Upper Watershed Blueprint

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Prepared for:

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Executive Summary

The Prior Lake-Spring Lake Watershed District (PLSLWD) took action to develop this Upper Watershed Blueprint comprehensively approach stormwater management in the Upper Watershed. This analysis will be used as a prioritized implementation roadmap for the PLSLWD and local partners to improve water quality conditions and reduce flooding in the watershed. This Upper Watershed Blueprint is intended to:

1) Recommend and prioritize programs, projects and policy to reduce phosphorus and runoff volume;
2) Identify partners and potential funding sources; and
3) Detail a 10-year schedule for prioritized program and project implementation including short-and long-term maintenance considerations.

Goals

Phosphorus Reduction Goals

The TMDL requires an annual TP reduction of about 2,959 pounds coming in from the surrounding Spring Lake watershed, out of a total load of 3,595 pounds. This is about 82% of the TP load from the watersheds that are tributary to Spring Lake. The goal of the Upper Watershed Blueprint is to significantly improve the water quality in runoff that originates in the Upper Watershed and move Spring Lake in positive direction towards meeting the overall TMDL goals.

Flood Reduction Goals

The flood reduction goal is to reduce the impacts of regional flooding on Spring Lake and Upper and Lower Prior Lake, as well as in the upper watershed where crops and residences are affected. Values that drive numerical objectives in the flood reduction-based goals are:

- Reduce the 30-day, 25-year return rainfall event high water level for Upper and Lower Prior Lake to 905.5, which protects infrastructure from being inundated and thus limiting emergency vehicle access.
- Limit the number of days that the lake is above the elevation where wake restrictions are applied. That trigger water elevation on Upper and Lower Prior Lakes is 904.0.
- Reduce the impact to structures on the lakes from significant rainfall and flooding events.
- Reduce the impact on upper watershed areas that are actively used for farming or rural residential homes.

Combining Goals

One of the original ambitions for the Upper Watershed Blueprint was to identify and evaluate projects that may provide both a water quality and a flood mitigation benefit. However, it was discovered during the process that the projects that were most beneficial for water quality provide little or no flood mitigation, and projects that are the most efficient for flood reduction offer little in terms of water quality benefit.

This separation is largely due to the nature of flooding in the district. The most beneficial water quality projects will function continuously throughout the year while the most efficient flood storage solutions will only function during significant flood events and would only provide treatment for a fraction of the total annual runoff from the Upper Watershed. As such, the potential projects have been sorted into two categories, water quality projects and flood reduction projects, so that the District may score and select projects by comparable cost-benefit ratios.

Potential Water Quality Projects

Spring Lake and Upper Prior Lake have been identified as impaired waters by the Minnesota Pollution Control Agency for excess nutrients. The high nutrient loading results in undesirable algae blooms and recreational use restrictions. The Total Maximum Daily Load (TMDL) study completed for the lakes requires an 82 percent reduction in total phosphorus (TP) from the watershed load to achieve the state water quality standard, which is about 2,959 pounds annually.

While small projects can provide incremental improvements to water quality and quantity concerns, this report is focused on larger projects that will have a more significant benefit. The 17 projects identified and evaluated in this report have the potential to reduce the annual phosphorous loads to Spring Lake significantly. The four projects with the highest phosphorous reduction potential identified in the study and their estimated load reductions are:

- Sutton Lake Iron Enhanced Sand Filter (IESF) - 735 pounds per year
- Ferric Chloride System Improvements Alternative 2 which includes upgrades to the system, assuming that the entire system can be optimized to remove 70% of the total phosphorous from half of the total flow – 911 pounds per year
- County Ditch 13 Chemical Treatment System – 1,062 pounds per year
- Buck Lake Chemical Treatment System – 793 pounds per year

The reductions presented above are the calculated based on individual projects with no changes in the watershed loads or flows. When connected in series, the reduction in pounds per year for the County Ditch 13 Chemical Treatment System Project and the Ferric Chloride System Improvements Alternative 2 Project would be less, because the incoming phosphorous loads would be less. Adding up the reductions with all projects constructed and taking the upstream load reductions into consideration, the total phosphorous load reduction in the Upper Watershed is an estimated 2,621 pounds.

Table ES.0.1 lists the four projects, annual phosphorous reduction with all of the projects constructed, the cost, and the unit costs in terms of dollars per pound of phosphorous reduction. These projects all have various funding mechanisms that are available to assist from feasibility study through construction and long-term maintenance.

Table ES.0.1. Top four projects.

Project	Annual Phosphorus Reduction Individually[1]	Annual Phosphorous Reduction in Series[2]	15-Year Lifecycle Cost	Cost Per Pound of Phosphorous Reduction[2]
1) Sutton Lake Iron-Enhanced Sand Filter	735	735	$1,836,000	$166
11) Ferric Chloride System Improvements Alternative 2	911	417	$2,069,000	$331
14) County Ditch 13 Chemical Treatment System	1,062	676	$2,500,000	$246
13) Buck Lake Chemical Treatment System	793	793	$2,431,000	$204
Total	3,501	2,621	$8,836,000	$225

1 – Phosphorous reduction value for each individual project.
2 – Phosphorous reduction value and cost per pound of phosphorous reduction for each project when includingcalculated changes in water quality from upstream BMPs.

In addition to the projects listed above, the District has received a state grant to perform a feasibility study for the Buck Lake East Wetland Enhancement Project. This project scored 3rd highest in the project scoring matrix results and will provide an estimated reduction in annual in total phosphorous load of 100 pounds. The District is also currently in the planning stages for the Spring West Iron-Enhanced Sand Filter Project, which provides an additional 249 pounds in annual phosphorous reduction. These two projects combined with the four projects identified above will bring the total reduction to approximately 2,970 pounds per year, which exceeds the TMDL goal for Spring Lake.

Potential Flood Reduction Projects

Resolving flooding issues on the Spring, Upper Prior and Lower Prior Lake is the second issue evaluated in the study. Periods of extreme flooding cause shoreline erosion and extended periods of no wake zones on the lake, and limit access for emergency vehicles due to road closures. Various models and scenarios indicate that the flooding is driven by discharge volumes to and from the lakes. Based on modeling conducted during this study, and on the 2016 Flood Study report, addressing these flooding concerns in the Upper Watershed will require upstream storage on a very large scale to provide a measurable benefit for both the magnitude and duration of flooding. Two potential projects evaluated that can make the most significant positive impact on the flooding are:

- Upper Watershed Lakes Controlled Outlet Storage:

  Install outlet controls on lakes in the Upper Watershed to limit discharge when targeted water levels are reached on Upper and Lower Prior Lakes. For this report, the targeted condition is to restrict flow from Swamp, Sutton, Fish and Buck Lakes when Upper and Lower Prior Lakes reach the no wake elevation of 904.0.

- Prior Lake Outlet Channel Modifications:

  Modify the culvert and discharge allowance for the Prior Lake outlet channel to permit a higher discharge rate during period when the capacity is available in downstream channels and basins. Work with the DNR and other partners to allow discharge through the outlet channel at a lower water level in advance of forecasted significant precipitation events to proactively provide storage to contain those events. This water level manipulation combined with a higher discharge rate have the potential to reduce the 25-year high water level on Prior Lake by 0.5 feet.

The Buck Lake East Wetland Enhancement Project scored the highest for flood reduction projects due to its cost competitive nature, but was not included above as it does not make as much impact to flood reduction compared to the other two projects identified above. If completed, this project will result in a 0.1 foot flood reduction in Prior Lake. Note that this project is already included in the potential phosphorus reduction projects identified above and the District will be completing a feasibility study for the project in 2021.

While not included in this report, the 2016 Flood Study also identified several opportunities with varying levels of impact on the flood elevations.

Policy Options

The report also considered potential regulatory modifications as non-structural options to reduce pollutant loading and limit changes in the rate and volume of runoff as development occurs in the Upper Watershed. Conversion of crop land to developed land by itself can significantly reduce nutrient and sediment loads. However, runoff from new impervious surface could exacerbate flood conditions in downstream lakes. New regulatory controls could potentially prevent increases in downstream flood elevations and have a modest (0.1 foot) reduction in the 25-year high water level on Prior Lake. These reductions are long-term as development and redevelopment occur over the coming decades.

Summary

The nature of the watershed and the causes of flooding present challenges identifying individual projects that address both water quality and flooding. The projects identified in this report were assessed and ranked based on phosphorous reduction potential, flood reduction potential, project cost, and overall feasibility. These scoring matrix rankings can be used to determine a priority list and schedule to implement future projects in the watershed. The District should evaluate any future land use changes or development in the Upper Watershed for potential water quality and flood reduction benefits that those changes may present.

Table ES.1 shows the 17 potential projects identified in the Upper Watershed Blueprint, and their associated pollutant load reduction and flood reduction impacts. To account for ongoing operations and maintenance costs where applicable, the overall cost is presented as a lifecycle cost over 15 years.

Table ES.0.2. Summary of results.

Project	Phosphorous Reduction (lbs/yr)	Flood Reduction (feet)	Phosphorous Reduction ($/lb)	Lifecycle Cost	Scoring Matrix Rank
WATER QUALITY PROJECTS					
1) Sutton Lake Iron-Enhanced Sand Filter	735	0.0	$166	$1,836,000	2
2) Swamp Lake Diversion to Geis Lake	161	0.0	$204	$492,000	11
3) Swamp Lake Iron-Enhanced Sand Filter	223	0.0	$159	$530,000	7
4) Buck Lake South Wetland Storage	95	0.1	$459	$652,000	10
5) Buck Lake East Wetland Enhancement	100	0.1	$119	$180,000	3
6) Buck Lake East Stream Restoration	10	0.0	$637	$96,000	9
7) County Ditch 13 Improvements	202	0.0	$389	$1,177,000	13
8) County Ditch 13 Repairs	50	0.0	$830	$623,000	12
9) County Ditch 13 Diversion	90	0.0	$924	$1,253,000	14
10) Ferric Chloride System Improvements Alternative 1	250	0.0	$107	$400,000	6
11) Ferric Chloride System Improvements Alternative 2	911	0.0	$151	$2,069,000	4
12) Spring West Iron-Enhanced Sand Filter	249	0.0	$112	$419,000	1
13) Buck Lake Chemical Treatment System	793	0.0	$204	$2,431,000	8
14) County Ditch 13 Chemical Treatment System	1,062	0.0	$157	$2,500,000	5
FLOOD REDUCTION PROJECTS					
15) Prior Lake Outlet Channel Modifications	0	0.5	$-	$2,385,000	2
16) County Ditch 13 Storage	0	0.0	$-	$978,000	3
17) Upper Watershed Lakes Controlled Outlet Storage	0	0.5	$-	$1,403,000	1

1.0 Introduction

1.1 PROJECT PURPOSE

Wenck has prepared this Upper Watershed Blueprint (UWB) report on behalf of the Prior Lake-Spring Lake Watershed District (PLSLWD). The report presents current conditions and alternatives for stormwater treatment for the Upper Watershed as well as solutions to work towards mitigating flood conditions on Spring, Upper Prior and Lower Prior Lakes.

1.2 BACKGROUND

The Upper Watershed is a 12,760-acre area tributary to Spring Lake, located completely in Scott County, Minnesota. The Upper Watershed represents about 2/3 of the total tributary area to Spring Lake and Upper and Lower Prior Lakes. The Upper Watershed boundaries are shown in Figure 1.1.

The primary land use in the Upper Watershed is agricultural, with some rural residential. The current Scott County zoning map is for rural residential, transition reserve, agricultural preservation, and urban expansion reserve. There are about 2,700 acres of National Wetland Inventory (NWI) Type 3, 4, and 5 wetlands in the Upper Watershed. Cities and townships in the Upper Watershed include a small portion of Sand Creek Township, Spring Lake Township and the City of Prior Lake.

The Upper Watershed is drained primarily through two channel systems. The eastern channel is identified as the Buck Lake system. The Buck Lake system starts at Fish Lake and then flows through a series of streams and wetlands into Buck Lake, and from Buck Lake through a large wetland complex before entering Spring Lake. The land use in the Buck Lake system is a mix of agricultural, wetlands, and residential.

The western half flows through Scott County Ditch 13, a largely man-made ditch that begins at Sutton Lake in the southwest area of the watershed. From Sutton Lake, the excavated channel flows north, through several agricultural fields and eventually to Spring Lake. There are two tributaries to County Ditch 13. One rises from Swamp Lake in the western portion of the watershed and flows through to the east and south before its confluence with the main branch of Ditch 13. The second rises at the southern extent of the Upper Watershed and flows north to meet with the main branch of Ditch 13 just west of Highway 13.

After the three ditches converge, the ditch crosses Highway 13 and Highway 282 before flowing into Spring Lake. Parts of the Ditch 13 flows pass through a Ferric Chloride treatment system before entering Spring Lake.

1.3 UPPER WATERSHED PROBLEMS

There are two primary problems for Spring Lake and Upper and Lower Prior Lakes, and the Upper Watershed is a significant contributor to both. First, phosphorus and sediment loading in runoff from the drainage area are the main sources of phosphorous in Spring Lake and Upper and Lower Prior Lakes. Spring Lake and Upper Prior Lake have been designated as Impaired Waters by the Minnesota Pollution Control Agency for excess nutrients, specifically total phosphorus (TP). This results in undesirable algae blooms and restrictions on

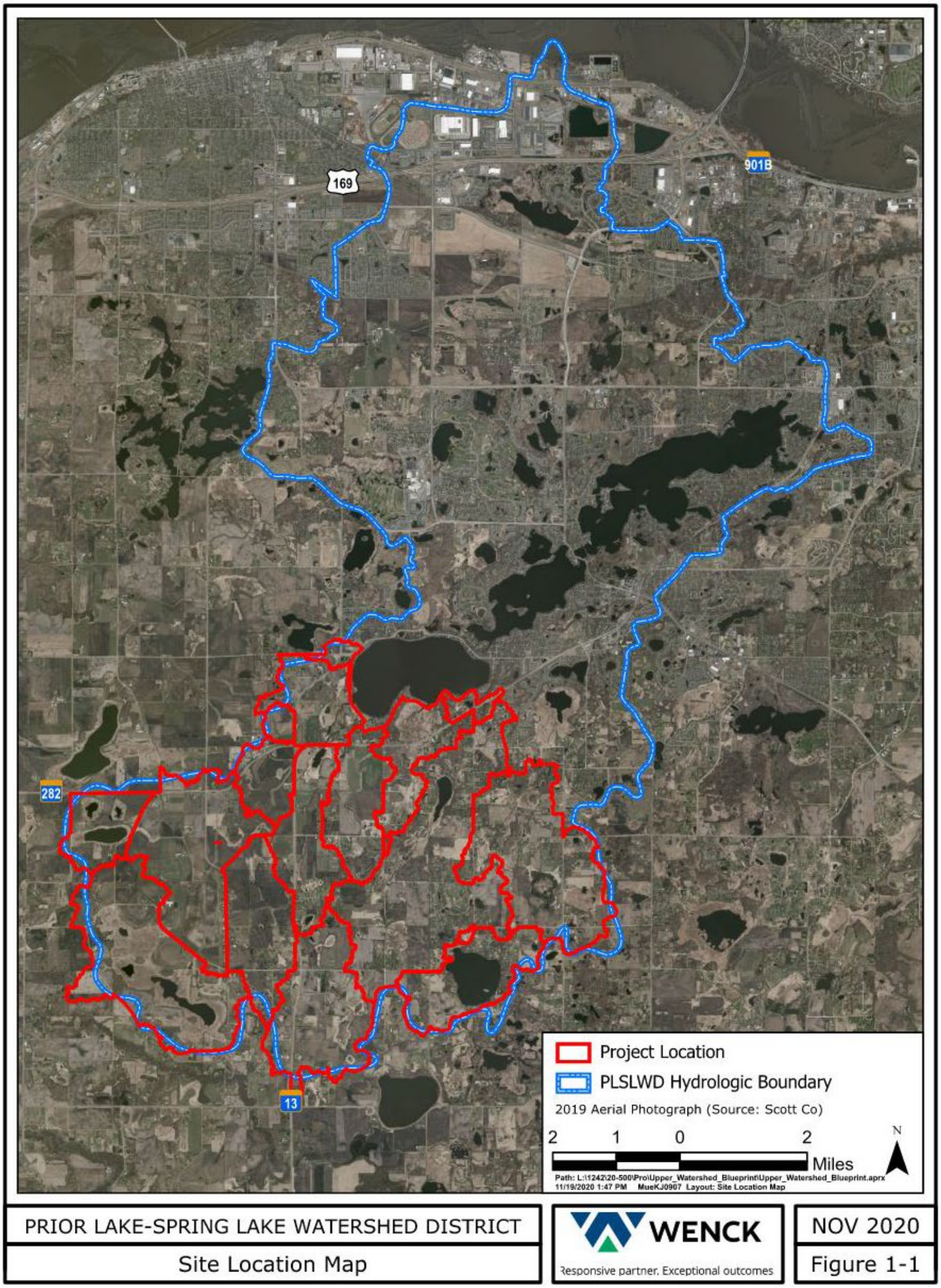


Figure 1.1. Site location map.

recreational use. Total Maximum Daily Load (TMDL) studies have been completed for each lake. Spring Lake requires an 83 percent overall reduction in TP to achieve the state water quality standard. Spring Lake discharges into Upper Prior Lake, and accounts for about 42 percent of that lake's nutrient load. Improvements to Spring Lake should result in improvements to Upper Prior Lake water quality.

The second problem relates to the volume of stormwater runoff draining downstream during periods of high rainfall. The runoff volume contributed from the Upper Watershed has a substantial impact on flooding on Spring Lake, Upper Prior Lake, and Lower Prior Lake. Flood elevations and extended periods of high water on the lakes result in safety issues related to emergency vehicle access on flooded roads, shoreline erosion, impact to older homes on the lake, and boating restrictions such as no wake requirements.

In addition, there are many localized flooding concerns in the Upper Watershed. Farmers lose crops due to flooding, rural residential homes become inaccessible, and there can be damage to secondary structures during flood events.

1.4 PROJECT PARTNERS

Identifying and working with project partners is a critical component of implementing watershed solutions towards effective water quality treatment and quantity mitigation. Scott Soil and Water Conservation District, Sand Creek Township, Spring Lake Township, City of Prior Lake, Scott County, and MnDOT were all consulted during this project. These partners will be crucial to successful implementation of projects. Working with these partners when they implement any capital improvements with potential for a water resources benefit and coordination of projects present opportunities for improving water quality in the watershed.

Some of the individual projects would happen on or impact public and private land in the Upper Watershed. The projects are shown as conceptual alternatives to improve the water quality and water level for the district and landowners were not specifically consulted on the individual projects. The District is committed to working with land owners and does not intend to use eminent domain or other means of land acquisition to complete any of the projects presented in the report.

1.5 FUNDING PROJECT PARTNERS

Lack of adequate funding can be a roadblock to successful implementation. Leveraging resources from various stakeholders and funding agencies will likely be necessary to meet project goals. Potential sources of funding for projects include:

- Board of Water and Soil Resources (BWSR)
- Minnesota Pollution Control Agency (MPCA)
- Minnesota Department of Natural Resources (DNR)
- United States Army Corps of Engineers (USACE)
- Legislative-Citizen Commission on Minnesota Resources (LCCMR)
- Lessard-Sams Outdoor Heritage Council Funding (LSOHC)
- Minnesota Department of Transportation (MnDOT)
- Scott Soil and Water Conservation District (SWCD)
- Legislative appropriation
- Ducks Unlimited
- Pheasants Forever

1.6 PROJECT GOALS

The overall project goal is a framework for a prioritized 10-year capital improvement plan targeted towards: 1) making measurable improvements in water quality, and 2) reducing the magnitude and frequency of flooding on Spring Lake and Upper and Lower Prior Lake. This report presents, evaluates, and prioritizes projects that can be implemented toward meeting those objectives.

Pollutant-Based Goals

The TMDL requires an annual TP reduction of about 2,959 pounds coming in from the surrounding Spring Lake watershed, out of a total load of 3,595 pounds. This is about 82% of the TP load from the watersheds that are tributary to Spring Lake. The goal of the Upper Watershed Blueprint is to significantly improve the water quality in runoff that originates in the Upper Watershed and move Spring Lake in positive direction towards meeting the overall TMDL goals.

Flood Reduction-Based Goals

The flood reduction goal is to reduce the impacts of regional flooding on Spring Lake and Upper and Lower Prior Lake, as well as in the upper watershed where crops and residences are affected. Impacts include shoreline erosion, infrastructure flooding that limits access for emergency vehicles, and homes built on the lake that are impacted by high waters. Some values that drive numerical objectives in the flood reduction-based goals are:

- Reduce the 30-day, 25-year return rainfall event high water level for Upper and Lower Prior Lake to 905.5, which protects infrastructure from being inundated and thus limiting emergency vehicle access.
- Limit the number of days that the lake is above the elevation where wake restrictions are applied. That trigger water elevation on Upper and Lower Prior Lakes is 904.0.
- Reduce the impact to structures on the lakes from significant rainfall and flooding events.
    - The current 100-year high water level based on the 1997 Flood Insurance Rate Map is 909.0, and the recorded high water level resulting from the 2014 flood was 908.9. Currently, there are about 165 primary structures that are at or below 909.0 based on LIDAR data and information received from the District.
    - The current 30 day, 25-year high water level for Upper and Lower Prior Lakes is 905.1. There are approximately 16 primary structures that are at or below 905.0.
    - The existing 30 day, 10-year, 30-day high water level is 904.3 and there are 6 primary structures that are at or below 904.5.
- Reduce the impact on upper watershed areas that are actively used for farming or rural residential homes.

1.7 REPORT ORGANIZATION

This report is separated into the following sections with data and information towards meeting those goals:

Section 2.0 – Data Summary
Section 3.0 – Project Targeting
Section 4.0 – Funding Sources
Section 5.0 – Project Conceptual Plans and Evaluation
Section 6.0 – Project Prioritization
Section 7.0 – Summary

2.0 Data Summary

2.1 INTRODUCTION

Wenck reviewed historical flow and water quality data for the Upper Watershed to map the TP loads and runoff volumes that are attributable to each of the subcatchments in the tributary area. Wenck also reviewed relevant previous reports.

2.1 HYDROLOGY DATA SUMMARY

Wenck used the District's PC-SWMM model to simulate the last ten years of precipitation (January 1, 2010- January 1, 2020) to estimate the volumes discharged from the Upper Watershed and each of the subwatersheds. Wenck created a precipitation file using 15-minute increment rainfall measurements at Flying Cloud Airport in Eden Prairie, about ten miles north of the watershed, the nearest with data available. Precipitation data discretized into longer durations (e.g. hourly and daily) was too coarse to capture the hydrologic response of the soils (i.e. peak rainfall intensities, which generate large runoff rates were averaged out by the longer discretization period. In many cases, using the 'averaged out' precipitation intensities associated with using the hourly or daily precipitation data resulted in little or no runoff because the 'averaged out' precipitation rate is less than the maximum infiltration rate of the soils.

The District routinely monitors flow and water level at various locations throughout the Upper Watershed. The PCSWMM model was previously calibrated to the Spring 2014 flood on Prior Lake using post-ice out water surface elevations as initial conditions and by calculating the snow water equivalent for the 2014 event. To simulate the last 10 years, Wenck added the following information to the model:

- Daily temperature data also obtained from the Flying Cloud airport (used for calculating evaporation and precipitation type).
- Typical monthly wind rates from Technical Bulletin 1955 (used for calculating evaporation).
- Typical initial soil freeze and spring thaw dates from MIDS (December 6 and April 7, respectively). These dates are used to tell the model to not allow infiltration during frozen ground conditions and cannot be varied year over year.
- Snow-water equivalent, snowmelt, snow management (i.e. plowable fraction), and snowpack formation parameters based on typical values published by Computational Hydraulics, Inc. Like the soil freeze dates, these values are unable to be changed year over year or within a season.

