creek** – Saint Croix River	-01 Long Meadows Lake – Saint Croix River	Long Meadows
	-02 Rock Creek	Rock Creek
	-03 Rush Lake	Rush Creek
	-04 Rush Creek	
	-05 Upper Goose Creek	Goose Creek
	-06 Lower Goose Creek	
	-07 Lagoo Creek – Saint Croix River	Lagoo Creek

Watershed-wide

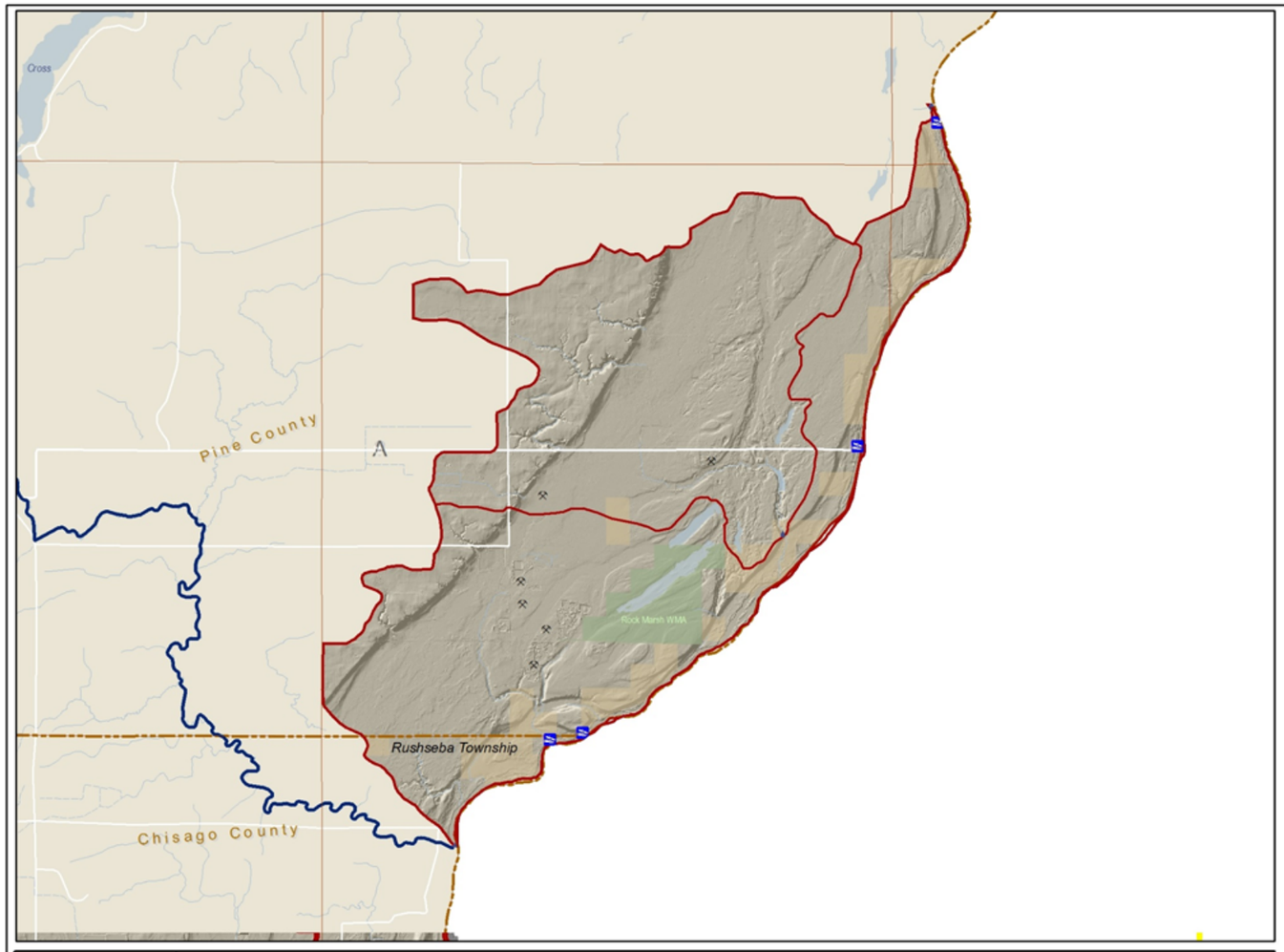
Table 12. Watershed-wide Implementation Strategies and Actions

Subwatershed	Waterbody and Location			Parameter (incl. non-pollutant stressors)	Water Quality		Strategies (see key below)	Strategy types and estimated scale of adoption needed to meet final water quality target	Interim 10-yr Milestones	Governmental Units with Primary Responsibility										Estimated Year to Achieve Water Quality Target
	Waterbody (ID)	Waterbody Name	**Location** and Upstream Influence Counties		Current Conditions	Goals / Targets and Estimated % Reduction				Lake Assn	Chis SWCD	Pine SWCD	MPCA	BWSR	Chisago County	Pine County	USDA NRCS	City	DNR	
All	All	All	Chisago and Pine County	Social Infrastructure (to address all pollutants/ stressors)	-	-	**Improve Education and Outreach**	K-12 Watershed Education	Support Chisago County Children's Water Festival and Pine County Environmental Day	x	x	x	x	x	x	x	x	x	x	2040
								Field Demonstration Days (cover crops, tillage, rain gardens, lakeshore restorations, etc.)	Organize 3 workshops within watershed		x	x					x			
								Experimental Farm Site - collect edge of field runoff data from an agricultural operation.	Install one Discovery Farms site within the watershed		x	x								
								General public outreach and education	Attend lake association meetings, provide educational materials on water quality, write news releases	x	x	x					x	x		
							Improve Policy	Unify stormwater ordinances	Explore watershed wide MIDS opportunities						x	x				
								Adopt County wide Individual Sewage Treatment Systems Standards Chapter 7080				x								
All	All	All	Chisago and Pine County	All Pollutant/Stressors	-	-	**Riparian Buffers**	Restore all riparian buffers along public waters and ditches per Minnesota Buffer Legislation (Laws of Minnesota 2015, Ch 4, art 4, s79)	100% of buffers installed by 2017 on Public Waters. 100% of buffers on Public Drainage Systems by 2018		x	x		x	x	x		x	x	Ongoing
All	82-0001	Lake Saint Croix	Washington County	Phosphorus	460 MT/yr	360 MT/yr	Detailed strategies have been developed as part of the Lake St. Croix TMDL and Lake St. Croix Implementation Plan. http://www.pca.state.mn.us/gp0r9fc													

Table 13. Lake Implementation Project Summary

	LAKES			FISH	GOOSE N	GOOSE S	HORSESHOE	MANDALL	RABOUR	ROCK	RUSH E	RUSH W
SETTING	Lake Type			General	Shallow	General	General	General	General	Shallow	General	General
	In-lake TP Concentration		[µg/L]	22	170	55	53	IF	IF	193	61	65
	TP Standard		[µg/L]	40	60	40	40	40	40	60	40	40
	Lake Surface Area		[ac]	319	272	447	224	47	52	81	1,484	1,579
	Watershed Area		[ac]	1,458	1,325	3,534	3,347	2,210	1,406	6,182	5,563	13,930
	Direct Drainage Dominant Land Covers	Developed		8%	5%	7%	6%	7%	5%	8%	5%	5%
		Cropland		8%	23%	17%	25%	22%	18%	30%	24%	20%
		Woodland		23%	9%	12%	20%	19%	23%	6%	9%	11%
		Grassland		26%	25%	27%	30%	40%	35%	39%	17%	30%
		Aquatic		34%	39%	37%	20%	13%	19%	16%	45%	34%
	Primary Phosphorus Sources	In-Lake		0%	76%	12%	0%	0%	0%	66%	28%	29%
		Watershed		100%	24%	88%	100%	100%	100%	34%	72%	71%
WATERSHED	**Load Reduction Needed**		[lb/yr]	0	355	596	563	0	0	1,763	1,236	2,137
		Biofilters		2	4	8	4	5	6	10	34	28
		Lawn management		1	1	0	2	1	1	2	2	4
		Septic upgrades		26	15	21	51	37	35	131	62	119
		Bioretention & infiltration		5	4	2	10	8	7	10	14	24
		Erosion control		4	2	20	2	6	6	46	59	444
		Agricultural BMPs		3	7	14	20	13	8	76	44	52
	Load Reduction Achieved		[lb/yr]	**40**	**33**	**65**	**88**	**70**	**63**	**274**	**216**	**671**
			[% of goal]	--	9%	11%	16%	--	--	16%	17%	31%
IN-LAKE	**Load Reduction Needed**		[lb/yr]	0	3,454	31	0	0	0	4,877	890	1,679
		Sediment P inactivation		0		31	0	0	0		890	1,447
		Trophic state alteration			2,995					3,776		
	Load Reduction Achieved		[lb/yr]	**0**	**2,995**	**31**	**0**	**0**	**0**	**3,776**	**890**	**1,447**
			[% of goal]	--	87%	100%	--	--	--	77%	100%	86%
	Load Reduction Achieved	Upstream lakes		0	234	265	10	0	0	0	721	0
TOTAL	**Total Reduction Needed**			0	4,043	892	573	0	0	6,640	2,847	3,816
	Total Reduction Achieved		[lb/yr]	**40**	**3,262**	**361**	**98**	**70**	**63**	**4,050**	**1,827**	**2,118**
			[% of goal]	--	81%	40%	17%	--	--	61%	64%	55%

Long Meadows Lake



Goose Creek WRAPS	
Subwatershed Name	**Long Meadows Lake - St. Croix**
Major Watershed Name	Lower St. Croix
Area (sq. miles)	23
% Slope (avg.)	1.4
# of Animals	60
Permitted Waste Discharges	None
Impaired Lakes Shoreline Septics	N/A
Dominant Hydrologic Soil Group	D
STEPL TP Load (lb/ac/yr)	0.51
STEPL Sediment Load (lb/ac/yr)	271
TMDL TP Load Estimate (lb/yr)	7,614
Subwatershed Land Cover	
Developed	3.3 %
Forested	41.4 %
Cropland	10.0 %
Grassland	10.7 %
Wetlands	32.8 5
Open Water	1.8 %
Watershed Entities	
Pine SWCD, Pine County, Pine City Township	
Major Resources	
St. Croix River	
Impairments	
None	
Aquatic Invasive Species	
None Known	
Next Downstream Waterbody/Subwatershed	
St. Croix River	

Figure 6. Long Meadows Lake Watershed Protection Considerations Map

Table 14. Long Meadows Lake Watershed Implementation Strategies and Actions

Subwatershed	Waterbody and Location			Parameter (incl. non-pollutant stressors)	Water Quality		Strategies (see key below)	Strategy types and estimated scale of adoption needed to meet final water quality target	Interim 10-yr Milestones	Governmental Units with Primary Responsibility									Estimated Year to Achieve Water Quality Target
	Waterbody (ID)	Waterbody Name	**Location** and Upstream Influence Counties		Current Conditions	Goals / Targets and Estimated % Reduction				Lake Assn	Chisago SWCD	Pine SWCD	MPCA	Chisago County	Pine County	USDA NRCS	City	MN NDR	
Long Meadows Lake	All	All	Chisago and Pine County	Phosphorus, Sediment, Bacteria	--	Maintain or improve	**Improve upland/field surface runoff controls** [to reduce or intercept farm field erosion]	50-ft buffers on all streams, 16.5-ft buffers on all public water ditches, and all buffer requirements met. See BMP maps for potential locations.	Buffers on 100% of streams and public water ditches		x					x			2030
								Rotational grazing plans or livestock exclusion watershed-wide	20% completed		x					x			
								Install WASCOBs and Grassed Waterways to control runoff. See BMP maps for potential locations.	Inventory all concentrated runoff paths. Install 7 projects.		x					x			
							Reduce bank/bluff/ravine erosion	Identify and stabilize all gullies within subwatershed. See BMP maps for potential locations.	Inventory all gullies. Install 2 gully stabilization projects.		x					x			
							Increase vegetative cover/root duration	Cover crops on 20% of short-season crops and all fallow land.	100 acres completed		x					x			
								Perennial vegetation on 22% of watershed (an increase of54%).	Increase perennial vegetation on 40 acres.		x					x			
							Prevent feedlot runoff	Fix all open lot runoff problems per 7020 rules and open lot agreement.	Inventory all feedlots within watershed. 1 open lot fix completed.		x		x			x			
							Improve fertilizer and manure application management	Apply fertilizer and manure based on soil test recommendations for optimal crop growth.	Promote soil testing and nutrient management planning.		x					x			
							Address failing septic systems	Replace all systems deemed Imminent Threat to Public Health because of surface water discharges	All upgrades completed					x					
								Upgrade failing septic systems (systems that do not meet 3 feet of separation)	Identify failing systems in shoreline district.					x					

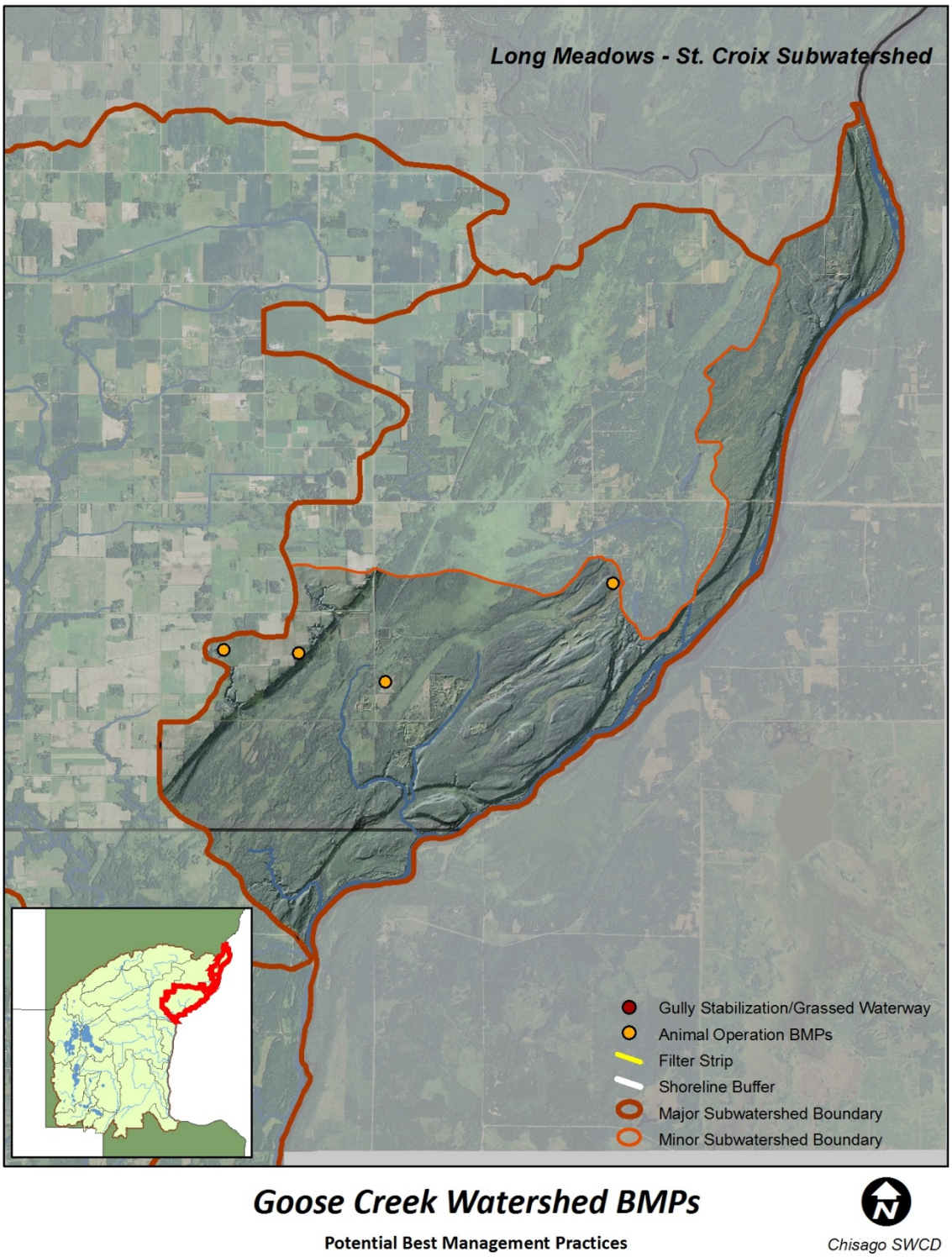


Figure 7. Long Meadows (Direct Drainage) Watershed Potential BMPs

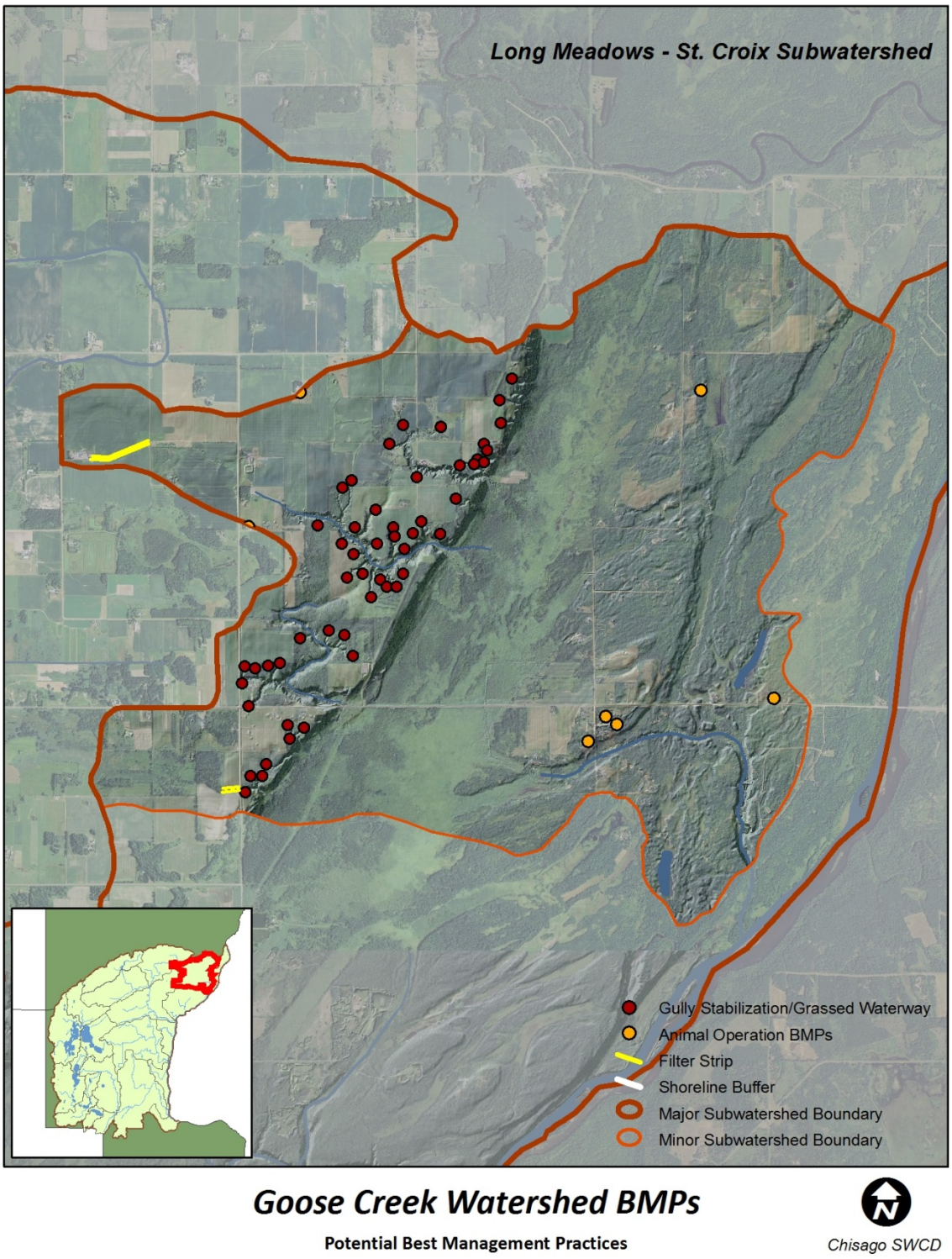
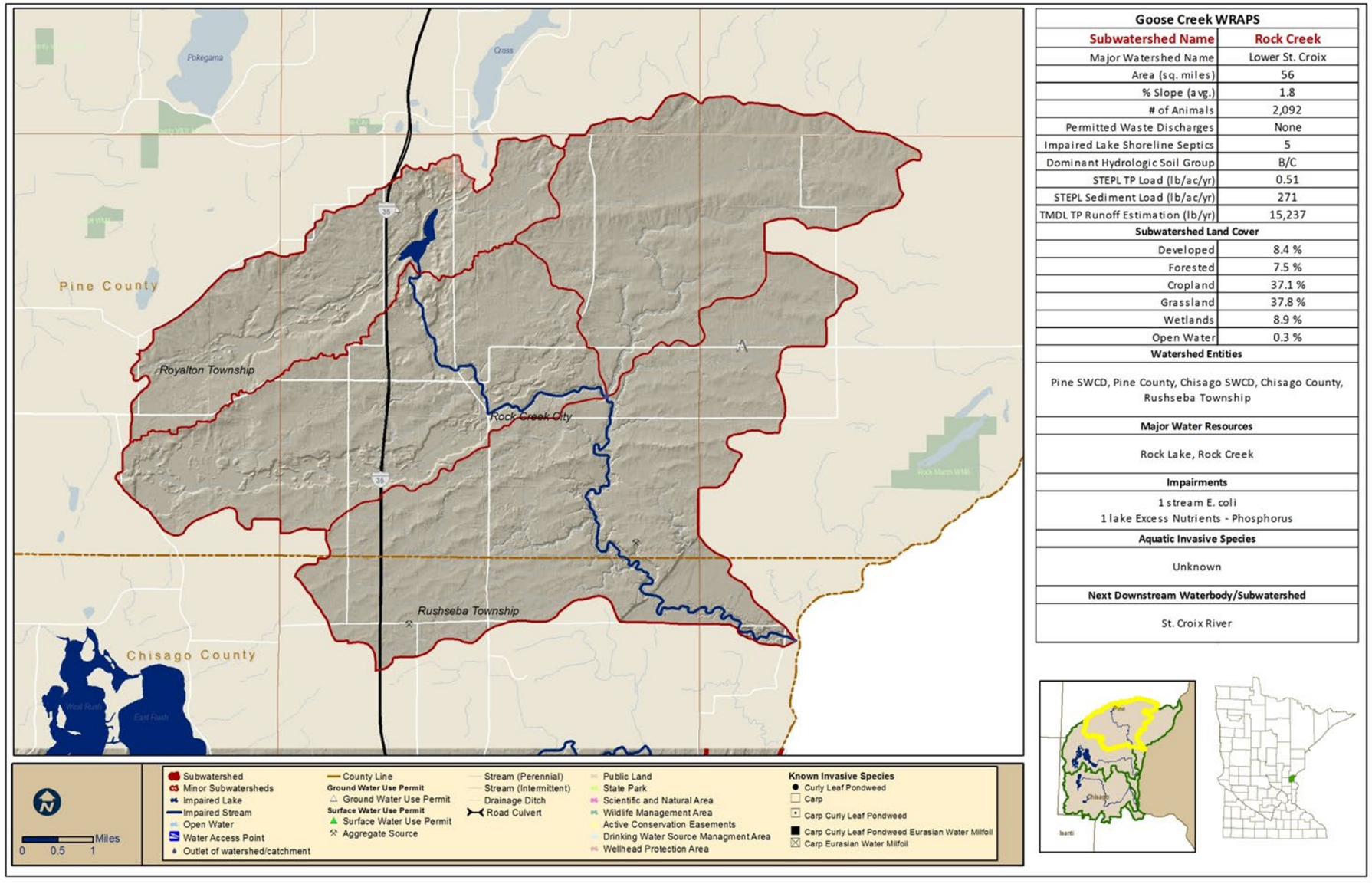


