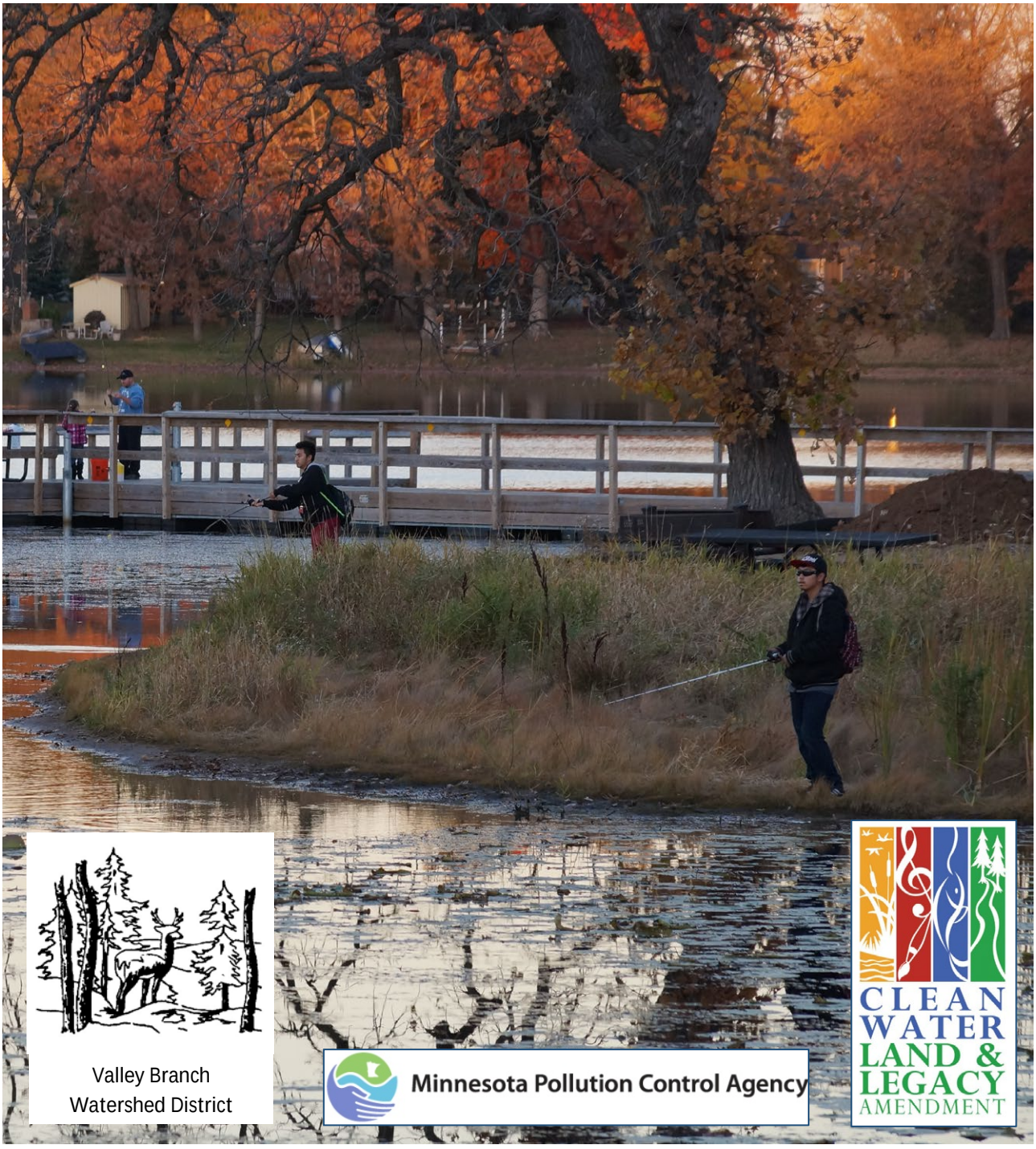
Valley Branch Watershed District

Watershed Restoration and Protection Strategy Report

Lower St. Croix River-Major Watershed

February 2016



Valley Branch Watershed District

Minnesota Pollution Control Agency

CLEAN WATER LAND & LEGACY AMENDMENT

wq-ws4-16a

*Note Regarding Legislative Charge

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

Project Partners

The following organizations and agencies contributed to the development of the Valley Branch Watershed District Restoration and Protection Strategies study.

Barr Engineering Co.

Century College

City of Afton

City of Lake Elmo

City of Maplewood

City of North St. Paul

City of Oakdale

City of West Lakeland

City of White Bear Lake

Metropolitan Council

Minnesota Board of Water and Soil Resources

Minnesota Department of Agriculture

Minnesota Department of Natural Resources

Minnesota Department of Transportation

Minnesota Pollution Control Agency

Ramsey Conservation District

Ramsey County

St. Croix River Association

Valley Brach Watershed District

Washington County Public Health and Environment

Washington County Public Works

Washington Conservation District

3M Tartan Park

Table of Contents

List of Tables

List of Figures

Key Terms

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

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

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

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

Hydrologic Unit Code (HUC): A Hydrologic Unit Code (HUC) is assigned by the USGS for each watershed. HUCs are organized in a nested hierarchy by size. For example, the Minnesota River Basin is assigned a HUC-4 of 0702 and the Pomme de Terre River Watershed is assigned a HUC-8 of 07020002.