With the additional information added to the model, and without changing any other input from the previous calibration, the PCSWMM model far over-predicted the amount of runoff for the Prior Lake watershed and the peak water surface elevation on Spring and Prior Lakes for the spring 2014 event. Wenck then recalibrated the model based on flow and stream level data provided by the District at eleven locations throughout the Upper Watershed. A perfect calibration across the entire 10-year calibration window is not possible due to the limitations of the model associated with:

- Year over year and seasonal differences of snow water equivalents, dates of initial soil freeze and thaw, and dates of lake ice-in and ice-out.
- Land use changes associated with a rapidly developing watershed (i.e. impervious, infiltration, and plowable fraction of snow).

The hydrologic inputs in the district PC-SWMM model were adjusted to obtain values to best reflect the measured conditions at the various monitoring points in the district. To achieve this calibration, Wenck used the built-in PCSWMM Sensitivity-based Radio Tuning Calibration (SRTC). For the calibration, Wenck ran a Monte Carlo analysis for the 2010-2020 period by adjusting the subwatershed hydrologic inputs based on published ranges of uncertainty associated with each parameter. The uncertainty associated with each hydrologic input shown in Table 2.1 below.

These uncertainties are based on the published ranges of uncertainties, and the value calculated by the PC-SWMM model when comparing actual field measurements to the predicted, modeled values.

Table 2.1. Calculated ranges of uncertainty associated with hydrologic inputs.

Hydrologic Input	Uncertainty (%)
Width	200
Percent Slope	25
Percent Imperviousness	20
Impervious Roughness	10
Pervious Roughness	50
Impervious Depression Storage	20
Pervious Depression Storage	50
Suction Head	50
Hydraulic Conductivity	50
Initial Deficit	25

Within any model analysis there is a practical limit to the amount of detail that can and should be collected and included in a model. The modeled level of detail should be commensurate with the purpose of the study. As such, there will always be uncertainty in some of the parameters included in the model.

- For example, it would be cost prohibitive to survey each storm sewer pipe to verify its size and invert elevation when construction plans and as-builts are available. The level of effort of such a survey would far exceed any benefit to the model, despite introducing some uncertainty in the accuracy of the storm sewer network.
- As another example, county soil records may show certain soils have a hydraulic conductivity (infiltration rate) of 2 inches per hour. As shown in Table 2.1, the uncertainty associated with the hydraulic conductivity is 50%, meaning that these soils may have an average infiltration of between 1 and 3 inches per hour as there is both uncertainty in the measurement of the infiltration rate as well as the uncertainty regarding the representativeness of the particular sample compared to all soils of that type in the watershed (e.g. at another location that soil classification may have more or less gravel that would change the infiltration rate by changing the amount of voids in the soil column). Completing soil testing across the entire watershed would be extremely cost prohibitive.

Accounting for this kind of uncertainty is a normal part of hydrologic and hydraulic modeling. To develop a well-calibrated model, the model is repeatedly analyzed using historical precipitation events and weather data until it mimics the observed/measured environment for those same events. In the example above, after running the model dozens of times, it may be determined that an average hydraulic conductivity of 2.2 inches per hour better matches the observed conditions than 2 inches per hour. This difference is within the published range of uncertainty and the model can be adjusted to use a hydraulic conductivity of 2.2 inches per hour. Importantly, running the model dozens of times is far less expensive than completing soil testing across the entire watershed. Similarly, the model can be run (calibrated) for different types of precipitation events in different sequences to understand each of the hydrologic inputs and remove the uncertainty associated with each parameter. When this process is complete and the model mimics natural, measured, conditions, the model is considered well-calibrated and the uncertainty that still exists is considered to meet industry standards for hydrologic modeling.

PCSWMM automatically completed a series of runs by manipulating the hydrologic input to the upper bound of its uncertainty range, the lower bound of its uncertainty range, and the median value of its uncertainty range while holding other parameters in the model constant. For uncertainty ranges exceeding 100%, additional runs are completed at half the upper and lower uncertainty bounds. The model ran forty iterations with varying hydrologic parameters to determine the best fit of these parameters to the measured values. Based on the goodness-of-fit, reducing the watershed width by half best matched the measured data at the eleven measured locations for the 2010-2020 period.

Wenck evaluated the flood mitigation benefits, in both peak water surface elevation and duration of time above the no wake water surface elevation, to Prior Lake for each of the proposed projects for the 10-year, 30-day and the 2014 water year. These were selected because the 10-year, 30-day is a significant stormwater event and the 2014 water year is the flood of record after the current Prior Lake outlet structure was installed. In general, the post ice-out water surface elevations on Prior Lake are within 0.6 feet of the observed values for the 2010-2020. However, due to the model limitations discussed at the beginning of this section, changes to the magnitude and duration of flooding on Prior Lake are reported as change from the baseline model (existing conditions). The focus should be on the relative benefit of each project.

The flow output summary from the PC-SWMM model is summarized in Figure 2.1, in terms of average annual volume of flow from each subwatershed area based on the 10-year model simulation. As showing in the figure, the Upper Watershed contributes about 10,000 acre-feet annually through County Ditch 13 and the Buck Lake system. Approximately 7,500 acre-feet of that runoff is contributed through the County Ditch 13 tributary area. The largest single subwatershed contributor to the total flow is the Sutton Lake subwatershed at just under 2,000 acre-feet annually.

Figure 2.1 shows the total annual volume of stormwater contributed by each of the subwatersheds, in acre-feet. Figure 2.2 presents the cumulative volume at each of the stream locations. The volumes are based on the district models using the previous 10 years of climate data. As presented in the map, the largest annual volume of runoff in the Upper Watershed originates in the County Ditch 13 system, including the discharges from Sutton Lake and the agricultural fields surrounding County Ditch 13.

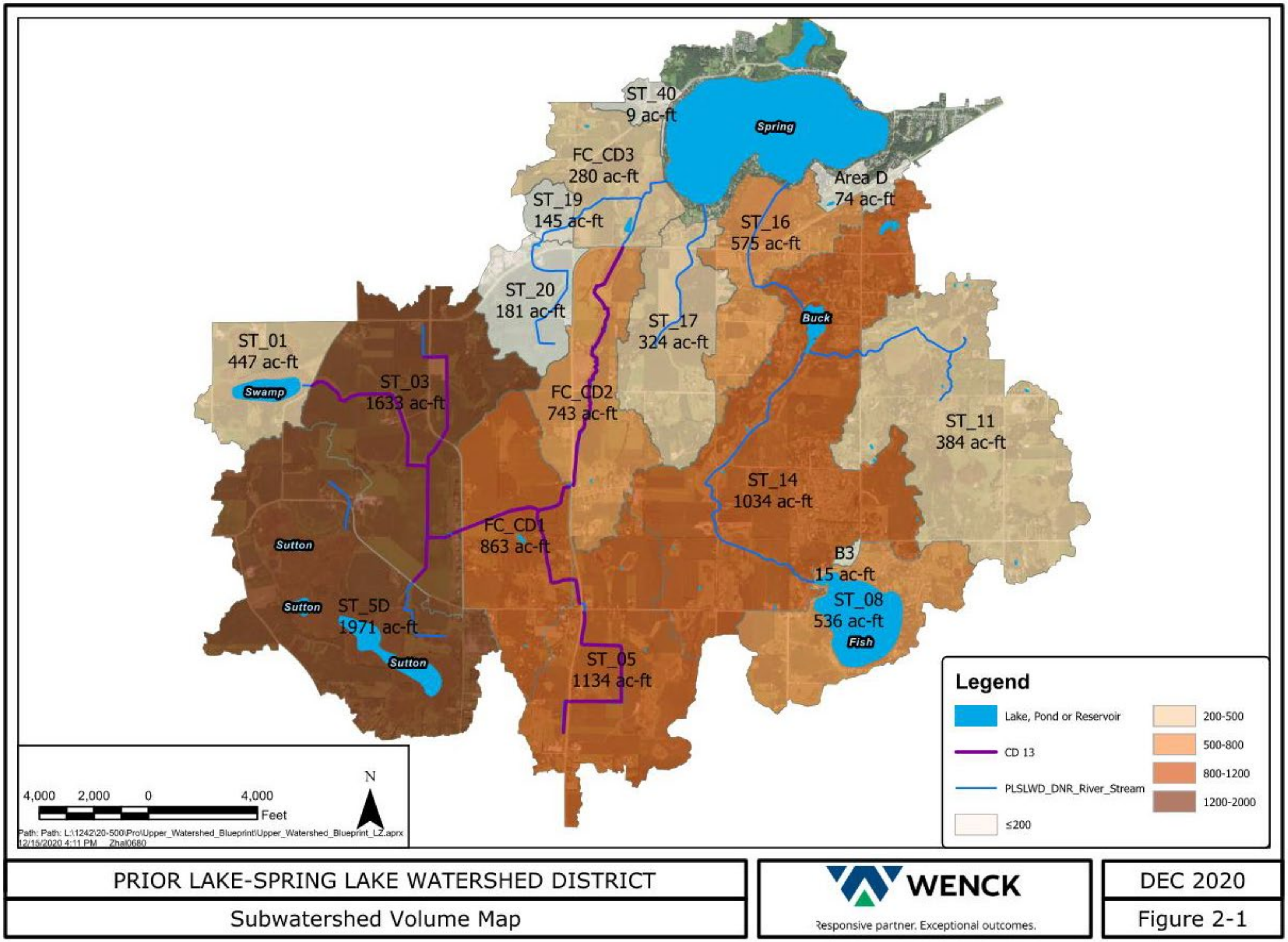


Figure 2.1. Subwatershed volume map.

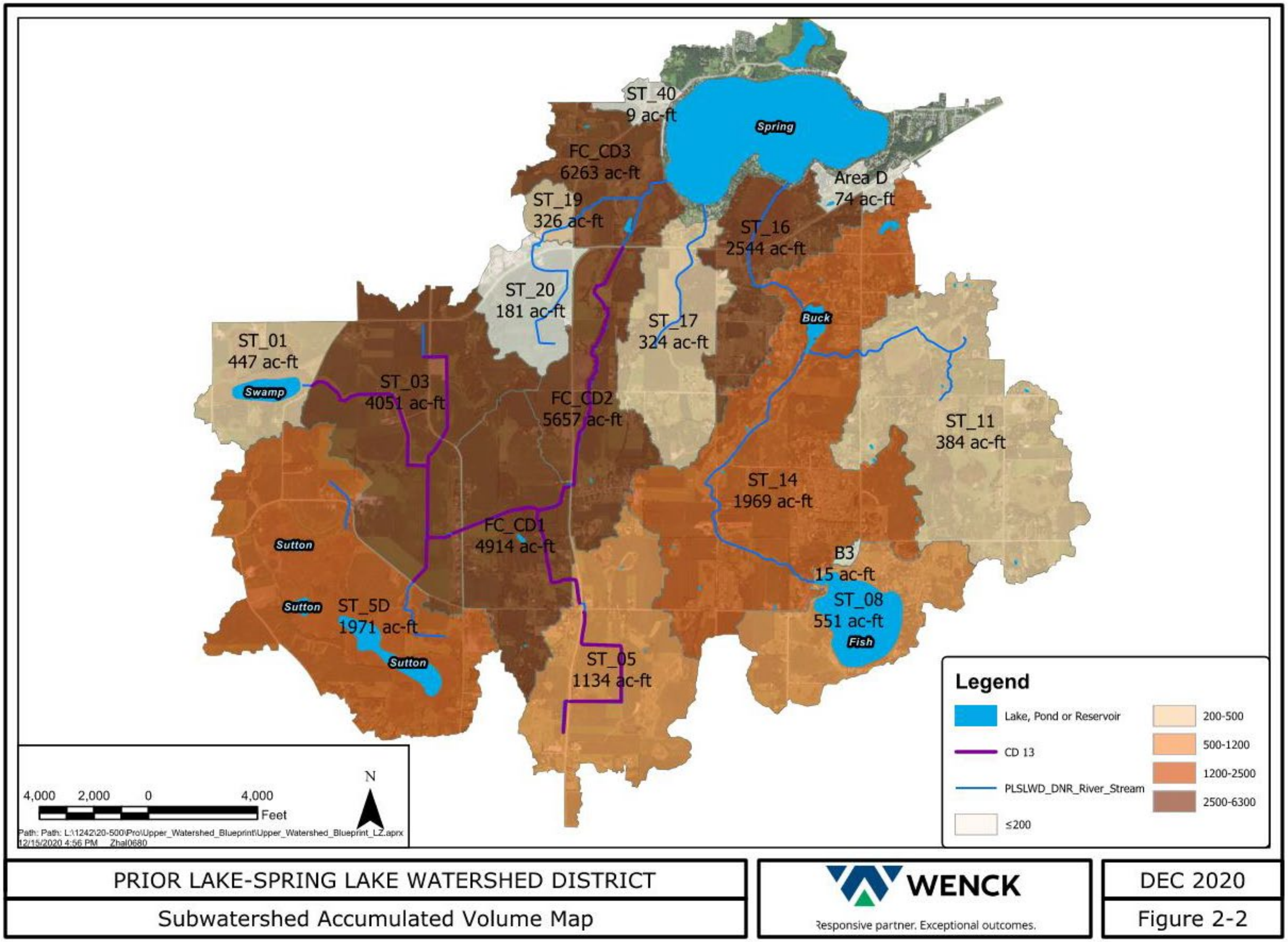


Figure 2.2. Accumulated volume map.

2.2 CHEMICAL DATA SUMMARY

Wenck used the chemistry data and flow volumes to estimate the total pounds of phosphorous originating in each of the subwatersheds, on an average annual basis. Total phosphorous is the driving factor in meeting the water quality goals for Spring Lake and Upper and Lower Prior Lakes.

Nine years (2011-2019) of stream and lake sampling data at 22 monitoring points were analyzed, including the parameters:

- Chloride
- Conductivity
- Total Iron
- Nitrate/Nitrite
- Ortho Phosphorous
- Soluble Reactive Phosphorous
- Temperature
- Total Phosphorous
- Total Suspended Solids
- Dissolved Oxygen
- E-Coli
- Dissolved Iron
- Nitrate + Nitrite
- pH
- Total Dissolved Phosphorous
- Total Kjeldahl Nitrogen
- Turbidity
- Volatile Suspended Solids

The total annual phosphorus loads contributed from each of the subwatersheds in the Upper Watershed are shown graphically in Figure 2.3. Figure 2.4 presents the cumulative load at each point in the watershed. The phosphorus loads shown in the figures are based on stream samples collected by the PLSLWD.

The total calculated phosphorous load from the upper watershed is about 6,380 pounds annually. Of that, the County Ditch 13 system contributes about 4,832 pounds and the Buck Lake channel contributes about 1,244 pounds, representing 75% and 19% of the total load respectively.

There are three primary discharges into Spring Lake from the Upper Watershed: County Ditch 13, the Buck Lake channel, and a smaller watershed between the two channels. These monitoring locations are identified as FC_CD3, ST-16 and ST-17 respectively. The ranges of total phosphorous concentration for the monitoring data for each of the streams are:

- County Ditch 13 ranges from 0.01 to 0.91 mg/L.
- Buck Lake channel ranges from 0.16 to 0.37 mg/L
- The third location at monitoring point ST-17 ranges from 0.046 to 0.867 mg/L.

In addition to the total phosphorous calculations and summation, Wenck calculated the total suspended solids (TSS) loads generated in the Upper Watershed. The average total annual TSS generated in the Upper Watershed is about 150 tons. We calculated the total annual TSS loads in tons per year at the various locations in the watershed using the average sample result and the total annual flow volume at that location. Figure 2-5 shows the total annual TSS loads throughout the watershed.

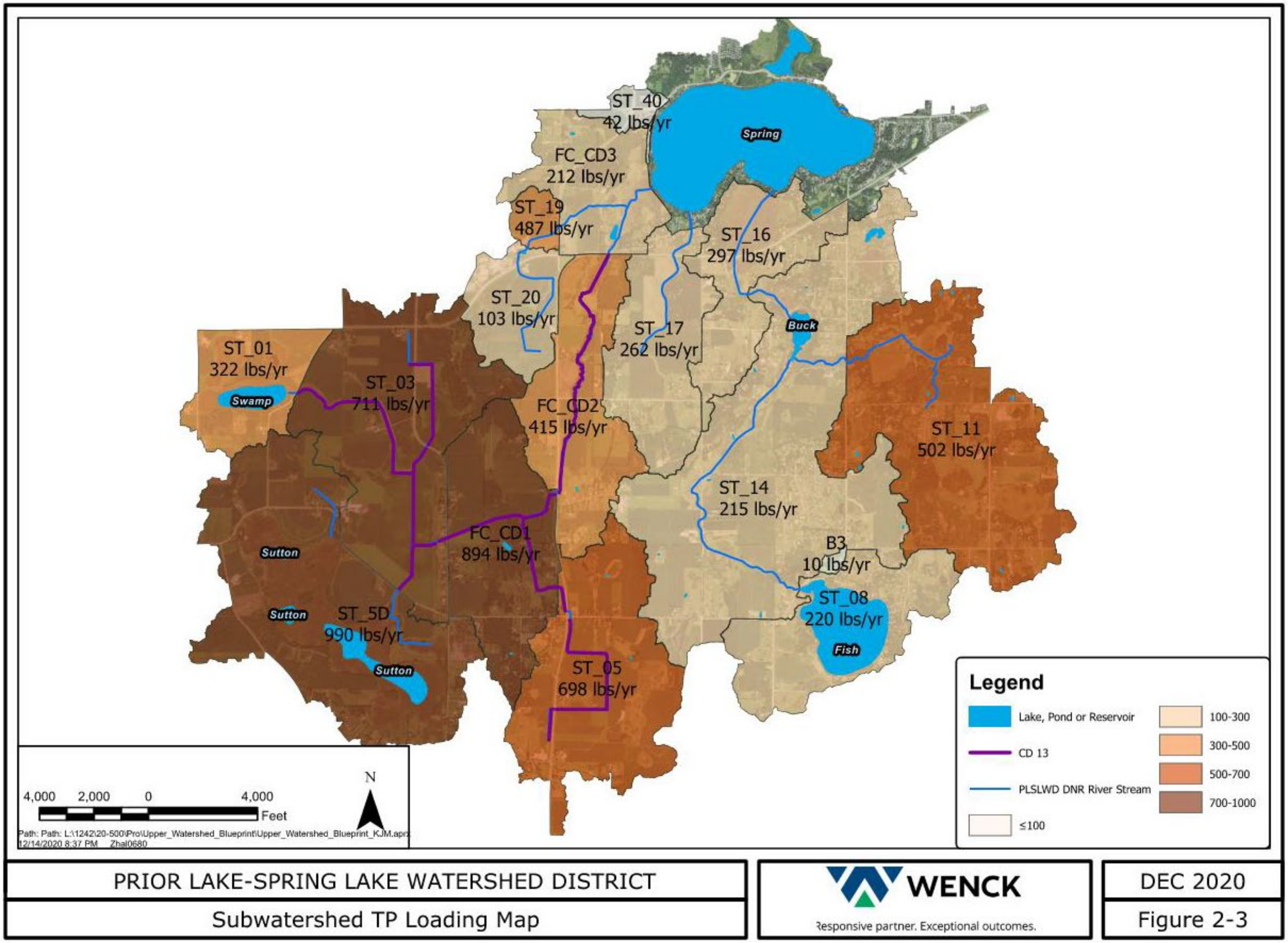


Figure 2.3. Subwatershed TP loading map.

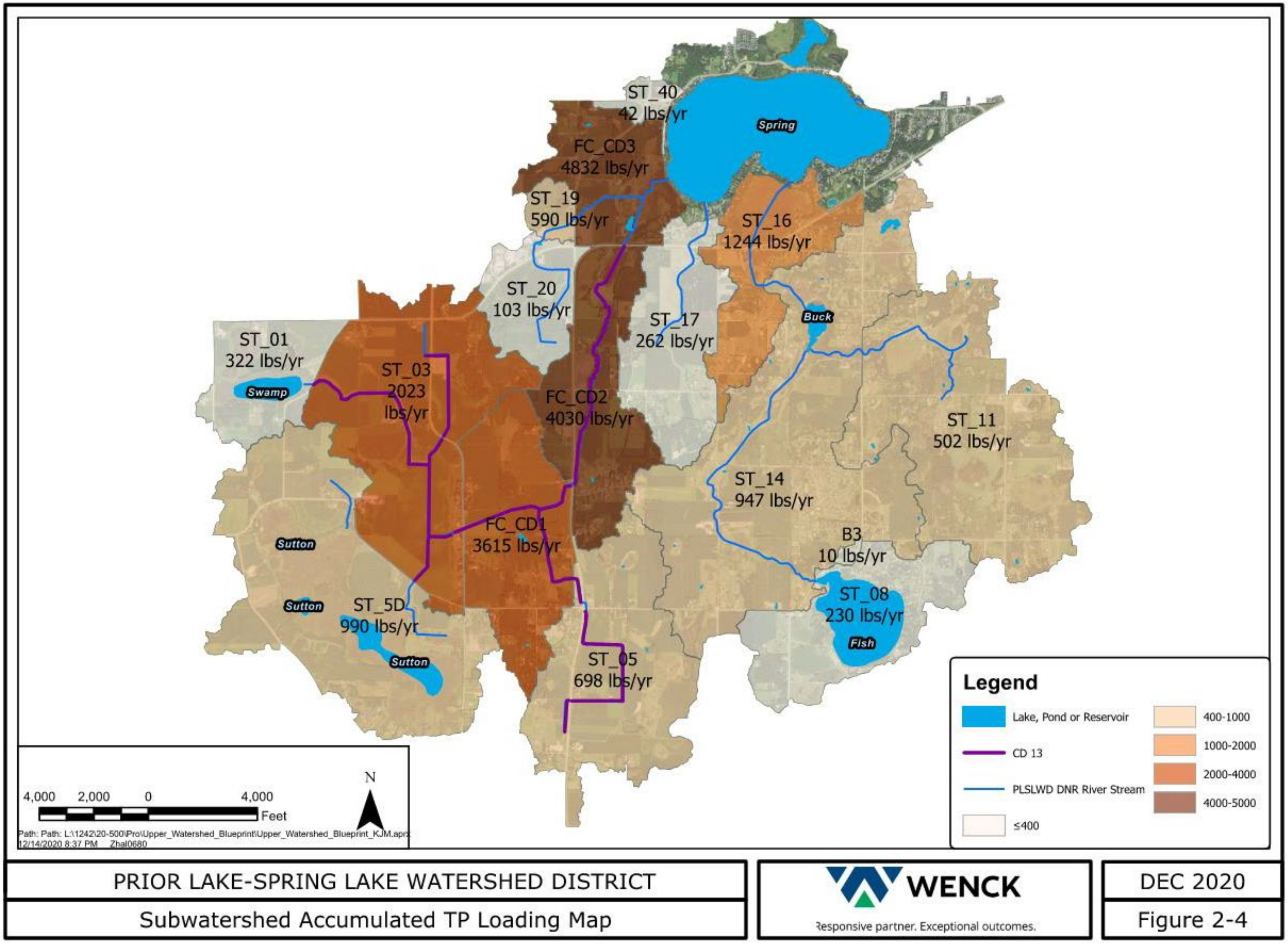


Figure 2.4. Accumulated TP loading map.