Figure 8. Long Meadows (Upstream) Watershed Potential BMPs

Rock Creek



Goose Creek WRAPS	
Subwatershed Name	**Rock Creek**
Major Watershed Name	Lower St. Croix
Area (sq. miles)	56
% Slope (avg.)	1.8
# of Animals	2,092
Permitted Waste Discharges	None
Impaired Lake Shoreline Septics	5
Dominant Hydrologic Soil Group	B/C
STEPL TP Load (lb/ac/yr)	0.51
STEPL Sediment Load (lb/ac/yr)	271
TMDL TP Runoff Estimation (lb/yr)	15,237
Subwatershed Land Cover	
Developed	8.4 %
Forested	7.5 %
Cropland	37.1 %
Grassland	37.8 %
Wetlands	8.9 %
Open Water	0.3 %
Watershed Entities	
Pine SWCD, Pine County, Chisago SWCD, Chisago County, Rushseba Township	
Major Water Resources	
Rock Lake, Rock Creek	
Impairments	
1 stream E. coli 1 lake Excess Nutrients - Phosphorus	
Aquatic Invasive Species	
Unknown	
Next Downstream Waterbody/Subwatershed	
St. Croix River	

Figure 9. Rock Creek Watershed Protection Considerations Map

Table 15: Rock Creek Watershed Implementation Strategies and Actions

Subwatershed	Waterbody and Location			Parameter (incl. non-pollutant stressors)	Water Quality		Strategies (see key below)	Strategy types and estimated scale of adoption needed to meet final water quality target	Interim 10-yr Milestones	Governmental Units with Primary Responsibility									Estimated Year to Achieve Water Quality Target
	Waterbody (ID)	Waterbody Name	**Location** and Upstream Influence Counties		Current Conditions	Goals / Targets and Estimated % Reduction				Lake Assn	Chis SWCD	Pine SWCD	MPCA	Chis County	Pine County	USDA NRCS	City	DNR	
Rock Creek	07030005-584	Rock Creek, Rock Lake to St. Croix River	Pine	Bacteria (*E. coli*)	Monthly geometric means = 28 - 718 org/100mL	All monthly geometric means < 126 org/100mL	**Improve livestock and manure management**	Rotational grazing plans or livestock exclusion watershed-wide	Inventory all properties with livestock. Complete 2 feedlot projects.		x	x				x			2040
								All MN R. ch. 7020 manure spreading setbacks are met	100% Compliance with MN R. ch. 7020				x						
								Total containment of manure storage	10% completed		x	x				x			
								Inventory and fix all open lot runoff problems per 7020 rules and open lot agreement	Inventory all feedlots within watershed. 1 open lot fix completed.		x	x	x			x			
							Improve urban/rural stormwater management [to reduce runoff of bacteria]	Promote pet waste receptacles and educate on proper disposal techniques.	Install pet waste receptacles in 2 public parks.				x		x		x		
								Buffers/riparian plantings in highest priority areas	Yr 4: ID problem areas. Yr 10: 10% completed		x	x				x			
							Address failing septic systems	Replace all systems deemed Imminent Threat to Public Health because of surface water discharges	All upgrades completed				x						
								Upgrade failing septic systems (systems that do not meet 3 feet of separation)	Upgrade 10 failing systems				x						
							Reduce Industrial/Municipal wastewater bacteria	Compliance with all TMDL waste load allocations at all discharge sites	Permit compliance				x				x		
								Reduce frequency/magnitude of bypasses	Reduce frequency/magnitude of bypasses				x				x		
Rock Creek	58-0117-00	Rock Lake	Pine	Phosphorus	Growing Season Average TP = 193 µg/L	Growing Season Average TP < 60 µg/L	**Improve upland/field surface runoff controls** [to reduce or intercept farm field erosion]	50-ft buffers on all streams, 16.5-ft buffers on all public water ditches, and all buffer requirements met.	Buffers on 100% of streams and public water ditches			x				x			2040
								Rotational grazing plans or livestock exclusion watershed-wide	20% completed			x				x			
								Inventory and Install WASCOBs and Grassed Waterways to control runoff. See BMP maps for potential locations.	Complete inventory and install 10 projects.			x				x			
							Reduce bank/bluff/ravine erosion	Inventory and stabilize all gullies within subwatershed. See BMP maps for potential locations.	Inventory all gullies and install five gully stabilization projects.			x				x			
							Increase vegetative cover/root duration	Cover crops on 20% of short-season crops and all fallow land.	40 acres completed			x				x			
								Perennial vegetation on 45% of watershed (an increase of 4%).	Increase perennial vegetation on 40 acres.			x				x			
							Prevent feedlot runoff	Inspect and fix all open lot runoff problems per 7020 rules and open lot agreement.	Inspect all feedlots within watershed. 1 open lot fix completed.			x	x			x			
							Improve fertilizer and manure application management	Apply fertilizer and manure based on soil test recommendations for optimal crop growth.	Promote soil testing and nutrient management planning.			x				x			

Subwatershed	Waterbody and Location			Parameter (incl. non-pollutant stressors)	Water Quality		Strategies (see key below)	Strategy types and estimated scale of adoption needed to meet final water quality target	Interim 10-yr Milestones	Governmental Units with Primary Responsibility									Estimated Year to Achieve Water Quality Target
	Waterbody (ID)	Waterbody Name	**Location** and Upstream Influence Counties		Current Conditions	Goals / Targets and Estimated % Reduction				Lake Assn	Chis SWCD	Pine SWCD	MPCA	Chis County	Pine County	USDA NRCS	City	DNR	
							Address failing septic systems	Replace all systems deemed Imminent Threat to Public Health because of surface water discharges	All upgrades completed						x				
								Upgrade failing septic systems (systems that do not meet 3 feet of separation)	Identify failing systems in shoreline district						x				
							Reduce in-water loading	Rough fish management	Yr 5: Design/complete study. Yr 10: TBD	x								x	
								Curly-leaf pondweed management	Management per DNR Invasive Aquatic Plant Management permit	x								x	
							Improve forestry management	Increase aforestation by 10% on high priority and steep agricultural fields	Convert 3 acres of cropland to forest.			x				x		x	
							Reduce Industrial/Municipal wastewater TP	Meet TMDL waste load allocations at all discharge sites	Permit compliance				x					x	
								Reduce frequency/magnitude of bypasses	Reduce frequency/magnitude of bypasses				x					x	
							Improve urban/rural stormwater management [to reduce runoff of TP]	Install infiltration basins on 10% of parcels. See Lake implementation tables.	Install 2 rain gardens	x		x							
								Install shoreline restoration/lakeshore buffers on 2,500 feet of lakeshore. See Lake implementation tables.	Install 100 feet of buffers	x		x							

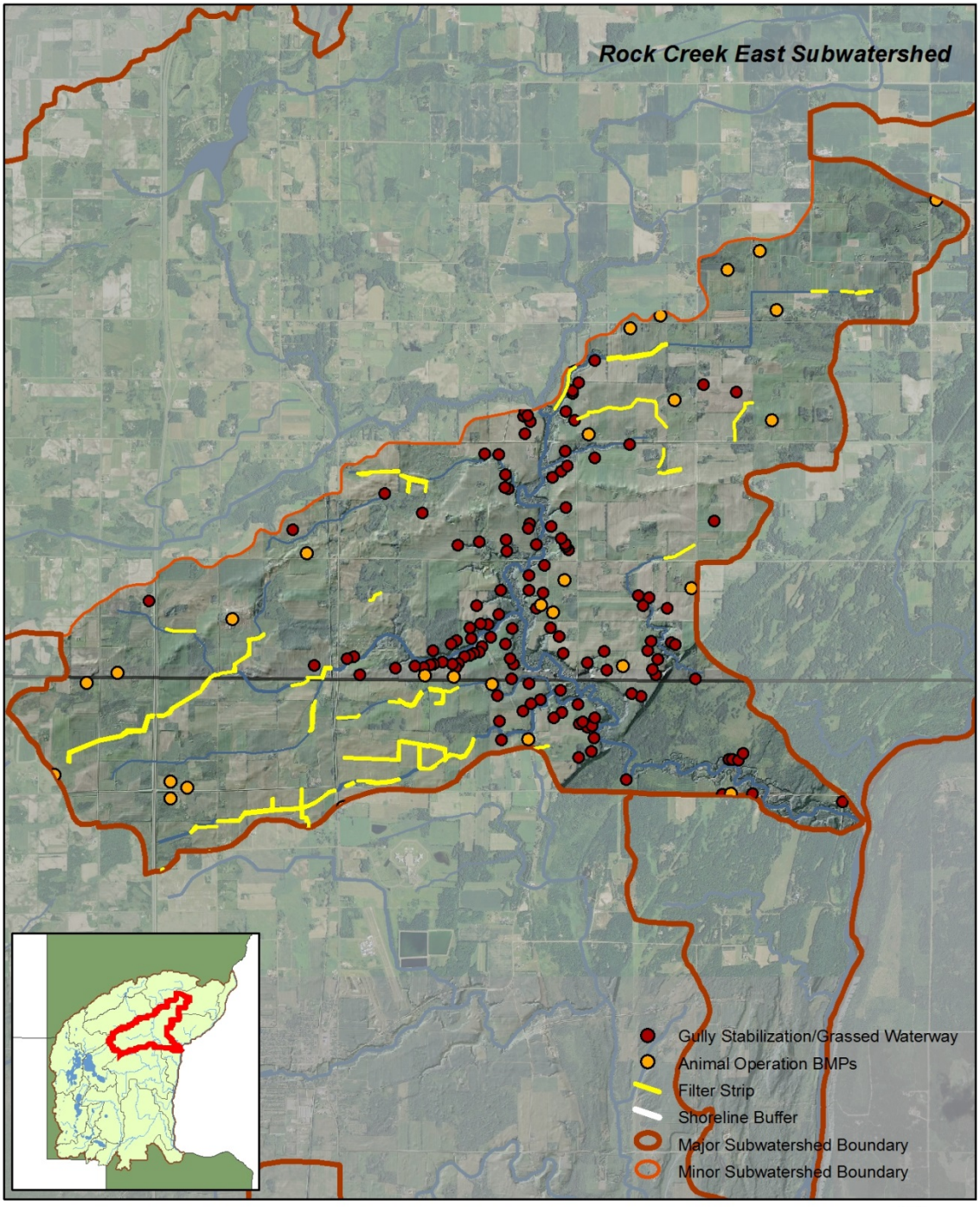


Figure 10. Rock Creek (East) Watershed Potential BMPs

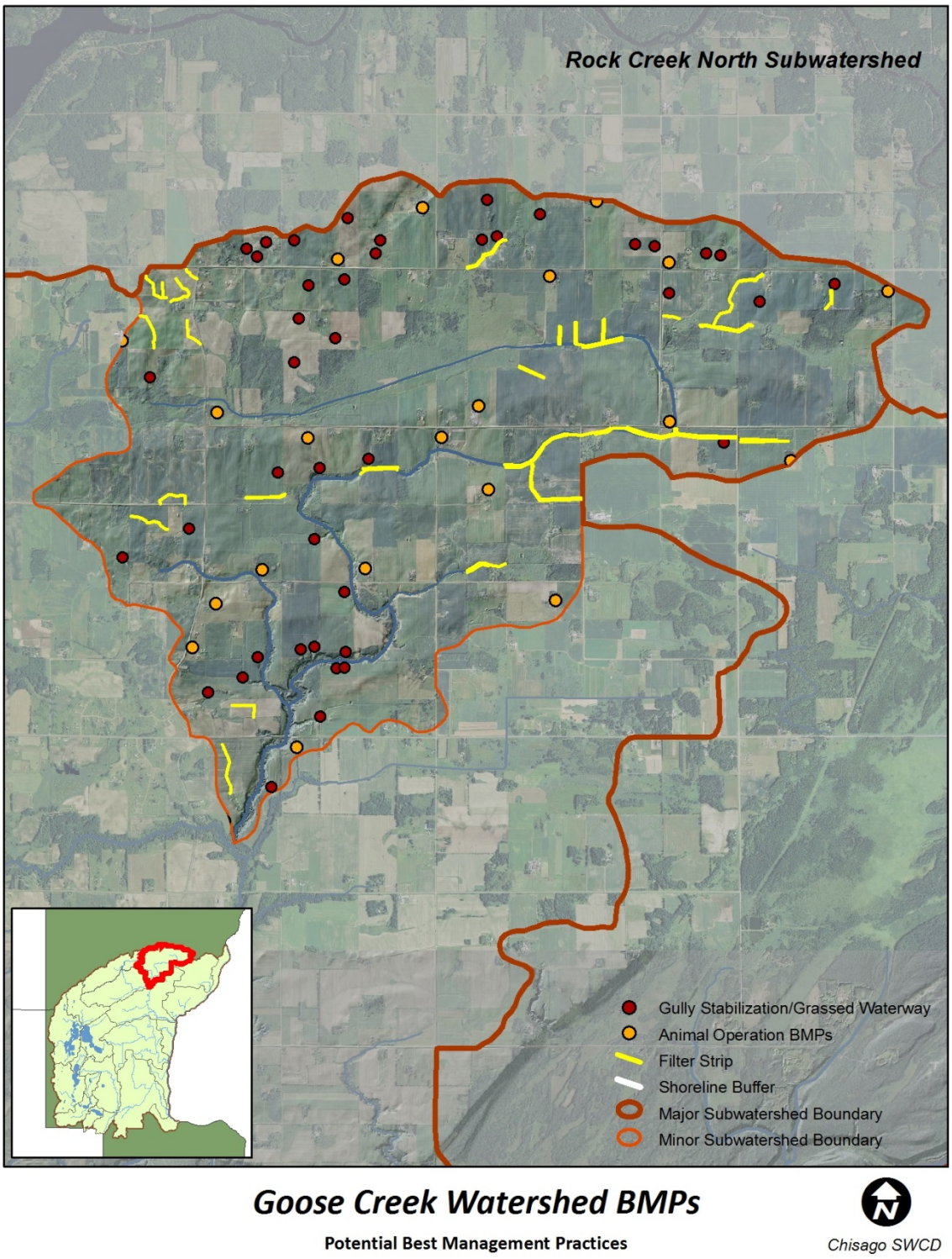


Figure 11. Rock Creek (North) Watershed Potential BMPs

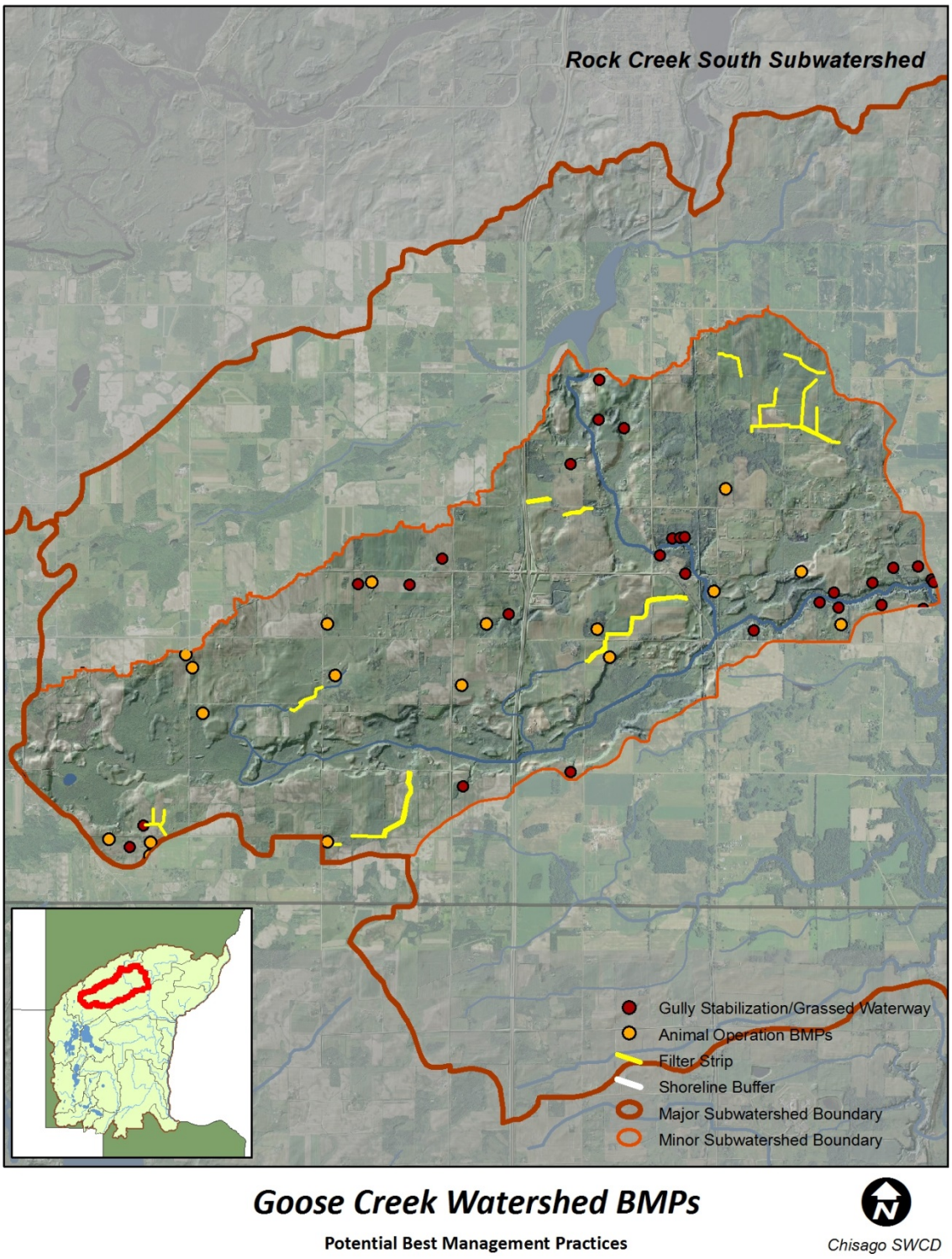


Figure 12. Rock Creek (South) Watershed Potential BMPs

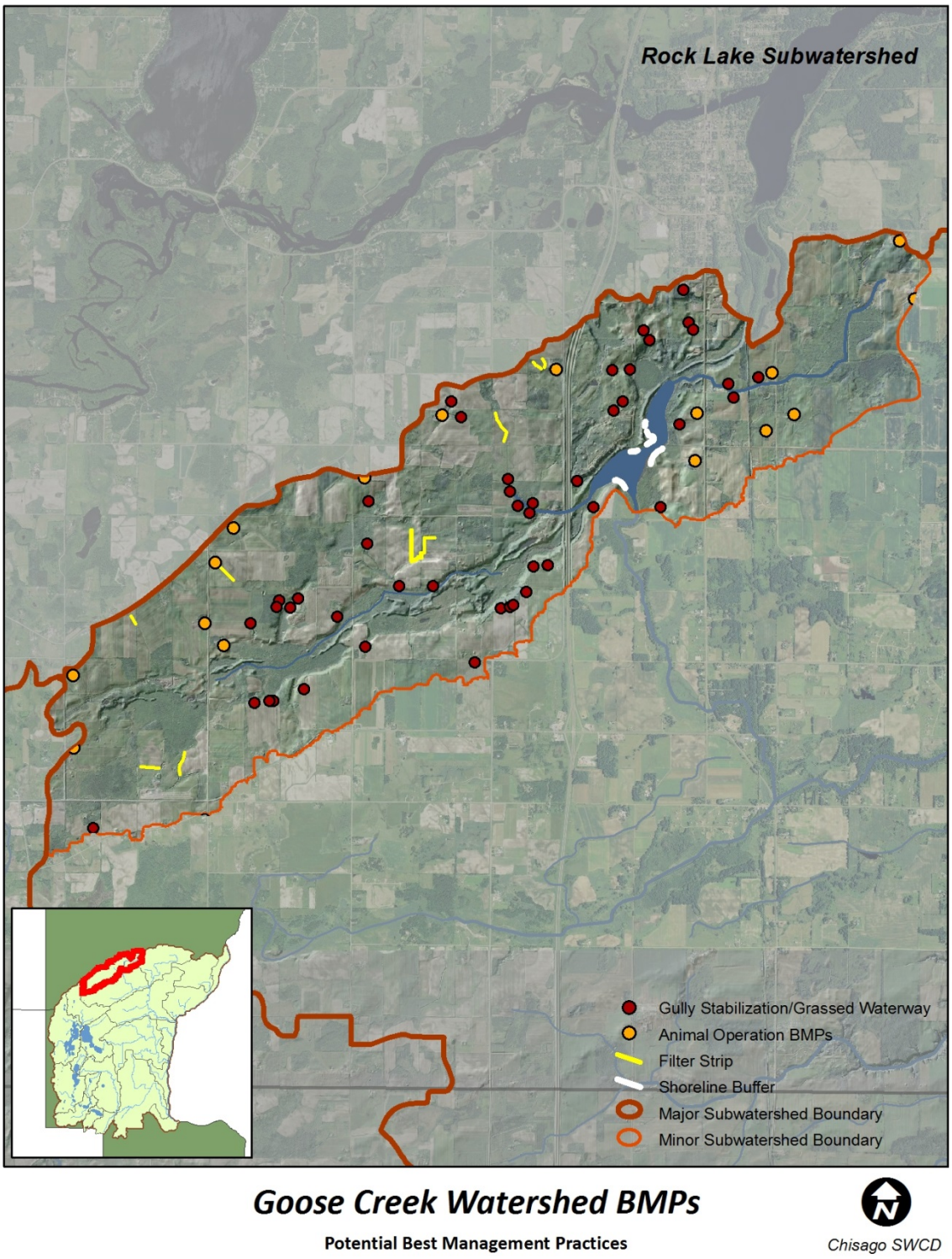


Figure 13. Rock Lake Watershed Potential BMPs

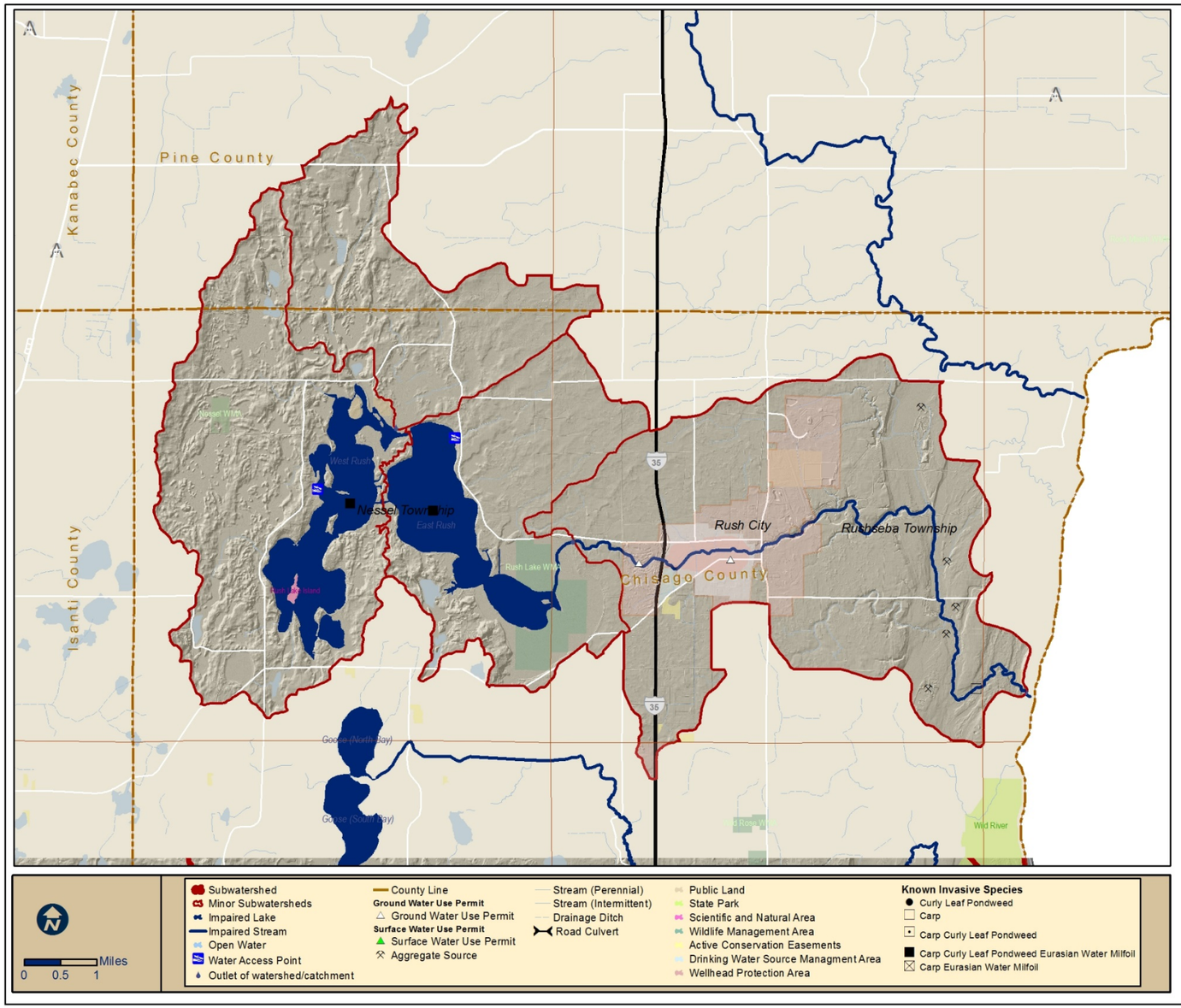
Table 16. Rock Lake Implementation Project Table

ROCK LAKE IMPLEMENTATION ACTIVITES CURRENT TP = 193 µg/L		Treated Area [ac]	Treated Area [% Watershed]	Estimated TP Load Reduction [lb P/yr]	Estimated TP Load Reduction [% Total Needed]	Potential Granting Organization	Project Partners	Estimated 30-year Costs
IN-LAKE	**Load Reduction Needed:**			**4,877**				
	Load Reduction Achieved:			**3,776**	**56.9%**			
Trophic state alteration	Including, but not limited to, carp management and/or curly-leaf pondweed management.			3,776	56.9%			
WATERSHED	**Load Reduction Needed:**			**1,763**				
	Load Reduction Achieved:			**274**	**4.1%**			
Biofilters	Shoreline buffers (2,512 feet total)	6	0.1%	1	0.0%	NRCS; CWF	NRCS; SWCD; LA; LO	$-$$
	Filter strips (9,007 feet total)	41	0.7%	9	0.1%			
Lawn management	Maintaining turfgrass and preventing transport of leaves and clippings on 25% of all parcels	24	0.4%	2	0.0%	Existing programs	City; SWCD; LA	$$
Septic system upgrades	Convert all failing to conforming	N/A	N/A	131	2.0%	CWF	County; Cities; LO	$
	Convert all ITPHSS to conforming (completed)	N/A	N/A	0	0.0%		County, LO	
Bioretention & Infiltration	Infiltration basins and large bioretention facilities (equivalent to one individual rain gardens on 10% of all parcels, or 19)	N/A	N/A	10	0.1%	CWF	SWCD; LA; LO	$$-$$$
Erosion control	Gully stabilization	N/A	N/A	46	0.7%	NRCS; CWF; City	NRCS; SWCD; City; LO	$$
Agricultural BMPs	Collection, storage, and treatment of manure (assumes 75% reduction of load)	N/A	N/A	36	0.5%	NRCS; Ag BMP; CWF	NRCS; SWCD; LO	$-$$
	10% of cropland converted to conservation tillage	187	3.0%	39	0.6%	NRCS; Ag BMP	NRCS; SWCD; LO	Variable
TOTAL	**Load Reduction Needed:**			**6,640**				
	Load Reduction Achieved:			**4,050**	**61.0%**			

Symbol key

Ag BMP	MDA Agricultural BMP Loan Program	LO	Landowners	$ < $500/lb TP removed/yr
CWF	Clean Water Fund	NRCS	Natural Resources Conservation Service	$$ = $500-$1500/lb TP removed/yr
			Soil and Water Conservation	$$$ > $1500 lb TP
CWP	Clean Water Partnerships/ 319 Grants	SWCD	District	removed/yr
LA	Lake Associations			

Rush Lake and Rush Creek



Goose Creek WRAPS	
Subwatershed Name	**Rush Lake**
Major Watershed Name	Lower St. Croix
Area (sq. miles)	35
% Slope (avg.)	1.9
# of Animals	538
Permitted Waste Discharges	None
Impaired Lake Shoreline Septics	454
Dominant Hydrologic Soil Group	B/C
STEPL TP Load (lb/ac/yr)	0.41
STEPL Sediment Load (lb/ac/yr)	199
TMDL TP Runoff Estimation (lb/yr)	9,158
Subwatershed Land Cover	
Developed	5.0 %
Forested	10.4 %
Cropland	21.6 %
Grassland	25.6 %
Wetlands	22.7 %
Open Water	14.7 %
Watershed Entities	
Chisago SWCD, Chisago County, Pine SWCD, Pine County, Nessel Township, Rush Lake Improvement Association	
Major Water Resources	
East Rush Lake, West Rush Lake	
Impairments	
Excess Nutrients - Phosphorus	
Aquatic Invasive Species	
Curly leaf pondweed, carp	
Next Downstream Waterbody/Subwatershed	
Rush Creek	

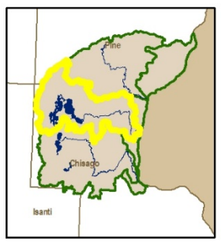


Figure 14. Rush Lake and Rush Creek Watershed Protection Considerations Map

Table 17: Rush Lake and Rush Creek Watershed Implementation Strategies and Actions

Subwatershed	Waterbody and Location: Waterbody (ID)	Waterbody and Location: Waterbody Name	Waterbody and Location: **Location** and Upstream Influence Counties	Parameter (incl. non-pollutant stressors)	Water Quality: Current Conditions	Water Quality: Goals / Targets and Estimated % Reduction	Strategies (see key below)	Strategy types and estimated scale of adoption needed to meet final water quality target	Interim 10-yr Milestones	Governmental Units with Primary Responsibility: Lake Assn	Chisago SWCD	Pine SWCD	MPCA	Chisago County	Pine County	USDA NRCS	City	MN NDR	Estimated Year to Achieve Water Quality Target
Rush Creek	07030005-509	Rush Creek, Rush Lake to St. Croix River	Chisago	Bacteria (E. coli)	Monthly geometric means = 6 - 419 org/100mL	All monthly geometric means < 126 org/100mL	**Improve livestock and manure management**	Rotational grazing plans or livestock exclusion watershed-wide	Complete 2 feedlot projects.		x					x			2040
								All MN R. ch. 7020 manure spreading setbacks are met	Ongoing				x						
								Total containment of manure storage	10% completed		x					x			
								Fix all open lot runoff problems per 7020 rules and open lot agreement	Inventory all feedlots within watershed. 1 open lot fix completed.		x					x			
							Improve urban/rural stormwater management [to reduce runoff of bacteria]	Promote pet waste receptacles and educate on proper disposal techniques.	Install pet waste receptacles in 2 public parks.		x		x	x			x		
								Buffers/riparian plantings in highest priority areas	Yr 4: ID problem areas. Yr 10: 10% completed		x					x			
							Address failing septic systems	Replace all systems deemed Imminent Threat to Public Health because of surface water discharges	All upgrades completed				x						
								Upgrade failing septic systems (systems that do not meet 3 feet of separation)	Upgrade 10 failing systems				x						
							Reduce Industrial/Municipal wastewater TP	Compliance with all TMDL waste load allocations at all discharge sites	Permit compliance				x				x		
								Reduce frequency/magnitude of bypasses	Reduce frequency/magnitude of bypasses				x				x		
				Fish IBI	-	-	**Stream Restoration and Habitat Improvements**	Restore stream sinuosity and re-establish native stream habitat per DNR Rush Creek restoration plan at former dam site.	100% complete		x			x			x	x	
Rush Creek	07030005-680	County Ditch 6, Headwaters to Rush River	Chisago	Phosphorus, Sediment, Bacteria, Habitat	--	Maintain or improve	**Improve upland/field surface runoff controls** [to reduce or intercept farm field erosion]	50-ft buffers on all streams, 16.5-ft buffers on all public water ditches, and all buffer requirements met. See BMP maps for potential locations.	Buffers on 100% of streams by 2017 and public water ditches by 2018		x					x			Ongoing
								Rotational grazing plans or livestock exclusion watershed-wide	20% completed		x					x			
								Install WASCOBs and Grassed Waterways to control runoff. See BMP maps for potential locations.	Inventory all concentrated runoff paths. Install 7 projects.		x					x			
							Reduce bank/bluff/ravine erosion	Identify and stabilize all gullies within subwatershed. See BMP maps for potential locations.	Inventory all gullies. Install 2 gully stabilization projects.		x					x			
							Increase vegetative cover/root duration	Cover crops on 20% of short-season crops and all fallow land.	100 acres completed		x					x			
								Perennial vegetation on 22% of watershed (an increase of54%).	Increase perennial vegetation on 40 acres.		x					x			
							Prevent feedlot runoff	Fix all open lot runoff problems per 7020 rules and open lot agreement.	Inventory all feedlots within watershed. 1 open lot fix completed.		x		x			x			

Subwatershed	Waterbody and Location			Parameter (incl. non-pollutant stressors)	Water Quality		Strategies (see key below)	Strategy types and estimated scale of adoption needed to meet final water quality target	Interim 10-yr Milestones	Governmental Units with Primary Responsibility									Estimated Year to Achieve Water Quality Target
	Waterbody (ID)	Waterbody Name	**Location** and Upstream Influence Counties		Current Conditions	Goals / Targets and Estimated % Reduction				Lake Assn	Chisago SWCD	Pine SWCD	MPCA	Chisago County	Pine County	USDA NRCS	City	MN NDR	
							Improve fertilizer and manure application management	Apply fertilizer and manure based on soil test recommendations for optimal crop growth.	Promote soil testing and nutrient management planning.		x					x			
							Address failing septic systems	Replace all systems deemed Imminent Threat to Public Health because of surface water discharges	All upgrades completed					x					
								Upgrade failing septic systems (systems that do not meet 3 feet of separation)	Identify failing systems in shoreline district					x					
Rush Creek	07030005-695	Unnamed Creek, Headwaters to Rush Lake	Chisago	Phosphorus, Sediment, Bacteria	--	Maintain or improve	**Improve upland/field surface runoff controls** [to reduce or intercept farm field erosion]	50-ft buffers on all streams, 16.5-ft buffers on all public water ditches, and all buffer requirements met. See BMP maps for potential locations.	Buffers on 100% of streams by 2017 and public water ditches by 2018		x					x			Ongoing
								Rotational grazing plans or livestock exclusion watershed-wide	20% completed		x					x			
								Install WASCOBs and Grassed Waterways to control runoff. See BMP maps for potential locations.	Inventory all concentrated runoff paths. Install 7 projects.		x					x			
							Reduce bank/bluff/ravine erosion	Identify and stabilize all gullies within subwatershed. See BMP maps for potential locations.	Inventory all gullies. Install 2 gully stabilization projects.		x					x			
							Increase vegetative cover/root duration	Cover crops on 20% of short-season crops and all fallow land.	100 acres completed		x					x			
								Perennial vegetation on 22% of watershed (an increase of54%).	Increase perennial vegetation on 40 acres.		x					x			
							Prevent feedlot runoff	Fix all open lot runoff problems per 7020 rules and open lot agreement.	Inventory all feedlots within watershed. 1 open lot fix completed.		x		x			x			
							Improve fertilizer and manure application management	Apply fertilizer and manure based on soil test recommendations for optimal crop growth.	Promote soil testing and nutrient management planning.		x					x			
							Address failing septic systems	Replace all systems deemed Imminent Threat to Public Health because of surface water discharges	All upgrades completed					x					
								Upgrade failing septic systems (systems that do not meet 3 feet of separation)	Identify failing systems in shoreline district					x					
Rush Creek	13-0069-01	East Rush Lake	Chisago	Phosphorus	Growing Season Average TP = 61 µg/L	Growing Season Average TP < 40 µg/L	**Improve upland/field surface runoff controls** [to reduce or intercept farm field erosion]	50-ft buffers on all streams, 16.5-ft buffers on all public water ditches, and all buffer requirements met. See BMP maps for potential locations.	Buffers on 100% of streams by 2017 and public water ditches by 2018		x					x			2040
								Rotational grazing plans or livestock exclusion watershed-wide	20% completed		x					x			
								Install WASCOBs and Grassed Waterways to control runoff. See BMP maps for potential locations.	Inventory all concentrated runoff paths. Install 7 projects.		x					x			
							Reduce bank/bluff/ravine erosion	Identify and stabilize all gullies within subwatershed. See BMP maps for potential locations.	Inventory all gullies. Install 2 gully stabilization projects.		x					x			

Subwatershed	Waterbody and Location			Parameter (incl. non-pollutant stressors)	Water Quality		Strategies (see key below)	Strategy types and estimated scale of adoption needed to meet final water quality target	Interim 10-yr Milestones	Governmental Units with Primary Responsibility									Estimated Year to Achieve Water Quality Target
	Waterbody (ID)	Waterbody Name	**Location** and Upstream Influence Counties		Current Conditions	Goals / Targets and Estimated % Reduction				Lake Assn	Chisago SWCD	Pine SWCD	MPCA	Chisago County	Pine County	USDA NRCS	City	MN NDR	
							Increase vegetative cover/root duration	Cover crops on 20% of short-season crops and all fallow land.	100 acres completed		x					x			
								Perennial vegetation on 22% of watershed (an increase of54%).	Increase perennial vegetation on 40 acres.		x					x			
							Prevent feedlot runoff	Fix all open lot runoff problems per 7020 rules and open lot agreement.	Inventory all feedlots within watershed. 1 open lot fix completed.		x		x			x			
							Improve fertilizer and manure application management	Apply fertilizer and manure based on soil test recommendations for optimal crop growth.	Promote soil testing and nutrient management planning.		x					x			
							Address failing septic systems	Replace all systems deemed Imminent Threat to Public Health because of surface water discharges	All upgrades completed					x					
								Upgrade failing septic systems (systems that do not meet 3 feet of separation)	Identify failing systems in shoreline district					x					
							Reduce in-water loading	Rough fish management	Yr 5: Design/complete study. Yr 10: TBD	x								x	
								Curly-leaf pondweed management	Management per DNR Invasive Aquatic Plant Management permit	x								x	
							Improve forestry management	Increase aforestation by 10% on high priority and steep agricultural fields	Convert five acres of cropland to forest.		x					x		x	
							Reduce Industrial/Municipal wastewater TP	Meet TMDL waste load allocations at all discharge sites	Permit compliance				x				x		
								Reduce frequency/magnitude of bypasses	Reduce frequency/magnitude of bypasses				x				x		
							Improve urban/rural stormwater management [to reduce runoff of TP]	Install infiltration basins on 10% of parcels. See Lake implementation tables.	Install 15 rain gardens	x	x								
								Install shoreline restoration/lakeshore buffers on 18,600 feet of lakeshore. See Lake implementation tables.	Install 1,500 feet of buffers	x	x								
Rush Creek	13-0069-02	West Rush Lake	Chisago	Phosphorus	Growing Season Average TP = 65 µg/L	Growing Season Average TP < 40 µg/L	**Improve upland/field surface runoff controls** [to reduce or intercept farm field erosion]	50-ft buffers on all streams, 16.5-ft buffers on all public water ditches, and all buffer requirements met. See BMP maps for potential locations.	Buffers on 100% of streams by 2017 and public water ditches by 2018		x					x			2040
								Rotational grazing plans or livestock exclusion watershed-wide	10% completed		x					x			
								Install WASCOBs and Grassed Waterways to control runoff. See BMP maps for potential locations.	Inventory all concentrated runoff paths. Install 15 projects.		x					x			
							Reduce bank/bluff/ravine erosion	Identify and stabilize all gullies within subwatershed. See BMP maps for potential locations.	Inventory all gullies. Install five gully stabilization projects.		x					x			
							Increase vegetative cover/root duration	Cover crops on 20% of short-season crops and all fallow land.	150 acres completed		x					x			

Subwatershed	Waterbody and Location			Parameter (incl. non-pollutant stressors)	Water Quality		Strategies (see key below)	Strategy types and estimated scale of adoption needed to meet final water quality target	Interim 10-yr Milestones	Governmental Units with Primary Responsibility									Estimated Year to Achieve Water Quality Target
	Waterbody (ID)	Waterbody Name	**Location** and Upstream Influence Counties		Current Conditions	Goals / Targets and Estimated % Reduction				Lake Assn	Chisago SWCD	Pine SWCD	MPCA	Chisago County	Pine County	USDA NRCS	City	MN NDR	
								Perennial vegetation on 35% of watershed (an increase of 5%).	Increase perennial vegetation on 40 acres.		x					x			
							Prevent feedlot runoff	Fix all open lot runoff problems per 7020 rules and open lot agreement.	3 open lot fix completed		x		x			x			
							Improve fertilizer and manure application management	Apply fertilizer and manure based on soil test recommendations for optimal crop growth.	Promote soil testing and nutrient management planning.		x					x			
							Address failing septic systems	Replace all systems deemed Imminent Threat to Public Health because of surface water discharges	All upgrades completed					x					
								Upgrade failing septic systems (systems that do not meet 3 feet of separation)	Identify failing systems in shoreline district					x					
							Reduce in-water loading	Rough fish management	Yr 5: Design/complete study. Yr 10: TBD	x								x	
								Curly-leaf pondweed management	Management per DNR Invasive Aquatic Plant Management permit	x								x	
							Improve forestry management	Increase aforestation by 10% on high priority and steep agricultural fields	Convert 7 acres of cropland to forest.		x					x		x	
							Reduce Industrial/Municipal wastewater TP	Meet TMDL waste load allocations at all discharge sites	Permit compliance				x				x		
								Reduce frequency/magnitude of bypasses	Reduce frequency/magnitude of bypasses				x				x		
							Improve urban/rural stormwater management [to reduce runoff of TP]	Install infiltration basins on 10% of parcels. See Lake implementation tables.	Install 15 rain gardens	x	x								
								Install shoreline restoration/lakeshore buffers on 24,700 feet of lakeshore. See Lake implementation tables.	Install 2,000 feet of buffers	x	x								