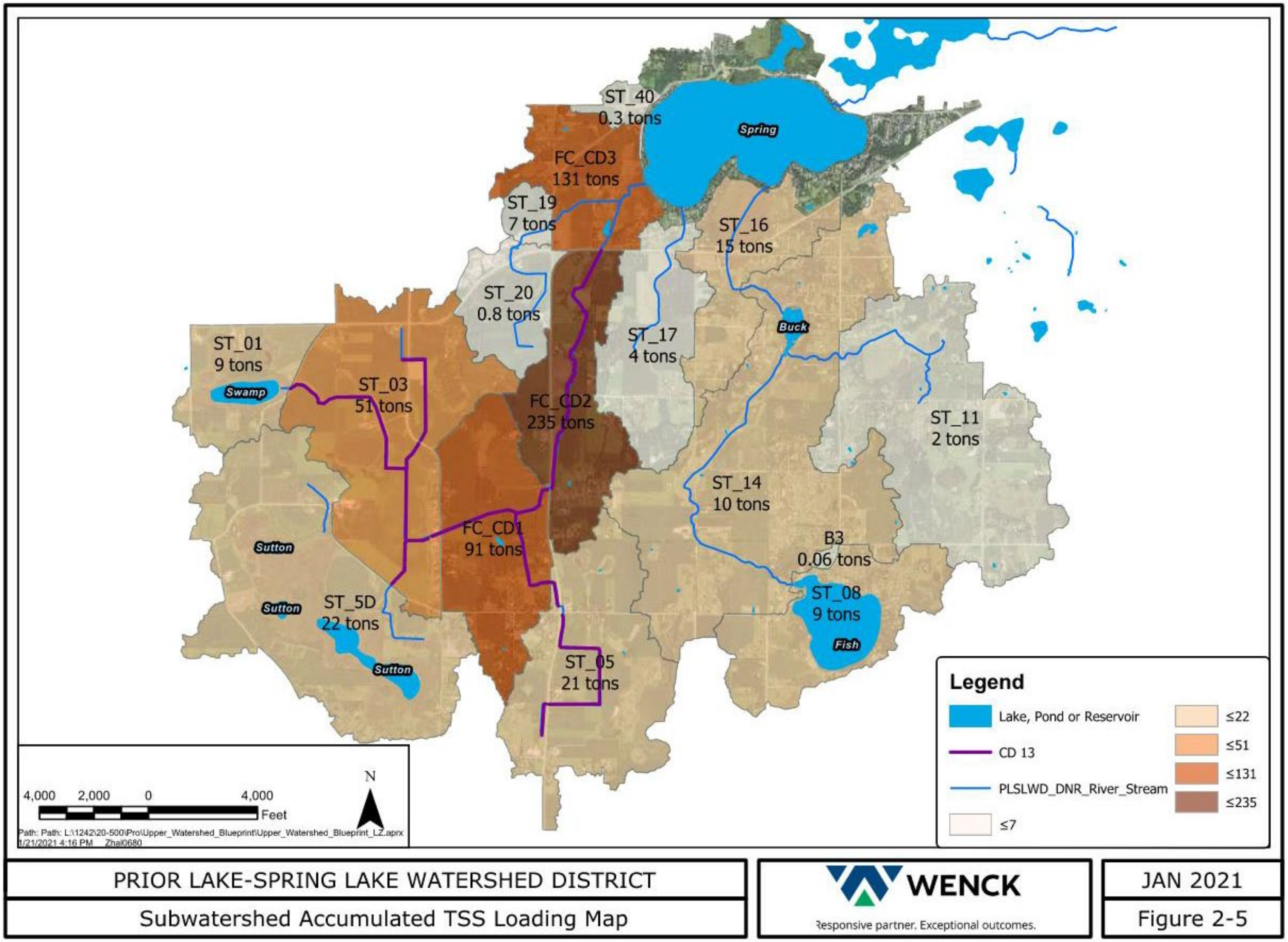


Figure 2.5. Accumulated TSS loading map.

As presented in the map, the Geis wetland appears to be removing a significant amount of the TSS generated in the upper watershed based on the reduction of total TSS load from 235 to 131 tons per year from watershed FC_CD2 to FC_CD3. The Buck Lake Channel system contributes about 15 tons of TSS annually to Spring Lake.

2.3 PRIOR REPORTS

Wenck reviewed information in several prior reports for the Upper Watershed. The reports included the following documents:

- *Spring Lake-Upper Prior Lake Nutrient TMDL* (Wenck Associates, May 2011)
- *Phosphorous release and accumulation in the sediments of Fish and Pike Lake, Scott County, MN* (Herman, Nicholas W, and Hobbs William O., St. Croix Research Station, Undated)
- *County Ditch 13 Plan and Profile* (1968 and 1984)
- *Prior Lake Stormwater Management & Flood Mitigation Study* (Barr Engineering, December 2016)
- *Subwatershed Analysis for West Upper Watershed* (Scott Soil and Water Conservation District, May 2015)
- *Stormwater Retrofit Investigation for the Subwatersheds of Spring Lake* (Scott Soil and Water Conservation District, September 2011)
- *PLSLWD Upper Watershed Review and Assessment Technical Memo* (Emmons and Olivier Resources, April 22, 2010)
- *Hwy 13 Wetland Survey and CD-13 Field Investigation Technical Memo* (Emmons Olivier Resources, August 29, 2017)
- *Feasibility of a Chemical Treatment System Downstream of Buck Lake* (Barr Engineering, October 2014.
- *Tile Drainage Assessment* (Scott Soil and Water Conservation District, September 2017)
- *Feasibility of a Chemical Treatment System Downstream of Buck Lake* (Barr Engineering, October 2014)
- Annual reports for the Ferric Chloride System as available on the PLSLWD website
- Sutton Lake Stormwater Storage Project Information available on the PLSLWD website

2.4 TMDL STUDY SUMMARY

The Total Maximum Daily Load (TMDL) report established goals for nutrient reduction in the Spring Lake and Upper Prior Lake watershed. The TMDL report was prepared in May 2011. The report estimated current nutrient loads for the lakes, waste load allocations and load allocations, and required reductions for the two impaired lakes. Some of the key outputs from the TMDL study are:

- The total internal and external phosphorous load to Spring Lake was 10,464 pounds per year and the total reduction goal was 8,640 pounds per year, or an 83% reduction.

- The external phosphorous load from the Spring Lake Watershed in the TMDL report is 3,595 pounds. This load includes some areas that are tributary to Spring Lake but are not in the upper watershed. The loads from areas that are not in the Upper Watershed are only a very small portion of the total load to Spring Lake.
- The TMDL report presents a target external phosphorous load reduction for the entire Spring Lake watershed of 2,959 pounds annually, which is 82% of the total phosphorous load in the TMDL report.
- 42% of the phosphorous load to Upper Prior Lake is attributed to discharges from Spring Lake, so reducing phosphorous in Spring Lake will have a positive benefit to Upper Prior Lake.
- Phosphorous load reduction from Spring Lake was identified as the key external load reduction target for Upper Prior Lake.

2.5 2016 FLOOD STUDY SUMMARY

The 2016 Flood Study included modeling and details for ten detention sites in the upper watershed with varying levels of improvement to the water levels on Prior Lake. These projects and their estimated benefit in water level reduction on Prior Lake and estimated costs are summarized in Table 2.2.

Table 2.2. 2016 Flood Study Upper Watershed storage sites.

Site Identification	Results	Cost[1]
Buck Lake (S-BL-001)	-0.3 feet	$760,000
S-BL-020	-0.1 feet	$290,000
Little Prior Lake (S-LPL-048)	<0.1	N/A
S-SPL-046	-0.1 feet	$970,000
S-SPL-054	<0.1	$440,000
S-SPL-059	<0.1	$290,000
S-SPL-078	-0.1 feet	$340,000
S-SPL-080	-0.1 feet	$310,000
S-SPL-094	-0.5 feet	$800,000
Sutton Lake (S-SUL-001)	-0.3 feet	$150,000
All ten storage sites	-1.2 feet	$4,350,000

[1] Cost in 2021 dollars with 2% annual inflation from reported cost in 2016 flood study report.

Of these 10 options, three showed a reduction of greater than 0.1 feet in the 25-year flood elevation based on the 2016 Flood Study report. The Buck Lake and Sutton Lake alternatives are evaluated in this report, using a slightly different approach. Site S-BL-020 is included in this report as the Buck lake East Wetland Enhancement project. The site located on the fields to the west of the airport, identified as S-SPL-094 was previously eliminated as an alternative due to landowner concerns.

2.6 EXISTING BMPS

Existing BMPs that have been implemented in the Upper Watershed provide a portion of the phosphorous reduction goals. The following existing BMPS are currently in use for Spring Lake and in the Upper Watershed:

- County Ditch 13 ferric chloride treatment system
- Cover crop planting and other lake friendly farming practices
- Spring Lake shoreline & Raymond Park restorations
- Fish Lake shoreline enhancement and prairie restoration
- Carp management on Spring Lake and Upper Prior Lake
- Alum Treatments on Spring Lake and Upper Prior Lake
- Curlyleaf pondweed assessment and management on Tier 1 Lakes
- CR 12/17 wetland restoration
- Tadpole Pond settling basin

3.0 Project Targeting

Wenck used the modeling and current conditions data to identify locations where phosphorous load and volume reduction projects can have the biggest positive impact on Spring Lake. The project targeting process first evaluated the loads and discharges at various locations in the watershed. The following are sites that were identified as high potential sites for positive benefits:

- Locations with high phosphorous loads and concentrations.
- Locations with high flow volume.
- Locations with topography, elevations and current land use that has potential to provide significant benefits with minimal negative impacts.

Wenck focused on large, regional projects that can have a significant impact, rather than on smaller scale opportunities due to the scale of treatment and volume control that will be needed to effectively make a beneficial impact. Smaller projects would be completed opportunistically over a long period of time.

Opportunities to restore connections to existing wetlands were also considered in targeting potential projects. These connections to existing and improved wetlands and natural resource corridors can help to inform and involve the community in water resource improvements projects by creating a beneficial public use of the spaces.

3.1 LAND USE AND SETTING REVIEW

The current land use and setting were analyzed based on topography and surface drainage, land ownership, the presence of productive farm fields, zoning, and existing wetlands. These criteria were evaluated to identify feasible locations that may be implemented as a part of a capital improvement plan.

3.2 NUTRIENT LOADING DATA

Nutrient loading data were also evaluated during the project targeting process. The subwatersheds with higher nutrient loads present the greatest opportunity to reduce nutrient loads from the Upper Watershed. Figure 2.3 presents the total phosphorous loads for individual subwatersheds. Figure 2.4 presents the cumulative phosphorous loads in the streams in the watershed. These values present the framework used to target locations where projects would provide the greatest potential for nutrient reducing benefits.

3.3 VOLUME DATA

The volume data was also evaluated to identify locations where projects could be implemented to achieve the greatest flood control benefit for the downstream lakes. The PC-SWMM model and Figures 2.1 and 2.2 were used to determine which areas of the Upper Watershed made the largest volume contributions to the runoff to Spring and Upper and Lower Prior Lakes.

Subwatersheds with a high phosphorous load relative to a low runoff volume are an opportunity to develop smaller scale projects requiring less infrastructure than projects that may require more up-front costs for similar reductions.

3.4 WATER QUALITY VS. FLOOD MITIGATION

One of the original ambitions for the Upper Watershed Blueprint was to identify and evaluate projects that may provide both a water quality and a flood mitigation benefit. However, it was discovered during the process that the projects that were most beneficial for water quality provide little or no flood mitigation, and projects that are the most efficient for flood reduction offer little in terms of water quality benefit.

This separation is largely due to the nature of flooding in the district. The most beneficial water quality projects will function continuously throughout the year while the most efficient flood storage solutions will only function during significant flood events and would only provide treatment for a fraction of the total annual runoff from the Upper Watershed.

3.5 ACTIVE VOLUME MANAGEMENT VS. CONTROLLED DISCHARGE RATE

The nature of flooding in the district is that the levels on Prior Lake are driven largely by the volume that discharges to the lake during a rainfall event. This is because the maximum allowable discharge through the Prior Lake outlet channel is limited to 65 cubic feet per second. That peak discharge rate is enough to lower the water level on Prior Lake by approximately 0.1 feet daily.

The District currently operates the low flow gate on the Prior Lake Outlet Channel, with DNR approval, when a significant rainfall event is forecast, and the water level is below the overflow weir elevation. Active volume management is using controls that open and close gates or valves based on criteria such as water level or predicted rainfall. These devices are only used when needed and do not cause any additional flooding or drainage issues unless the criteria are met. This early system of active outlet management helps to reduce the impact of the rainfall event on the Prior Lake water levels.

Managing flood levels on Prior Lake by using storage areas in the upper watershed can also be approached by passively managing flow rates to reduce the peak discharges or by providing storage for the large events that cause flooding. Passive controls include structures that are built to limit flow at certain elevations, such as an orifice with an overflow weir. These devices operate continuously and can increase the frequency and magnitude of surface water related problems during smaller events when they are not needed. Passive rate control in the Upper Watershed can quickly inundate storage areas and ditches and result in additional flooding of properties in the Upper Watershed during smaller events. These devices can also result in a higher baseline, using valuable storage capacity during small rainfall events that cannot then be utilized when a larger rainfall occurs.

Controlled management of outlets on the lakes in the Upper Watershed provides opportunity to retain a portion of the water volume that causes flooding on Prior Lake, when it is needed, without increasing the extent of the 100-year floodplain for any additional properties surrounding those lakes. The controls would result in prolonged inundation of the water bodies when they are used but can decrease the magnitude of the event on both the ditches and the water bodies downstream of the storage location. These can hold back hundreds of acre-feet of water that would otherwise contribute to higher water levels on Prior Lake.

While retaining stormwater in upper watershed areas can have a positive impact on the water levels on Prior Lake, they may result in little impact on Spring Lake or the streams and ditches in the upper watershed. This is because: 1.) the streams and Spring Lake reach a peak water level at an earlier time in the modeled rainfall event, 2.) the high water level in the streams and ditches, and Spring Lake, is more a function of flow rate than the volume of discharge that impacts Prior Lake, and 3.) when holding back water in the Upper Watershed, and then releasing it when conditions on Prior Lake allow, the streams and ditches have a second smaller peak, where water levels rise and water levels remain above the normal base flow for a longer period than under current conditions.

3.6 GIS TOOLS

A GIS-based web mapping application was developed to depict the lower subwatersheds total phosphorus (TP) values as they exist now and how these values will change depending on whether different projects are implemented.

The application shows the existing total phosphorous values and color-coded map with value ranges assigned to each color. A menu on the lower left-hand side of the application provides the ability to select different projects or combinations of projects. This will change the layer, color, and symbology that is displayed on the map to depict the total phosphorous value range for the selected project. The project name and value range will also be reflected in the ‘Proposed total phosphorous values’ legend on top of the project selection menu. The application provides users with the ability to select each subwatershed to view the specific values and other relevant information. Additional tools are provided that allow users to change basemaps, create bar charts to visualize phosphorous value changes by project or groups of projects, print maps and turn different layers on and off.

3.7 OTHER PROJECTS CONSIDERED

Several projects were discussed during the screening process that were not evaluated for various reasons. Those projects that were considered, along with reasons for not carrying them through a full evaluation are presented in Table 3.1.

Table 3.1. Projects considered but not evaluated.

Project	Location	Reason for Not Evaluating
Ducks Unlimited Wetland Improvements	Ducks Unlimited Wetland at the location of the Buck Lake discharge to Spring Lake	Improving the Ducks Unlimited Wetland or converting to different regime (i.e., wild rice) presents an opportunity for an esthetic and natural resource benefit. Improvements would not necessarily offer a significant improvement in water quality, and the location and elevation of the wetland in comparison to Spring Lake does not present opportunities for flood mitigation.
Highway 282/13 Interchange	Intersection of Highway 282 and 13	This may become a viable alternative site for a future improvement when an intersection update is planned. However, without a full understanding of what the improved interchange will be, a specific project cannot be defined for evaluation. Additionally, this is a topographically high point and is not suitable for a significant stormwater treatment project with current grades.
Re-meander and improve County Ditch 13	Various locations along County Ditch 13	Much of the ditch is currently in good condition with well-established banks and buffers and not a significant contributor to the concerns in the Upper Watershed. The reduction in overall erosion and sediment load would be minimal.
Stormwater reuse for irrigation	Various	The farmers in the Upper Watershed typically do not use irrigation systems.
Reintroduce beavers to steams to create natural pools	Buck Lake South Wetland, various stream locations	Projects will require relatively precise elevations and management to prevent unintended impacts. Continually managing nature to maintain the proper levels is not feasible in an urban setting.
Reroute drainage from County Ditch 13 to the central ditch, between the Buck Lake Channel and County Ditch 13	Near 186th Avenue	Elevations do not allow a connection to the Spring Central Stream.
Wetland restorations on agricultural fields	Various locations	The total benefit from individual fields is limited. This alternative should be offered as a lake friendly farming opportunity.

4.0 Funding Sources

Wenck identified potential funding sources for the projects identified in the project. We discussed the opportunities with the various agencies who have input on public project funding for water resources projects and the types of projects that can be funded under their programs. Several of the agencies participated in a funding partners meeting to further that discussion. Table 4.1 presents a summary of some of those funding sources and the types of projects that may be eligible for funding.

Table 4.1. Potential funding sources.

Source	Funding Mechanism	Project Types	Typical Funding Match
Board of Soil and Water Resources	Projects and Practices Grants	Surface water and drinking water protection, enhancement, and improvements	Project proposer provides 25% matching funds
	Watershed-based Implementation Funding Program	Pursue watershed-based project instead of on a project by project basis	Project proposer provides 10% matching funds
	Multipurpose Drainage Management Grants	Reduce erosion and sedimentation, peak flows and flooding, improve water quality for priority Chapter 103E drainage systems.	Project proposer provides 25% matching funds
Minnesota DNR	Flood Hazard Mitigation Grant Assistance Program	Flood damage reduction studies	Project proposer provides 50% matching funds
Minnesota Pollution Control Agency	Conservation Partners Legacy Grants	Conservation projects that restore, enhance, or protect forests, wetlands, prairies, and habitat for fish, game, and wildlife	Project proposer provides 10% matching funds
	Clean Water Partnership	Nonpoint pollution projects to improve surface waters	Provides loans up to $1M
	Section 319 Small Watershed Grants	Surface water quality projects	Project proposer provides 40% non-federal matching funds
	Clean Water Revolving Fund	Construction of accepted engineering practices that provide water quality benefits	Project proposer provides 20% matching funds
US Army Corps of Engineers	Continuing Authorities Programs Section 206	Restoration of degrading aquatic ecosystem structure, function and process	Federal Funds up to $10M. Project sponsor pays 35% of project cost

Source	Funding Mechanism	Project Types	Typical Funding Match
Legislative-Citizen Commission on Minnesota Resources	Environment and Natural Resources Trust Fund	Activities that protect, conserve, preserve, and enhance Minnesota's air, water, land, fish, wildlife, and other natural resources	None specified but is expected
Lessard-Sams Outdoor Heritage Council	Outdoor Heritage Fund	Habitat protection, restoration, and enhancement	Project proposer provides 10% matching funds
Ducks Unlimited	Outdoor Heritage Fund	Waterfowl habitat protection, restoration, and enhancement	50% proposer match
Pheasants Forever	Outdoor Heritage Fund	Habitat protection, restoration, and enhancement	50% proposer match

5.0 Project Conceptual Plans and Evaluation

This section presents concept plans for the various alternatives identified in this study. The subsections describe reasoning and analysis used to select the project locations and suggested alternatives for capital improvement projects.

Ideally, projects can be located and implemented to provide benefits in terms of both water quality and in flood mitigation. The nature of the setting, nutrient loads, and flooding in the Upper Watershed does not offer realistic opportunities to achieve both goals.

The most effective phosphorus load reduction projects will operate continuously throughout the rainy season and provide no flood reduction benefits. The most effective and feasible flood mitigation projects in the Upper Watershed operate on a periodic basis in response to or with predictions of a rainfall or high-water event. Much of the reason for this need to separate the goals is because the flooding in the watershed and for the downstream lakes is driven by the total volume of water and by the limits on the allowed discharge from the overall system. Flood reduction requires a significant storage component and results in increases in flooding in that area of the Upper Watershed.

A table of the potential benefits, challenges in design, permitting and construction, estimated cost and funding partners is also included in the summaries. Because the projects that provide flood relief and those that address water quality are separate, this section is arranged to include *water quality improvement alternatives in sections 5.1 through 5.14 and flood mitigation alternatives in 5.15 through 5.17*. Section 5.18 discusses future policy direction as it can impact water quality and flooding.

Note that these projects are only concepts. Should the District decide to move forward with any one of these projects, they would be tested for viability in partnership with the landowners, coordinated with the proper permitting authorities, and explored further with a feasibility study before moving forward.

The projects presented in this section have been evaluated using the GIS tool specific to the Upper Watershed. One of the outputs from that GIS tool is a map book that shows the specific project locations and benefits achieved by each project. The map book is included as Appendix A.

5.1 SUTTON LAKE IRON-ENHANCED SAND FILTER

Water Quality Project

Subwatershed

Sutton Lake is identified as a priority target location first because it has the highest identified phosphorous and volume load in the Upper Watershed and the highest modeled annual discharge volume. The calculated annual runoff volume, phosphorous load, and total suspended solids load from Sutton Lake are:

Total Annual Volume	1971 acre-feet
Total Annual Phosphorous Load	990 pounds
Total Suspended Solids Load	22 tons

In addition to the chemical data and model outputs, the setting at the discharge from Sutton Lake is suitable for an iron enhanced sand filter (IESF). The ditch discharging from Sutton Lake drops approximately nine feet in elevation over less than 1,000 feet to provide topography for a gravity-controlled treatment system. In addition to the favorable topography, the landowner upstream of the road crossing has expressed a willingness to work with the district to construct this type of solution.

Project Concept

Iron- enhanced sand filters (IESF) are a relatively new tool that is used to remove phosphorus from stormwater runoff. IESFs contain iron filings which bind phosphorus and remove it from the stormwater, trapping it in the filter.

The conceptual plan for the Sutton Lake IESF is shown in Figure 5.1. This filter is approximately 2.2 acres in surface area and situated along the ditch from Sutton Lake to Sutton Lake Boulevard. The filter would optimally be constructed in cells to allow ease of maintenance. The overall footprint would be sized to allow the entire Sutton Lake discharge volume to be filtered with an infiltration rate of 5 inches per hour, assuming that the discharge can be controlled to be evenly distributed through the year. The filter would consist of a one-foot layer of iron enhanced sand, overlying a coarse drainage layer with drain tiles to collect the filtered discharge. The drain tile would be discharged to a larger culvert to discharge into County Ditch 13 downstream of Sutton Lake Boulevard.

Figure 5.1. Sutton Lake IESF.

Results Summary

Table 5.1. Sutton Lake IESF Summary.

Parameter	Results
Prior Lake Flood reduction potential	0.0 feet
Spring Lake Flood reduction potential	0.0 feet
Phosphorous load reduction	735 pounds/year
Implementation challenges	1) High cost/funding 2) Easements with landowners
Estimated construction cost	$1,760,000
15-year lifecycle cost	$1,836,000
15-years cost per pound of P reduction	$166
Project partners	One affected landowner SWCD Sand Creek Township
Future capital expenditures years 16-30	Replace iron/sand mixture Annual operation and maintenance
Estimated cost years 16-30	$792,000
30-year cost per pound of P reduction	$120
Funding partners	BWSR, MPCA, SWCD
Implementation timeframe	2 – 4 years. The project has a willing landowner and it is a type of project that is frequently funded

5.2 SWAMP LAKE DIVERSION TO GEIS LAKE

Water Quality Project

Subwatershed Overview

Swamp Lake is identified as a priority target location because it has potential to provide some improvements in water quality and the setting is favorable to treat the discharges to the County Ditch 13 system. A diversion routing part of the Swamp Lake runoff to Geis Lake was identified as a potential project location because elevations would allow a diversion outlet and an existing 18-inch drain tile formerly connected from the Swamp Lake wetland and discharging to Geis Lake may be able to be used for the diversion. The calculated annual runoff volume, phosphorous load and total suspended solids load from Swamp Lake, assuming that a new diversion would reroute between 25% and 75% of the total Swamp Lake discharge are:

Total Annual Volume	110-330 ac-ft
Total Annual Phosphorous Load	80-240 pounds
Total Suspended Solids Load	2-6 tons

Figure 5.2. Swamp Lake diversion to Geis Lake.

Project Concept

The Swamp Lake diversion would reconnect an 18" drain tile from the mitigated wetland north of Swamp Lake as shown in Figure 5.2. The original drain was routed to Geis Lake and discharged to the Picha Creek watershed basin. The concept would use controls to determine when discharge is routed to Geis Lake and when the discharges are routed to County Ditch 13. The outlet controls could be based on Spring Lake levels, Swamp Lake levels, rainfall forecasts or other criteria that provide the maximum benefit but do not adversely impact the Picha Creek Basin or Geis Lake. Any runoff diverted to Geis Lake would reduce the volume and corresponding phosphorous loads to Spring Lake. Optimization of outlet control triggers will be fleshed out in a feasibility study for the Swamp Lake.