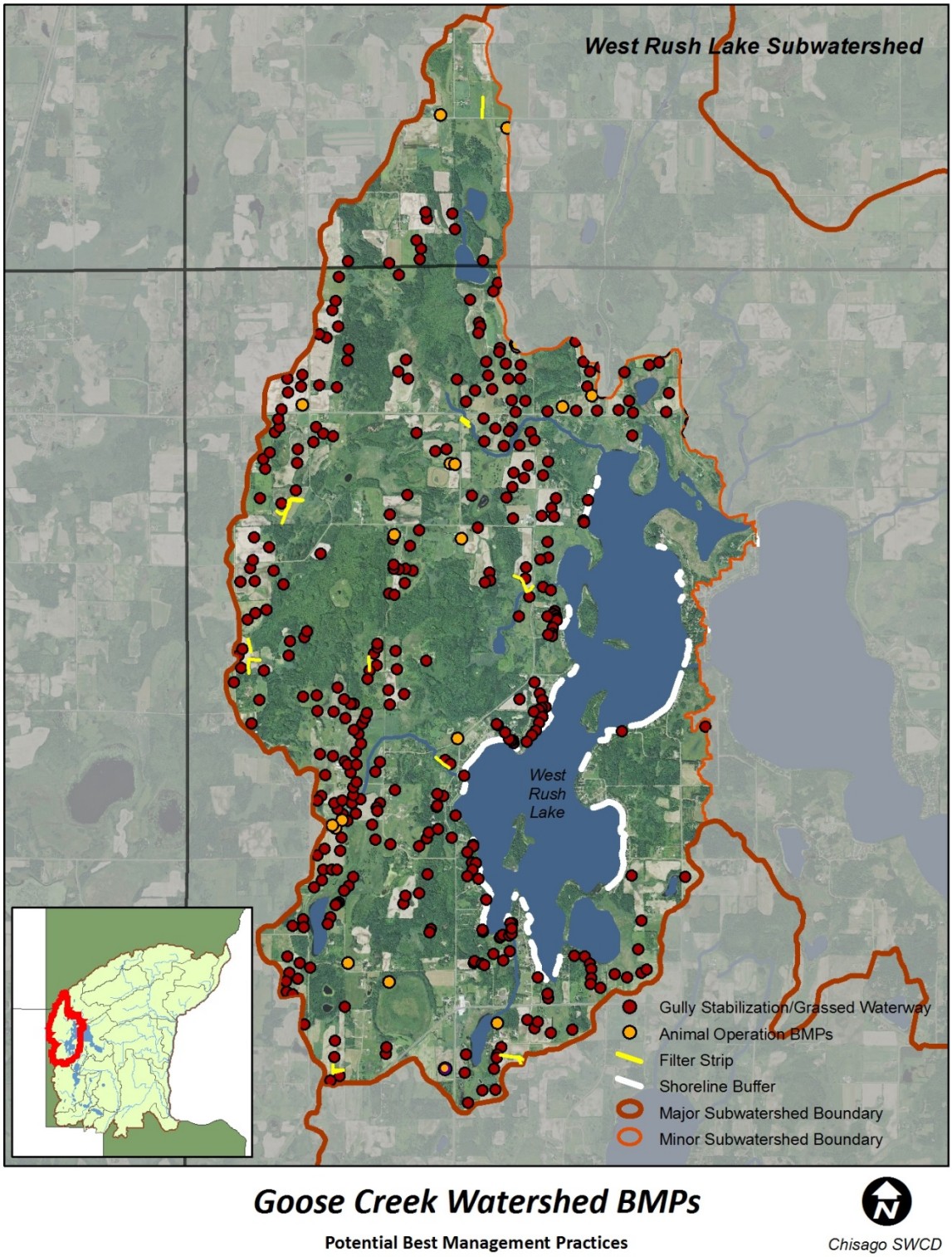


Figure 15. West Rush Lake Watershed Potential BMPs

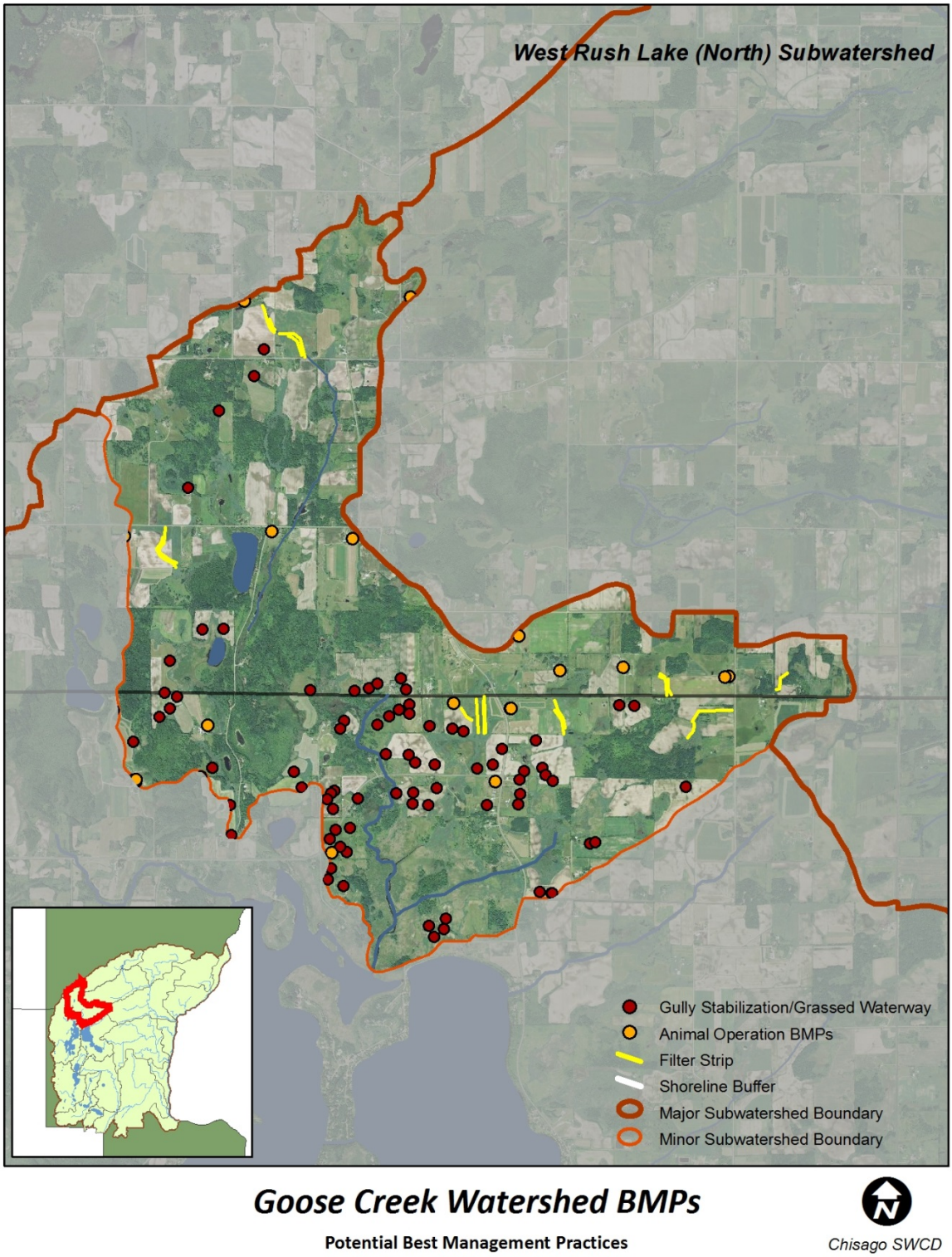


Figure 16. West Rush Lake North Watershed Potential BMPs

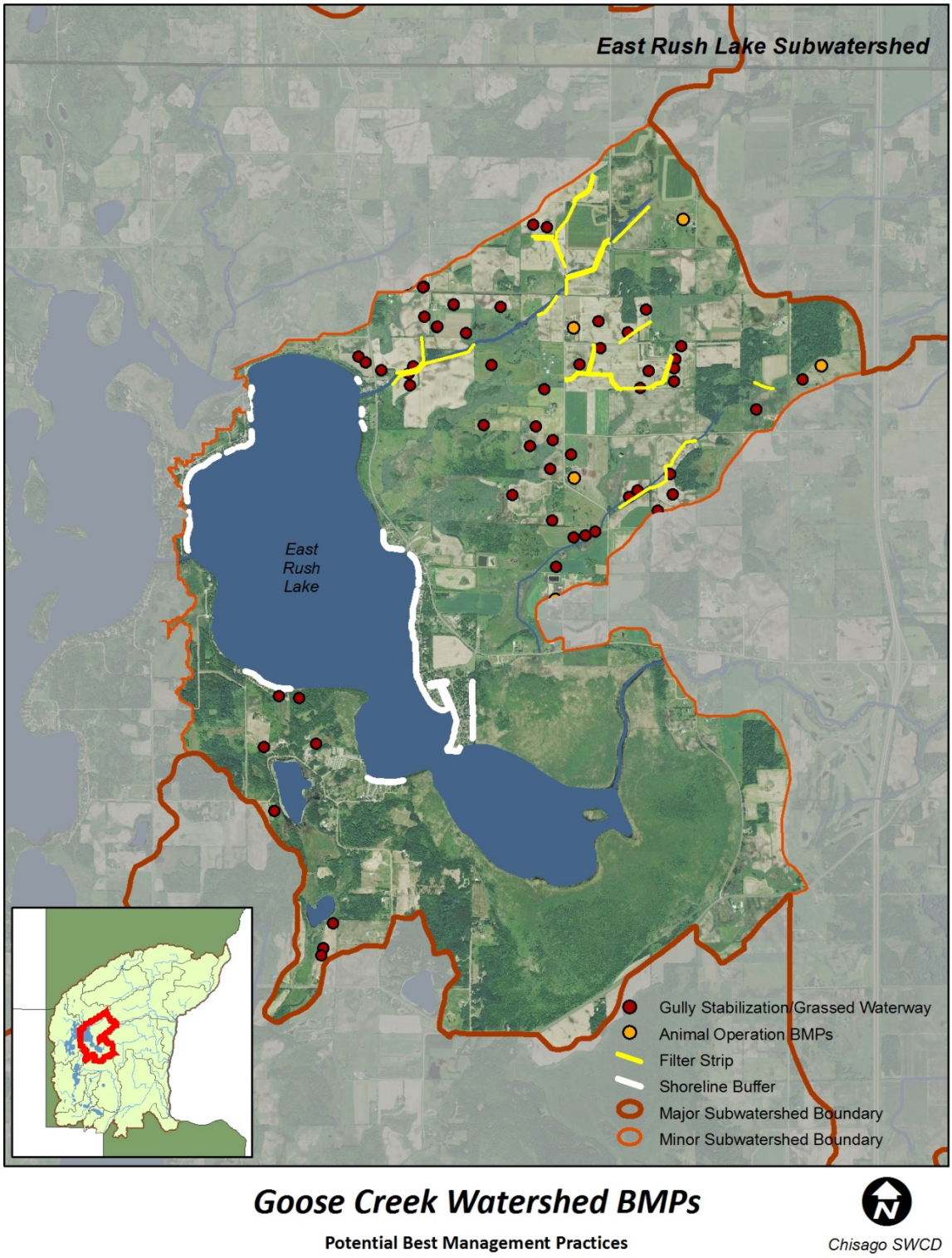


Figure 17. East Rush Lake Watershed Potential BMPs

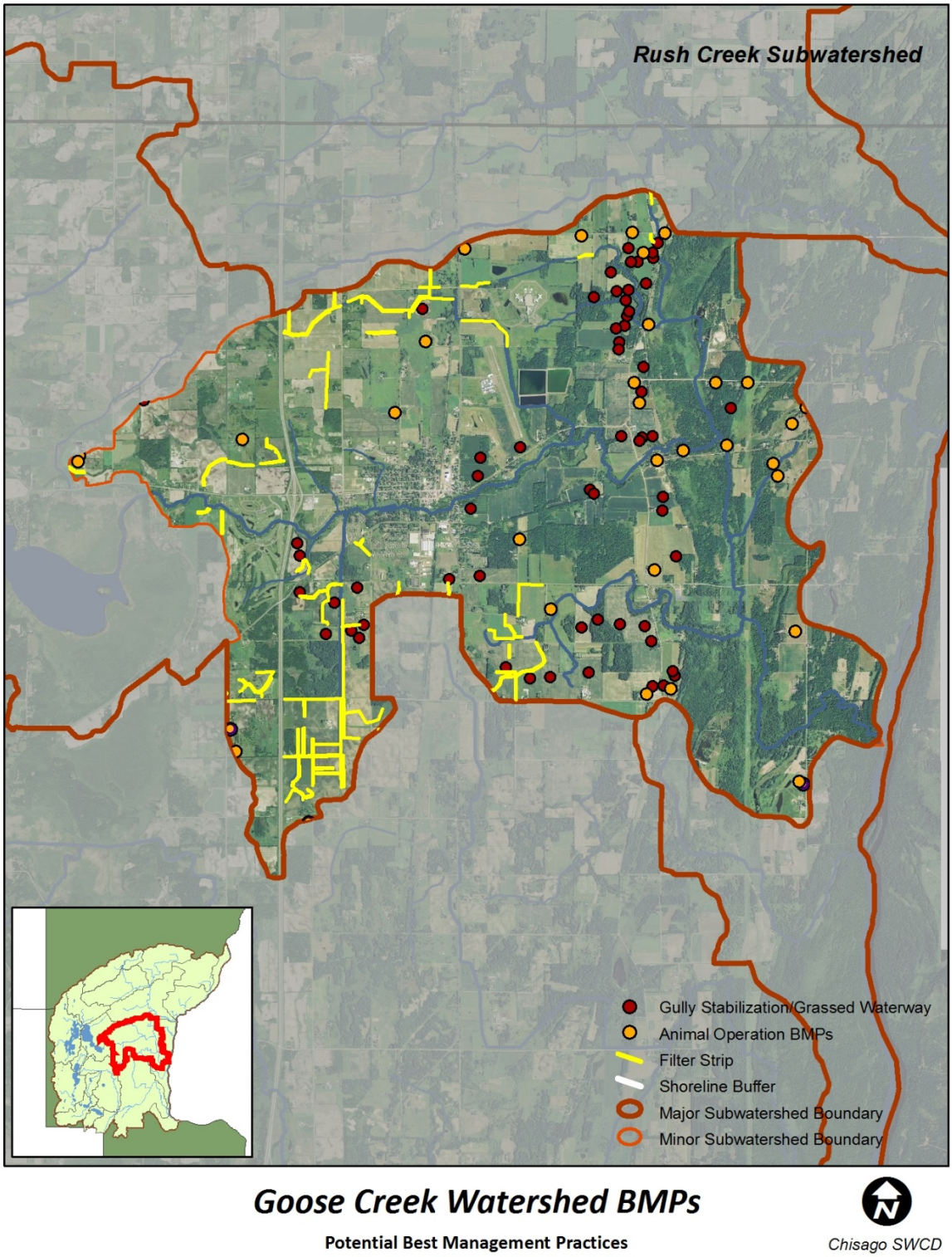


Figure 18. Rush Creek Watershed Potential BMPs

Table 18. West Rush Lake Implementation Project Table

RUSH LAKE WEST IMPLEMENTATION ACTIVITES CURRENT TP = 65 µg/L		Treated Area [ac]	Treated Area [% Watershed]	Estimated TP Load Reduction [lb P/yr]	Estimated TP Load Reduction [% Total Needed]	Potential Granting Organization	Project Partners	Estimated 30-year Costs
IN-LAKE	**Load Reduction Needed:**			**1,679**				
	Load Reduction Achieved:			**1,447**	**37.9%**			
Trophic state alteration	Including, but not limited to, carp management and/or curly-leaf pondweed management.			1,447	37.9%			
WATERSHED	**Load Reduction Needed:**			**2,137**				
	Load Reduction Achieved:			**671**	**17.6%**			
Biofilters	Shoreline buffers (24,729 feet total)	57	0.4%	9	0.2%	NRCS; CWF	NRCS; SWCD; LA; LO	$-$$
	Filter strips (27,732 feet total)	127	0.9%	19	0.5%			
Lawn management	Maintaining turfgrass and preventing transport of leaves and clippings on 25% of all parcels	59	0.4%	4	0.1%	Existing programs	City; SWCD; LA	$$
Septic system upgrades	Convert all failing to conforming	N/A	N/A	76	2.0%	CWF	County; Cities; LO	$
	Convert all ITPHSS to conforming (completed)	N/A	N/A	43	1.1%		County, LO	
Bioretention & Infiltration	Infiltration basins and large bioretention facilities (equivalent to one individual rain gardens on 10% of all parcels, or 47)	N/A	N/A	24	0.6%	CWF	SWCD; LA; LO	$$-$$$
Erosion control	Gully stabilization	N/A	N/A	444	11.6%	NRCS; CWF; City	NRCS; SWCD; City; LO	$$
Agricultural BMPs	Collection, storage, and treatment of manure (assumes 75% reduction of load)	N/A	N/A	9	0.2%	NRCS; Ag BMP; CWF	NRCS; SWCD; LO	$-$$
	10% of cropland converted to conservation tillage	285	2.0%	43	1.1%	NRCS; Ag BMP	NRCS; SWCD; LO	Variable
TOTAL	**Load Reduction Needed:**			**3,816**				
	Load Reduction Achieved:			**2,118**	**55.5%**			

Symbol key

Ag BMP	MDA Agricultural BMP Loan Program	LO	Landowners	$ < $500/lb TP removed/yr
CWF	Clean Water Fund	NRCS	Natural Resources Conservation Service	$$ = $500-$1500/lb TP removed/yr
CWP	Clean Water Partnerships/ 319 Grants	SWCD	Soil and Water Conservation District	$$$ > $1500 lb TP removed/yr
LA	Lake Associations			

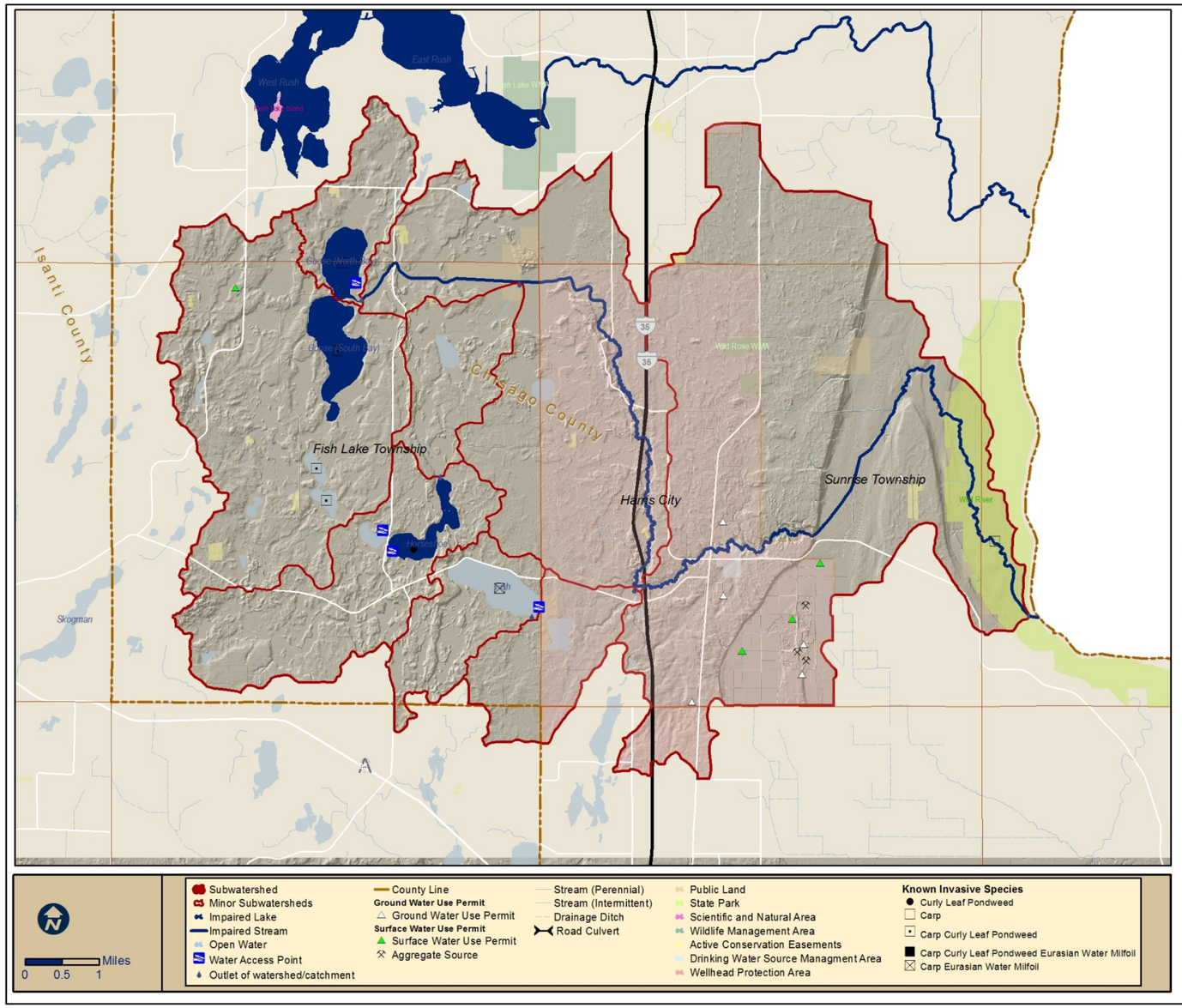
Table 19. East Rush Lake Implementation Project Table

RUSH LAKE EAST IMPLEMENTATION ACTIVITES CURRENT TP = 61 µg/L		Treated Area [ac]	Treated Area [% Watershed]	Estimated TP Load Reduction [lb P/yr]	Estimated TP Load Reduction [% Total Needed]	Potential Granting Organization	Project Partners	Estimated 30-year Costs
IN-LAKE	**Load Reduction Needed:**			**890**				
	Load Reduction Achieved:			**890**	**31.3%**			
Trophic state alteration	Including, but not limited to, carp management and/or curly-leaf pondweed management.			890	31.3%			
WATERSHED	**Load Reduction Needed:**			**1,236**				
	Load Reduction Achieved:			**216**	**7.6%**			
Biofilters	Shoreline buffers (18,616 feet total)	43	0.8%	8	0.3%	NRCS; CWF	NRCS; SWCD; LA; LO	$-$$
	Filter strips (32,709 feet total)	150	2.7%	27	0.9%			
Lawn management	Maintaining turfgrass and preventing transport of leaves and clippings on 25% of all parcels	35	0.6%	2	0.1%	Existing programs	City; SWCD; LA	$$
Septic system upgrades	Convert all failing to conforming	N/A	N/A	43	1.5%	CWF	County; Cities; LO	$
	Convert all ITPHSS to conforming (completed)	N/A	N/A	19	0.7%		County, LO	
Bioretention & Infiltration	Infiltration basins and large bioretention facilities (equivalent to one individual rain gardens on 10% of all parcels, or 28)	N/A	N/A	14	0.5%	CWF	SWCD; LA; LO	$$-$$$
Erosion control	Gully stabilization	N/A	N/A	59	2.1%	NRCS; CWF; City	NRCS; SWCD; City; LO	$$
Agricultural BMPs	Collection, storage, and treatment of manure (assumes 75% reduction of load)	N/A	N/A	20	0.7%	NRCS; Ag BMP; CWF	NRCS; SWCD; LO	$-$$
	10% of cropland converted to conservation tillage	136	2.4%	24	0.8%	NRCS; Ag BMP	NRCS; SWCD; LO	Variable
TOTAL	**Load Reduction Needed:**			**2,847**				
	Load Reduction Achieved:			**1,827**	**64.2%**			

Symbol key

Ag BMP	MDA Agricultural BMP Loan Program	LO	Landowners	$ < $500/lb TP removed/yr
CWF	Clean Water Fund	NRCS	Natural Resources Conservation Service	$$ = $500-$1500/lb TP removed/yr
CWP	Clean Water Partnerships/ 319 Grants	SWCD	Soil and Water Conservation District	$$$ > $1500 lb TP removed/yr
LA	Lake Associations			

Goose Lake and Goose Creek



Goose Creek WRAPS	
Subwatershed Name	**Goose Creek**
Major Watershed Name	Lower St. Croix
Area (sq. miles)	70
% Slope (avg.)	2.4
# of Animals	1,077
Permitted Waste Discharges	Harris
Impaired Lake Shoreline Septics	346
Dominant Hydrologic Soil Group	B
STEPL TP Load (lb/ac/yr)	0.42
STEPL Sediment Load (lb/ac/yr)	210
TMDL TP Load Estimate (lb/yr)	18,730
Subwatershed Land Cover	
Developed	6.4 %
Forested	21.0 %
Cropland	22.8 %
Grassland	28.4 %
Wetlands	18.0 %
Open Water	3.5 %
Watershed Entities	
Chisago SWCD, Chisago County, Harris, Nessel Township, Fish Lake Township, North Sunrise Township	
Major Water Resources	
Goose (North Bay), Goose (South Bay), Mandall, Rabour, Mandall, Horseshoe, Fish, Little Horseshoe , Goose Creek	
Impairments	
Excess Nutrients - Phosphorus, 1 stream E. coli, 1 stream fish bioassessment	
Aquatic Invasive Species	
Curly leaf pondweed, Carp	
Next Downstream Waterbody/Subwatershed	
St. Croix River	

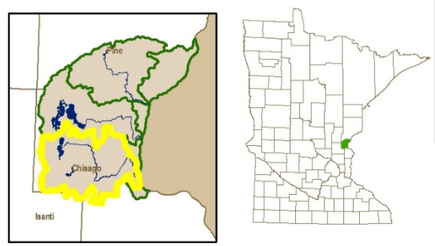


Figure 19. Goose Lake and Goose Creek Watershed Protection Considerations Map

Table 20: Goose Lake and Goose Creek Watershed Implementation Strategies and Actions

Subwatershed	Waterbody and Location: Waterbody (ID)	Waterbody and Location: Waterbody Name	Waterbody and Location: **Location** and Upstream Influence Counties	Parameter (incl. non-pollutant stressors)	Water Quality: Current Conditions	Water Quality: Goals / Targets and Estimated % Reduction	Strategies (see key below)	Strategy types and estimated scale of adoption needed to meet final water quality target	Interim 10-yr Milestones	Governmental Units with Primary Responsibility: Lake Assn	Chis. SWCD	Pine SWCD	MPCA	Chisago Co.	Pine County	USDA NRCS	City	DNR	Estimated Year to Achieve Water Quality Target
Goose Creek	07030005-510	Goose Creek, Headwaters to St. Croix River	Chisago	Bacteria (E. coli)	Monthly geometric means = 9 - 334 org/100mL	All monthly geometric means < 126 org/100mL	**Improve livestock and manure management**	Rotational grazing plans or livestock exclusion watershed-wide	Inventory all properties with livestock. Complete 1 feedlot project.		x					x			2040
								All MN R. ch. 7020 manure spreading setbacks are met	Ongoing				x						
								Total containment of manure storage	10% completed		x					x			
								Fix all open lot runoff problems per 7020 rules and open lot agreement	Inventory all feedlots within watershed.		x					x			
							Improve urban stormwater management [to reduce runoff of bacteria]	Promote pet waste receptacles and educate on proper disposal techniques.	Install pet waste receptacles in 2 public parks.		x		x	x			x		
								Buffers/riparian plantings in highest priority areas	Yr 4: ID problem areas. Yr 10: 10% completed		x					x			
							Address failing septic systems	Replace all systems deemed Imminent Threat to Public Health because of surface water discharges	All upgrades completed				x						
								Upgrade failing septic systems (systems that do not meet 3 feet of separation)	Upgrade 10 failing systems				x						
							Reduce Industrial/Municipal wastewater TP	Meet TMDL waste load allocations at all discharge sites	Permit compliance				x				x		
								Reduce frequency/magnitude of bypasses	Reduce frequency/magnitude of bypasses				x				x		
Goose Creek	07030005-729	Unnamed Creek, Headwaters to St. Croix River	Chisago	Phosphorus, Sediment, Bacteria	--	Maintain or improve	**Improve upland/field surface runoff controls** [to reduce or intercept farm field erosion]	50-ft buffers on all streams, 16.5-ft buffers on all public water ditches, and all buffer requirements met. See BMP maps for potential locations.	Buffers on 100% of streams by 2017 and public water ditches by 2018		x					x			Ongoing
								Rotational grazing plans or livestock exclusion watershed-wide	20% completed		x					x			
								Install WASCOBs and Grassed Waterways to control runoff. See BMP maps for potential locations.	Inventory all concentrated runoff paths. Install 7 projects.		x					x			
							Reduce bank/bluff/ravine erosion	Identify and stabilize all gullies within subwatershed. See BMP maps for potential locations.	Inventory all gullies. Install 2 gully stabilization projects.		x					x			
							Increase vegetative cover/root duration	Cover crops on 20% of short-season crops and all fallow land.	100 acres completed		x					x			
								Perennial vegetation on 22% of watershed (an increase of54%).	Increase perennial vegetation on 40 acres.		x					x			
							Prevent feedlot runoff	Fix all open lot runoff problems per 7020 rules and open lot agreement.	Inventory all feedlots within watershed. 1 open lot fix completed.		x		x			x			
							Improve fertilizer and manure application management	Apply fertilizer and manure based on soil test recommendations for optimal crop growth.	Promote soil testing and nutrient management planning.		x					x			

Subwatershed	Waterbody and Location			Parameter (incl. non-pollutant stressors)	Water Quality		Strategies (see key below)	Strategy types and estimated scale of adoption needed to meet final water quality target	Interim 10-yr Milestones	Governmental Units with Primary Responsibility									Estimated Year to Achieve Water Quality Target
	Waterbody (ID)	Waterbody Name	**Location** and Upstream Influence Counties		Current Conditions	Goals / Targets and Estimated % Reduction				Lake Assn	Chis. SWCD	Pine SWCD	MPCA	Chisago Co.	Pine County	USDA NRCS	City	DNR	
							Address failing septic systems	Replace all systems deemed Imminent Threat to Public Health because of surface water discharges	All upgrades completed					x					
								Upgrade failing septic systems (systems that do not meet 3 feet of separation)	Identify failing systems in shoreline district					x					
Goose Creek	07030005-741	Unnamed Creek, Headwaters to Goose Lake	Chisago	Phosphorus, Sediment, Bacteria	--	Maintain or improve	**Improve upland/field surface runoff controls** [to reduce or intercept farm field erosion]	50-ft buffers on all streams, 16.5-ft buffers on all public water ditches, and all buffer requirements met. See BMP maps for potential locations.	Buffers on 100% of streams by 2017 and public water ditches by 2018		x					x			Ongoing
								Rotational grazing plans or livestock exclusion watershed-wide	20% completed		x					x			
								Install WASCOBs and Grassed Waterways to control runoff. See BMP maps for potential locations.	Inventory all concentrated runoff paths. Install 7 projects.		x					x			
							Reduce bank/bluff/ravine erosion	Identify and stabilize all gullies within subwatershed. See BMP maps for potential locations.	Inventory all gullies. Install 2 gully stabilization projects.		x					x			
							Increase vegetative cover/root duration	Cover crops on 20% of short-season crops and all fallow land.	100 acres completed		x					x			
								Perennial vegetation on 22% of watershed (an increase of54%).	Increase perennial vegetation on 40 acres.		x					x			
							Prevent feedlot runoff	Fix all open lot runoff problems per 7020 rules and open lot agreement.	Inventory all feedlots within watershed. 1 open lot fix completed.		x		x			x			
							Improve fertilizer and manure application management	Apply fertilizer and manure based on soil test recommendations for optimal crop growth.	Promote soil testing and nutrient management planning.		x					x			
							Address failing septic systems	Replace all systems deemed Imminent Threat to Public Health because of surface water discharges	All upgrades completed					x					
								Upgrade failing septic systems (systems that do not meet 3 feet of separation)	Identify failing systems in shoreline district					x					
Goose Creek	13-0073-00	Horseshoe Lake	Chisago	Phosphorus	Growing Season Average TP = 53 µg/L	Growing Season Average TP < 40 µg/L	**Improve upland/field surface runoff controls** [to reduce or intercept farm field erosion]	50-ft buffers on all streams, 16.5-ft buffers on all public water ditches, and all buffer requirements met. See BMP maps for potential locations.	Buffers on 100% of streams by 2017 and public water ditches by 2018.		x					x		x	
								Rotational grazing plans or livestock exclusion watershed-wide	10% completed		x					x			2040
								Install WASCOBs and Grassed Waterways to control runoff. See BMP maps for potential locations.	Inventory all concentrated runoff paths.		x					x			
							Reduce bank/bluff/ravine erosion	Identify and stabilize all gullies within subwatershed. See BMP maps for potential locations.	Inventory all gullies.		x					x			

Subwatershed	Waterbody and Location			Parameter (incl. non-pollutant stressors)	Water Quality		Strategies (see key below)	Strategy types and estimated scale of adoption needed to meet final water quality target	Interim 10-yr Milestones	Governmental Units with Primary Responsibility									Estimated Year to Achieve Water Quality Target
	Waterbody (ID)	Waterbody Name	**Location** and Upstream Influence Counties		Current Conditions	Goals / Targets and Estimated % Reduction				Lake Assn	Chis. SWCD	Pine SWCD	MPCA	Chisago Co.	Pine County	USDA NRCS	City	DNR	
							Increase vegetative cover/root duration	Cover crops on 20% of short-season crops and all fallow land.	80 acres completed		x					x			
								Perennial vegetation on 35% of watershed ag land (an increase of 5%).	Increase perennial vegetation on 30 acres		x					x			
							Prevent feedlot runoff	Fix all open lot runoff problems per 7020 rules and open lot agreement.	3 open lot fixes completed		x		x			x			
							Improve fertilizer and manure application management	Fix all open lot runoff problems per 7020 rules and open lot agreement. Apply fertilizer and manure based on soil test recommendations for optimal crop growth.	3 open lot fixes completed Promote soil testing and nutrient management planning.		x		x			x			
							Address failing septic systems	Replace all systems deemed Imminent Threat to Public Health because of surface water discharges	All upgrades completed					x					
								Upgrade failing septic systems (systems that do not meet 3 feet of separation)	Identify failing systems in shoreline district					x					
							Improve forestry management	Increase aforestation by 10% on high priority and steep agricultural fields	Convert five acres of cropland to forest.		x					x			x
							Reduce Industrial/Municipal wastewater TP	Meet TMDL waste load allocations at all discharge sites	Permit compliance				x				x		
								Reduce frequency/magnitude of bypasses	Reduce frequency/magnitude of bypasses				x				x		
							Improve urban/rural stormwater management [to reduce runoff of TP]	Install infiltration basins on 10% of parcels. See Lake implementation tables.	Install 1 rain garden	x	x								
								Install shoreline restoration/lakeshore buffers on 4,000 feet of lakeshore. See Lake implementation tables.	Install 100 feet of buffers	x	x								
Goose Creek	13-0083-01	Goose (North Bay)	Chisago	Phosphorus	Growing Season Average TP = 170 µg/L	Growing Season Average TP < 60 µg/L	**Improve upland/field surface runoff controls** [to reduce or intercept farm field erosion]	50-ft buffers on all streams, 16.5-ft buffers on all public water ditches, and all buffer requirements met. See BMP maps for potential locations.	Buffers on 100% of streams by 2017 and public water ditches by 2018.		x					x			
								Rotational grazing plans or livestock exclusion watershed-wide	50% completed		x					x			2040
								Install WASCOBs and Grassed Waterways to control runoff. See BMP maps for potential locations.	Inventory all concentrated runoff paths. Install one project.		x					x			
							Reduce bank/bluff/ravine erosion	Identify and stabilize all gullies within subwatershed. See BMP maps for potential locations.	Inventory all gullies. Install one gully stabilization project.		x					x			
							Increase vegetative cover/root duration	Cover crops on 20% of short-season crops and all fallow land (totaling 5% of watershed)	100 acres completed		x					x			
								Perennial vegetation on 30% of watershed ag land (an increase of 5%).	Increase perennial vegetation on 30 acres		x					x			
							Prevent feedlot runoff	Fix all open lot runoff problems per 7020 rules and open lot agreement.	1 open lot fix completed		x		x			x			

Subwatershed	Waterbody and Location			Parameter (incl. non-pollutant stressors)	Water Quality		Strategies (see key below)	Strategy types and estimated scale of adoption needed to meet final water quality target	Interim 10-yr Milestones	Governmental Units with Primary Responsibility									Estimated Year to Achieve Water Quality Target
	Waterbody (ID)	Waterbody Name	**Location** and Upstream Influence Counties		Current Conditions	Goals / Targets and Estimated % Reduction				Lake Assn	Chis. SWCD	Pine SWCD	MPCA	Chisago Co.	Pine County	USDA NRCS	City	DNR	
							Improve fertilizer and manure application management	Fix all open lot runoff problems per 7020 rules and open lot agreement. Apply fertilizer and manure based on soil test recommendations for optimal crop growth.	1 open lot fix completed Promote soil testing and nutrient management planning.		x		x			x			
							Address failing septic systems	Replace all systems deemed Imminent Threat to Public Health because of surface water discharges	All upgrades completed					x					
								Upgrade failing septic systems (systems that do not meet 3 feet of separation)	Identify failing systems in shoreline district					x					
							Reduce in-water loading	Rough fish management	Yr 5: Design/complete study. Yr 10: TBD	x								x	
								Curly-leaf pondweed management	Management per DNR Invasive Aquatic Plant Management permit	x								x	
							Improve forestry management	Increase aforestation by 10% on high priority and steep agricultural fields	Convert five acres of cropland to forest.		x					x		x	
							Reduce Industrial/Municipal wastewater TP	Meet TMDL waste load allocations at all discharge sites	Permit compliance				x				x		
								Reduce frequency/magnitude of bypasses	Reduce frequency/magnitude of bypasses				x				x		
							Improve urban/rural stormwater management [to reduce runoff of TP]	Install infiltration basins on 10% of parcels. See Lake implementation tables.	Install 2 rain gardens	x	x								
								Install shoreline restoration/lakeshore buffers on 4,000 feet of lakeshore. See Lake implementation tables.	Install 200 feet of buffers	x	x								
Goose Creek	13-0083-02	Goose (South Bay)	Chisago	Phosphorus	Growing Season Average TP = 55 µg/L	Growing Season Average TP < 40 µg/L	**Improve upland/field surface runoff controls** [to reduce or intercept farm field erosion]	50-ft buffers on all streams, 16.5-ft buffers on all public water ditches, and all buffer requirements met. See BMP maps for potential locations.	Buffers on 100% of streams by 2017 and public water ditches by 2018.		x					x			2040
								Rotational grazing plans or livestock exclusion watershed-wide	50% completed		x					x			
								Install WASCOBs and Grassed Waterways to control runoff. See BMP maps for potential locations.	Inventory all concentrated runoff paths. Install five projects.		x					x			
							Reduce bank/bluff/ravine erosion	Identify and stabilize all gullies within subwatershed. See BMP maps for potential locations.	Inventory all gullies. Install 3 gully stabilization projects.		x					x			
							Increase vegetative cover/root duration	Cover crops on 20% of short-season crops and all fallow land.	150 acres completed		x					x			
								Perennial vegetation on 35% of watershed (an increase of 4%).	Increase perennial vegetation on 40 acres.		x					x			
							Prevent feedlot runoff	Fix all open lot runoff problems per 7020 rules and open lot agreement.	3 open lot fix completed		x		x			x			

Subwatershed	Waterbody and Location			Parameter (incl. non-pollutant stressors)	Water Quality		Strategies (see key below)	Strategy types and estimated scale of adoption needed to meet final water quality target	Interim 10-yr Milestones	Governmental Units with Primary Responsibility									Estimated Year to Achieve Water Quality Target
	Waterbody (ID)	Waterbody Name	**Location** and Upstream Influence Counties		Current Conditions	Goals / Targets and Estimated % Reduction				Lake Assn	Chis. SWCD	Pine SWCD	MPCA	Chisago Co.	Pine County	USDA NRCS	City	DNR	
							Improve fertilizer and manure application management	Apply fertilizer and manure based on soil test recommendations for optimal crop growth.	Promote soil testing and nutrient management planning.		x					x			
							Address failing septic systems	Replace all systems deemed Imminent Threat to Public Health because of surface water discharges	All upgrades completed					x					
								Upgrade failing septic systems (systems that do not meet 3 feet of separation)	Identify failing systems in shoreline district					x					
							Reduce in-water loading	Rough fish management	Yr 5: Design/complete study. Yr 10: TBD	x									x
								Curly-leaf pondweed management	Management per DNR Invasive Aquatic Plant Management permit	x									x
							Improve forestry management	Increase aforestation by 10% on high priority and steep agricultural fields	Convert 7 acres of cropland to forest.		x					x			x
							Reduce Industrial/Municipal wastewater TP	Meet TMDL waste load allocations at all discharge sites	Permit compliance				x					x	
								Reduce frequency/magnitude of bypasses	Reduce frequency/magnitude of bypasses				x					x	
							Improve urban/rural stormwater management [to reduce runoff of TP]	Install infiltration basins on 10% of parcels. See Lake implementation tables.	Install 10 rain gardens	x	x								
								Install shoreline restoration/lakeshore buffers on 6,700 feet of lakeshore. See Lake implementation tables.	Install 1,000 feet of buffers	x	x								
Goose Creek	13-0074-00	Mandall Lake	Chisago	Phosphorus	Unknown		**Improve upland/field surface runoff controls** [to reduce or intercept farm field erosion]	50-ft buffers on all streams, 16.5-ft buffers on all public water ditches, and all buffer requirements met. See BMP maps for potential locations.	Buffers on 100% of streams by 2017 and public water ditches by 2018.		x					x			Ongoing
								Rotational grazing plans or livestock exclusion watershed-wide	20% completed		x					x			
								Install WASCOBs and Grassed Waterways to control runoff. See BMP maps for potential locations.	Inventory all concentrated runoff paths.		x					x			
							Reduce bank/bluff/ravine erosion	Identify and stabilize all gullies within subwatershed. See BMP maps for potential locations.	Inventory all gullies.		x					x			
							Increase vegetative cover/root duration	Cover crops on 20% of short-season crops and all fallow land.	20 acres completed		x					x			
								Perennial vegetation on 35% of watershed (an increase of 4%).	Increase perennial vegetation on 10 acres.		x					x			
							Prevent feedlot runoff	Fix all open lot runoff problems per 7020 rules and open lot agreement.	1 open lot fix completed		x		x			x			
							Improve fertilizer and manure application	Apply fertilizer and manure based on soil test recommendations for optimal crop growth.	Promote soil testing and nutrient management planning.		x					x			

Subwatershed	Waterbody and Location			Parameter (incl. non-pollutant stressors)	Water Quality		Strategies (see key below)	Strategy types and estimated scale of adoption needed to meet final water quality target	Interim 10-yr Milestones	Governmental Units with Primary Responsibility									Estimated Year to Achieve Water Quality Target
	Waterbody (ID)	Waterbody Name	**Location** and Upstream Influence Counties		Current Conditions	Goals / Targets and Estimated % Reduction				Lake Assn	Chis. SWCD	Pine SWCD	MPCA	Chisago Co.	Pine County	USDA NRCS	City	DNR	
							management													
							Address failing septic systems	Replace all systems deemed Imminent Threat to Public Health because of surface water discharges	All upgrades completed					x						
								Upgrade failing septic systems (systems that do not meet 3 feet of separation)	Identify failing systems in shoreline district					x						
							Reduce in-water loading	Rough fish management. Follow Goose Lake plan.	Yr 5: Design/complete study. Yr 10: TBD	x									x	
								Curly-leaf pondweed management. Follow Goose Lake plan.	Management per DNR Invasive Aquatic Plant Management permit	x									x	
							Improve forestry management	Increase aforestation by 10% on high priority and steep agricultural fields	Convert 2 acres of cropland to forest.		x					x			x	
							Improve urban/rural stormwater management [to reduce runoff of TP]	Install infiltration basins on 10% of parcels. See Lake implementation tables.	Install five rain gardens	x	x									
								Install shoreline restoration/lakeshore buffers on 1,800 feet of lakeshore. See Lake implementation tables.	Install 100 feet of buffers	x	x								
Goose Creek	13-0079-00	Rabour Lake	Chisago	Phosphorus			**Improve upland/field surface runoff controls** [to reduce or intercept farm field erosion]	50-ft buffers on all streams, 16.5-ft buffers on all public water ditches, and all buffer requirements met. See BMP maps for potential locations.	Buffers on 100% of streams by 2017 and public water ditches by 2018.		x					x				
								Rotational grazing plans or livestock exclusion watershed-wide	10% completed		x					x				Ongoing
								Install WASCOBs and Grassed Waterways to control runoff. See BMP maps for potential locations.	Inventory all concentrated runoff paths. Install 1 project.		x					x			
							Reduce bank/bluff/ravine erosion	Identify and stabilize all gullies within subwatershed. See BMP maps for potential locations.	Inventory all gullies.		x					x			
							Increase vegetative cover/root duration	Cover crops on 20% of short-season crops and all fallow land.	20 acres completed		x					x			
								Perennial vegetation on 35% of watershed (an increase of 4%).	Increase perennial vegetation on 20 acres.		x					x			
							Prevent feedlot runoff	Fix all open lot runoff problems per 7020 rules and open lot agreement.	1 open lot fix completed		x		x			x			
							Improve fertilizer and manure application management	Apply fertilizer and manure based on soil test recommendations for optimal crop growth.	Promote soil testing and nutrient management planning.		x					x			
							Address failing septic systems	Replace all systems deemed Imminent Threat to Public Health because of surface water discharges	All upgrades completed					x					
								Upgrade failing septic systems (systems that do not meet 3 feet of separation)	Identify failing systems in shoreline district					x					

Subwatershed	Waterbody and Location			Parameter (incl. non-pollutant stressors)	Water Quality		Strategies (see key below)	Strategy types and estimated scale of adoption needed to meet final water quality target	Interim 10-yr Milestones	Governmental Units with Primary Responsibility									Estimated Year to Achieve Water Quality Target
	Waterbody (ID)	Waterbody Name	**Location** and Upstream Influence Counties		Current Conditions	Goals / Targets and Estimated % Reduction				Lake Assn	Chis. SWCD	Pine SWCD	MPCA	Chisago Co.	Pine County	USDA NRCS	City	DNR	
							Reduce in-water loading	Rough fish management. Follow Goose Lake plan.	Yr 5: Design/complete study. Yr 10: TBD	x								x	
								Curly-leaf pondweed management. Follow Goose Lake plan.	Management per DNR Invasive Aquatic Plant Management permit	x								x	
							Improve forestry management	Increase aforestation by 10% on high priority and steep agricultural fields	Convert 1 acres of cropland to forest.		x					x		x	
							Reduce Industrial/Municipal wastewater TP	Meet TMDL waste load allocations at all discharge sites	Permit compliance				x						
								Reduce frequency/magnitude of bypasses	Reduce frequency/magnitude of bypasses				x						
							Improve urban/rural stormwater management [to reduce runoff of TP]	Install infiltration basins on 10% of parcels. See Lake implementation tables.	Install 1 rain garden	x	x								
								Install shoreline restoration/lakeshore buffers on 2,200 feet of lakeshore. See Lake implementation tables.	Install 100 feet of buffers	x	x								
Goose Creek	13-0068-00	Fish Lake	Chisago	Phosphorus	Unknown		**Improve upland/field surface runoff controls** [to reduce or intercept farm field erosion]	50-ft buffers on all streams, 16.5-ft buffers on all public water ditches, and all buffer requirements met. See BMP maps for potential locations.	Buffers on 100% of streams by 2017 and public water ditches by 2018.		x					x			
								Rotational grazing plans or livestock exclusion watershed-wide	10% completed		x					x			Ongoing
								Install WASCOBs and Grassed Waterways to control runoff. See BMP maps for potential locations.	Inventory all concentrated runoff paths. Install 1 project.		x					x			
							Reduce bank/bluff/ravine erosion	Identify and stabilize all gullies within subwatershed. See BMP maps for potential locations.	Inventory all gullies. Install 1 gully stabilization project.		x					x			
							Increase vegetative cover/root duration	Cover crops on 20% of short-season crops and all fallow land.	10 acres completed		x					x			
								Perennial vegetation on 35% of watershed (an increase of 4%).	Increase perennial vegetation on 10 acres.		x					x			
							Prevent feedlot runoff	Fix all open lot runoff problems per 7020 rules and open lot agreement.	1 open lot fix completed		x		x			x			
							Improve fertilizer and manure application management	Apply fertilizer and manure based on soil test recommendations for optimal crop growth.	Promote soil testing and nutrient management planning.		x					x			
							Address failing septic systems	Replace all systems deemed Imminent Threat to Public Health because of surface water discharges	All upgrades completed					x					
								Upgrade failing septic systems (systems that do not meet 3 feet of separation)	Identify failing systems in shoreline district					x					
							Reduce in-water loading	Rough fish management	Yr 5: Design/complete study. Yr 10: TBD	x								x	

Subwatershed	Waterbody and Location			Parameter (incl. non-pollutant stressors)	Water Quality		Strategies (see key below)	Strategy types and estimated scale of adoption needed to meet final water quality target	Interim 10-yr Milestones	Governmental Units with Primary Responsibility									Estimated Year to Achieve Water Quality Target
	Waterbody (ID)	Waterbody Name	**Location** and Upstream Influence Counties		Current Conditions	Goals / Targets and Estimated % Reduction				Lake Assn	Chis. SWCD	Pine SWCD	MPCA	Chisago Co.	Pine County	USDA NRCS	City	DNR	
								Curly-leaf pondweed management	Management per DNR Invasive Aquatic Plant Management permit	x								x	
							Improve forestry management	Increase aforestation by 10% on high priority and steep agricultural fields	Convert 1 acre of cropland to forest.		x					x		x	
							Reduce Industrial/Municipal wastewater TP	Meet TMDL waste load allocations at all discharge sites	Permit compliance				x						
								Reduce frequency/magnitude of bypasses	Reduce frequency/magnitude of bypasses				x						
							Improve urban/rural stormwater management [to reduce runoff of TP]	Install infiltration basins on 10% of parcels. See Lake implementation tables.	Install 2 rain gardens	x	x								
								Install shoreline restoration/lakeshore buffers on 3,000 feet of lakeshore. See Lake implementation tables.	Install 100 feet of buffers	x	x								
Goose Creek	13-0080-00	Little Horseshoe Lake	Chisago	Phosphorus	Unknown		**Improve upland/field surface runoff controls** [to reduce or intercept farm field erosion]	50-ft buffers on all streams, 16.5-ft buffers on all public water ditches, and all buffer requirements met. See BMP maps for potential locations.	Buffers on 100% of streams by 2017 and public water ditches by 2018.		x					x			Ongoing
								Rotational grazing plans or livestock exclusion watershed-wide	10% completed		x					x			
								Install WASCOBs and Grassed Waterways to control runoff. See BMP maps for potential locations.	Inventory all concentrated runoff paths.		x					x			
							Reduce bank/bluff/ravine erosion	Identify and stabilize all gullies within subwatershed. See BMP maps for potential locations.	Inventory all gullies.		x					x			
							Increase vegetative cover/root duration	Cover crops on 20% of short-season crops and all fallow land.	10 acres completed		x					x			
								Perennial vegetation on 35% of watershed (an increase of 4%).	Increase perennial vegetation on 10 acres.		x					x			
							Prevent feedlot runoff	Fix all open lot runoff problems per 7020 rules and open lot agreement.	Ongoing		x		x			x			
							Improve fertilizer and manure application management	Apply fertilizer and manure based on soil test recommendations for optimal crop growth.	Promote soil testing and nutrient management planning.		x					x			
							Address failing septic systems	Replace all systems deemed Imminent Threat to Public Health because of surface water discharges	All upgrades completed					x					
								Upgrade failing septic systems (systems that do not meet 3 feet of separation)	Identify failing systems in shoreline district					x					
							Reduce in-water loading	Rough fish management	Yr 5: Design/complete study. Yr 10: TBD	x								x	
								Curly-leaf pondweed management	Management per DNR Invasive Aquatic Plant Management permit	x								x	