Modeling Results Summary

The recalibrated PCSWMM model was updated to reflect a proposed weir structure to limit normal flows out of the existing outlet and a proposed diversion outlet to Geis Lake. The results of the proposed diversion are shown in Table 5.2 and are not expected to noticeably change the flooding severity on Prior Lake.

Table 5.2. Impacts of Swamp Lake Diversion to flooding severity on Prior Lake.

Flooding Severity	**10-year, 30-day Flood[1]**	**25-year, 30-day Flood[1]**	**2014 water Year[1]**
Change in peak water surface elevation relative to existing conditions (feet)	0.0	0.0	-0.1
Change in time above no wake Water level on Prior Lake (days)	-1	-1	-3

[1] + Increase in peak water surface elevation or number of days above no wake water level on Prior Lake (904.0 ft)
- Decrease in peak water surface elevation or number of days above no wake water level on Prior Lake

Table 5.3. Swamp Lake Diversion to Geis Lake summary.

Parameter	**Results**
Prior Lake Flood reduction potential	0.0 feet
Spring Lake Flood reduction potential	0.0 feet
Phosphorous load reduction	161 pounds *(80-240 pounds[1])*
Implementation challenges	1) Permitting difficulty 2) Easement acquisition
Estimated construction cost	$476,000
15-year lifecycle cost	$492,000
15-years cost per pound of P reduction	$204 *($139-$417[1])*
Project partners	2-3 affected landowners SWCD Sand Creek Township
Future capital expenditures years 16-30	Annual operation and maintenance
Estimated cost years 16-30	$15,000
30-year cost per pound of P reduction	$126
Funding partners	SWCD, MnDNR – FDR Grant
Implementation timeframe	4 – 8 years. Multiple landowners. Diverting water to a different watershed would be challenging. Funding availability is limited.

1- Values are the range of results if 25 to 75% of the discharges are routed to Geis Lake. Final values need to consider the operating range and factors.

5.3 SWAMP LAKE IRON-ENHANCED SAND FILTER

Water Quality Project

Subwatershed Overview

Swamp Lake is identified as a priority target location because it has potential to provide some improvements in water quality and the setting is favorable to treat the discharges to the County Ditch 13 system. The ditch bottom elevation is about 3-4 feet below the Swamp Lake outlet at Redwing Trail, providing a change in elevation that will be amenable to constructing a gravity controlled system, and the construction can be confined to the area within the existing limits of the ditch. Although the volume and phosphorous loads are relatively low for the Swamp Lake discharge relative to other subwatersheds, the physical setting of Swamp Lake is favorable to providing some water quality benefits. The calculated annual runoff volume, phosphorous load, and total suspended solids from Swamp Lake are:

Total Annual Volume	447 acre-feet
Total Annual Phosphorous Load	322 pounds
Total Suspended Solids Load	9 tons

Project Concept

The filter is sized to allow the entire Swamp Lake discharge volume to be filtered with an infiltration rate of 5 inches per hour, assuming that the discharge can be controlled to be evenly distributed through the year through construction of a weir or other structure at the Swamp Lake outlet. As shown in Figure 5.3 the filter would be approximately 0.5 acres in size, placed near the invert elevation of the Redwing Trail culvert crossing from Sutton Lake. The filter would consist of a one-foot layer of iron enhanced sand, overlying a coarse drainage layer with drain tiles to collect the filtered discharge. The drain tile will be collected in a larger culvert to discharge into the ditch at the downstream end of the filter. It is anticipated that the filter can be fit mostly within the existing ditch to ensure that long term impacts to the productive farmland, if any, are minimized.

Figure 5.3. Swamp Lake IESF.

Project Summary

Table 5.4. Swamp Lake IESF summary.

Parameter	Results
Prior Lake Flood reduction potential	0.0 feet
Spring Lake Flood reduction potential	0.0 feet
Phosphorous load reduction	223 Pounds
Implementation challenges	1) Access 2) Easement acquisition 3) Funding
Estimated construction cost	$480,000
15-year lifecycle cost	$530,000
15-years cost per pound of P reduction	$159
Project partners	Two affected landowners SWCD, Spring Lake Township
Future capital expenditures years 16-30	Replace iron/sand mixture Annual operation and maintenance
Estimated cost years 16-30	$261,000
30-year cost per pound of P reduction	$118
Funding partners	BWSR, DNR, SWCD
Implementation timeframe	3 – 5 years. Only one landowner, impacts limited to the existing ditch area. The project type is frequently funded

Water Quality Project

5.4 BUCK LAKE SOUTH WETLAND STORAGE

Subwatershed

Although the Buck Lake system contributes smaller loads in terms of both volume and pollutants compared to County Ditch 13, projects in the Buck Lake subwatershed can still provide a benefit. The area between Fish Lake and Buck Lake includes a 100-acre wetland that may be suitable for improvements and enhancements. The improvements can leverage an existing natural area to provide benefits in terms of both water quality and flood controls. The calculated annual runoff volume, phosphorous load, and total suspended solids through this wetland are:

Total Annual Volume	1034 acre-feet
Total Annual Phosphorous Load	947 Pounds
Total Suspended Solids Load	10 tons

The wetland areas upstream of Buck Lake were identified as a potential location for wetland enhancements due to their size and the topography. This is a favorable location for storage and attenuation of suspended solids and phosphorous. A concept sketch of the Buck Lake South Wetland Improvements is shown in Figure 5.4.

Project Concept

The wetlands in the areas upstream of Buck Lake are nearly 100 acres. The conceptual plan for this area is to construct stepped berms with controlled outlets to hold more runoff in the wetlands and allow a larger surface area for storage during smaller rainfall events. At 1-1/2 feet in depth, the wetlands can retain almost 150 acre-feet of stormwater, which represents 15% of the total annual runoff generated from the area upstream of Buck Lake. This increased storage capacity can provide mitigation to flooding in Prior Lake and extended runoff detention as well as retention of suspended solids, phosphorous and nutrients. Outlet automation based on rainfall predictions and water levels on downstream water bodies can be implemented to optimize the system operation.

This proposed solution can be designed to minimize the impacts to private properties and limit any increase in the floodplain areas by limiting the storage areas to the existing wetland footprints. The outlets and overflow details can be adjusted to reduce or eliminate any of these impacts.

The Farmer-Led Council expressed concern about potential impacts to adjacent and upstream agricultural areas for this project.

Results Summary

The Minnesota Stormwater Manual estimates a 40% phosphorous reduction for wetlands. The 40% reduction is used to estimate the potential phosphorous reduction achieved by reconnecting the flood plain wetlands to the ditch as well as for other projects that include improved wetlands. Details are summarized in Table 5.5.

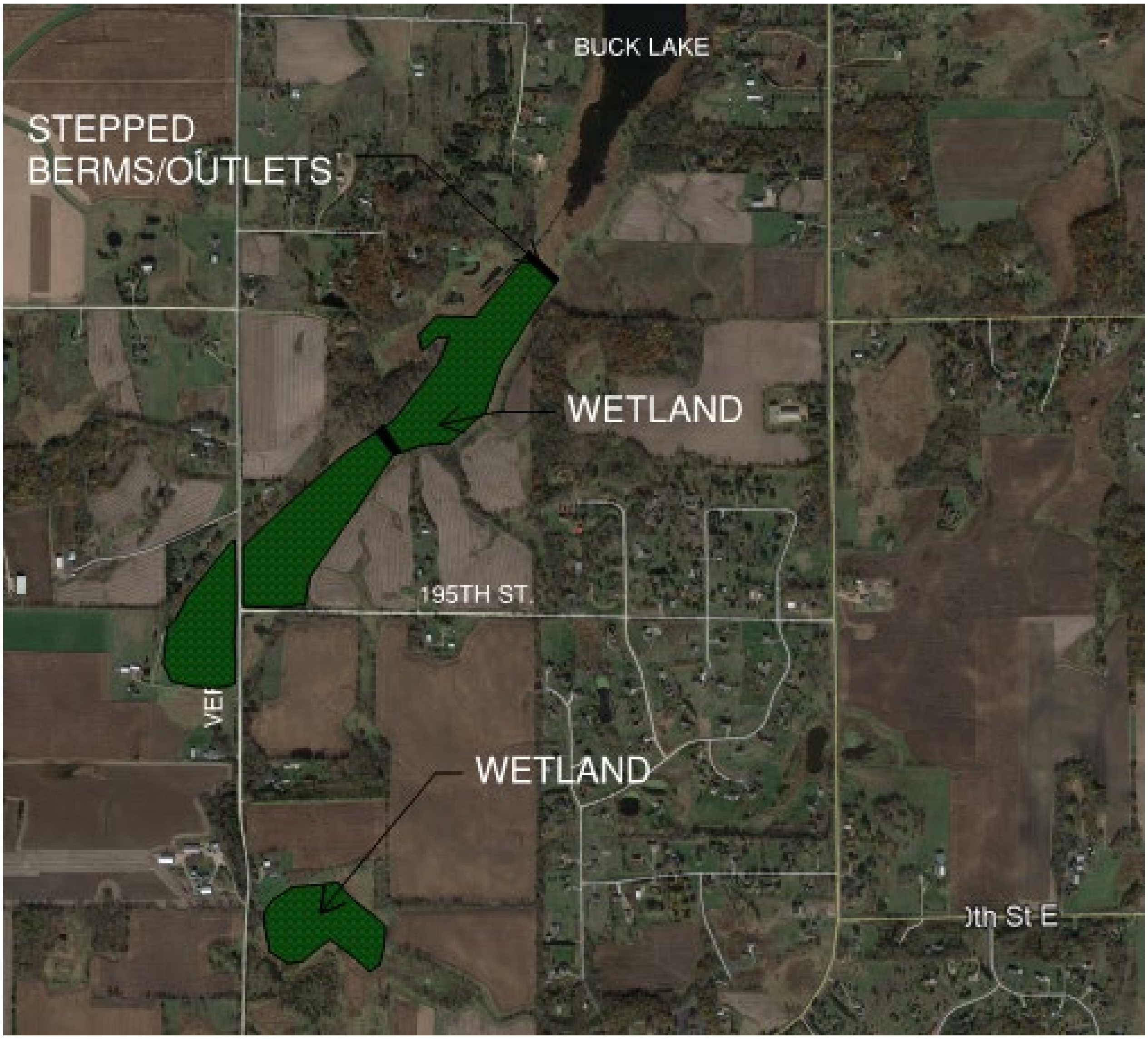


Figure 5.4. Buck Lake South wetland storage.

Table 5.5. Buck Lake South Wetland Storage summary.

Parameter	Results
Prior Lake Flood reduction potential	-0.1 feet[1]
Spring Lake Flood reduction potential	0.0 feet
Phosphorous load reduction	95 Pounds[2]
Implementation challenges	1) High cost/funding 2) Easement acquisition 3) Accessibility 4) Flood Plain changes associated
Estimated construction cost	$620,000
15-year lifecycle cost	$652,000
15-years cost per pound of P reduction	$459
Project partners	>10 affected landowners SWCD
Future capital expenditures years 16-30	Annual operation and maintenance
Future capital expenditures years 16-30	$39,000
30-year cost per pound of phosphorous reduction	$242
Funding partners	BWSR, SWCD, LCCMR, LSOHC, Ducks Unlimited, Pheasants Forever
Implementation timeframe	7 – 10 years. Multiple landowners. Ideal for heritage funding, affected areas need to be placed in conservation easement.

1- Modeled 25-year, 30-year rainfall event change in high water level on Prior Lake
2- Reduction based on 10% reduction through impoundment and extended detention.

5.5 BUCK LAKE EAST STREAM RESTORATION

Water Quality Project

Subwatershed

The watershed to the east of Buck Lake, identified as the Buck Lake East subwatershed, is relatively high in phosphorus load in consideration of the annual runoff volume. Most of the watershed flows through a stream and wetlands that run into Buck Lake on the south end of the lake. The calculated annual runoff volume, phosphorous load, and total suspended solids load. The calculated annual runoff volume, phosphorous load, and total suspended solids through this reach of stream are:

Total Annual Volume	384 ac-ft
Total Annual Phosphorous Load	502 pounds
Total Suspended Solids Load	2 tons

Project Concept

The stream that flows to Buck Lake from the wetland was identified by PLSLWD as a potential target location for a stream bank restoration. There is a reach of the stream to the west of Fairlawn Avenue that has degraded and has an eroding bank. Restoring this reach of stream will reduce the sediment and phosphorus load to Buck Lake. Using natural vegetation for restoration would also require clearing the tree canopy to allow natural sunlight on the stream, or the banks may be restored with hard armoring such as rip rap or other engineered products. Potential beneficial projects in the Buck Lake East watershed are shown in Figure 5.5. The benefits provided by this project are summarized in Table 5.7.

Results Summary

Table 5.6. Buck Lake East Stream Restoration summary.

Parameter	Results
Prior Lake Flood reduction potential	0.0 feet
Spring Lake Flood reduction potential	0.0 feet
Phosphorous load reduction	10 Pounds
Implementation challenges	1) Tree removal 2) Access 3) Easement acquisition
Estimated construction cost	$89,000
15-year lifecycle cost	$96,000
15-years cost per pound of P reduction	$637
Project partners	Four affected landowners SWCD Spring Lake Township
Future capital expenditures years 16-30	Annual operation and maintenance Erosion repair Vegetation management
Future capital expenditures years 16-30	$7,000
Estimated cost years 16-30	$343
Funding partners	SWCD, DNR
Implementation timeframe	2 – 4 years. Lowest cost alternative. Landowners would be only affected during construction and not long-term. Possible delays for objections over tree impacts.

5.6 BUCK LAKE EAST WETLAND ENHANCEMENT

Water Quality Project

Subwatershed

The watershed to the east of Buck Lake, identified as the Buck Lake East subwatershed, is relatively high in phosphorus load in consideration of the annual runoff volume. Most of the watershed flows through a stream and wetlands that run into Buck Lake on the south end of the lake. The calculated annual runoff volume, phosphorous load, and total suspended solids load through the Buck Lake East wetland are:

Total Annual Volume	384 ac-ft
Total Annual Phosphorous Load	502 pounds
Total Suspended Solids Load	2 tons

Project Concept

The channel discharge starts at a 40-acre wetland situated near the center of the subwatershed. The wetland discharges into the beginning of the stream at a private road crossing. This wetland was also identified as a potential location for upper watershed flood storage and modeled in the *Prior Lake Stormwater Management & Flood Mitigation Study* (Barr 2016). Improvement of this wetland would provide phosphorous reduction and some flood attenuation. The restoration can be as simple as constructing a berm with an outlet structure to contain the water at a higher elevation and reduce the discharge rate. The location is shown in Figure 5.5.

The Farmer-Led Council was supportive of this project, as long as it would not impact the agricultural areas immediately adjacent and upstream.

Figure 5.5. Buck Lake East wetland enhancement.

Results Summary

Table 5.7. Buck Lake East wetland enhancement summary.

Parameter	Results
Prior Lake Flood reduction potential	0.0 feet
Spring Lake Flood reduction potential	0.0 feet
Phosphorous load reduction	100 pounds[1]
Implementation challenges	1) Easement acquisition 2) Access 3) Flood Plain changes
Estimated construction cost	$167,000
15-year cost	$180,000
15-years cost per pound of P reduction	$119
Project partners	Three affected landowners SWCD Spring Lake Township
Future capital expenditures between year 16-30	Annual operation and maintenance Vegetation management
Estimated cost year 16-30	$16,000
30-year cost per pound of P reduction	$59
Funding partners	BWSR, SWCD, LSOHC
Implementation timeframe	2-4 years. The District has been approved for funding to conduct a feasibility study for this project.

1 - Removal based on ½ of the watershed flowing through the wetland and 40% phosphorous reduction.

5.7 COUNTY DITCH 13 IMPROVEMENTS

Water Quality Project

Subwatershed

The subwatersheds that flow to and through County Ditch 13 are a significant contributor of phosphorous to Spring Lake. The TP load in County Ditch 13 at the road crossing at Highway 282 is about 4,030 pounds per year based on the stream flow sampling and data. Improvements that capture or mitigate even a fraction of the total flow through this reach of ditch can provide a measurable benefit in pounds of phosphorous reduction annually. The calculated annual runoff volume, phosphorous load, and total suspended solids load through County Ditch 13 at this location are:

Total Annual Volume	5,657 ac-ft
Total Annual Phosphorous Load	4,030 pounds
Total Suspended Solids Load	235 tons

These reaches of County Ditch 13 were included in the evaluation because it is the location with the highest annual phosphorous loads and the greatest potential for load reduction.

Most of the areas along County Ditch 13 are currently productive agricultural land and would not be likely candidates for ditch improvements or restoration. Much of County Ditch 13 has a well-established buffer, which provides sediment and phosphorous reduction from the surface runoff. The ditch appears to be well vegetated and in good condition to minimize bank erosion. This is one of the farm friendly practices in use in the Upper Watershed that effectively reduce the pollutant and sediment loads from those watersheds.

Project Concept

The wetlands on the overbank of County Ditch 13 and north of the single-family homes on Butterfly Lane comprise about 20 acres in total area. Conceptually, the wetland on the east bank of the ditch can be excavated to a bench near the existing normal flow elevation of the ditch, and the larger wetland area can be restored to a more functional condition. This can allow for lower velocity and increased mitigation during low flow conditions. Even though small in area, these improvements can make an incremental improvement in the water quality. Locations and concepts for this improvement are shown in Figure 5.6. A summary of the County Ditch 13 improvements is provided in Table 5.7.

Figure 5.6. County Ditch 13 improvements.

Results Summary

Table 5.8. County Ditch 13 Improvements summary.

Parameter	Results
Prior Lake Flood reduction potential	0.0 feet
Spring Lake Flood reduction potential	0.0 feet
Phosphorous load reduction	202 pounds
Implementation challenges	1) Access 2) Easement acquisition 3) High cost/funding
Estimated construction cost	$1,151,000
15-year lifecycle cost	$1,177,000
15-years cost per pound of P reduction	$389
Project partners	>10 affected landowners SWCD, Spring Lake Township Farmer Led Council
Future capital expenditures years 16-30	Annual operation and maintenance Vegetation management Erosion repair
Future capital expenditures years 16-30	$31,000
Estimated cost years 16-30	$199
Funding partners	BWSR, SWCD, DNR
Implementation timeframe	5 – 7 years. Multiple affected landowners. Improvements would result in loss of productive fields.

5.8 COUNTY DITCH 13 REPAIRS

Water Quality Project

Subwatershed

Two locations on County Ditch 13 were identified by the District as needing repair. The reach immediately downstream of the Sutton Lake outlet has been eroded and the reach from 190th Street to Geis Wetland has frequent washouts and bank erosion.

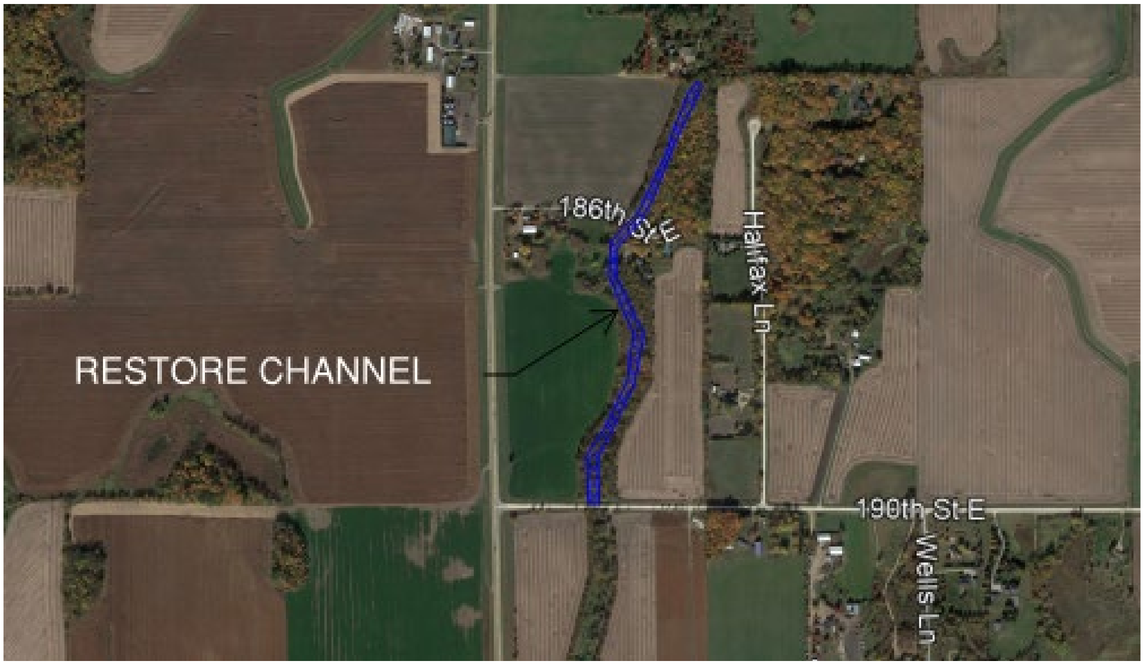
Project Concept

The ditch downstream of Sutton Lake is relatively steep compared to other areas of the County Ditch 13 system. The repairs would include regrading and stabilizing the banks with native vegetation and constructing a series of rip rap check dams to reduce the velocity and the erosion in the ditch. The location for these repairs is shown in Figure 5.7.

Figure 5.7. County Ditch 13 repairs at Sutton Lake.

The stretch of ditch between 190th Street and Geis Wetland will be regraded to repair the undercut sections of ditch. The area is relatively wooded, and selective tree removal to allow a more robust vegetative growth on the bank and significantly improve the stability. Targeted locations in the ditch will be armored with rip rap to protect heavily shaded areas and to direct the flow to reduce the erosive forces. The location for these repairs is shown in Figure 5.8. The Farmer-Led Council expressed strong support of this project as long as it does not impact the agricultural areas.

Figure 5.8. County Ditch 13 repairs south of Geis Wetland.



Results Summary

The results of these repairs of County Ditch 13 are presented in Table 5.8. These repairs represent a very small incremental improvement in the overall water quality for the system.

Table 5.9. County Ditch 13 Repairs summary.

Parameter	**Results**
Prior Lake Flood reduction potential	0.0 feet
Spring Lake Flood reduction potential	0.0 feet
Phosphorous load reduction	50 pounds
Implementation challenges	1) Access 2) Easement Acquisition 3) Minimal positive impact
Estimated construction cost	$597,000
15-year lifecycle cost	$623,000
15-years cost per pound of P reduction	$830
Project partners	Landowners, SWCD Spring Lake Township, Farmer Led Council
Future capital expenditures years 16-30	Annual Operation and maintenance Vegetation management Erosion repairs
Estimated cost years 16-30	$31,000
30-year cost per pound of P reduction	$436
Funding Partners	BWSR, SWCD, DNR
Implementation Timeframe	3 – 7 years. Disturbances limited to the current ditch area only during construction.

5.9 COUNTY DITCH 13 DIVERSION

Water Quality Project

Subwatershed

The watersheds upstream of Langford Avenue contribute more than half of the total phosphorous loads from the Upper Watershed. The calculated total annual runoff volume, phosphorous load, and total suspended solids load through County Ditch 13 at Langford Avenue are:

Total Annual Volume	4,914 ac-ft
Total Annual Phosphorous Load	3,615 pounds
Total Suspended Solids Load	91 tons

Project Concept

The existing topography would allow a portion of the flow through County Ditch 13 to be diverted to the Buck Lake system, although it would need to be a piped discharge due to the topography between the two channels. The discharge would flow from County Ditch 13 near the crossing at Langford Avenue to the Buck Lake system near the intersection of Vergus Avenue and 195th Street Northeast. Possible benefits provided by this diversion include:

- Reducing the flow through County Ditch 13 from the diversion to Spring Lake. This would reduce the volume flowing County Ditch 13 and the ferric chloride treatment system and potentially improve the efficiency of that system.
- The corridor created by a discharge would create an opportunity for a trail connection between Langford Avenue and Vergus Avenue.
- The diversion could take advantage of the wetland systems upstream of Buck Lake to provide retention and treatment of the runoff from the County Ditch 13 subwatersheds. This benefit would be further enhanced if the Buck Lake wetland storage alternative were implemented.