Subwatershed	Waterbody and Location			Parameter (incl. non-pollutant stressors)	Water Quality		Strategies (see key below)	Strategy types and estimated scale of adoption needed to meet final water quality target	Interim 10-yr Milestones	Governmental Units with Primary Responsibility									Estimated Year to Achieve Water Quality Target
	Waterbody (ID)	Waterbody Name	**Location** and Upstream Influence Counties		Current Conditions	Goals / Targets and Estimated % Reduction				Lake Assn	Chis. SWCD	Pine SWCD	MPCA	Chisago Co.	Pine County	USDA NRCS	City	DNR	
							Improve forestry management	Increase aforestation by 10% on high priority and steep agricultural fields	Convert 1 acre of cropland to forest.		x					x		x	
							Improve urban/rural stormwater management [to reduce runoff of TP]	Install infiltration basins on 10% of parcels. See Lake implementation tables (included in Horseshoe Lake table).	Install 1 rain garden	x	x								
								Install shoreline restoration/lakeshore buffers on 200 feet of lakeshore. See Lake implementation tables (included in Horseshoe Lake table).	Install 1 shoreline buffer	x	x								

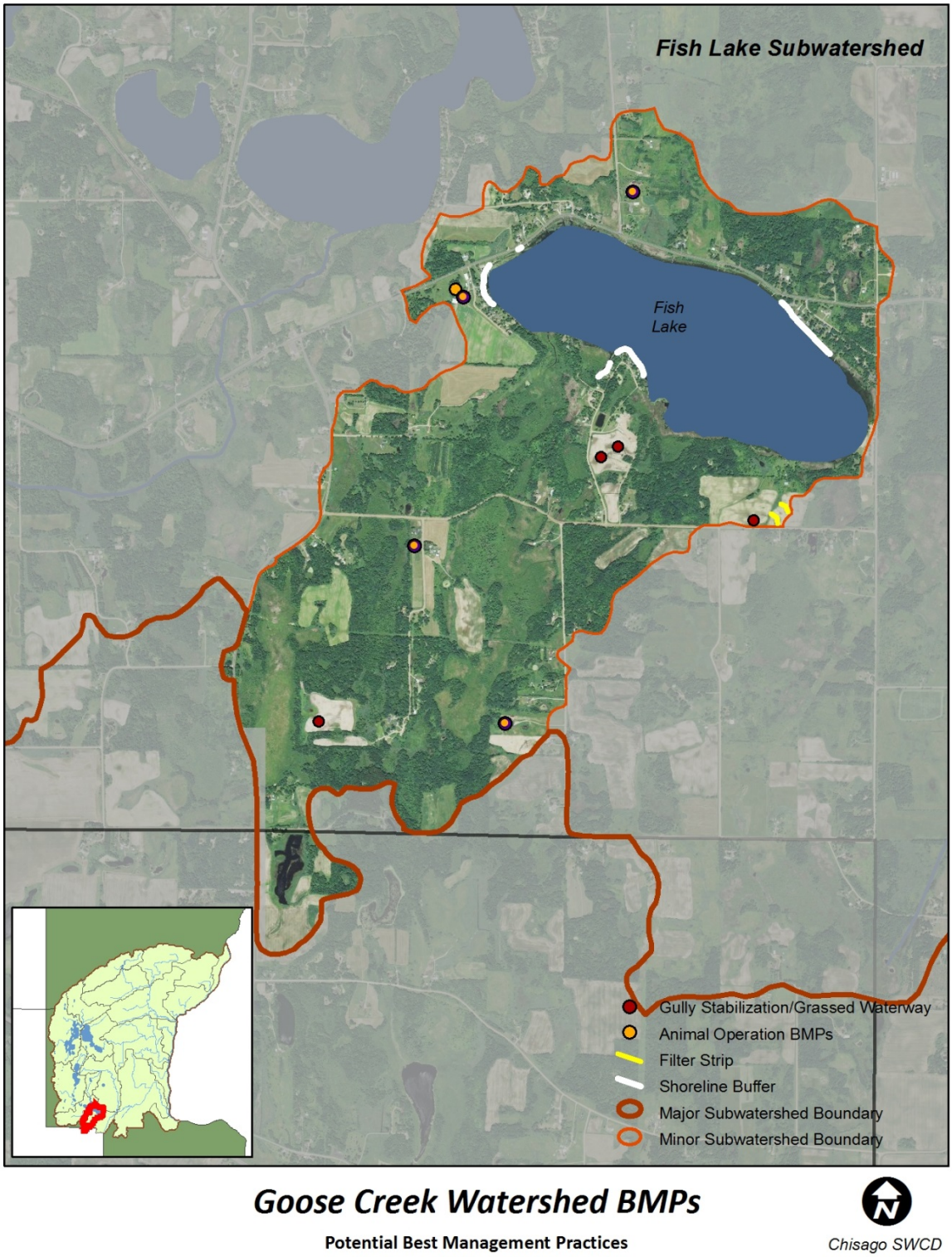


Figure 20. Fish Lake Watershed Potential BMPs

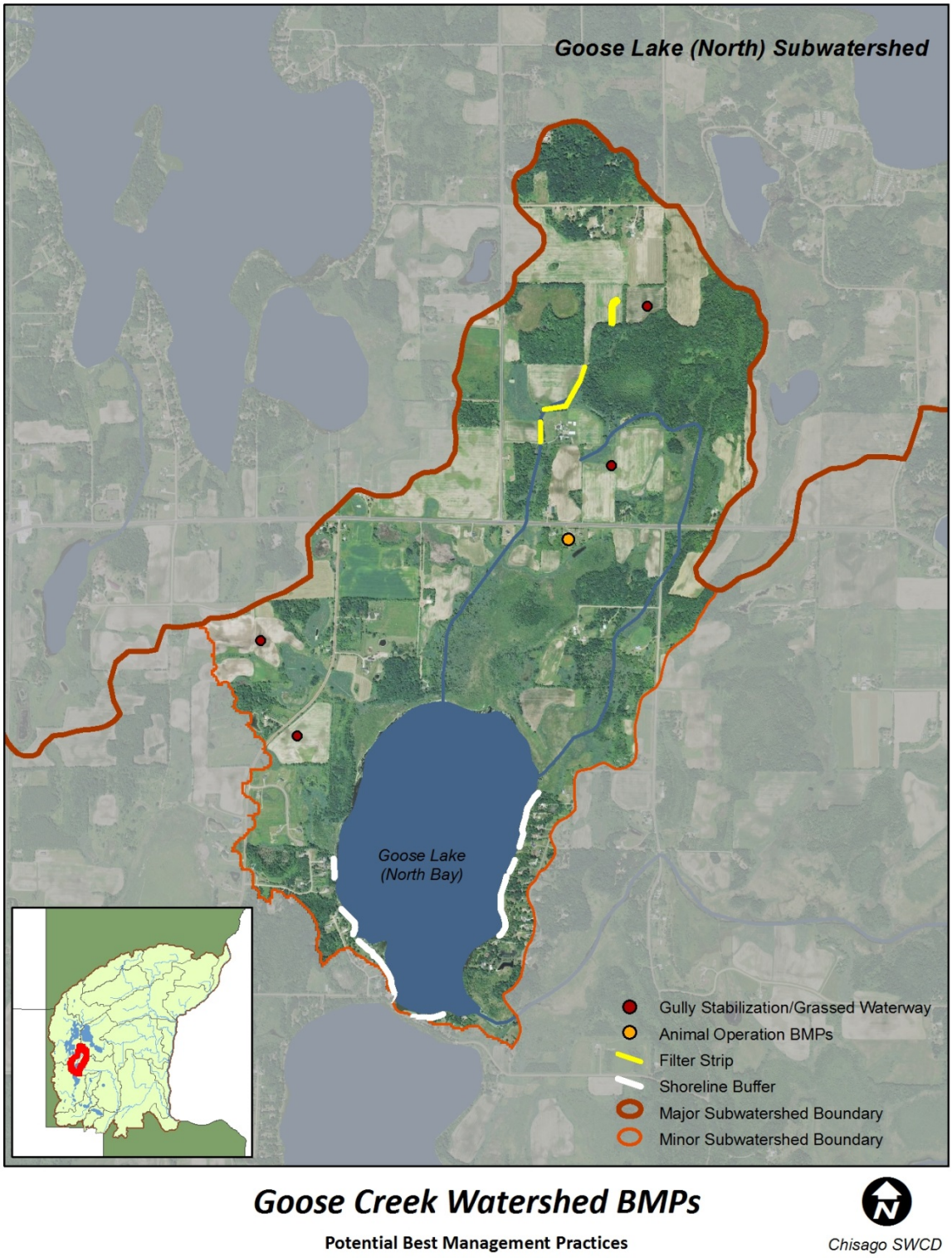


Figure 21. Goose Lake North Watershed Potential BMPs

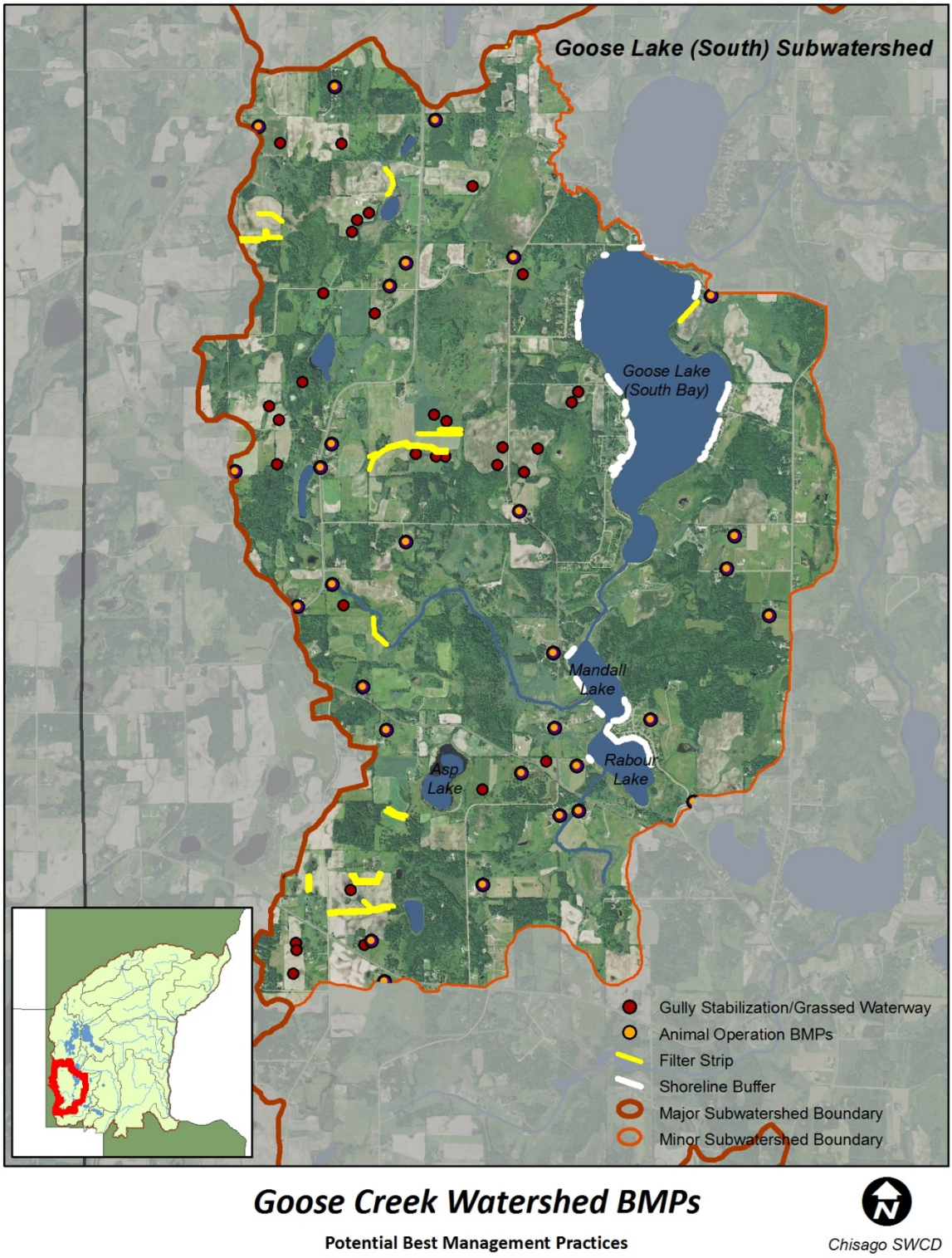


Figure 22. Goose Lake South Watershed Potential BMPs

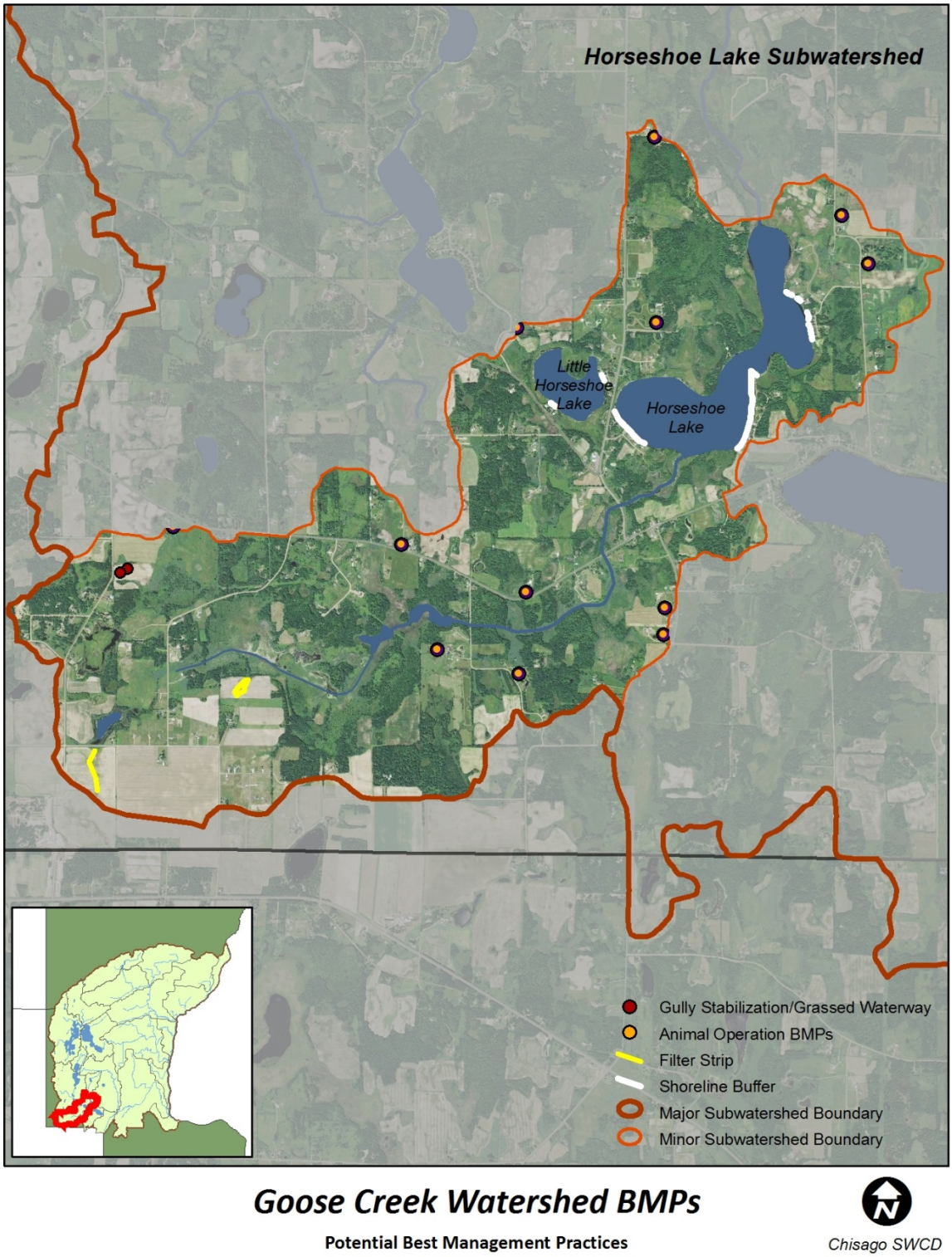


Figure 23. Horseshoe Lake Watershed Potential BMPs

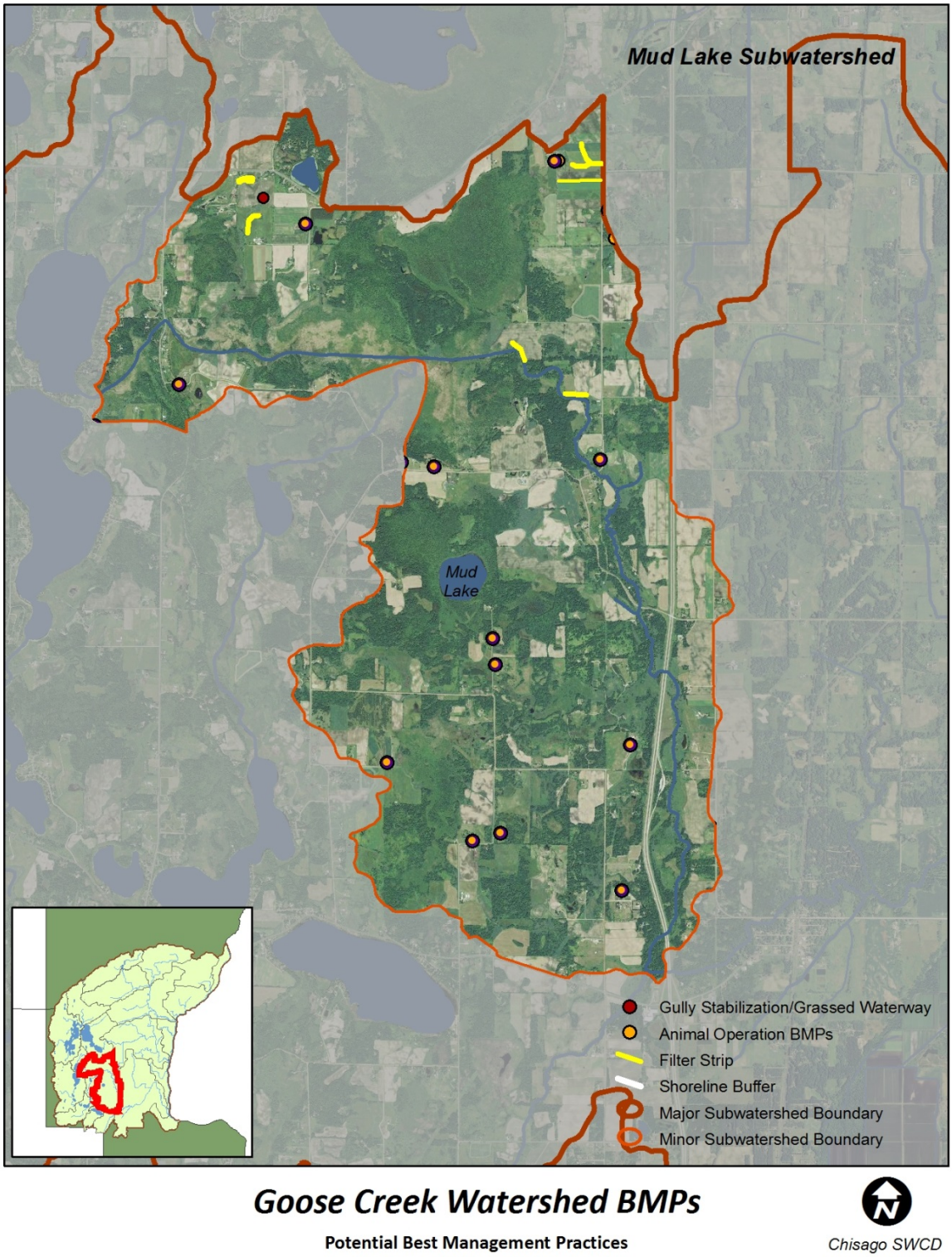


Figure 24. Mud Lake Watershed Potential BMPs

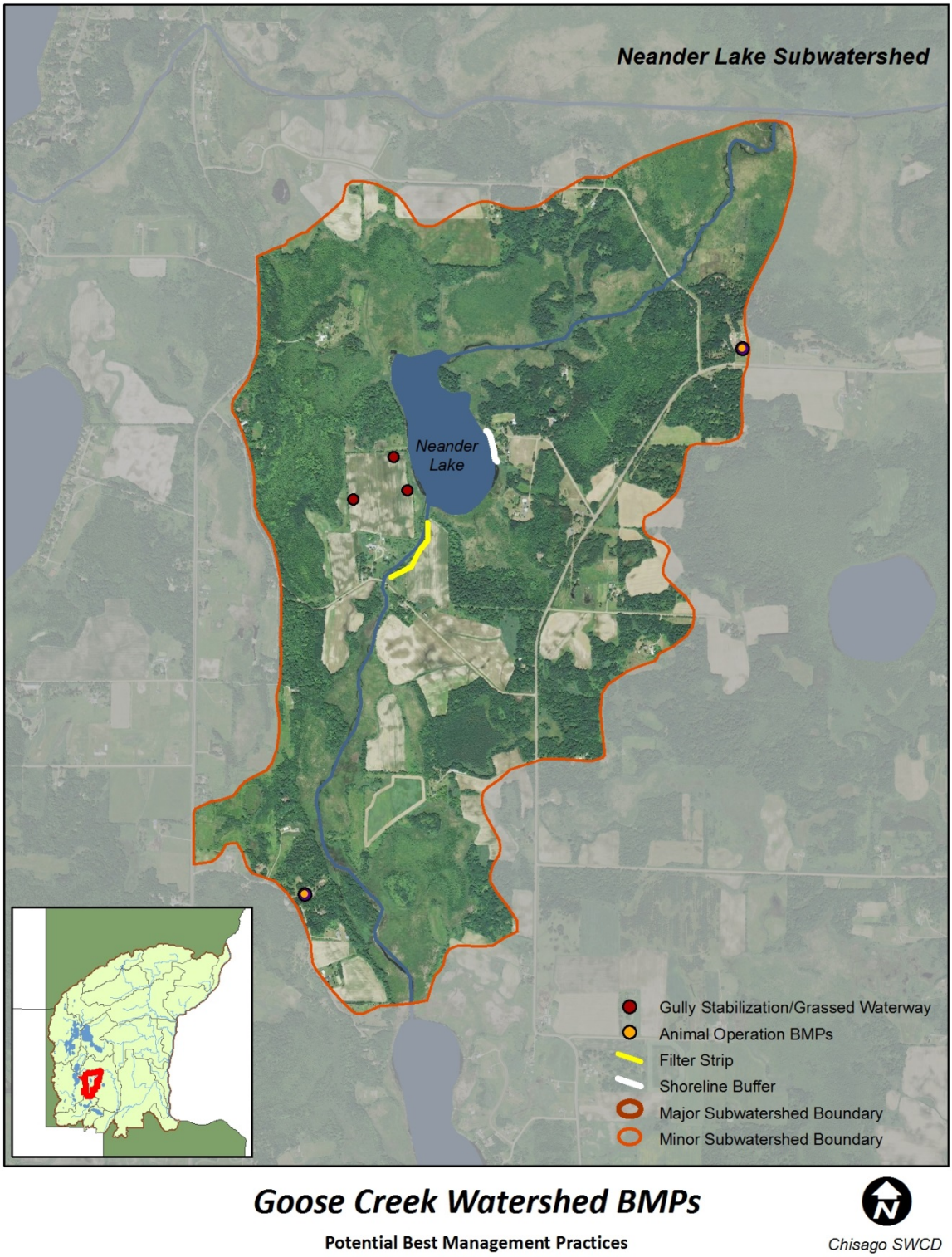


Figure 25. Neander Lake Watershed Potential BMPs

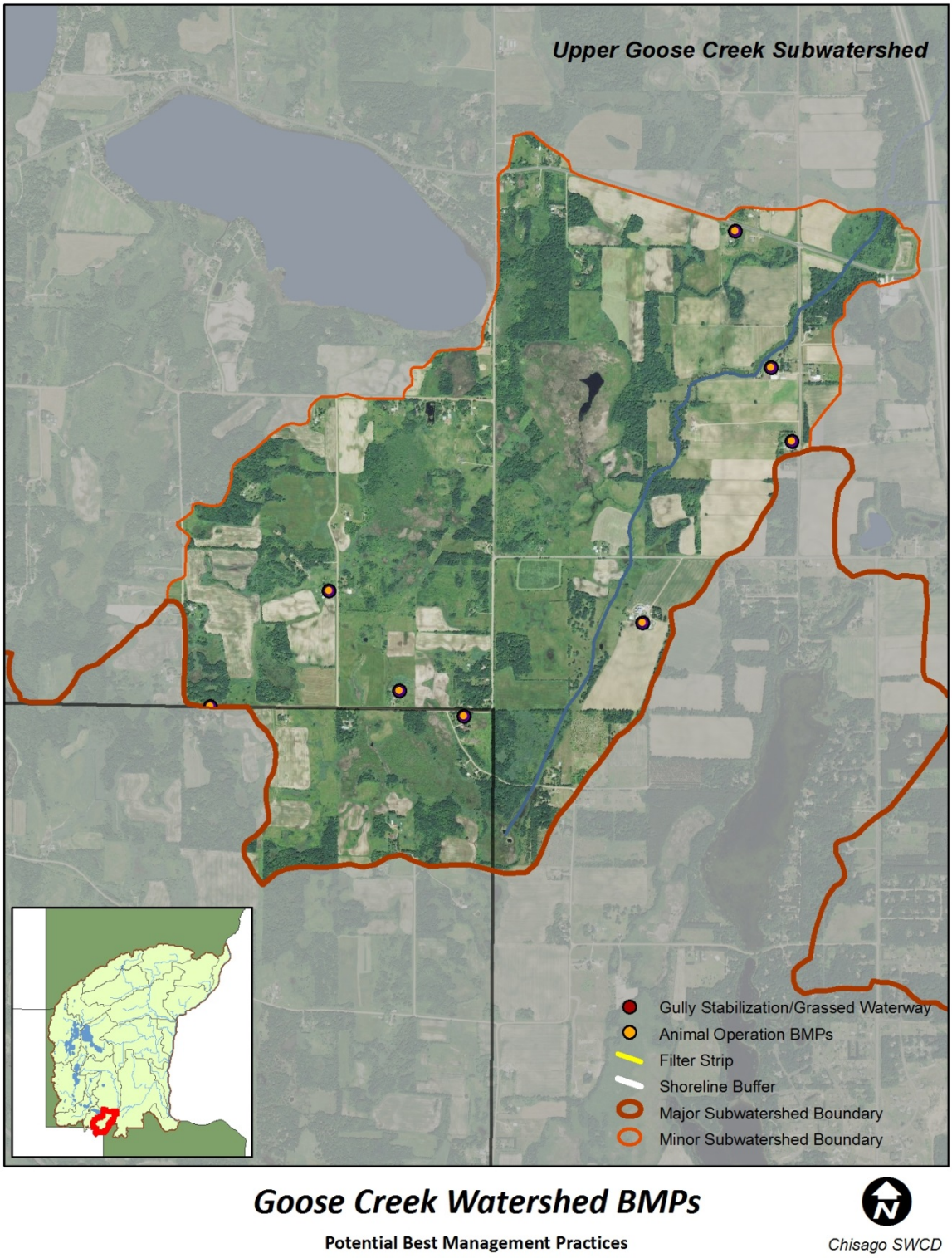


Figure 26. Upper Goose Creek Watershed Potential BMPs

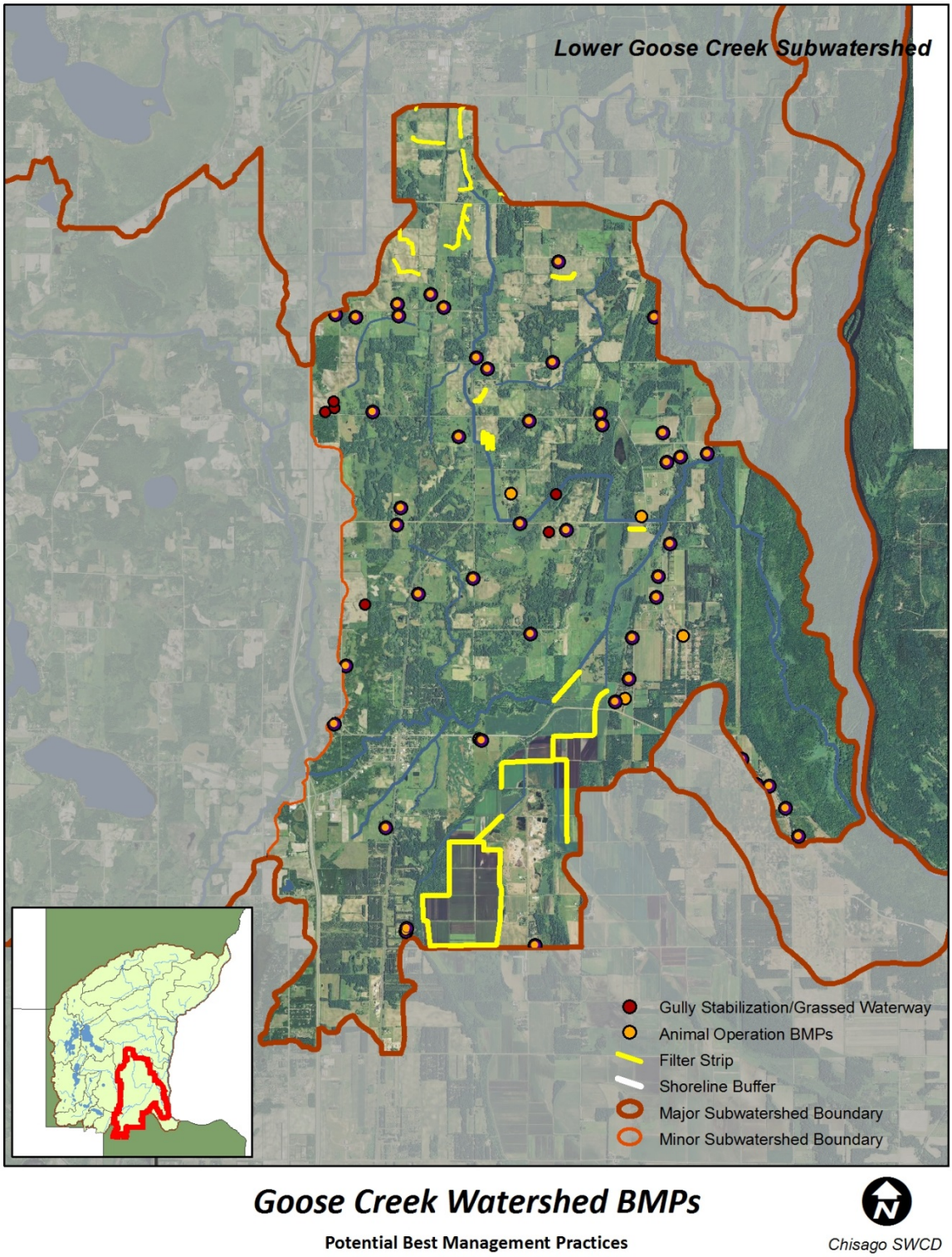


Figure 27. Lower Goose Creek Watershed Potential BMPs

Table 21. Fish Lake Implementation Project Table

FISH LAKE IMPLEMENTATION ACTIVITES CURRENT TP = 22 µg/L		Treated Area [ac]	Treated Area [% Watershed]	Estimated TP Load Reduction [lb P/yr]	Estimated TP Load Reduction [% Total Needed]	Potential Granting Organization	Project Partners	Estimated 30-year Costs
IN-LAKE	**Load Reduction Needed:**			**0**				
	Load Reduction Achieved:			**0**	**N/A**			
Trophic state alteration	Including, but not limited to, carp management and/or curly-leaf pondweed management.			0	N/A			
WATERSHED	**Load Reduction Needed:**			**0**				
	Load Reduction Achieved:			**40**	**N/A**			
Biofilters	Shoreline buffers (3,030 feet total)	7	0.5%	1	N/A	NRCS; CWF	NRCS; SWCD; LA; LO	$-$$
	Filter strips (416 feet total)	2	0.1%	0	N/A			
Lawn management	Maintaining turfgrass and preventing transport of leaves and clippings on 25% of all parcels	12	0.8%	1	N/A	Existing programs	City; SWCD; LA	$$
Septic system upgrades	Convert all failing to conforming	N/A	N/A	14	N/A	CWF	County; Cities; LO	$
	Convert all ITPHSS to conforming (completed)	N/A	N/A	12	N/A		County, LO	
Bioretention & Infiltration	Infiltration basins and large bioretention facilities (equivalent to one individual rain gardens on 10% of all parcels, or 9)	N/A	N/A	5	N/A	CWF	SWCD; LA; LO	$$-$$$
Erosion control	Gully stabilization	N/A	N/A	4	N/A	NRCS; CWF; City	NRCS; SWCD; City; LO	$$
Agricultural BMPs	Collection, storage, and treatment of manure (assumes 75% reduction of load)	N/A	N/A	1	N/A	NRCS; Ag BMP; CWF	NRCS; SWCD; LO	$-$$
	10% of cropland converted to conservation tillage	12	0.8%	2	N/A	NRCS; Ag BMP	NRCS; SWCD; LO	Variable
TOTAL	**Load Reduction Needed:**			**0**				
	Load Reduction Achieved:			**40**	**N/A**			

Symbol key

Ag BMP	MDA Agricultural BMP Loan Program	LO	Landowners	$ < $500/lb TP removed/yr
CWF	Clean Water Fund	NRCS	Natural Resources Conservation Service	$$ = $500-$1500/lb TP removed/yr
CWP	Clean Water Partnerships/ 319 Grants	SWCD	Soil and Water Conservation District	$$$ > $1500 lb TP removed/yr
LA	Lake Associations			

Table 22. Goose Lake North Implementation Project Table

GOOSE LAKE NORTH IMPLEMENTATION ACTIVITES CURRENT TP = 170 µg/L		Treated Area [ac]	Treated Area [% Watershed]	Estimated TP Load Reduction [lb P/yr]	Estimated TP Load Reduction [% Total Needed]	Potential Granting Organization	Project Partners	Estimated 30-year Costs
IN-LAKE	**Load Reduction Needed:**			**3,454**				
	Load Reduction Achieved:			**2,995**	**74.1%**			
Trophic state alteration	Including, but not limited to, carp management and/or curly-leaf pondweed management.			2,995	74.1%			
WATERSHED	**Load Reduction Needed:**			**355**				
	Load Reduction Achieved:			**33**	**0.8%**			
Biofilters	Shoreline buffers (4,739 feet total)	11	0.8%	2	0.1%	NRCS; CWF	NRCS; SWCD; LA; LO	$-$$
	Filter strips (2,231 feet total)	10	0.8%	2	0.1%			
Lawn management	Maintaining turfgrass and preventing transport of leaves and clippings on 25% of all parcels	9	0.7%	1	0.0%	Existing programs	City; SWCD; LA	$$
Septic system upgrades	Convert all failing to conforming	N/A	N/A	12	0.3%	CWF	County; Cities; LO	$
	Convert all ITPHSS to conforming (completed)	N/A	N/A	3	0.1%		County, LO	
Bioretention & Infiltration	Infiltration basins and large bioretention facilities (equivalent to one individual rain gardens on 10% of all parcels, or 7)	N/A	N/A	4	0.1%	CWF	SWCD; LA; LO	$$-$$$
Erosion control	Gully stabilization	N/A	N/A	2	0.0%	NRCS; CWF; City	NRCS; SWCD; City; LO	$$
Agricultural BMPs	Collection, storage, and treatment of manure (assumes 75% reduction of load)	N/A	N/A	1	0.0%	NRCS; Ag BMP; CWF	NRCS; SWCD; LO	$-$$
	10% of cropland converted to conservation tillage	30	2.3%	6	0.2%	NRCS; Ag BMP	NRCS; SWCD; LO	Variable
TOTAL	**Load Reduction Needed:**			**4,043**				
	Load Reduction Achieved:			**3,262**	**80.7%**			

Symbol key

Ag BMP	MDA Agricultural BMP Loan Program	LO	Landowners	$ < $500/lb TP removed/yr
CWF	Clean Water Fund	NRCS	Natural Resources Conservation Service	$$ = $500-$1500/lb TP removed/yr
CWP	Clean Water Partnerships/ 319 Grants	SWCD	Soil and Water Conservation District	$$$ > $1500 lb TP removed/yr
LA	Lake Associations			

Table 23. Goose Lake South Implementation Project Table