Diverting flows from County Ditch 13 to the Buck Lake channel as shown in Figure 5.9 presents both opportunities and challenges. The diversion would decrease flows and loads through the downstream reach of County Ditch 13; however, it would increase the flows and loads to Buck Lake by an equal amount.

The flows allowed through a diversion would need to be balanced to not cause a negative impact on the loads or flood levels on Buck Lake. The diversion would also need to be coupled with some form of treatment, such as the wetland enhancements in section 4.3, an IESF, or a proprietary treatment device to prevent increasing the nutrient loads to Buck Lake. A full feasibility study would need to be completed to confirm the effectiveness and benefit provided by a diversion. The system would also need to consider the existing ferric chloride treatment systems and any impact, positive or negative, on that existing BMP.

The recalibrated PCSWMM model was updated to reflect a proposed 3-foot diameter pipe, approximately 4,000 feet long, to route part of the flood flows to Buck Lake. The modifications do not change the frequency or severity of flooding severity on Prior Lake.

Figure 5.9. County Ditch 13 Diversion.

Results Summary

Table 5.10. County Ditch 13 Diversion summary.

Parameter	Results
Total annual volume of water diverted	*1,228 ac-ft*[1]
Total annual P load in water diverted	*904 pounds*[1]
Prior Lake Flood reduction potential	0.0 feet
Spring Lake Flood reduction potential	0.0 feet
Phosphorous load reduction	90 pounds[2]
Implementation challenges	1) Access 2) Easement acquisition 3) High cost/funding 4) Permitting 5) Adverse impacts to Buck Lake
Estimated construction cost	$1,203,000
15-year lifecycle cost	$1,253,000
15-years cost per pound of P reduction	$924
Project partners	6+ landowners, SWCD
Future capital expenditures years 16-30	Annual operation and maintenance Erosion repair
Estimated cost years 16-30	$62,000
30-year cost per pound of P reduction	$487
Funding partners	
Implementation timeframe	7 – 10 years. Multiple affected landowners. Significant studies needed to evaluate impacts on Buck Lake system. Funding availability is limited.

1 – Assumes diversion of 25% of the total County Ditch 13 flow and load at this location.
2 – Assumes that the Buck Lake wetland system reduces phosphorous loading by 40% per literature values and 25% of the flow is treated.

5.10 FECL SYSTEM IMPROVEMENTS ALTERNATIVE 1

Water Quality Project

Subwatershed Overview

This is a targeted location because it is the final discharge point of the County Ditch 13 system before entering Spring Lake and there is an existing treatment system in place. The calculated total annual runoff volume, phosphorous load, and total suspended solids load at the ferric chloride system are:

Total Annual Volume	5,657 ac-ft
Total Annual Phosphorous Load	4,030 pounds
Total Suspended Solids	235 tons

Project Concept

Between 2014 and 1019, the existing ferric chloride system removed between 43 and 72% of the soluble reactive phosphorous, and about 19% and 48% in total phosphorous, as provided in the *Ferric Chloride Water Treatment Facility 2019 Operating Report*. These are reported based on the operating calendar of Spring through Fall each year. Generally, the reduction has been decreasing over time.

Based on the reported reduction of about 500 pounds of total phosphorous annually from 2014 through 2019, and the calculated average annual load of 4,030 total phosphorus load, the removal is approximately 12%. The difference in values than those in the annual reports are attributable to months when the ferric chloride system is not operating, flow bypass, or other factors.

The 2007 USEPA Report *Advanced Wastewater Treatment to Achieve Low Concentration of Phosphorous* reported a total phosphorous reduction from 0.50 to 0.45 mg/L in its influent to 0.05 mg/L in the effluent, for a total reduction of about 90%. Given the more sporadic concentration and flow than in a wastewater treatment plant, the ferric chloride treatment system cannot be expected to operate at such a high efficiency. However, the system should be improvable to reach a removal efficiency of nearly 70% of the total phosphorous. Minor modifications to the system could provide for increased annual phosphorous reduction. Some possible inefficiencies in the current system include:

- The desilt pond is somewhat undersized for the County Ditch 13 flow. The pond surface area is about 2.5 acres. Increasing the pond footprint would increase the residence time and improve the sedimentation capacity of the flocculated particles as well as suspended solids and particulate phosphorous.
- The injection port is in a short length of culvert and the treatment could benefit from improved mixing between the ferric chloride injection point and the desilt pond.
- The discharge rate from Geis Wetland is not controlled so it is subject to variations in flow rate. Even though the system flow is monitored, and the dosage is calibrated based on flow, it may operate more efficiently with a more constant flow rate.

Currently, discharges through the County Ditch 13 system flow into Geis Wetland located south of Highway 13. Geis Wetland flows over a weir, through the culvert crossing under Highway 13, and to the channel downstream. Most of the discharge at this location is routed through a 24-inch culvert, where it is mixed with ferric chloride, and then into a sedimentation basin identified as the desilt pond. The iron in the ferric chloride binds with the phosphorous in the stormwater and creates particles that settle out in the desilt pond prior to discharge to Spring Lake.

The building that houses the pumps and tank for ferric chloride is located on the south side of Highway 13. The ferric chloride is pumped from the equipment through a double walled pipe, about 900 feet, and into the 24-inch culvert. Extremely high flows bypass the culvert and flow over a weir and directly to Spring Lake without treatment. Out of about 1,200 measurements at the desilt pond and on Spring Lake from 2014 through 2019, the water level in the desilt pond was higher than the bypass weir for 97 measurements. The water level in Spring Lake was above the weir for 66 of those measurements. These data show that the upstream discharges from large rainfall events in the County Ditch 13 watershed area only bypassed the desilt pond 31 times out of 1,200 measurements so most of the discharges through County Ditch 13 are treated prior to discharge to Spring Lake.

The ferric chloride system locations are shown in Figure 5.10.

Figure 5.10. Ferric Chloride System improvements alternative 1.

Two possible options were evaluated for improvements to the system to increase the volume that passes through the system, improve mixing efficiency, or improve the settlement of flocculated particles. This project presents the first possible modification to the ferric chloride treatment system as presented in Table 5.9.

Improvement Alternative 1: Improved mixing and flow optimization.

- Construct a mixing tank, with a new 700-foot long pipe directly to the desilt pond from Geis Wetland. Construct the outlet to discharge at a rate that optimizes the overall operation of the system. Include real time flow measurement to the discharge from Geis Wetland to the desilt pond to optimize dosing rates.
- Install a treatment device to provide pre-settlement of flocculated particles.

Results Summary

Table 5.11. FeCl System Improvements Alternative 1 summary.

Parameter	**Results**
Prior Lake Flood reduction potential	0.0 feet
Spring Lake Flood reduction potential	0.0 feet
Phosphorous load reduction	250 pounds[1]
Implementation challenges	1) Permitting 2) Siting new equipment
Estimated construction cost	$275,000
15-year lifecycle cost	$400,000
15-years cost per pound of P reduction	$107
Project partners	2 affected landowners SWCD Spring Lake Township MPCA
Future capital expenditures years 16-30	Replace pumps, tanks, and infrastructure. Chemical purchases Annual operation and maintenance
Estimated cost years 16-30	$179,000
30-year cost per pound of P reduction	$77
Funding partners	BWSR SWCD MPCA
Implementation timeframe	2 – 7 years. The project would require a study to confirm the ideal parameters. Need access agreements for modifications.

1 – Assumes a 50% increase in the potential phosphorous reduction. Additional study needs to be completed to determine optimal operating parameters and treatment capacity.
2 – Anticipated that 75% of the discharge will be treated and that the overall system will reduce phosphorous by 70%. Jar tests would be required to determine actual reduction efficiency.
3 – Number of affected landowners would depend on the location where a new basin is sited.

5.11 FECL SYSTEM IMPROVEMENTS ALTERNATIVE 2

Water Quality Project

Subwatershed Overview

This is a targeted location because it is the final discharge point of the County Ditch 13 system before entering Spring Lake and there is an existing treatment system in place. The calculated total annual runoff volume, phosphorous load, and total suspended solids load at the ferric chloride system are:

Total Annual Volume	5,657 ac-ft
Total Annual Phosphorous Load	4,030 pounds
Total Suspended Solids	235 tons

Project Concept

The background to the existing project was further explained in the previous Section 5.10. Based on the summary of the existing FeCl system, two possible options were evaluated for improvements to the system to increase the volume that passes through the system, improve mixing efficiency, or improve the settlement of flocculated particles. This project explores a second possible modifications to the ferric chloride treatment system as presented in Table 5.10.

Improvement Alternative 2: Increase settling basin capacity.

- Construct a mixing tank, with a new 700-foot long pipe directly to the desilt pond from Geis Wetland. Construct the outlet to discharge at a rate that optimizes the overall operation of the system. Include real time flow measurement to the discharge from Geis Wetland to the desilt pond to optimize dosing rates.
- Evaluate options to increase the footprint and settling capacity of the desilt pond; or
- Construct a flow splitter and site a second basin in the vicinity of the existing Ferric Chloride treatment building and the ditch that is suitable and amenable to increasing the treatment capacity.

One possibility to increase the settling capacity is to increase the footprint of the desilt pond, as shown in Figure 5.11. This would increase the detention time, and combined with improved mixing of the flocculant, can improve the efficiency of the existing system. Other locations in the vicinity of the existing Ferric Chloride system may be identified in the future; however, the existing topography and land use in the vicinity of the existing system are not currently suitable for construction of a second basin.

Figure 5.11 Ferric Chloride system improvements alternative 2

Results Summary

Table 5.12. FeCl System Improvements Alternative 2 summary.

Parameter	**Results**
Prior Lake Flood reduction potential	0.0 feet
Spring Lake Flood reduction potential	0.0 feet
Phosphorous load reduction	911 pounds[2]
Implementation challenges	1) Permitting 2) Identifying available land 3) Land acquisition 4) Wetland impacts
Estimated construction cost	$1,561,000
15-year lifecycle cost	$2,069,000
15-years cost per pound of P reduction	$151
Project partners	Multiple Landowners[3] SWCD, Spring Lake Township, MPCA
Future capital expenditures years 16-30	Replace Pumps, tanks, and infrastructure. Pond dredging Chemical purchases Annual Operation and maintenance

Parameter	Results
Estimated cost years 16-30	$639,000
30-year cost per pound of P reduction	$99
Funding partners	BWSR SWCD MPCA
Implementation timeframe	5 – 10 years. Need to identify suitable property for expansion. Expanding the existing basin impacts the adjacent wetlands.

1 – Assumes a 50% increase in the potential phosphorous reduction. Additional study needs to be completed to determine optimal operating parameters and treatment capacity.
2 – Anticipated that 75% of the discharge will be treated and that the overall system will reduce phosphorous by 70%. Jar tests would be required to determine actual reduction efficiency.
3 – Number of affected landowners would depend on the location where a new basin is sited.

5.12 SPRING WEST IRON-ENHANCED SAND FILTER

Water Quality Project

Subwatershed

This area has a small contributing subwatershed with a high relative phosphorous load. A feedlot and associated lagoon are potential sources of some of that phosphorous load. Based on the preliminary design calculations provided by the District, the current preferred concept is for an IESF at this location, which has potential to reduce the particulate phosphorous loading by 168 pounds annually and ortho-phosphorous 81 pounds of ortho-phosphorous. The calculated total annual runoff volume phosphorous load, and total suspended solids load from the upstream subwatersheds are:

Total Annual Volume	326 ac-ft
Total Annual Phosphorous Load	590 pounds
Total Suspended Solids Load	7 tons

Project Concept

The Spring West IESF project is currently in the feasibility study and concept plan stage. The concept will use the existing ditch to construct a filter to remove phosphorous, similar to the IESF suggested for the Sutton Lake and Swamp Lake outlets. The final details on sizing and location are still being considered. The general location of the Spring West IESF is shown in Figure 5.12.

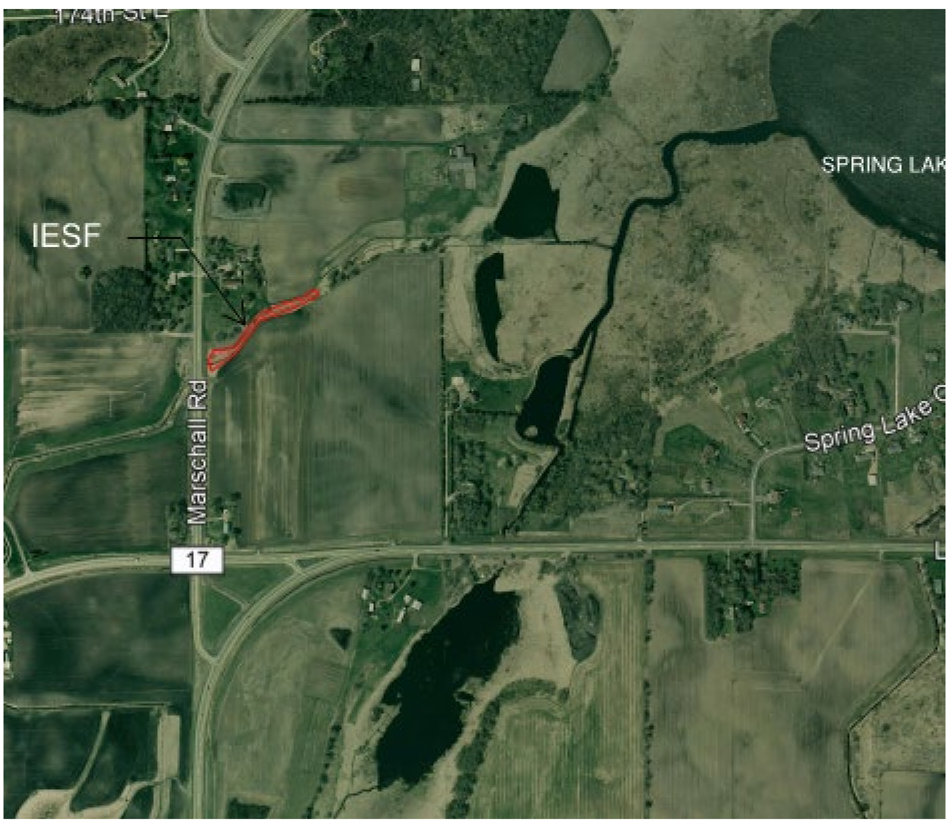


Figure 5.12. Spring West IESF.

Results Summary

Table 5.13. Spring West IESF filter summary.

Parameter	Results
Prior Lake Flood reduction potential	0.0 feet
Spring Lake Flood reduction potential	0.0 feet
Phosphorous load reduction	249 pounds
Implementation challenges	1) Easement Acquisition
Estimated construction cost	$344,000
15-year lifecycle cost	$419,000
15-years cost per pound of P reduction	$112
Project partners	One affected landowner SWCD Spring Lake Township
Future capital expenditures years 16-30	Replace iron/sand mixture Annual operation and maintenance
Estimated cost years 16-30	$277,000
30-year cost per pound of P reduction	$93
Funding partners	BWSR SWCD MPCA
Implementation timeframe	1 – 3 years. The project is already being planned by the District and it is a type of project that is frequently funded

5.13 BUCK LAKE CHEMICAL TREATMENT SYSTEM

Water Quality Project

Subwatershed Overview

This is a targeted location because it is the final discharge point of the Buck Lake system. A chemical treatment system was evaluated in the 2014 report, *Feasibility of a Chemical Treatment System Downstream of Buck Lake.* The calculated total annual runoff volume, phosphorous load, and total suspended solids load at this location are:

Total Annual Volume	1,969 ac-ft
Total Annual Phosphorous Load	1,244 pounds
Total Suspended Solids Load	10 tons

Project Concept

The concept presented as the preferred alternative in the report is a ferric chloride treatment system located upstream of the location where the Buck Lake channel crosses highway 13. The project includes constructing a diversion structure to direct the channel flow to a treatment system and settling pond sited on a portion of the Prior Lake Jehovah's Witness property that is currently unused and is not highly suitable for future use. The layout is shown in Figure 5.13.

Construction for this alternative would include constructing a weir in the channel and a culvert from the channel to the treatment system and settling pond. The treatment would include ferric chloride or alum injection and a mixing tank prior to discharge into the basin. The basin will discharge treated water back into the channel on the downstream side of the diversion weir. Additional studies will be necessary for a chemical treatment system to optimize the various operating parameters.

Figure 5.13. Buck Lake chemical treatment system.

Results Summary

Table 5.14. Buck Lake Chemical Treatment System results summary.

Parameter	**Results[1]**
Prior Lake Flood reduction potential	0.0 feet
Spring Lake Flood reduction potential	0.0 feet
Phosphorous load reduction	793 pounds
Implementation challenges	1) Easement acquisition 2) Land acquisition 3) Sludge/sediment disposal
Estimated construction cost	$1,539,000
15-year lifecycle cost	$2,431,000
15-years cost per pound of P reduction	$204
Project partners	Two affected landowners SWCD MNDOT work in the right of way
Future capital expenditures years 16-30	Replace pumps, tanks, and infrastructure. Pond dredging Chemical purchases Annual Operation and maintenance
Estimated cost years 16-30	$1,129,000
30-year cost per pound of P reduction	$149
Funding partners	BWSR, SWCD, MPCA
Implementation timeframe	5 – 10 years. Land acquisition or easement for the basin would be required. The project needs significant testing and analysis to confirm parameters

1- Results based on 2014 Report *Feasibility of a Chemical Treatment System Downstream of Buck Lake*

5.14 COUNTY DITCH 13 CHEMICAL TREATMENT SYSTEM

Water Quality Project

Subwatershed Overview

This is a targeted location because it is a location with relatively high phosphorous load coming from the Sutton and Swamp Lake watersheds and it is topographically the lowest area between the lakes and Xeon Avenue. The calculated total annual runoff volume, phosphorous load, and total suspended solids load at the ferric chloride system are:

Total Annual Volume	4,051 ac-ft
Total Annual Phosphorous Load	2,023 pounds
Total Suspended Solids Load	91 tons

Project Concept

Construction for this alternative would include constructing a weir in the ditch and a culvert from the ditch to the treatment system and settling pond. The settling pond and treatment system would be constructed on approximately 3-4 acres of the adjacent 16-acre parcel. Spoils generated during construction may be used to raise the elevation of other parts of the property to raise the elevation for protection during high water events on the ditch. The basin will discharge treated water back into the channel on the downstream side of the diversion weir. The treatment would include ferric chloride or alum injection and a mixing tank prior to discharge into the basin. The layout is shown in Figure 5.14.

The landowner was provided with an opportunity to provide comment on the project. One of the questions that arose during this discussion was whether this feature would be better suited downstream. The system location shown in the figure was selected because it is topographically the most suitable location that is downstream of Swamp and Sutton Lake and several hundred acres of farmland. A location approximately ¼ mile downstream of the location shown in Figure 5.13 confluence with the stream from the would provide increased benefit in phosphorous reduction because the treatment would also include the stream entering the ditch from the south. This location, however, would require a significantly larger footprint and would impact more land because of the topographical difference and the increased system flow.

Based on feedback from the landowner, this project should minimize the impact to agricultural areas to the greatest extent possible. Replacement agricultural acres in a nearby location may be necessary in order for the project to be feasible.

Additional studies will be necessary for a chemical treatment system to optimize the most efficient chemical and the other operating parameters. For the purposes of this study, it is assumed that 75% of the flow can be treated with 70% phosphorous reduction potential using ferric chloride.

Figure 5.14. County Ditch 13 chemical treatment system.

Results Summary

Table 5.15. County Ditch 13 Chemical Treatment System summary.

Parameter	**Results**
Prior Lake Flood reduction potential	0.0 feet
Spring Lake Flood reduction potential	0.0 feet
Phosphorous load reduction	1,062 pounds
Implementation challenges	1) Easement acquisition 2) Land acquisition 3) Sludge/sediment disposal
Estimated construction cost	$1,739,000
15-year lifecycle cost	$2,500,000
15-years cost per pound of P reduction	$157
Project partners	One affected landowner[1] SWCD
Future capital expenditures years 16-30	Replace pumps, tanks, and infrastructure. Pond dredging Chemical purchases Annual Operation and maintenance
Estimated cost years 16-30	$971,000
30-year cost per pound of P reduction	$109
Funding partners	BWSR, SWCD, MPCA
Implementation timeframe	5 – 7 years. Land acquisition or easement for the basin would be required, but the project offers opportunity to provide owner with a benefit. The project needs significant testing and analysis to confirm parameters.

[1] Affected landowner is based on current concept. There may be more suitable locations affecting different properties.

5.15 PRIOR LAKE OUTLET CHANNEL MODIFICATIONS

Flood Reduction Project

The Prior Lake outlet channel modifications is a volume and flood based alternative and does not affect the water quality. The goal of this alternative is to actively manage the water level on Upper and Lower Prior Lake in anticipation of a predicted rainfall event and to renegotiate a discharge agreement to allow a higher maximum discharge rate when downstream conditions allow.

Subwatershed Overview

The Prior Lake Outlet Channel (PLOC) is the outlet from Prior Lake to the Minnesota River. Prior to the construction of the outlet channel in 1983, Spring Lake and Prior Lake were landlocked and subject to more frequent flooding and higher water levels. The outlet was constructed through a joint agreement with City of Prior Lake, the City of Shakopee, the Shakopee Mdewakanton Sioux Community, and the Prior Lake-Spring Lake Watershed District.

The operation of the outlet is controlled by the Prior Lake Outlet Control Structure Management Policy and Operating Procedures approved by the Minnesota DNR. The approved operation of the outlet includes:

- The maximum discharge through the outlet channel is 65 cubic feet per second (cfs). The discharge rate is controlled by the peak capacity of the downstream culvert.
- The accordion weir allows discharge when the Lower Prior Lake water level reaches 902.45 feet above MSL.
- The outlet structure includes a low flow gate that can be opened to allow discharge when the Lower Prior Lake Elevation is between 902 and 902.5 as approved by the DNR.

Project Concept

Modifications to the PLOC can have a significant effect on the lake flooding with minimal land disturbance in terms of both grading and expanding existing flood plains. The concepts for modifying the outlet channel include:

- Renegotiate the discharge agreement to allow allowances for an increased discharge rate. The limiting factor for the discharge rate is the downstream 36-inch diameter culvert. Increasing the outlet size to a 54-inch diameter culvert would allow the added capacity.
- Allow discharges to lower water levels when a significant rainfall event is forecast to provide capacity to store the coming runoff and reduce the high-water level of the lakes.

At the allowed discharge rate, the lake water level recedes by only about 0.1 foot per day. Renegotiating the DNR agreement for the PLOC to allow discharges under some circumstances could provide significant relief from the duration and frequency of lake flooding. Feasible modifications may include:

- Allow the district to open the low flow gate when water levels are at or below 902.0 when significant rainfall is expected to provide storage capacity for the incoming event.

- Allow the district to release greater than 65 cfs when the downstream channel flow allows a higher rate of discharge. The channel is large enough to carry a larger flow when areas between Prior Lake and the Minnesota River are not discharging at high rates. The time to reduce the water level in Prior Lake by one foot would be reduced from about 10.5 days to 4.5 days by increasing the peak discharge rate to 150 cfs.

The recalibrated PCSWMM model was updated with two configurations to reflect a proposed Prior Lake outlet structure capable of discharging 150 cfs:

- **Increased Outlet Capacity:** The Prior Lake outlet capacity is increased to 150-cfs, the estimated conveyance capacity of the downstream channel. The rating curve for low and normal discharges remains unchanged. This analysis shows that during the 2014 water year, the peak flood elevation would have been approximately one foot lower and the duration of time above the no wake water level shorter by approximately one month.

- **Increased Outlet Capacity Forecasting + Drawdown:** The Prior Lake outlet capacity is increased to 150-cfs, the estimated conveyance capacity of the downstream channel. When the following conditions were met, a preemptive drawdown at a rate of 85-cfs was added (this rate was assumed that the estimated conveyance capacity of the downstream channel could not exceed 150-cfs). Lake drawdown is conducted when all of the following conditions are met:

    - Rainfall event occurs between May and October
    - Prior Lake level is higher than 901.5 feet
    - More than 1 inch of rain is in the 3-day forecast based on the national weather service
        - Note that a 'perfect' forecast was assumed (i.e. the observed rainfall was assumed to be forecast three days prior to the rainfall occurring)

  This scenario establishes the theoretical maximum reduction in flooding severity on Prior Lake. Even during this scenario, water levels on Prior Lake are expected to exceed the no wake elevation by one quarter of a foot and for more than one week.

Results Summary

These two analyses of modifications to Prior Lake have the greatest benefit of all scenarios analyzed, to flooding severity on Prior Lake. The results of these analyses are shown in Table 5.16 and a summary of the results are shown in Table 5.17.

Table 5.16. Impacts of Proposed Outlet Channel Modifications to flooding severity.

Scenario	Flooding Severity	10-year, 30-day Flood[1]	25-year, 30-day Flood[1]	2014 Water Year[1]
Increased Outlet Capacity	Change peak water surface elevation relative to existing conditions (feet)	-0.3	-0.5	-0.9
	Change in time above no wake water level on Prior Lake (days)	-14	-17	-29
Increased Outlet Capacity Increased Outlet Capacity with Flood Forecasting + Drawdown	Change peak water surface elevation relative to existing conditions (feet)	N/A[2]	N/A[2]	-2.6
	Change in time above no wake water level on Prior Lake (days)	N/A[2]	N/A[2]	-53

1 + Increase in peak water surface elevation or number of days above no wake water level on Prior Lake (904.0 ft)
- Decrease in peak water surface elevation or number of days above no wake water level on Prior Lake
2 Not simulated because the predictive modeling does not fit into the rainfall distribution curve for design rainfall events.

Table 5.17. Prior Lake Outlet Channel Modification results summary.

Parameter	Results
Prior Lake Flood reduction potential	-0.5 feet
Spring Lake Flood reduction potential	0.0 feet
Phosphorous load reduction	0 pounds
Implementation challenges	1) Land use agreements 2) Access 3) Modification of Discharge Agreement
Estimated construction cost	$2,321,000
15-year lifecycle cost	$2,385,000
Cost per foot of Prior Lake high water level reduction ($/foot/100,000)	$48
Project partners	Multiple affected Landowners City of Prior Lake SWCD SMSC City of Shakopee
Funding partners	SWCD DNR
Future capital expenditures years 16-30	Cleaning pipes and structures Annual Operation and maintenance
Estimated cost years 16-30	$77,000
30-year Cost per foot of Prior Lake high water level reduction ($/foot/100,000)	$49

5.16 COUNTY DITCH 13 STORAGE

Flood Reduction Project

Subwatershed Overview

This is a targeted location because it is on the Ditch 13 system, which represents a large portion of the total volume and phosphorous generated in the Upper Watershed. The location is at the junction where the branches from Sutton Lake and Swamp Lake meet, just upstream of the airport and Xeon Avenue. The calculated total annual runoff volume, phosphorous load, and total suspended solids load at this location are:

Total Annual Volume	4,051 ac-ft
Total Annual Phosphorous Load	3,615 pounds
Total Suspended Solids Load	51 tons

Project Concept

Many of the fields adjacent to the ditch along this reach are used for hay and frequently flood. The fields range in elevation from about 930 to 934, and the 10-year high water level is about 933.

The concept for this location is to construct a berm along the west bank of the ditch at the 10-year high water level of the ditch, to protect the fields from surface water flooding up to the 10-year rainfall event. The area behind the berm will be excavated to provide 150 acre-feet of storage, which would only be used in the event of a rainfall event large enough to overtop the berm. The concept plan for this consideration also includes a controlled outlet that can be used to drain the stored water after water elevations on Upper and Lower Prior Lake have receded to 904.0 or another protective elevation selected.

Excavated spoil material may be used to construct the berm and to elevate other fields in the area to reduce the probability of flooding. This project would benefit the landowner because it reduces the frequency of flooding and uses excavated material to increase the elevation of adjacent fields. However, the project does not provide any tangible benefit to the district in terms of flood reduction for the lakes or for the streams and ditches in the Upper Watershed. Figure 5.15 shows the conceptual plan for this alternative.

Additionally, the landowner/farmer of this field provided some initial feedback on this project through the Farmer-Led Council. If areas of the property would not longer be available for farming, there would need to be equivalent acreage replacement to the landowner/farmer in a close proximity to the project in order to make it viable.

Figure 5.15. County Ditch 13 Storage.

Results Summary

Table 5.18. County Ditch 13 Storage results summary.

Parameter	Results
Prior Lake Flood reduction potential	0.0 feet
Spring Lake Flood reduction potential	0.0 feet
Phosphorous load reduction	0 pounds[1]
Implementation challenges	1) Land use agreements
Estimated construction cost	$952,000
15-year lifecycle cost	$978,000
Cost per foot of Prior Lake high water level reduction ($/foot/100,000)	NA
Project partners	One affected landowner SWCD Farmer Led Council
Funding partners	SWCD, DNR
Future capital expenditures years 16-30	Cleaning pipes and structures Annual Operation and maintenance
Estimated cost years 16-30	$31,000
30-year Cost per foot of Prior Lake high water level reduction ($/foot/100,000)	NA
Implementation timeframe	5 – 10 years. Land acquisition or easement for the basin would be required. The project can provide a landowner benefit.

[1] Phosphorous reduction would not happen in a normal precipitation year, small reductions would be seen for events that overtop the berm.

5.17 UPPER WATERSHED LAKES CONTROLLED OUTLET STORAGE

Flood Reduction Project

The Upper Watershed lakes controlled outlet storage concept is only intended for flood reduction and does *not* provide regular nutrient reduction.

Subwatershed Overview

This is a targeted location because Sutton, Swamp, Fish and Buck Lakes are natural, existing basins to hold stormwater in the Upper Watershed and reduce runoff volumes to Spring Lake. The total potential storage in these lakes is greater than 300 acre-feet per foot of depth. The calculated total annual runoff volume, phosphorous load, and total suspended solids load from these locations, as a sum of the loads from the four lakes, are:

Total Annual Volume	4,387 ac-ft
Total Annual Phosphorous Load	2,489 pounds
Total Suspended Solids Load	50 tons

Project Concept

The Upper Watershed storage concept includes constructing controlled outlets on Sutton, Swamp, Fish and Buck Lakes. The outlets remain open under normal conditions and are modeled as closed when the water level on Upper and Lower Prior Lakes reaches the no-wake zone elevation of 904.0. The controlled outlets were modeled to have an overflow weir at the 25-year high water level for those lakes to allow overflow discharges during extremely large rainfall events. Figure 5.16 shows the conceptual plan for this alternative.

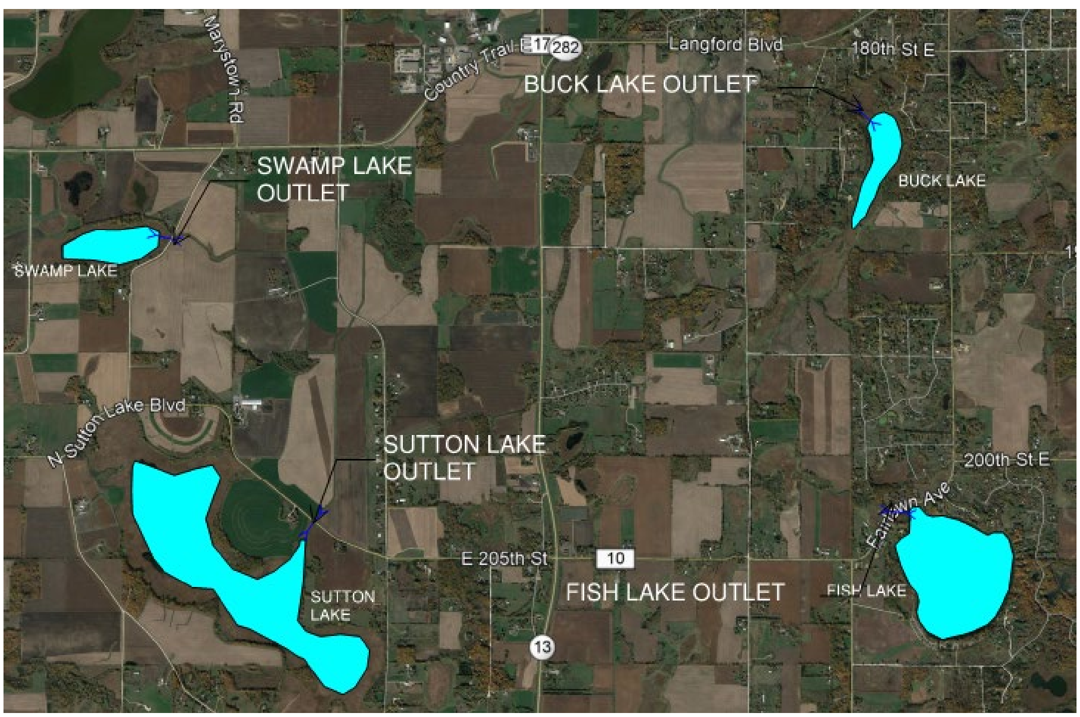


Figure 5.16. Upper Watershed Lakes Controlled Outlet Storage concept.

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Results Summary

Table 5.19. Upper Watershed Lakes Controlled Outlet Storage results summary.

Parameter	**Results**
Prior Lake Flood reduction potential	-0.5 feet
Spring Lake Flood reduction potential	-0.1 feet
Phosphorous load reduction	0 pounds
Implementation challenges	1) Land use agreements 2) Permitting challenges and timeframe 3) Multiple affected landowners
Estimated construction cost	$1,206,000
15-year lifecycle cost	$1,403,000
Cost per foot of Prior Lake high water level reduction ($/foot/100,000)	$29
Project partners	Multiple affected landowners[1] SWCD
Funding partners	SWCD DNR
Future capital expenditures years 16-30	Cleaning pipes and structures Annual Operation and maintenance
Estimated cost years 16-30	$153,000
30-year Cost per foot of Prior Lake high water level reduction ($/foot/100,000)	$31
Implementation Timeframe	5 – 10 years. The project would require buy-ins from several landowners and an extensive permitting process. Multiple phases would extend schedules.

[1] This concept would impact all landowners on lakes with controlled outlets with increased durations of inundation during events when the outlets are operated.

Managed outlet controls on the four upper watershed lakes were also analyzed individually to determine the effect of installing a controlled outlet on only one lake at a time, rather than all four lakes together. Essentially, the largest improvement in high water levels on Prior Lake would be achieved with outlet controls at Buck Lake or Sutton Lake. Table 5.20 reflects the result of the models with managed outlet controls and estimated costs associated with each lake individually.

Table 5.20. Controlled Outlets on Individual Lakes summary.

Lake	**Prior Lake Results**	**Spring Lake Results**	**15-year cost**
Sutton Lake	-0.2 feet	-0.1 feet	$351,000
Swamp Lake	-0.1 feet	0.0 feet	$314,000
Fish Lake	-0.1 feet	0.0 feet	$321,000
Buck Lake	-0.2 feet	-0.1 feet	$358,000

5.18 POLICY

Governing policy can also have a significant effect on water quality and quantity, but policy direction takes time and often needs to wait until lands are developed. The current district rules for land disturbing activities are:

- Maintain existing discharge rates for the 2, 10, and 100-year rainfall events.
- Provide for infiltration or other means of retention to retain the equivalent of 1 inch of runoff from all new and reconstructed impervious surfaces on sites with one or more acre of new impervious surfaces. Retain 0.5 inches of runoff from all impervious surfaces for sites with less than one acre of new impervious surfaces.
- In addition to the infiltration requirement, provide additional BMPs or infiltration to retain the runoff from a 2-year rainfall event.

Some watersheds have more strict policies for development either on a district wide basis or in selected high priority areas of the district. These enhanced policies can be implemented to improve the water quality or to address downstream flooding concerns. Some of the enhanced policies that may be considered are:

- Require that new developments meet greater than the typical standards for stormwater retention and treatment.
- Encourage low impact design standards to minimize impervious surfaces in new developments.
- Encourage and support the use of retention and treatment practices other than infiltration, such as manufactured treatment devices and stormwater reuse.
- Provide for easement areas, such as increased easement over ditches and streams, to allow for larger regional storage or treatment systems.
- Provide regional ponds and treatment facilities to centralize the systems and allow opportunities to optimize the use to provide maximum benefits for the watershed.
- Require stormwater management to meet typical district standards on smaller projects and not only larger developments.

Current policies should be reviewed and updated to provide the maximum possible benefit as currently open land is developed in the future. The future policies will need to be balanced with reasonable land use and take any restrictions on the land into consideration, such as high water tables, low permeability soil, environmental concerns and other restrictions as identified in the Minnesota Stormwater Manual.

Future Land Use Impact on Water Quality

Conversion of crop land to developed land by itself will significantly improve the water quality. The SWCD 2040 Land Use maps show much of the farmland along County Ditch 13, upstream of Langford Avenue as a Transition Area. The Transition Area is zoned as 1 unit per 10 acres with clustered developments.

Taking this subwatershed and using the Model My Watershed tool developed by the Stroud Water Research Center, conversion of the estimated 875 acres of cropland upstream of Langford Avenue to 20% low density mixed land use, 20% open space, and the remaining

60% remaining in crops would reduce the phosphorous load from this area of the watershed by about 30%. Converting the entire subwatershed to low density mixed land use would reduce that load by 75%. This is a significant benefit to the water quality for the lakes, but it would happen over many years and will not provide any short-term solutions. Adding additional controls for new developments will increase that load reduction. Policies that will directly improve the water quality include:

- Include requirements to reduce phosphorous in stormwater runoff from new construction and development to a higher standard than the Guidelines in the MPCA Stormwater Manual and NPDES permit.
- Requiring the retention of stormwater through infiltration, rainwater harvesting, or other technologies.
- Allow the use of manufactured treatment devices as treatment alternatives to meet future stormwater treatment goals where infiltration is not feasible.
- Evaluate opportunities to incorporate larger scale BMP construction as lands develop in the Upper Watershed.

Future Land Use Impact on Lake Flooding

Wenck reviewed several policies and ordinances that could be adopted within the Upper Watershed to better manage flooding on Prior Lake. These policies and ordinances were added to the recalibrated PCSWMM model to determine the effectiveness of each:

- **2040 Land Use- *No Onsite Rate Control*:** Land use in the Upper Watershed is transitioned from primarily agricultural areas to the land uses changes occur on the attached map. In general, the watershed area west of Highway 13 transitions from agricultural land use to *Urban Transition* land use, which SWCD defines as one structure per 10 acres. The area east of Highway 13 transitions to *Rural or Large-Lot Residential*, which Met Council defines as one residence per 1-2 acres. While unlikely, should these properties be developed individually, they may not trigger stormwater pollution and rate control rules. To understand the worst-case outcome, Wenck assumed this area was developed with no stormwater rate control was required for the area east of Highway 13.

  Based on the expected land use changes, the area of west of Highway 13 is expected to have reduced rates and volume of runoff; however, this is more than offset by the increased volume of runoff from the imperviousness from development east of Highway 13 and will result in a slight increase in the flood severity on Prior Lake. While rate control policies and ordinances may help flooding on public and private property and infrastructure adjacent to the development, the increased volume of runoff (not rate control) increases flood severity on Prior Lake.

- **2040 Land Use- *Onsite Rate Control for Residential Area (East of Highway 13)*:** This analysis assumes the land is developed identically to the "2040 Land Use- *No Onsite Rate Control*"; however, stormwater rate control (but not volume control) features are added along with development. This scenario marginally improves the flooding severity outcomes on Prior Lake over the *No Onsite Rate Control* scenario, but because the volume of runoff from the new development drives flooding severity on Prior Lake, the lake is still expected to have somewhat worsened flooding severity than during current conditions.

- **Development East of Highway 13 required to match 100-year Post Development Stormwater Runoff Rates to Pre-Development 50-year Rates:** This analysis assumes the land is developed identically to the "2040 Land Use- *No Onsite Rate Control*"; however, stormwater rate control (but not volume control) features are added requiring post-development 100-year peak discharge rates to match pre-project 50-year peak discharge rates. This scenario marginally improves the flooding severity outcomes on Prior Lake over the *No Onsite Rate Control* scenario and does not improve the outcome over typical rate control rules (i.e. proposed peak discharge rates must be less than or match pre-development peak discharge rates), but because the volume of runoff from the new development drives flooding severity on Prior Lake, the lake is still expected to have somewhat worsened flooding severity than during current conditions.

- **Development East of Highway 13 required to match 100-year Post Development Stormwater Runoff Rates to Pre-Development 50-year Rates and Abstract the First 1.1-inches of Runoff from New Development**: This analysis assumes the land is developed identically to the "Development East of Highway 13 required to match 100-year Post Development Stormwater Runoff Rates to Pre-Development 50-year Rates"; however, stormwater rate control and volume features are added along with development. Based on the guidance from the Minnesota Pollution Control Agency, the first 1.1-inches of runoff is abstracted for the new development greater than one acre. This scenario is the only scenario to improve flooding severity outcomes on Prior Lake over current conditions and demonstrates the importance of volume control in the Upper Watershed to reducing flooding severity on Prior Lake.

The results of these analyses are shown in Table 5.22.

Table 5.21. Impacts of proposed policy changes to flooding severity on Prior Lake.

Scenario	Flooding Severity	10-year, 30-day Flood[1]	25-year, 30-day Flood[1]	2014 Water Year[1]
2040 Land Use- No Onsite Rate Control	Change peak water surface elevation relative to existing conditions (feet)	0.2	0.2	0.4
	Change in time above no wake water level on Prior Lake (days)	4	2	8
2040 Land Use- Onsite Runoff Control for Residential Areas (East of Highway 13)	Change peak water surface elevation relative to existing conditions (feet)	0.1	0.1	0.3
	Change in time above no wake water level on Prior Lake (days)	1	1	8
Development East of Highway 13 required to match 100-year Post Development Stormwater Runoff Rates to Pre-Development 50-year Rates	Change peak water surface elevation relative to existing conditions (feet)	0.1	0.1	0.3
	Change in time above no wake water level on Prior Lake (days)	1	1	8
Development East of Highway 13 have 100-year Post Project rate match pre-project 50-year rates +1.1" of Abstraction	Change peak water surface elevation relative to existing conditions (feet)	-0.1	-0.1	N/A[2]
	Change in time above no wake water level on Prior Lake (days)	-2	-1	

1 + Increase in peak water surface elevation or number of days above no wake water level on Prior Lake (904.0 ft)
- Decrease in peak water surface elevation or number of days above no wake water level on Prior Lake

2 Conditional on BMP media recovery times, therefore not simulated

6.0 Project Screening

Several of the projects described in Section 5 have potential to provide a significant reduction the total phosphorous concentration. Four of the projects will have a moderate benefit for the flooding concerns on Prior Lake. The nutrient reduction projects and flood mitigation projects do not have a significant crossover in benefits.

This section presents the screening results for the projects discussed in Section 5. The projects are screened based on phosphorous reduction, Upper Prior, and Lower Prior Lake flood reduction potential, construction costs, total lifecycle cost per pound of phosphorous reduction, and on overall feasibility.

The scoring for the alternatives is based on a maximum score of 50 for each category, with the alternative that has the best value for that category being scored 50 and the others receiving a score based on the ratio of that value to the score. For example, the highest score for total pounds of phosphorous reduction is for a chemical treatment system on County Ditch 13, with a reduction of 1,062 pounds of phosphorous annually. The score for total annual phosphorous reduction for each of the other options is calculated by multiplying the value calculated for that alternative by 50 and dividing by 1062. A similar formula is used for each category.

6.1 PROJECT SCORING MATRIX

The scoring for each individual project is provided in table 6.1 through 6.17. A summary of the values used to score the projects is shown in Table 6.18, including the annual phosphorous reduction, flood reduction potential, cost per pound of phosphorous reduction, and the total lifecycle cost for each alternative. Table 6.19 provides the scores for each alternative based on the scoring categories and the scoring method described above.
The total score presented in each alternative is the sum of the screening categories and the rank is included, with 1 being the highest scoring project for either nutrient reduction or flood reduction.

Table 6.1. Sutton Lake Iron-Enhanced Sand Filter score.

Category	Description	Score
Total Annual Phosphorous Load Reduction	735 pounds	35
Flood Reduction Potential	No change in Prior Lake High Water Level	0
Cost per Pound of Phosphorous Reduction	$166	32
Lifecycle Cost	$1,836,000	3
Implementation Challenges	1) High cost/funding 2) Easements with landowners	41
Total Score	**Rank: 2**	**111**

Table 6.2. Swamp Lake Diversion to Geis Lake.

Category	Description	Score
Total Annual Phosphorous Load Reduction	161 pounds[1]	8
Flood Reduction Potential	No change in Prior Lake High Water Level	0
Cost per Pound of Phosphorous Reduction	$204	26
Lifecycle Cost	$492,000	10
Implementation Challenges	1) Permitting difficulty 2) Easement acquisition	8
Total Score	**Rank: 11**	**52**

1- The phosphorous load reduction potential is estimated with 50% of the total discharge from Swamp Lake diverted to Geis Lake.

Table 6.3. Swamp Lake Iron-Enhanced Sand Filter.

Category	Description	Score
Total Annual Phosphorous Load Reduction	223 pounds	10
Flood Reduction Potential	No change in Prior Lake High Water Level	0
Cost per Pound of Phosphorous Reduction	$159	34
Lifecycle Cost	$530,000	9
Implementation challenges	1) Access 2) Easement acquisition 3) Funding	41
Total Score	**Rank: 7**	**94**

Table 6.4. Buck Lake South Wetland Storage.

Category	Description	Score
Total Annual Phosphorous Load Reduction	95 pounds	4
Flood Reduction Potential	-0.1	10
Cost per Pound of Phosphorous Reduction	$459	12
Lifecycle Cost	$652,000	7
Implementation Challenges	1) High cost/funding 2) Easement acquisition 3) Accessibility 4) Flood Plain changes associated	25
Total Score	**Rank: 10**	**58**

Table 6.5. Buck Lake East Stream Restoration.

Category	Description	Score
Total Annual Phosphorous Load Reduction	10 pounds	0
Flood Reduction Potential	No change in Prior Lake High Water Level	0
Cost per Pound of Phosphorous Reduction	$637	8
Lifecycle Cost	$96,000	50
Implementation Challenges	1) Land ownership & easements 2) Accessibility 3) Tree Removal required	31
Total Score	**Rank: 9**	**89**

Table 6.6. Buck Lake East Wetland Enhancement.

Category	Description	Score
Total Annual Phosphorous Load Reduction	100 pounds	5
Flood Reduction Potential	-0.1 feet	10
Cost per Pound of Phosphorous Reduction	$119	45
Lifecycle Cost	$180,000	27
Implementation Challenges	1) Easement acquisition 2) Access 3) Flood Plain changes	24
Total Score	**Rank: 3**	**111**

Table 6.7. County Ditch 13 Improvements.

Category	Description	Score
Total Annual Phosphorous Load Reduction	202 pounds	9
Flood Reduction Potential	No change in Prior Lake High Water Level	0
Cost per Pound of Phosphorous Reduction	$389	14
Lifecycle Cost	$1,177,000	4
Implementation Challenges	1) Access 2) Easement acquisition 3) High cost/funding	12
Total Score	**Rank: 13**	**39**

Table 6.8. County Ditch 13 Repairs.

Category	Description	Score
Total Annual Phosphorous Load Reduction	50 pounds	2
Flood Reduction Potential	No change in Prior Lake High Water Level	0
Cost per Pound of Phosphorous Reduction	$830	6
Lifecycle Cost	$623,000	8
Implementation Challenges	1) Access 2) Easement Acquisition 3) Minimal positive impact	28
Total Score	**Rank: 12**	**44**

Table 6.9. County Ditch 13 Diversion.

Category	Description	Score
Total Annual Phosphorous Load Reduction	90 pounds[1]	4
Flood Reduction Potential	No change in Prior Lake High Water Level	0
Cost per Pound of Phosphorous Reduction	$924	6
Lifecycle Cost	$1,253,000	4
Implementation Challenges	1) Access 2) Easement acquisition 3) High cost/funding 4) Permitting 5) Adverse impacts to Buck Lake	9
Total Score	**Rank: 14**	**23**

[1] The phosphorous load reduction potential is estimated with 25% of the total discharge at County Ditch 13 diverted and treated by the enhanced Buck Lake wetland storage at 10% reduction

Table 6.10. Ferric Chloride System Improvements Alternative 1.