GOOSE LAKE SOUTH IMPLEMENTATION ACTIVITES CURRENT TP = 55 µg/L		Treated Area [ac]	Treated Area [% Watershed]	Estimated TP Load Reduction [lb P/yr]	Estimated TP Load Reduction [% Total Needed]	Potential Granting Organization	Project Partners	Estimated 30-year Costs
IN-LAKE	**Load Reduction Needed:**			**31**				
	Load Reduction Achieved:			**31**	**3.5%**			
Trophic state alteration	Including, but not limited to, carp management and/or curly-leaf pondweed management.			31	3.5%			
WATERSHED	**Load Reduction Needed:**			**596**				
	Load Reduction Achieved:			**65**	**7.2%**			
Biofilters	Shoreline buffers (6,696 feet total)	15	0.4%	2	0.3%	NRCS; CWF	NRCS; SWCD; LA; LO	$-$$
	Filter strips (7,063 feet total)	32	0.9%	5	0.6%			
Lawn management	Maintaining turfgrass and preventing transport of leaves and clippings on 25% of all parcels	6	0.2%	0	0.0%	Existing programs	City; SWCD; LA	$$
Septic system upgrades	Convert all failing to conforming	N/A	N/A	5	0.6%	CWF	County; Cities; LO	$
	Convert all ITPHSS to conforming (completed)	N/A	N/A	15	1.7%		County, LO	
Bioretention & Infiltration	Infiltration basins and large bioretention facilities (equivalent to one individual rain gardens on 10% of all parcels, or 34)	N/A	N/A	2	0.3%	CWF	SWCD; LA; LO	$$-$$$
Erosion control	Gully stabilization	N/A	N/A	20	2.2%	NRCS; CWF; City	NRCS; SWCD; City; LO	$$
Agricultural BMPs	Collection, storage, and treatment of manure (assumes 75% reduction of load)	N/A	N/A	4	0.4%	NRCS; Ag BMP; CWF	NRCS; SWCD; LO	$-$$
	10% of cropland converted to conservation tillage	60	1.7%	10	1.1%	NRCS; Ag BMP	NRCS; SWCD; LO	Variable
TOTAL	**Load Reduction Needed:**			**892**				
	Load Reduction Achieved:			**361**	**40.4%**			

Symbol key

Ag BMP	MDA Agricultural BMP Loan Program	LO	Landowners	$ < $500/lb TP removed/yr
CWF	Clean Water Fund	NRCS	Natural Resources Conservation Service	$$ = $500-$1500/lb TP removed/yr
CWP	Clean Water Partnerships/ 319 Grants	SWCD	Soil and Water Conservation District	$$$ > $1500 lb TP removed/yr
LA	Lake Associations			

Table 24. Horseshoe Lake Implementation Project Table

HORSESHOE LAKE IMPLEMENTATION ACTIVITES CURRENT TP = 53 µg/L		Treated Area [ac]	Treated Area [% Watershed]	Estimated TP Load Reduction [lb P/yr]	Estimated TP Load Reduction [% Total Needed]	Potential Granting Organization	Project Partners	Estimated 30-year Costs
IN-LAKE	**Load Reduction Needed:**			**0**				
	Load Reduction Achieved:			**0**	**N/A**			
Trophic state alteration	Including, but not limited to, carp management and/or curly-leaf pondweed management.			0	N/A			
WATERSHED	**Load Reduction Needed:**			**563**				
	Load Reduction Achieved:			**88**	**15.4%**			
Biofilters	Shoreline buffers (4,105 feet total)	9	0.3%	2	0.3%	NRCS; CWF	NRCS; SWCD; LA; LO	$-$$
	Filter strips (2,128 feet total)	10	0.3%	2	0.3%			
Lawn management	Maintaining turfgrass and preventing transport of leaves and clippings on 25% of all parcels	25	0.7%	2	0.3%	Existing programs	City; SWCD; LA	$$
Septic system upgrades	Convert all failing to conforming	N/A	N/A	35	6.1%	CWF	County; Cities; LO	$
	Convert all ITPHSS to conforming (completed)	N/A	N/A	16	2.8%		County, LO	
Bioretention & Infiltration	Infiltration basins and large bioretention facilities (equivalent to one individual rain gardens on 10% of all parcels, or 20)	N/A	N/A	10	1.7%	CWF	SWCD; LA; LO	$$-$$$
Erosion control	Gully stabilization	N/A	N/A	2	0.3%	NRCS; CWF; City	NRCS; SWCD; City; LO	$$
Agricultural BMPs	Collection, storage, and treatment of manure (assumes 75% reduction of load)	N/A	N/A	5	0.9%	NRCS; Ag BMP; CWF	NRCS; SWCD; LO	$-$$
	10% of cropland converted to conservation tillage	83	2.5%	15	2.6%	NRCS; Ag BMP	NRCS; SWCD; LO	Variable
TOTAL	**Load Reduction Needed:**			**573**				
	Load Reduction Achieved:			**98**	**17.1%**			

Symbol key

Ag BMP	MDA Agricultural BMP Loan Program	LO	Landowners	$ < $500/lb TP removed/yr
CWF	Clean Water Fund	NRCS	Natural Resources Conservation Service	$$ = $500-$1500/lb TP removed/yr
			Soil and Water Conservation	$$$ > $1500 lb TP
CWP	Clean Water Partnerships/ 319 Grants	SWCD	District	removed/yr
LA	Lake Associations			

Table 25. Mandall Lake Implementation Project Table

MANDALL LAKE IMPLEMENTATION ACTIVITES CURRENT TP = unknown		Treated Area [ac]	Treated Area [% Watershed]	Estimated TP Load Reduction [lb P/yr]	Estimated TP Load Reduction [% Total Needed]	Potential Granting Organization	Project Partners	Estimated 30-year Costs
IN-LAKE	**Load Reduction Needed:**			**0**				
	Load Reduction Achieved:			**0**	**N/A**			
Trophic state alteration	Including, but not limited to, carp management and/or curly-leaf pondweed management.			0	N/A			
WATERSHED	**Load Reduction Needed:**			**0**				
	Load Reduction Achieved:			**70**	**N/A**			
Biofilters	Shoreline buffers (1,802 feet total)	4	0.2%	1	N/A	NRCS; CWF	NRCS; SWCD; LA; LO	$-$$
	Filter strips (6,709 feet total)	31	1.4%	4	N/A			
Lawn management	Maintaining turfgrass and preventing transport of leaves and clippings on 25% of all parcels	19	0.8%	1	N/A	Existing programs	City; SWCD; LA	$$
Septic system upgrades	Convert all failing to conforming	N/A	N/A	27	N/A	CWF	County; Cities; LO	$
	Convert all ITPHSS to conforming (completed)	N/A	N/A	11	N/A		County, LO	
Bioretention & Infiltration	Infiltration basins and large bioretention facilities (equivalent to one individual rain gardens on 10% of all parcels, or X)	N/A	N/A	8	N/A	CWF	SWCD; LA; LO	$$-$$$
Erosion control	Gully stabilization	N/A	N/A	6	N/A	NRCS; CWF; City	NRCS; SWCD; City; LO	$$
Agricultural BMPs	Collection, storage, and treatment of manure (assumes 75% reduction of load)	N/A	N/A	6	N/A	NRCS; Ag BMP; CWF	NRCS; SWCD; LO	$-$$
	10% of cropland converted to conservation tillage	48	2.2%	7	N/A	NRCS; Ag BMP	NRCS; SWCD; LO	Variable
TOTAL	**Load Reduction Needed:**			**0**				
	Load Reduction Achieved:			**70**	**N/A**			

Symbol key

Ag BMP	MDA Agricultural BMP Loan Program	LO	Landowners	$ < $500/lb TP removed/yr
CWF	Clean Water Fund	NRCS	Natural Resources Conservation Service	$$ = $500-$1500/lb TP removed/yr
			Soil and Water Conservation	$$$ > $1500 lb TP
CWP	Clean Water Partnerships/ 319 Grants	SWCD	District	removed/yr
LA	Lake Associations			

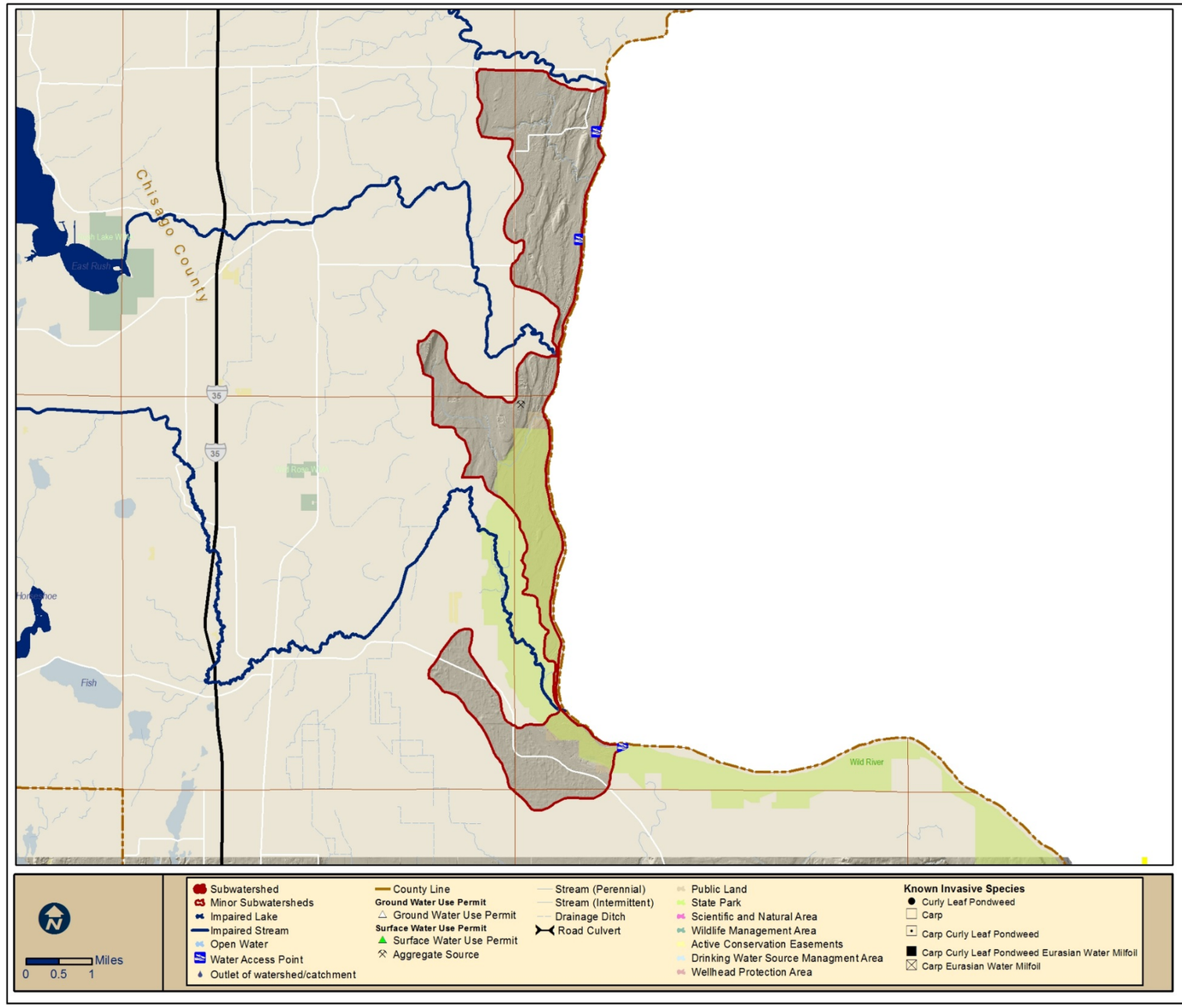
Table 26. Rabour Lake Implementation Project Table