Category	Description	Score
Total Annual Phosphorous Load Reduction	250 pounds[1]	12
Flood Reduction Potential	No change in Prior Lake High Water Level	0
Cost per Pound of Phosphorous Reduction	$107	50
Lifecycle Cost	$400,000	12
Implementation Challenges	1) Permitting 2) Siting new equipment	28
Total Score	**Rank: 6**	**102**

[1] The phosphorous load reduction potential assumes a 50% improvement on the existing system.

Table 6.11. Ferric Chloride system Improvements Alternative 2.

Category	Description	Score
Total Annual Phosphorous Load Reduction	911 pounds[1]	43
Flood Reduction Potential	No change in Prior Lake High Water Level	0
Cost per Pound of Phosphorous Reduction	$151	48
Lifecycle Cost	$2,069,000	2
Implementation Challenges	1) Permitting 2) Identifying available land 3) Land acquisition 4) Wetland impacts	28
Total Score	**Rank: 4**	**108**

[1] The phosphorous load reduction potential assumes a 70% total reduction for 50% of the flow passing through the system.

Table 6.12. Spring West Iron-Enhanced Sand Filter.

Category	Description[1]	Score
Total Annual Phosphorous Load Reduction	249 pounds	12
Flood Reduction Potential	No change in Prior Lake High Water Level	0
Cost per Pound of Phosphorous Reduction	$112	48
Lifecycle Cost	$419,000	11
Implementation Challenges	1) Easement Acquisition	50
Total Score	**Rank: 1**	**121**

[1] Values and information provided by Emmons Olivier Resources.

Table 6.13. Buck Lake Chemical Treatment System.

Category	Description[1]	Score
Total Annual Phosphorous Load Reduction	793 pounds	37
Flood Reduction Potential	No change in Prior Lake High Water Level	0
Cost per Pound of Phosphorous Reduction	$204	26
Lifecycle Cost	$2,431,000	2
Implementation Challenges	1) Easement acquisition 2) Land acquisition 3) Sludge/sediment disposal	26
Total Score	**Rank: 8**	**91**

[1] Values and information in 2014 Feasibility Study for a Chemical Treatment System on Buck Lake.

Table 6.14. County Ditch 13 Chemical Treatment System.

Category	Description	Score
Total Annual Phosphorous Load Reduction	1,062 pounds	50
Flood Reduction Potential	No change in Prior Lake High Water Level	0
Cost per Pound of Phosphorous Reduction	$157	34
Lifecycle Cost	$2,500,000	2
Implementation Challenges	1) Easement acquisition 2) Land acquisition 3) Sludge/sediment disposal	28
Total Score	**Rank: 5**	**104**

The following tables present the three options discussed in the report that are targeted at providing only flooding relief, as well as the Buck Lake East and Buck Lake South projects, which both provide 0.1 feet of flood reduction potential. The scores are only in consideration of the five alternatives listed and the ranks are for those projects.

Table 6.15. Prior Lake Outlet Channel Modifications.

Category	Description	Score
Total Annual Phosphorous Load Reduction	0 pounds	0
Flood Reduction Potential	0.5 feet	50
Cost per Foot of Flood Reduction	$48	19
Lifecycle Cost	$2,385,000	4
Implementation Challenges	1) Land use agreements 2) Access 3) Modification of Discharge Agreement	22
Total Score	**Rank: 3**	**85**

Table 6.16. Upper Watershed Lakes Controlled Outlet Storage.

Category	Description	Score
Total Annual Phosphorous Load Reduction	0 pounds	0
Flood Reduction Potential	0.5 feet	50
Cost per Foot of Flood Reduction	$29	17
Lifecycle Cost	$1,403,000	6
Implementation Challenges	1) Land use agreements 2) Permitting challenges and timeframe 3) Multiple affected landowners	31
Total Score	**Rank: 2**	**104**

Table 6.17. Buck Lake South Wetland Storage.

Category	Description	Score
Total Annual Phosphorous Load Reduction	95 pounds	4
Flood Reduction Potential	0.1 feet	10
Cost per Foot of Flood Reduction	$66	7
Lifecycle Cost	$652,000	14
Implementation Challenges	1) Easements for construction and maintenance 2) Extended detention time on upstream lakes affecting property owners	40
Total Score	**Rank: 4**	**75**

Table 6.18. Buck lake East Wetland Enhancement

Category	Description	Score
Total Annual Phosphorous Load Reduction	100 pounds	5
Flood Reduction Potential	0.1 feet	10
Cost per Foot of Flood Reduction	$18	50
Lifecycle Cost	$180,000	50
Implementation Challenges	1) High cost/funding 2) Easement acquisition 3) Accessibility 4) Flood Plain changes associated	50
Total Score	**Rank: 1**	**165**

6.2 PROJECT RANKING SUMMARY

Table 6.21 provides a summary of the values used for the rankings of the 14 projects that address phosphorous reduction and Table 6.22 presents values for the six projects that address flooding concerns. The scores and rankings for each of the projects identified are listed in Table 6.23 for the phosphorous-reducing projects and in Table 6.24 for the flood mitigation projects. These matrices of values and scoring can be used to prioritize and implement future projects that will move the district towards improved water quality and flood conditions.

Table 6.19. Summary of values for phosphorous reduction projects.

Project	Annual Phosphorous Reduction (pounds)	Flood Reduction Potential (feet)	Cost per Pound of Phosphorous Reduction	Lifecycle Cost
1) Sutton Lake Iron-Enhanced Sand Filter	735	0.0	$166	$1,836,000
2) Swamp Lake Diversion to Geis Lake	161	0.0	$204	$492,000
3) Swamp Lake Iron-Enhanced Sand Filter	223	0.0	$159	$530,000
4) Buck Lake South Wetland Storage	95	0.1	$459	$652,000
5) Buck Lake East Wetland Enhancement	100	0.1	$119	$180,000
6) Buck Lake East Stream Restoration	10	0.0	$637	$96,000
7) County Ditch 13 Improvements	202	0.0	$389	$1,177,000
8) County Ditch 13 Repairs	50	0.0	$830	$623,000
9) County Ditch 13 Diversion	90	0.0	$924	$1,253,000
10) Ferric Chloride System Alternative 1	250	0.0	$107	$400,000
11) Ferric Chloride System Alternative 2	911	0.0	$151	$2,069,000
12) Spring West Iron-Enhanced Sand Filter	249	0.0	$112	$419,000
13) Buck Lake Chemical Treatment System	793	0.0	$204	$2,431,000
14) CD 13 Chemical Treatment System	1062	0.0	$157	$2,500,000

Table 6.20. Summary of values for flood mitigation projects.

Project	Annual Phosphorous Reduction (pounds)	Flood Reduction Potential (feet)	Cost per foot in flood reduction ($100K/foot)	Lifecycle Cost
15) Prior Lake Outlet Channel Modifications	0	0.5	$48	$2,385,000
16) County Ditch 13 Storage	0	0.0	-	$978,000
17) Upper Watershed Lakes Controlled Outlet Storage	0	0.5	$29	$1,403,000
4) Buck Lake South Wetland Storage	95	0.1	$66	$652,000
5) Buck Lake East Wetland Enhancement	100	0.1	$18	$180,000

Table 6.21. Summary of scores for phosphorous reduction projects.

Project	Annual P Reduction	Flood Reduction Potential	Cost per Pound of P Reduction	Lifecycle Cost	Feasibility	Total Score
1) Sutton Lake Iron-Enhanced Sand Filter	35	0	32	3	41	111
2) Swamp Lake Diversion to Geis Lake	8	0	26	10	8	52
3) Swamp Lake Iron-Enhanced Sand Filter	10	0	34	9	41	94
4) Buck Lake South Wetland Storage	4	10	12	7	25	58
5) Buck Lake East Wetland Enhancement	5	10	45	27	24	111
6) Buck Lake East Stream Restoration	0	0	8	50	31	89
7) County Ditch 13 Improvements	9	0	14	4	12	39
8) County Ditch 13 Repairs	2	0	6	8	28	44
9) County Ditch 13 Diversion	4	0	6	4	9	23
10) Ferric Chloride System Improvements Alternative 1	12	0	50	12	28	102
11) Ferric Chloride System Improvements Alternative 2	43	0	35	2	28	108
12) Spring West Iron-Enhanced Sand Filter	12	0	48	11	50	121
13) Buck Lake Chemical Treatment System	37	0	26	2	26	91
14) CD 13 Chemical Treatment System	50	0	34	2	18	104

Table 6.22. Summary of scores for projects that provide flood mitigation.

Project	Annual P Reduction	Flood Reduction Potential	Cost per foot in flood reduction	Lifecycle Cost	Feasibility	Total Score
15) Prior Lake Outlet Channel Modifications	0	50	19	4	22	85
16) County Ditch 13 Storage	0	0	0	9	20	29
17) Upper Watershed Lakes Controlled Outlet Storage	0	50	17	6	31	104
4) Buck Lake South Wetland Storage	4	10	7	14	40	75
5) Buck Lake East Wetland Enhancement	5	10	50	50	50	165

7.0 Summary

This Upper Watershed Blueprint identified potential projects to address water quality and flood reduction improvements for Spring, Upper Prior and Lower Prior Lakes. Seventeen projects were evaluated in detail and ranked in accordance with their several metrics, including cost effectiveness, and ease of implementation, and potential to help meet water quality and flood reduction goals.

7.1 REDUCING PHOSPHORUS LOADING

The 17 projects identified and evaluated in this report have the potential to reduce the annual phosphorous loads to Spring Lake significantly. The four projects with the highest phosphorous reduction potential identified in the study and their estimated load reductions are:

- 14) - County Ditch 13 Chemical Treatment System – 1,062 pounds per year.
- 11) - Ferric Chloride System Improvements Alternative 2 which includes upgrades to the system, assuming that the entire system can be optimized to remove 70% of the total phosphorous from half of the total flow – 911 pounds per year.
- 1) - Sutton Lake Iron Enhanced Sand Filter (IESF) - 735 pounds per year.
- 4) - Buck Lake Chemical Treatment System – 793 pounds per year.

These four projects combine to reduce the total phosphorous loads from the Upper Watershed by about 3,501 pounds annually when taken individually, or just over half of the watershed load. When applied as a series, these four projects reduce the total phosphorous load by 2,621 pounds annually. These projects have various funding mechanisms that are available to assist from feasibility study through construction and long-term maintenance.

In addition, the District is in planning stages for the Spring West IESF, which has an estimate phosphorous reduction of 249 pounds annually. The district has also received a grant to perform a feasibility study for the project identified as the Buck Lake East Wetland enhancement. This project scored 3rd highest in the project scoring matrix results and will provide an estimated reduction in annual in total phosphorous load of 100 pounds. These projects, combined with the four projects identified above, bring the total reduction to about 2,970 pounds per year, which is approximately the TMDL reduction goal.

7.2 REDUCING FLOODING IMPACTS

The most cost-effective pollutant load reducing projects would appear to have limited flood control impacts. To address these concerns, the Blueprint includes options to address Upper Watershed flooding as well as high water elevations on the lake system. The most effective structural options are:

- <u>15) - Prior Lake Outlet Channel Modifications:</u>

  Install outlet controls on lakes in the Upper Watershed to limit discharge when targeted water levels are reached on Upper and Lower Prior Lakes. For this report, the targeted condition is to restrict flow from Swamp, Sutton, Fish and Buck Lakes when Upper and Lower Prior Lakes reach the no wake elevation of 904.0.

- 17) - Upper Watershed Lakes Controlled Outlet Storage:

  Modify the culvert and discharge allowance for the Prior Lake outlet channel to permit a higher discharge rate during period when the capacity is available in downstream channels and basins. Work with the DNR and other partners to allow discharge through the Prior Lake outlet channel at a lower water level in advance of forecasted significant precipitation events to provide storage to contain those events. This water level manipulation combined with a higher discharge rate have potential to reduce the 25-year high water level on Prior Lake by 0.5 feet.

The report also considered potential regulatory modifications as a non-structural option to reduce pollutant loading and limit changes in the rate and volume of runoff as development occurs in the Upper Watershed. Conversion of crop land to developed land by itself can significantly reduce nutrient and sediment loads. However, runoff from new impervious surface could exacerbate flood conditions in downstream lakes. New regulatory controls could potentially prevent increases in downstream flood elevations and have a modest (0.1 foot) reduction in the 25-year high water level on Prior Lake. These reductions are long-term as development and redevelopment occur over the coming decades.

- Require development and redevelopment east of Highway 13 to limit 100-year post project runoff rate to the pre-project 50-year rates and require 1.1" of runoff volume abstraction.
- Modeling indicates that volume retention for future development is critical to reducing or maintaining current flood elevations on Upper and Lower Prior Lake. Future policy should provide a framework to encourage alternatives to infiltration for areas where it is not feasible, such as stormwater harvesting, green infrastructure, and other options that reduce the volume of discharge as new impervious surfaces are added.

7.3 NEXT STEPS

This Upper Watershed Blueprint is a framework to prepare a long-term improvement plan to move towards improving water quality and reducing flood impacts in the District. The information can be re-evaluated with any changes in land use and other conditions in the Upper Watershed. Table 7.1 through 7.3 present a summary of 3 project groupings to meet or near the TMDL goal for phosphorous reduction. The projects included in the groupings are based on the overall project evaluations presented in this report. In practice, implementation will be driven by availability of funding and securing necessary permits and stakeholder approvals. The projects included in tables 7.1 through 7.3 and reasons why these projects are included in the groupings, are:

Water Quality Projects:

- **12) - Spring West Iron Enhanced Sand Filter:** This project provides a total annual phosphorous reduction of 249 pounds and is already underway and the most likely to be constructed in the short-term. *Scoring Matrix Rank: 1*
- **1) - Sutton Lake Iron Enhanced Sand Filter:** This project has the second highest phosphorous reduction potential and has a good probability of landowner approval. The IESF provides an estimated 735 pounds of phosphorous reduction annually. *Scoring Matrix Rank: 2*

- **5) - Buck Lake East Wetland Enhancement:** The district recently received a grant to perform a feasibility study for this project. This will provide an estimated phosphorous reduction of 100 pounds per year. *Scoring Matrix Rank: 3*
- **11) - Ferric Chloride System Improvements Alternative 2:** This project is second on the list of total phosphorous reduction at up to 911 pounds per year, depending on ability to increase the sedimentation capacity. *Scoring Matrix Rank: 4*
- **14) - County Ditch 13 Chemical Treatment System:** This project has the highest phosphorous reduction potential of the 14 projects identified, at 1,062 pounds per year. *Scoring Matrix Rank: 5*
- **13) - Buck Lake Chemical Treatment System:** This project ranks third in potential annual phosphorous reduction at 793 pounds annually. *Scoring Matrix rank: 8*

Two projects scoring higher than the Buck Lake chemical treatment system are not included in the targeted solutions. These are:

- **3) - Swamp Lake Iron-Enhanced Sand Filter:** This project ranked seventh in the overall scoring but would not provide enough additional phosphorous reduction to meet the TMDL goal.
- **10) - Ferric Chloride System Improvements Alternative 1:** This project was ranked sixth in the matrix, but only one of the Ferric Chloride system improvements alternatives can be included.

A summary of the six targeted projects is presented in Table 7.1. The table presents the annual phosphorous load reduction, 15-year lifecycle cost, and the cost per pound of each project, as well as for the six projects collectively. This grouping including all six projects provides phosphorous reduction that meets the TMDL goal of 2,959 pounds per year.

Table 7.1. Suggested grouping alternative one.

Project	Annual Phosphorous Reduction	15-Year Lifecycle Cost	Cost Per Pound of Phosphorous Reduction
1) Sutton Lake Iron-Enhanced Sand Filter	735	$1,836,000	$166
14) County Ditch 13 Chemical Treatment System	676	$2,500,000	$246
11) Ferric Chloride System Improvements Alternative 2	417	$2,069,000	$331
13) Buck Lake Chemical Treatment System	793	$2,431,000	$204
12) Spring West Iron-Enhanced Sand Filter	249	$419,000	$112
5) Buck Lake East Wetland Enhancement	100	$180,000	$119
Total	2,970	$9,435,000	$215

Completing five or six major capital projects in a 10-year period can be an aggressive schedule, so we also evaluated a grouping with the five highest scoring projects in the analysis as well. The five projects combined reduce the total phosphorous load by approximately 2,177 pounds annually, which is short of the TMDL goal by about 800 pounds. These five high-scoring projects are summarized in table 7.20.

Table 7.2 Suggested grouping alternative two.

Project	Annual Phosphorous Reduction	15-Year Lifecycle Cost	Cost Per Pound of Phosphorous Reduction
1) Sutton Lake Iron-Enhanced Sand Filter	735	$1,836,000	$166
5) Buck Lake East Wetland Enhancement	100	$180,000	$119
11) Ferric Chloride System Improvements Alternative 2	417	$2,069,000	$331
12) Spring West Iron-Enhanced Sand Filter	249	$419,000	$112
14) County Ditch 13 Chemical Treatment System	676	$2,500,000	$246
Total	2,177	$7,004,000	$214

The third grouping includes the five highest scoring projects but substitutes the Buck Lake chemical treatment system for the Ferric Chloride system improvements. This has a total phosphorous reduction of 2,513 pounds, which falls short of the TMDL goal but his higher than the reduction for grouping number two. A summary of these five projects is presented in Table 7.3.

Table 7.3 Suggested grouping alternative three.

Project	Annual Phosphorous Reduction	15-Year Lifecycle Cost	Cost Per Pound of Phosphorous Reduction
1) Sutton Lake Iron-Enhanced Sand Filter	735	$1,836,000	$166
5) Buck Lake East Wetland Enhancement	100	$180,000	$119
14) County Ditch 13 Chemical Treatment System	676	$2,500,000	$246
12) Spring West Iron-Enhanced Sand Filter	249	$419,000	$112
13) Buck Lake Chemical Treatment System	753	$2,431,000	$215
Total	2,513	$7,366,000	$195

The three project groupings provide between 2,178 and 2,930 pounds of annual phosphorous reduction at a total cost of between about $7 million and $9.4 million. The grouping with the highest cost and highest phosphorous reduction includes six projects and the other two groupings include only five of the six.

Flood Reduction Projects:

- **5) - Buck Lake East Wetland Enhancement:** This project is already included in the implementation schedule as a phosphorous reduction project and not included in the potential implementation schedule presented. This project scored highest on the scoring matrix primarily due to cost. *Scoring Matrix Rank: 1*
- **17) - Upper Watershed Lakes Controlled Outlet Storage:** This was the second highest scoring flood mitigation alternative in all categories and could reduce the 25-year high water level on Upper and Lower Prior Lake by about 0.5 feet. *Scoring Matrix Rank: 2*
- **15) - Prior Lake Outlet Channel Modifications:** This was the third alternative that can reduce the 25-year high water level on Upper and Lower Prior Lake by 0.5 feet but at a much higher cost and with a much lower feasibility. *Scoring Matrix Rank: 3*

All of the flood reduction projects will require significant stakeholder buy-in because of the impact to private property and the number of properties that will be affected. It would be reasonable to begin evaluating multiple options at once in terms of engaging stakeholders in the process to determine which options are the most feasible.

In total, these pollutant reduction projects could reduce the total annual phosphorous loads from the Upper Watershed by an estimated 2,178-2,930 pounds. This meets or nearly meets the annual reduction goal in the TMDL report. Either of the flood reduction projects can decrease the flood levels on Upper and Lower Prior Lake by about 0.5 feet.

Table 7.4 presents a recommended schedule for the consideration of potential improvements with projects ranked 1 through 5 in the scoring matrix and the Buck Lake chemical treatment facility. In practice, implementation will be driven by availability of funding and securing necessary permits and stakeholder approvals.

Table 7.4. Potential implementation schedule.

Project	Year									
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
POLLUTANT LOAD REDUCTION PROJECTS										
5) Buck Lake East Wetland Enhancement										
Feasibility, assemble funding	■	■								
Construct		■	■							
12) Spring West Iron Enhanced Sand Filter										
Feasibility, assemble funding	■	■								
Construct		■	■							
14) County Ditch 13 Chemical Treatment System										
Feasibility, assemble funding, permitting			■	■	■					
Construct						■	■			
1) Sutton Lake Iron Enhanced Sand Filter										
Feasibility, assemble funding				■	■					
Construct					■	■				
11) Ferric Chloride System Improvements Alternative 2										
Feasibility, assemble funding, permitting					■	■	■	■		
Construct (multiple phases)								■	■	■
13) Buck Lake Chemical Treatment System										
Feasibility, assemble funding, permitting								■	■	■
Construct (multiple phases, runs beyond year 10)										■
Opportunistic Projects										
As opportunities, funding is available		■	■	■	■	■	■	■	■	■
FLOOD CONTROL PROJECTS										
17) Upper Watershed Lakes Controlled Outlet Storage										
Feasibility, assemble funding, permitting, stakeholder work		■	■	■	■	■	■			
Construct (multiple phases)				■	■	■	■	■	■	■
15) Prior Lake Outlet Channel Modifications										
Feasibility, permitting, agency and stakeholder work				■	■	■	■	■	■	■
Construct (multiple phases)							■	■	■	■
POLICY OPTIONS										
Adopt new development controls										
Stakeholder discussions	■	■								
Rule revisions		■	■							

Appendix A

GIS Map Book

Click the following link to access the GIS Map Book for the project: Map Book.

Appendix B

Upper Watershed Meeting Minutes:

1) Kickoff Meeting: June 30, 2020
2) Partner Engagement Meeting: July 15, 2020
3) Farmer-Led Council Meeting Notes: August 4, 2020
4) Funding Partner Meeting: October 2, 2020
5) Partner Engagement Meeting: October 7, 2020

PRIOR LAKE-SPRING LAKE WATERSHED DISTRICT

Upper Watershed Blueprint

Kickoff Meeting Minutes

June 30, 2020

1. District and Wenck Team Members
    a. PLSLWD
        i. Maggie Karschnia – Project Manager
        ii. Diane Lynch – District Administrator
        iii. Jaime Rockney – District water quality and monitoring Data – Water Resource Specialist
        iv. Carl Almer – district engineer not present. Need to fill Carl in week of July 6.
    b. Wenck Associates
        i. Todd Hubmer – Project Manager.
        ii. Brian Kallio – BMP siting and planning, assisting Todd, general project overview
        iii. Ju Zhang – data and water quality modeling
        iv. Ross Mullen – PC SWMM, hydrology and hydraulics
        v. Kevin Muller – GIS specialist
        vi. Ed Matthiesen – BMP siting and planning, general understanding of the district, senior engineer and advisor. Involved in design and construction of PL outlet channel, FeCl system.
        vii. Joe Bischoff – Lake management and TMDLs
2. Schedule Discussion
    a. Week of July 6:
        i. Post kick-off meeting
        ii. July 8 – board packet memo for project update
    b. July 14 – short update for the Board
    c. Week of July 13 – Partnership engagement meeting
    d. August 5 board packet update memo for August 11 meeting. Monthly updates through the end of the year.
    e. Funding partners meeting week of August 3 with Doodle poll next week.
    f. Second partnership engagement meeting during the first week of September
    g. Report drafts:
        i. 30% - 60% draft for September 8th board meeting (September 3 packet)
        ii. 90% draft for October 13th board meeting (October 7 packet)
        iii. Some flexibility in drafts
3. Review Partner and Stakeholder List
    a. Include project partners in green from table provided by the district for the July Partner engagement meeting
    b. Include Citizen Advisory Committee and farmer Led Council
        i. CAC has upcoming discussions on flooding concerns in the upper watershed
        ii. FLC can assist with contacts and understanding of landowners in the watershed.
4. Data Collected Summary
    a. Review of 2016 flood study, available water quality data, modeling data in progress
5. SWMM Model Status and Review
    a. Current model received from DNR
    b. Updating model to include yearly average rainfalls rather than event based.
    c. Some other model updates are being completed by EOR. Wenck will work with current, significant changes are not expected from the updates.