RABOUR LAKE IMPLEMENTATION ACTIVITES CURRENT TP = unknown		Treated Area [ac]	Treated Area [% Watershed]	Estimated TP Load Reduction [lb P/yr]	Estimated TP Load Reduction [% Total Needed]	Potential Granting Organization	Project Partners	Estimated 30-year Costs
IN-LAKE	**Load Reduction Needed:**			**0**				
	Load Reduction Achieved:			**0**	**N/A**			
Trophic state alteration	Including, but not limited to, carp management and/or curly-leaf pondweed management.			0	N/A			
WATERSHED	**Load Reduction Needed:**			**0**				
	Load Reduction Achieved:			**63**	**N/A**			
Biofilters	Shoreline buffers (2,242 feet total)	5	0.4%	1	N/A	NRCS; CWF	NRCS; SWCD; LA; LO	$-$$
	Filter strips (7,799 feet total)	36	2.5%	5	N/A			
Lawn management	Maintaining turfgrass and preventing transport of leaves and clippings on 25% of all parcels	18	1.3%	1	N/A	Existing programs	City; SWCD; LA	$$
Septic system upgrades	Convert all failing to conforming	N/A	N/A	26	N/A	CWF	County; Cities; LO	$
	Convert all ITPHSS to conforming (completed)	N/A	N/A	9	N/A		County, LO	
Bioretention & Infiltration	Infiltration basins and large bioretention facilities (equivalent to one individual rain gardens on 10% of all parcels, or X)	N/A	N/A	7	N/A	CWF	SWCD; LA; LO	$$-$$$
Erosion control	Gully stabilization	N/A	N/A	6	N/A	NRCS; CWF; City	NRCS; SWCD; City; LO	$$
Agricultural BMPs	Collection, storage, and treatment of manure (assumes 75% reduction of load)	N/A	N/A	4	N/A	NRCS; Ag BMP; CWF	NRCS; SWCD; LO	$-$$
	10% of cropland converted to conservation tillage	25	1.8%	4	N/A	NRCS; Ag BMP	NRCS; SWCD; LO	Variable
TOTAL	**Load Reduction Needed:**			**0**				
	Load Reduction Achieved:			**63**	**N/A**			

Symbol key

Ag BMP	MDA Agricultural BMP Loan Program	LO	Landowners	$ < $500/lb TP removed/yr
CWF	Clean Water Fund	NRCS	Natural Resources Conservation Service	$$ = $500-$1500/lb TP removed/yr
CWP	Clean Water Partnerships/ 319 Grants	SWCD	Soil and Water Conservation District	$$$ > $1500 lb TP removed/yr
LA	Lake Associations			

Lagoo Creek



Goose Creek WRAPS	
Subwatershed Name	**Lagoo Creek - St. Croix**
Major Watershed Name	Lower St. Croix
Area (sq. miles)	12.0
% Slope (avg.)	1.9
# of Animals	107
Permitted Waste Discharges	None
Impaired Lake Shoreline Septics	N/A
Dominant Hydrologic Soil Group	A
STEPL TP Load (lb/ac/yr)	0.41
STEPL Sediment Load (lb/ac/yr)	199
TMDL TP Load Estimate (lb/yr)	5667
Subwatershed Land Cover	
Developed	4.2 %
Forested	42.8 %
Cropland	13.5 %
Grassland	12.5 %
Wetlands	22.5 %
Open Water	4.3 %
Watershed Entities	
Chisago SWCD, Chisago County, North Sunrise Township, Nessel Township	
Major Water Resources	
St. Croix River	
Impairments	
None	
Aquatic Invasive Species	
None Known	
Next Downstream Waterbody/Subwatershed	
St. Croix River	

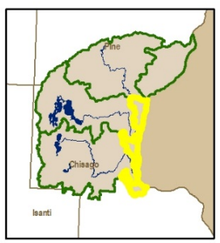


Figure 28. Lagoo Creek Watershed Protection Considerations Map

Table 27: Lagoo Creek Watershed Implementation Strategies and Actions

Subwatershed	Waterbody and Location			Parameter (incl. non-pollutant stressors)	Water Quality		Strategies (see key below)	Strategy types and estimated scale of adoption needed to meet final water quality target	Interim 10-yr Milestones	Governmental Units with Primary Responsibility									Estimated Year to Achieve Water Quality Target
	Waterbody (ID)	Waterbody Name	**Location** and Upstream Influence Counties		Current Conditions	Goals / Targets and Estimated % Reduction				Lake Assn	Chisago SWCD	Pine SWCD	MPCA	Chisago County	Pine County	USDA NRCS	City	MN NDR	
Lagoo Creek	All	All	Chisago County	Phosphorus, Sediment, Bacteria	--	Maintain or improve	**Improve upland/field surface runoff controls** [to reduce or intercept farm field erosion]	50-ft buffers on all streams, 16.5-ft buffers on all public water ditches, and all buffer requirements met. See BMP maps for potential locations.	Buffers on 100% of streams by 2017 and public water ditches by 2018.		x					x			Ongoing
								Rotational grazing plans or livestock exclusion watershed-wide	20% completed		x					x			
								Install WASCOBs and Grassed Waterways to control runoff. See BMP maps for potential locations.	Inventory all concentrated runoff paths. Install 7 projects.		x					x			
							Reduce bank/bluff/ravine erosion	Identify and stabilize all gullies within subwatershed. See BMP maps for potential locations.	Inventory all gullies. Install 2 gully stabilization projects.		x					x			
							Increase vegetative cover/root duration	Cover crops on 20% of short-season crops and all fallow land.	100 acres completed		x					x			
								Perennial vegetation on 22% of watershed (an increase of54%).	Increase perennial vegetation on 40 acres.		x					x			
							Prevent feedlot runoff	Fix all open lot runoff problems per 7020 rules and open lot agreement.	Inventory all feedlots within watershed. 1 open lot fix completed.		x		x			x			
							Improve fertilizer and manure application management	Apply fertilizer and manure based on soil test recommendations for optimal crop growth.	Promote soil testing and nutrient management planning.		x					x			
							Address failing septic systems	Replace all systems deemed Imminent Threat to Public Health because of surface water discharges	All upgrades completed					x					
								Upgrade failing septic systems (systems that do not meet 3 feet of separation)	Identify failing systems in shoreline district					x					

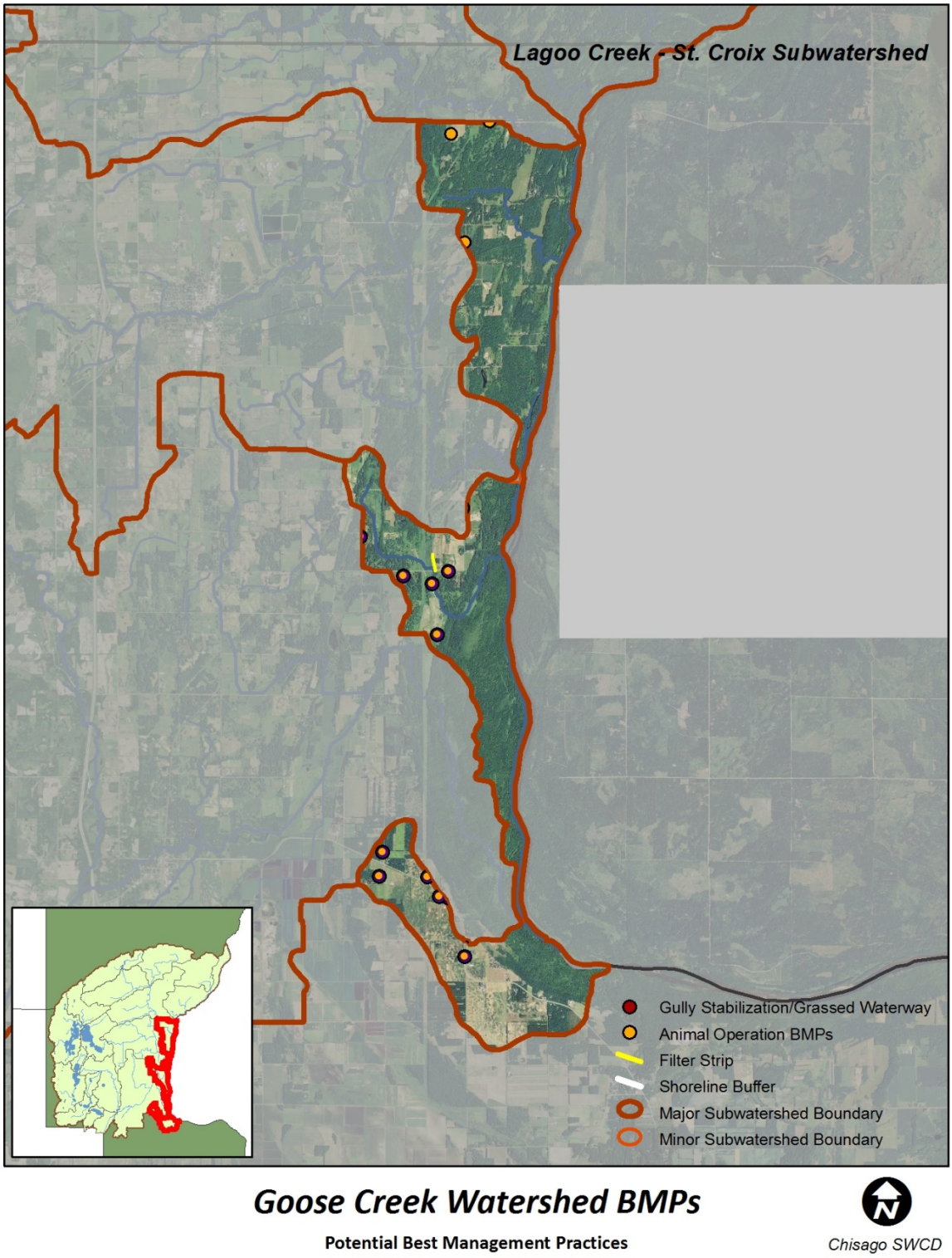


Figure 29. Lagoo Creek Watershed Potential BMPs

Table 28. Key for Strategies Colum

Parameter (incl. non-pollutant stressors)	Strategy Key	
	Description	Example BMPs/actions
TSS	Improve upland/field surface runoff controls: Soil and water conservation practices that reduce soil erosion and field runoff, or otherwise minimize sediment from leaving farmland	Cover crops
		Water and sediment basins, terraces
		Rotations including perennials
		Conservation cover easements
		Grassed waterways
		Strategies to reduce flow- some of flow reduction strategies should be targeted to ravine subwatersheds
		Residue management - conservation tillage
		Forage and biomass planting
		Open tile inlet controls - riser pipes, french drains
		Contour farming
		Wetland restoration
		Stripcropping
	Protect/stabilize banks/bluffs: Reduce collapse of bluffs and erosion of streambank by reducing peak river flows and using vegetation to stabilize these areas.	Strategies for altered hydrology (reducing peak flow)
		Streambank stabilization
		Riparian forest buffer
		Livestock exclusion - controlled stream crossings
	Stabilize ravines: Reducing erosion of ravines by dispersing and infiltrating field runoff and increasing vegetative cover near ravines. Also, may include earthwork/regrading and revegetation of ravine.	Field edge buffers, borders, windbreaks and/or filter strips
		Contour farming and contour buffer strips
		Diversions
		Water and sediment control basin
		Terrace
		Conservation crop rotation
		Cover crop
		Residue management - conservation tillage
	Improve forestry management	Proper Water Crossings and road construction
		Forest Roads - Cross-Drainage
		Maintaining and aligning active Forest Roads

Parameter (incl. non-pollutant stressors)	Strategy Key	
	Description	Example BMPs/actions
		Closure of Inactive Roads & Post-Harvest
		Location & Sizing of Landings
		Riparian Management Zone Widths and/or filter strips
	Improve urban stormwater management [to reduce sediment and flow]	See MPCA Stormwater Manual: http://stormwater.pca.state.mn.us/index.php/Information_on_pollutant_removal_by_BMPs
Nitrogen (TN) or Nitrate	Increase fertilizer and manure efficiency: Adding fertilizer and manure additions at rates and ways that maximize crop uptake while minimizing leaching losses to waters	Nitrogen rates at Maximum Return to Nitrogen (U of MN rec's)
		Timing of application closer to crop use (spring or split applications)
		Nitrification inhibitors
		Manure application based on nutrient testing, calibrated equipment, recommended rates, etc.
	Store and treat tile drainage waters: Managing tile drainage waters so that nitrate can be denitrified or so that water volumes and loads from tile drains are reduced	Saturated buffers
		Restored or constructed wetlands
		Controlled drainage
		Woodchip bioreactors
		Two-stage ditch
	Increase vegetative cover/root duration: Planting crops and vegetation that maximize vegetative cover and capturing of soil nitrate by roots during the spring, summer and fall.	Conservation cover (easements/buffers of native grass & trees, pollinator habitat)
		Perennials grown on marginal lands and riparian lands
		Cover crops
		Rotations that include perennials
Phosphorus (TP)	Improve upland/field surface runoff controls: Soil and water conservation practices that reduce soil erosion and field runoff, or otherwise minimize sediment from leaving farmland	Strategies to reduce sediment from fields (see above - upland field surface runoff)
		Constructed or restored wetlands
		Pasture management
		Restored wetlands

Parameter (incl. non-pollutant stressors)	Strategy Key	
	Description	Example BMPs/actions
	Reduce bank/bluff/ravine erosion	Strategies to reduce TSS from banks/bluffs/ravines (see above for sediment)
	Increase vegetative cover/root duration: Planting crops and vegetation that maximize vegetative cover and minimize erosion and soil losses to waters, especially during the spring and fall.	Conservation cover (easements/buffers of native grass & trees, pollinator habitat)
		Perennials grown on marginal lands and riparian lands
		Cover crops
		Rotations that include perennials
	Preventing feedlot runoff: Using manure storage, water diversions, reduced lot sizes and vegetative filter strips to reduce open lot phosphorus losses	Open lot runoff management to meet 7020 rules
		Manure storage in ways that prevent runoff
	Improve fertilizer and manure application management: Applying phosphorus fertilizer and manure onto soils where it is most needed using techniques which limit exposure of phosphorus to rainfall and runoff.	Soil P testing and applying nutrients on fields needing phosphorus
		Incorporating/injecting nutrients below the soil
		Manure application meeting all 7020 rule setback requirements
	Address failing septic systems: Fixing septic systems so that on-site sewage is not released to surface waters. Includes straight pipes.	Sewering around lakes
		Eliminating straight pipes, surface seepages
	Reduce in-water loading: Minimizing the internal release of phosphorus within lakes	Rough fish management
		Curly-leaf pondweed management
		Alum treatment
		Lake drawdown
		Hypolimnetic withdrawal
	Improve forestry management	See forest strategies for sediment control

Parameter (incl. non-pollutant stressors)	Strategy Key	
	Description	Example BMPs/actions
	Reduce Industrial/Municipal wastewater TP	Municipal and industrial treatment of wastewater P
		Upgrades/expansion. Address inflow/infiltration.
	Treat tile drainage waters: Treating tile drainage waters to reduce phosphorus entering water by running water through a medium which captures phosphorus	Bioreactor
	Improve urban stormwater management	See MPCA Stormwater Manual: http://stormwater.pca.state.mn.us/index.php/Information_on_pollutant_removal_by_BMPs
E. coli	Reducing livestock bacteria in surface runoff: Preventing manure from entering streams by keeping it in storage or below the soil surface and by limiting access of animals to waters.	Strategies to reduce field TSS (applied to manured fields, see above)
		Improved field manure (nutrient) management
		Adhere/increase application setbacks
		Improve feedlot runoff control
		Animal mortality facility
		Manure spreading setbacks and incorporation near wells and sinkholes
		Rotational grazing and livestock exclusion (pasture management)
	Reduce urban bacteria: Limiting exposure of pet or waterfowl waste to rainfall	Pet waste management
		Filter strips and buffers
		See MPCA Stormwater Manual: http://stormwater.pca.state.mn.us/index.php/Information_on_pollutant_removal_by_BMPs
	Address failing septic systems: Fixing septic systems so that on-site sewage is not released to surface waters. Includes straight pipes.	Replace failing septic (SSTS) systems
		Maintain septic (SSTS) systems
	Reduce Industrial/Municipal wastewater bacteria	Reduce straight pipe (untreated) residential discharges
		Reduce WWTP untreated (emergency) releases

Parameter (incl. non-pollutant stressors)	Strategy Key	
	Description	Example BMPs/actions
Dissolved Oxygen	Reduce phosphorus	See strategies above for reducing phosphorus
	Increase river flow during low flow years	See strategies above for altered hydrology
	In-channel restoration: Actions to address altered portions of streams.	
Chloride	Road salt management	[Strategies currently under development within Twin Cities Metro Area Chloride Management Plan]
Altered hydrology; peak flow and/or low base flow (Fish/Macroinvertebrate IBI)	Increase living cover: Planting crops and vegetation that maximize vegetative cover and evapotranspiration especially during the high flow spring months.	Grassed waterways
		Cover crops
		Conservation cover (easements & buffers of native grass & trees, pollinator habitat)
		Rotations including perennials
	Improve drainage management: Managing drainage waters to store tile drainage waters in fields or at constructed collection points and releasing stored waters after peak flow periods.	Treatment wetlands
		Restored wetlands
	Reduce rural runoff by increasing infiltration: Decrease surface runoff contributions to peak flow through soil and water conservation practices.	Conservation tillage (no-till or strip till w/ high residue)
		Water and sediment basins, terraces
	Improve urban stormwater management	See MPCA Stormwater Manual: http://stormwater.pca.state.mn.us/index.php/Information_on_pollutant_removal_by_BMPs
	Improve irrigation water management: Increase groundwater contributions to surface waters by withdrawing less water for irrigation or other purposes.	Groundwater pumping reductions and irrigation management

Parameter (incl. non-pollutant stressors)	Strategy Key	
	Description	Example BMPs/actions
Poor Habitat (Fish/Macroinvertebrate IBI)	Improve riparian vegetation: Planting and improving perennial vegetation in riparian areas to stabilize soil, filter pollutants and increase biodiversity	50' vegetated buffer on protected of waterways
		One rod ditch buffers
		Lake shoreland buffers
		Increase conservation cover: in/near water bodies, to create corridors
		Improve/increase natural habitat in riparian, control invasive species
		Tree planting to increase shading
		Streambank and shorline protection/stabilization
		Wetland restoration
		Accurately size bridges and culverts to improve stream stability
	Restore/enhance channel: Various restoration efforts largely aimed at providing substrate and natural stream morphology.	Retrofit dams with multi-level intakes
		Restore riffle substrate
		Two-stage ditch
		Dam operation to mimic natural conditions
		Restore natural meander and complexity
Water Temperature	Urban stormwater management	See MPCA Stormwater Manual: http://stormwater.pca.state.mn.us/index.php/Information_on_pollutant_removal_by_BMPs
	Improve riparian vegetation Actions primarily to increase shading, but also some infiltration of surface runoff.	Riparian vegetative buffers
		Tree planting to increase shading
Connectivity (Fish IBI)	Removal fish passage barriers: Identify and address barriers.	Dam removal
		Properly size and place culverts for flow and fish passage
		Construct nature-like fish passage

4. Monitoring Plan

Stream Monitoring

Many Goose Creek Watershed sites in Pine and Chisago Counties have been monitored through the years. There is currently not a watershed wide stream monitoring program. Pour point monitoring at subwatershed sites (Goose Creek - 07030005-510, Rush Creek - 07030005-516, Rock Creek - 07030005-584) was done in the past for a variety of parameters including: flow, TSSs, TP, total Kjeldahl nitrogen, E. coli, and nitrates.

If funding is available, the SWCDs will set up a monitoring program to monitor for nutrients, E. coli, and flow. Ideally, it would be a twice per month plus storm event program designed to take samples at many tributaries and branches of the Goose Creek Watershed. If funding is not available for new monitoring programs, the monitoring that is completed will be done following the MPCA's 10-year monitoring cycle.

Currently, most of the streams in the direct drainage to the St. Croix River area are not being monitored on a regular basis. Some of these streams have had some monitoring in the past, but no formal plans are in place to make permanent monitoring stations. This is due to the lack of available funding for continuous monitoring at both the state and local level. As funding becomes available monitoring will be explored to implementation the scenarios in Table 29 as well as lake monitoring.

Table 29 - Ideal stream monitoring scenarios

Stream	Parameters	Frequency	Goal	Responsible Party
Goose Creek - 07030005-510	TP, TSS, N+N, E. coli, DO, Temp, Stage	Once monthly: April – October. Storm events when possible.	Minimum 3 locations along the stream, more if possible	MPCA, SWCD, County
Rush Creek - 07030005-516	TP, TSS, N+N, E. coli, DO, Temp, Stage	Once monthly: April – October. Storm events when possible.	Minimum 3 locations along the stream, more if possible	MPCA, SWCD, County
Rock Creek - 07030005-584	TP, TSS, N+N, DO, Temp, Stage	Once monthly: April – October. Storm events when possible.	Minimum 2 locations along the stream, more if possible	MPCA, SWCD, County
Unnamed Tributaries	TP, TSS, N+N, DO, Temp, Stage	Once monthly: April – October. Storm events when possible.	Several Locations	MPCA, SWCD, County

Lake Monitoring

Chisago County currently monitors 8 lakes within the Goose Creek Watershed. These include: Fish Lake, Goose Lake North, Goose Lake South, Horseshoe Lake, Mandall Lake, Rabour Lake, East Rush Lake, and West Rush Lake. These lakes are monitored for TP, chlorophyll-*a*, ammonia nitrogen, transparency, and temperature. These lakes are monitored once per month from May-September.

No known monitoring locations or programs exist within the Pine County portion of the Goose Creek Watershed – however, Rock Lake has been monitored through the MPCA Surface Water Assessment Grant in the past.

The DNR will continue to conduct macrophyte and fish surveys as allowed by their regular schedule. Currently fish surveys are conducted every five years and macrophyte surveys are conducted as staffing and funding allow on a 10-year rotation, unless there are special situations – this mostly applies to Linwood Lake. The smaller lakes without public access are surveyed if the opportunity arises.

BMP Monitoring

On-site monitoring of implementation practices should also take place in order to better assess BMP effectiveness. A variety of criteria such as land use, soil type, and other watershed characteristics, as well as monitoring feasibility, will be used to determine which BMPs to monitor. Under these criteria, monitoring of a specific type of implementation practice can be accomplished at one site but can be applied to similar practices under similar criteria and scenarios. Effectiveness of other BMPs can be extrapolated based on monitoring results.

All BMP monitoring will be done in accordance with funding availability. Currently no BMP monitoring or monitoring programs are in place in Chisago or Pine Counties.

BMP effectiveness monitoring is currently not being done widespread due to funding. There are not many funding opportunities to encourage this type of practice on the local level. It would be viewed as beneficial by the local implementers if the opportunity was available.

5. References and Further Information

Rush Lake Clean Water Partnership Project (Steve McComas and Dave Schuler 2002)

Rush Creek Watershed Surface Water Assessment Grant (Chisago SWCD 2009, 2010)

Goose Creek Watershed Surface Water Assessment Grant (Chisago SWCD 2009, 2010)

Lake St. Croix TMDL (MPCA 2012)

Lower St. Croix River Monitoring and Assessment Report (MPCA 2014)

Lower St. Croix Stressor Identification Study (MPCA 2014)

Goose Creek Watershed TMDL Study DRAFT (Chisago SWCD and EOR)
http://www.pca.state.mn.us/hh89xpd

Goose Creek Watershed Reports

All Goose Creek Watershed reports referenced in this watershed report are available at the Lower St. Croix River Watershed webpage: http://www.pca.state.mn.us/index.php/water/water-types-and-programs/watersheds/lower-st.-croix-river.html.