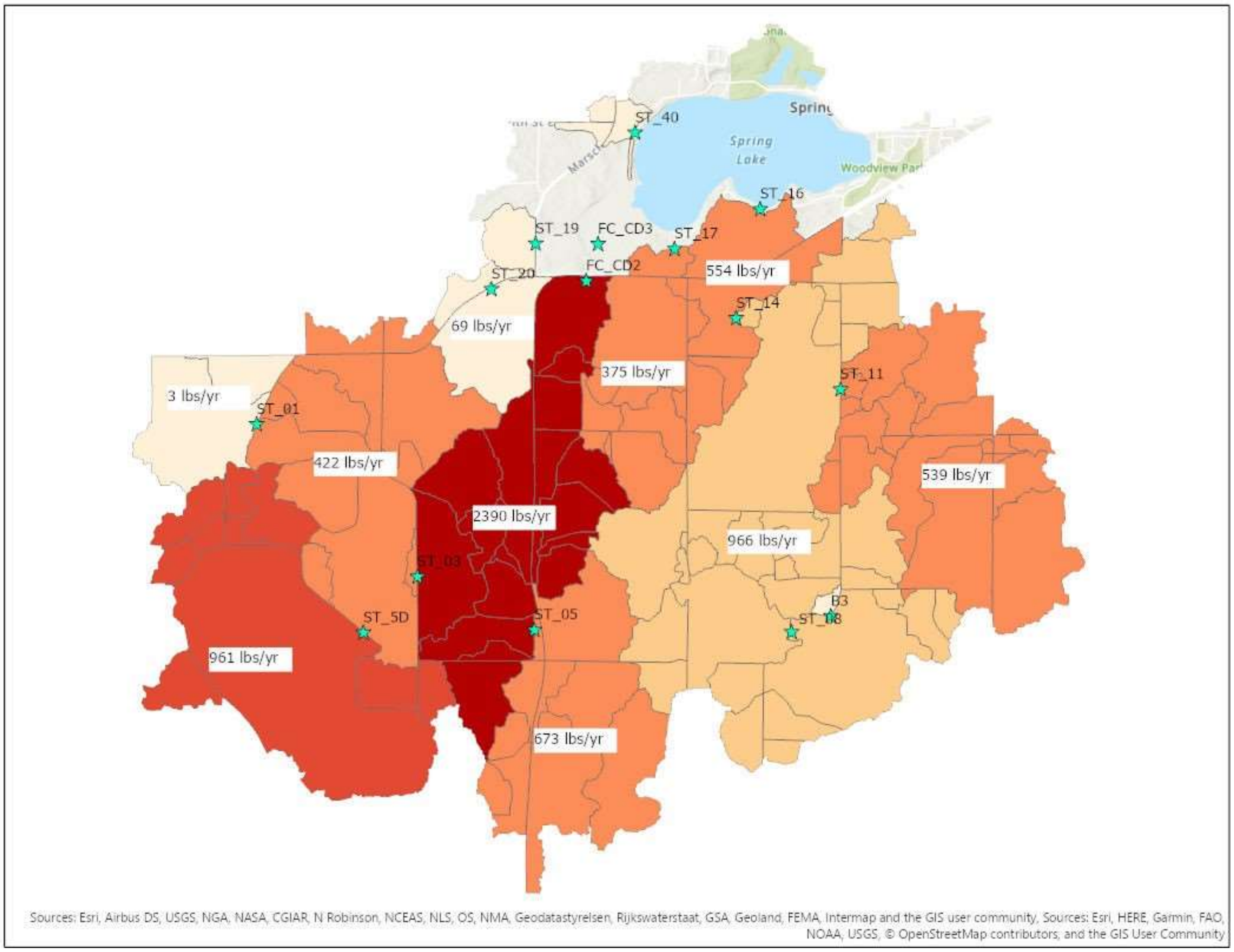
PRIOR LAKE-SPRING LAKE WATERSHED DISTRICT

Upper Watershed Blueprint
Partner Engagement Meeting Minutes
July 15, 2020

1. Introductions
   a. PLSLWD
      i. Maggie Karschnia – Project Manager
      ii. Diane Lynch – District Administrator
      iii. Jaime Rockney – District water quality and monitoring Data – Water Resource Specialist
      iv. Carl Almer – district engineer
   b. Wenck Associates
      i. Todd Hubmer – Project Manager.
      ii. Brian Kallio – Assistant PM, BMP siting and planning, general project overview
   c. Project Partners
      i. PLSLWD
      ii. Wenck
      iii. Scott County
      iv. Spring Lake Township
      v. Sand Creek Township
      vi. City of Prior Lake
      vii. MNDOT
      viii. Watershed landowners
      ix. Citizens Advisory Committee
      x. Farmer Led Council
2. PLSLWD goals:
   a. Meet state water quality goals on Spring Lake, which will positively impact the downstream water quality on Upper and Lower Prior Lakes (TMDL Goals) Ultimately, the goal is to have Spring Lake and Upper and Lower Prior meet state water quality goals
   b. Reduce the risk associated with high water levels on Spring Lake and Prior Lake
      i. Protect public safety and maintain emergency access
      ii. Protect public utility infrastructure
      iii. Maintain traffic flow through the County Road 21 corridor
      iv. Maintain access to private properties.
      v. Reduce the frequency and duration of no-wake limits and impact to recreational users
   c. Meet these goals without other adverse impacts

   The goals can be met through several means. Programs and policy can help over time. Identifying capital improvement projects and opportunities for BMPs that can be implemented to achieve the goals
3. Preliminary findings to date The project area is the upper watershed – the area tributary to Spring Lake – north boundary at approximately at County road 12 and the south at Swamp Lake, Sutton Lake and Fish Lake
   a. Preliminary annual phosphorous loading by subwatershed

i. Copy of the preliminary loading map from measured phosphorous and flow in 2018. Total of over 6,000 pounds of phosphorous exported to Spring Lake in 2018
ii. TMDLs are not being met. This project is to identify opportunities for projects to meet the TMDL goals



b. Preliminary annual volume by watershed
   i. Per the 2016 BarrFlood Study, 50% of the runoff volume discharged through the prior lake outlet is from County Ditch 13 and over 80% is from the upper watershed. CD 13 contributes a large portion of both volume and phosphorous to the lakes.
c. PC-SWMM Models updated to simulate actual rainfall data from Flying Cloud Airport. This is the closest monitoring station to the watershed with consistent and reliable data.
d. This data will be the basis for much of the planning for the project

4. Project Purpose:
   a. Prepare a blueprint with a 10-year capital improvement to create a prioritized list of targets to move towards meeting the state water quality standards and flood reduction in the watershed That goal being stabilizing the water levels in the lakes and reaching the TMDL targeted goals for water quality. This is an aggressive schedule that requires input and opportunities with stakeholders in the watershed to be successful.
      i. Calculate Phosphorous and TSS removals
      ii. Volume Reduction and impact on lake elevations
      iii. Cost-benefit comparisons
      iv. Social Impacts
   b. Identify funding partnerships to assist in moving towards meeting the water quality and quantity improvements in the district

5. Purposes of Partner Engagement:
    a. Keep the partner communities and other interested parties informed of the project
    b. Ensure communication and collaboration for future improvements targeted towards meeting the PLSLWD goals
    c. Create and supplement partnerships between the District and local partners with a focus on improving the water resources for the upper watershed
        i. Understanding the partners and their plans are important to achieve the goals.
    d. Identify problem areas as recognized by the partner communities
        i. Troy Kuphal identify the condition as a social problem in dealing with multiple landowners and entities.
    e. Identify upcoming projects, programs and policies, that have possibilities for future collaboration Looking for win-win-win type of opportunities and partnerships.
        i. Road Improvements
        ii. Wetland restoration
        iii. Habitat restoration
        iv. Regional trail systems
        v. Water resources related policy
        vi. Development planning
        vii. Park planning
        viii. Conservation planning
        ix. Including habitat and water improvements in conjunction with the capital improvements.
    f. Understand the long-term goals, development, zoning, and other information that may help to drive water quality opportunities
    g. Identify current practices and policies that can be improved or updated to help in meeting the district goals
    h. Identify and review water resources based studies and reports
    i. Understand land ownership in the watershed
    j. Ensure early notification and correspondence for future projects, monitoring and/or studies
    k. Identify hurdles or roadblocks that may impair the implementation. Stakeholder partnerships are important and will assist with relationships and knowing the needed contacts and people to discuss the identified BMP's

Thoughts from participants:

Christopher Crowhurst (Citizens Advisory Committee0:

- Committee recently met and looked at 4 items.
    - Sutton lake outlet construction – scheduled for Winter 2020
    - Geis Pond needing dredging – recent survey
    - Inlet to Spring Lake from Buck Lake drainage possibly dredging, or other maintenance, add a small weir to increase storage. This is mostly a flow through wetland
    - Spring Lake West watershed project
    - Krueger family is a resource with information on phosphorous and e-coli. They have dairy and are working on an animal waste management project.
    - Is the Buffer on CD 13 adequate? Buffer does meet the state standard and some areas do not drain directly to the ditch.
    - CD 13 slow the flow, decrease erosion, and rename it? Convert upland to wetland will create concerns for the landowners. Giving up production is a major concern.
- Melissa – County has a CIP and will share items in the study area.
- Troy Kuphal:
    - SWCD goals are aligned with the WD
    - They can bring a good understanding of the landscape – physical and social
    - Conflicts between ag and conservation
    - Goal to find production-based conservation practices – incorporation of maximum

conservation with agricultural land use
    - Finding solutions that help with water resources and are acceptable to the community
    - Difficult in finding sites – some may have 4 or 5 landowners to negotiate with.
    - 2014 SWA report
    - Ditch 13 is a difficult setting due to land use. Highly productive farmland
- Chad Sandey – Sand Creek Township
    - Very interested and has ideas around Sutton Lake – he owns 150 acres
    - Only a small piece of the township is in the district
    - Make sure landowners are aware – even concepts can lead to misunderstandings (regarding regional trail map)
- Pete Young:
    - Only a small part of Prior Lake is in the Upper Watershed
    - Small scale projects don't provide the needed cost-benefit.
    - Source control such as street sweeping
    - Very supportive of our efforts
- Megan Tasca:
    - County supportive of any partnerships
    - Willing to look at regional trails, highways, etc.
    - Limited funding currently for land acquisition, etc.
- Todd Hubmer:
    - Idea of a regional trail, conservation practice around the wetland upstream of Buck Lake as an opportunity
    - Fitting into programs like Lessard Sams.
    - County would offer support and willing to discuss

6. Next Steps
    a. Today: first shareholders meeting
    b. Week of August 3rd: Funding Partner Engagement Meeting week of August 3rd
    c. August 11th: board update
    d. First week of September: Partnership Engagement meeting #2
    e. September 8th: 30%-60% draft report presented at the board meeting
    f. October 13th: 90% draft report presented at the board meeting
    g. Schedule Attached

Farmer-Led Council Meeting Notes
August 4th, 2020

UPPER WATERSHED BLUEPRINT DISCUSSION

The following is a summary of feedback from the Farmer-Led Council Meeting attendees on the Upper Watershed Blueprint Project:

Greatest Challenges:

- Limited acreage in immediate area; farming land is precious
- Receiving adequate funding to make projects financially feasible for farmers
- Getting multiple landowner cooperation on a large project will be challenging

Greatest Opportunities:

- Start at the source of the largest problems: divide upper watershed into subwatersheds and concentrate efforts where it matters most
- Research benefits of increased & strategic pattern tiling and/or creating underground storage under farm fields
- Help landowners face problems on their property & find win-win solutions (erosion, unprofitable field areas, etc.)
- Note: farmers provided specific project area suggestions that were provided to Wenck

How to Better Connect with Farmers on New Projects:

- Communication – communication – communication
- Make a phone call vs. sending a letter as first point of contact
- Pay attention to development causing flooding issues – respond to farmer concerns
- FLC members will help the Watershed District connect with farmers that they have no existing relationship with.

New ideas:

- Find solutions for stormwater ponds or wetlands that are contributing phosphorous loading – farmers have seen poor water quality coming out of some locations
- Wet soil management: use swales and low areas to store & manage small amounts of water; completing multiple of these could make a big impact
- Increase the outlet capacity to Prior Lake
- Target swamps for storage – bench drainage/storage systems in unusable land

Upper Watershed Blueprint
Funding Partners Meeting Minutes
October 2, 2020

1. Attendees
   a. Prior Lake Spring Lake Watershed District
      - Maggie Karschnia, Diane Lynch, Jaime Rockne, Carl Almer
   b. Wenck Associates
      - Brian Kallio, Todd Hubmer, Ed Matthiesen
   c. BWSR
      - Melissa King
   d. MNDOT
      - Dan Gullickson
   e. LCCMR
   f. MPCA
      - Bryan Spindler
   g. LSOHC
      - Mark Johnson

h. Army Corps of Engineers
      - Nathan Campbell
2. Project Background
   a. The Prior Lake Spring Lake Watershed District, along with Wenck Associates, is studying its Upper Watershed to identify potential projects to reduce phosphorous loading towards meeting the TMDL goals for Spring Lake and Upper Prior Lake, and to reduce the frequency and magnitude of flooding on Prior Lake.
   b. Funding sources are a key component of identifying and implementing projects towards meeting those goals.
      - No discussion
3. Purpose of this meeting
   a. Discuss specific project ideas and programs that are available to assist with funding those projects
   b. Identify ways that projects can be modified to provide a better fit with various funding mechanisms
   c. Determine whether the Watershed District or another local partner such as city or county may be the best entity to apply for funding
      - No discussion
4. Specific Project concepts (see Maps)
   a. Sutton Lake Evaluation and Filter
      - LSOHC has funding available for habitat/wetland restoration and maintenance. If that were worked into a solution, there could be come funding availability
      - BWSR, MPCA and clean water funds all have potential funding available for treatment projects
   b. Swamp Lake Reroute
   c. County Ditch 13 Reroute
      - BWSR small amounts for multi-purpose drainage management for 103E drainage systems for specific practices
      - MPCA may have loans available, up to $5 million perpetual available lons for

BMP Projects, with shown treatment of diversion, but no grants.

d. FeCl System Modifications
   - MPCA: some might be under MS4 criteria – opportunities

e. Buck Lake Channel
    - Opportunities for LSOHC funding for restorations. Land needs to be in a conservation easement, owned or otherwise controleld
    - LSOHC looking for projects valued at $400K or more, call for funding request goes out April 1 and would go before legislature in 2022.
    - Quicker route is for projects up to $$00K, administered by DNR nd requiring 10% match
    - Also worth checking on LCCMR emerging issues account
    - Clean Water Council may also have availability
    - Ducks Unlimited and Pheasants forever may also have funding available for habitat restoration projects.

5. PLOC Modifications – this was discussed in 2016 flood study done after the 2014 flood. There were significant hurdles to adding a second culvert related to agreements and easements.
    - Options in the flood study included, adding a second pipe to increase discharge rate or lowering the water level prior to a predicted rainfall
    - Pipe bursting mentioned by Bruce Loney
    - Second outlet was determined to be too costly, too long of a process.
6. Additional Feedback:
    a. Melissa King: BWSR Comeptitive grants programs and watershed based implementation funding program. BWSR has private land conservation easement programs as well.
    b. Wellhead protection grants that can be explored if present.
    c. Bryan Spindler MPCA: some 319 grants focussed on small watershed
    d. Nate Campbell Corps of Engineers: many of the projects could fit in their Cap 206 acquatic ecosystem restoration projects. Have worked with LSOHC. Not necessarily a grant, Corps does a FS. Info on qualifications attached.
7. Attachments:
    a. E-mail From MPCA
    b. CAP 206 program information

Brian F. Kallio

From: Spindler, Bryan (MPCA) <bryan.spindler@state.mn.us>
Sent: Friday, October 2, 2020 10:37 AM
To: Brian F. Kallio
Subject: RE: PLSLWD Upper Watershed Funding Partners Engagement Meeting Agenda

[EXTERNAL EMAIL]

Here are some links to the Loans and Grants from MPCA to check out

https://www.pca.state.mn.us/water/cwp-loans

https://www.pca.state.mn.us/water/section-319-small-watersheds-focus

https://www.pca.state.mn.us/water/clean-water-partnership-and-section-319-programs

Cindy Penny is a contact for the 319 program

Stormwater related:

https://www.pca.state.mn.us/water/wastewater-and-stormwater-financial-assistance

Bill Dunn is a contact

In general, here is what MPCA has available
https://www.pca.state.mn.us/water/financial-assistance-water-projects

Bryan Spindler
Environmental Specialist
Watershed Division
MPCA, Mankato
507-344-5267

From: Brian F. Kallio <bkallio@wenck.com>
Sent: Friday, October 2, 2020 9:26 AM
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Subject: PLSLWD Upper Watershed Funding Partners Engagement Meeting Agenda

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Here is an agenda for this morning's discussion.

Thank you,

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Continuing Authorities Program

The term “Continuing Authorities Program” or “CAP” means a group of legislative authorities under which the Corps of Engineers is authorized to plan, design, and implement certain types of water resources projects without additional project specific congressional authorization. A requirement for application is sponsorship and cost sharing. The sponsoring agency may be a state, county, city, tribes or other group. Additional requirements for each of the small project authorities are detailed in this brochure.

Procedure for Getting a Project

1 → 2 → 3

1. Local Sponsor notifies Corps of problem
2. Corps conducts site investigation after receipt of letter from local sponsor
3. Corps requests study funds
4. Corps conducts project study
5. Local sponsor and Corps sign agreement to construct and maintain a project
6. Corps prepares plans and specs
7. Corps initiates construction

**Cost sharing for lands, easements, rights-of way, relocations and disposal areas as well as cost sharing for operations, maintenance, repair, replacement and rehabilitation varies by project authority.*

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St. Paul District

STREAMBANK AND SHORELINE PROTECTION

Section 14 of the Flood Control Act of 1946, as amended

PROJECT SCOPE ▶

Provide for protection of public facilities/services in imminent threat of damage by natural stream and shoreline erosion

STUDY COSTS ▶

Initial $100,000 = 100% Federal
Amount over $100,000 = 50% Federal and 50% non-Federal

PROJECT COSTS ▶

Non-Federal sponsor pays 35% of total project costs with a minimum of 5% in cash
Maximum Federal costs of $5,000,000

FLOOD CONTROL

Section 205 of the Flood Control Act of 1948, as amended

PROJECT SCOPE ▶

Provides for local protection from flooding by the construction or improvement of flood control works

STUDY COSTS ▶

Initial $100,000 = 100% Federal
Amount over $100,000 = 50% Federal and 50% non-Federal

PROJECT COSTS ▶

Non-Federal sponsor pays 35% of total project costs with a minimum of 5% in cash
Maximum Federal costs of $10,000,000

BENEFICIAL USE OF DREDGED MATERIAL

Section 204 of the Water Resources Development Act of 1992, as amended

PROJECT SCOPE ▶

Provides for protection, restoration, and creation of aquatic and/or wetland habitats associated with dredging for authorized navigation projects

STUDY COSTS ▶

100% Federal

PROJECT COSTS ▶

Non-Federal sponsor pays 35% of total project costs
Maximum Federal costs of $10,000,000

AQUATIC ECOSYSTEM RESTORATION

Section 206 of the Water Resources Development Act of 1996, as ammended

PROJECT SCOPE ▶

Provides restoration of degraded aquatic ecosystem structure, function and dynamic processes to a less degraded, more natural condition

STUDY COSTS ▶

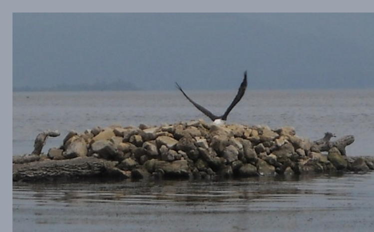
Initial $100,000 = 100% Federal
Amount over $100,000 = 50% Federal and 50% non-Federal

PROJECT COSTS ▶

Non-federal sponsor pays 35% of total project costs
Maximum Federal costs of $10,000,000

PROJECT MODIFICATION FOR THE IMPROVEMENT OF THE ENVIRONMENT

Section 1135 of the Water Resources Development Act of 1986, as amended



PROJECT SCOPE ▶

Provides for improving environmental quality through modifications to Corps structures and operations of Corps structures or implementation of measures in affected areas

STUDY COSTS ▶

Initial $100,000 = 100% Federal
Amount over $100,000 = 50% Federal and 50% non-Federal

PROJECT COSTS ▶

Non-Federal sponsor pays 25% of total project costs
Maximum Federal costs of $10,000,000

Upper Watershed Blueprint

Partner Engagement Meeting Minutes

October 7, 2020

1. Attendees
    a. Prior Lake Spring Lake Watershed District
    b. Wenck Associates
    c. Citizen Advisory Committee
    d. Farmer Led Council
    e. Spring Lake Township
    f. Sand Creek Township
    g. Scott County
    h. MNDOT
2. Project Background
    a. The Prior Lake Spring Lake Watershed District, along with Wenck Associates, is studying its Upper Watershed to identify potential projects to reduce phosphorous loading towards meeting the TMDL goals for Spring Lake and Upper Prior Lake, and to reduce the frequency and magnitude of flooding on Prior Lake.
    b. Working with and agreements with local partners are a key component of identifying and implementing projects towards meeting those goals.
3. Purpose of this meeting
    a. Discuss specific project ideas in the watershed
    b. Receive feedback from project partners
    c. Identify locations where local partners have planned capital improvement project that have potential for stormwater management BMPs
4. Specific Project concepts (see Maps)
    a. Sutton Lake Evaluation and Filter
    b. Swamp Lake Reroute
    c. County Ditch 13 Reroute
    d. County Ditch 13 Improvements
    e. FeCl System Modifications
    f. Buck Lake Channel

Notes:

1. Swamp Lake Diversion
    a. Troy Kuphal – projects have been done working on improvements Picha Creek. Not expected to be a target location
    b. Todd Hubmer – existing 18” drain tile that flows from south of 282 to Geis Lake. Disconnected for Swamp Lake wetland mitigation site project.
2. Sutton Lake-
    a. Large source of P and volume- highest in the upper watershed
    b. Controlled outlet under construction
    c. Lake evaluation to determine sources.
    d. IESF on Sutton Lake is an option under consideration.

e. This area has grade to allow gravity filtration.
f. Chad Sandey – see what kind of bounce is created by the control structure? Neighbors on the lake want to see the impact of that.
    i. Additional bounce not expected from a filter.
    ii. Bounce is the biggest concern of the neighbors and landowners on the lake.
g. Using Sutton as a short term storage solution for flooding concerns on downstream lakes
    i. This would be a concern of lakeshore property owners.
h. Control structure was added in the 70's but it was washed out.

3. CD 13
    a. Reroute or improve section of ditch.
        i. Diversion – bypass from 13 to Buck Lake channel.
            1. 3,600 feet, mostly underground due to grades
            2. Several landowners impacted.
            3. CD13 – issues with benefited properties?
        ii. CD 13 improvement
            1. Incorporate conservation design drainage aspects. Scott SWCD has some funding available.
            2. Significant land needed for planning proper designs.
            3. Per ditch authority, there is a question of how far CD 13 is established. Not sure where it ends.
            4. Hard sell to landowners on ditch widening. This would eat into crop land so compensation would be needed.
            5. Easements are "reasonable use" for ditch maintenance. Undefined easement or right of way.
            6. County needs to purchase right of way for any improvements.
            7. County is more reactive on ditches. No Multi-purpose drainage management plans.
            8. Landowner near crossing with CD13 and highway 13 recently repaired ditch on their property to the county ditch and wants more horse pasture. They may be difficult on increasing any storage in the wetland area.
        iii. FeCl system modifications
            1. Look at improving the mixing or increasing the percentage of water that is treated.
            2. Jaime: Water is bypassing the system about 8% of the time. 5% of that is due to high water on spring lake and not from the head water.
            3. Only a few times in the last 10 years where the system is not flowing. Usually steady flow.
        iv. Buck lake channel/wetland
            1. Wetland improvement projects, stream restoration.
            2. No comments provided.
        v. Looking at Ducks unlimited wetland for opportunities
        vi. Intersection of 282/13. Future improvements and possible opportunity to work with MNDOT.
        vii. Spring West IESF currently in concept planning at the district.
            1. Manure pond removal also.
            2. IESF and potential wetland restoration that district staff is evaluating and discussing with landowners.