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

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

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

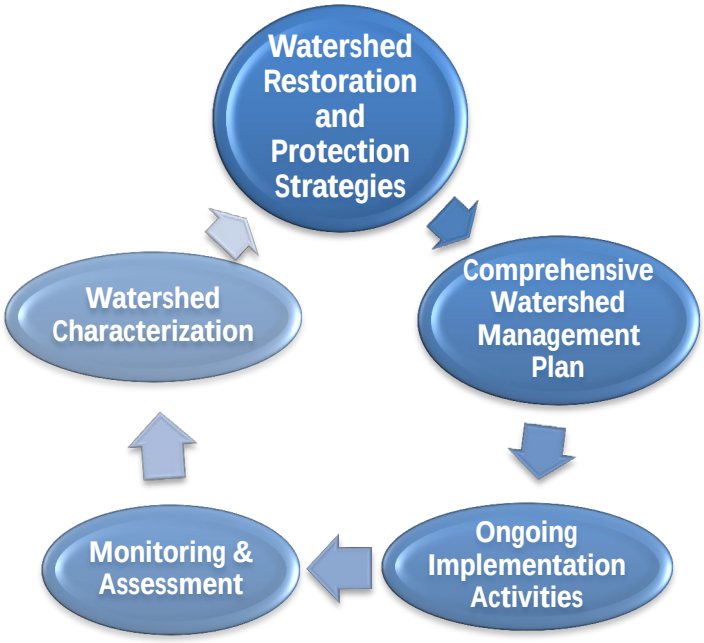
Restoration: This term is used to characterize actions taken in watersheds of impaired waters to improve conditions, eventually to meet water quality standards and achieve beneficial uses of the waterbodies.

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

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

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

What is the WRAPS Report?



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

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

Purpose	· Support local working groups and jointly develop scientifically-supported restoration and protection strategies to be used for subsequent implementation planning · Summarize watershed approach work done to date including the following reports: o Valley Branch Watershed District Watershed Management Plan (2015) o Valley Branch Watershed District 2012 & 2013 Annual Reports o Valley Branch Watershed District Total Maximum Daily Load Report (2015 draft)
Scope	· Impacts to aquatic recreation in lakes and streams and aquatic life in streams
Audience	· Local working groups (local governments, SWCDs, watershed management groups, etc.) · State agencies (MPCA, DNR, BWSR, etc.) · Local interest groups (citizen residents)

1. Watershed Background & Description

The Valley Branch Watershed District (VBWD) was established on November 14, 1968, in response to a citizen's petition of the State of Minnesota to address water resource issues in the watershed. Ever since the VBWD's establishment, one of its primary goals has been to maintain, protect, and/or improve the quality of all surface waters within the VBWD.

The VBWD is located on the eastern edge of the Minneapolis-St. Paul Metropolitan area and covers approximately 70 square miles. Approximately one square mile of the 70 is in Ramsey County, the remainder lies within Washington County. The VBWD includes all or part of the cities of Lake Elmo, Woodbury, Afton, Oakdale, Grant, Pine Springs, Oak Park Heights, St. Mary's Point, North Saint Paul, Maplewood, and White Bear Lake, and the townships of Baytown and West Lakeland.

The VBWD is divided into 39 major subwatersheds, with each major subwatershed associated with a water body. These 39 major subwatersheds are non-overlapping and include the "direct" or "local" drainage area tributary to that major waterbody (i.e., the Valley Creek subwatershed does not include the subwatersheds of upstream waterbodies ultimately tributary to Valley Creek). The major subwatersheds are shown in Figure 1.

The drainage system of the VBWD is characterized by many wetlands, lakes, streams, and conveyance systems, which all eventually drain to the St. Croix River or are landlocked, but would drain to the St. Croix River if they were to overflow. Prior to the VBWD constructing a flood relief and water quality project (referred to as Project 1007) in 1987, all of the land within the VBWD eventually drained to Valley Creek on its way to the St. Croix River. Now, instead of flowing to Valley Creek, the outflows from the northern two-thirds of VBWD enter a storm sewer pipe along Interstate 94, which discharges into the St. Croix River. In 2010, Kelle's Creek, which had been under the Lower St. Croix Watershed Management Organization's jurisdiction, was added to the VBWD. Today, approximately 40% of the VBWD remains landlocked; more than 50 landlocked basins are greater than approximately five acres and many of the more than 1,000 smaller wetlands and basins within VBWD are also landlocked.

The existing land use within the VBWD is shown in Figure 1 and is based on the Metropolitan Council 2010 Land Use dataset. The land use percentage breakdown is summarized in Figure 2. The most common types of land cover within the VBWD are Natural, Park, and Open Space (39%), Residential (23%), and Agricultural (23%).

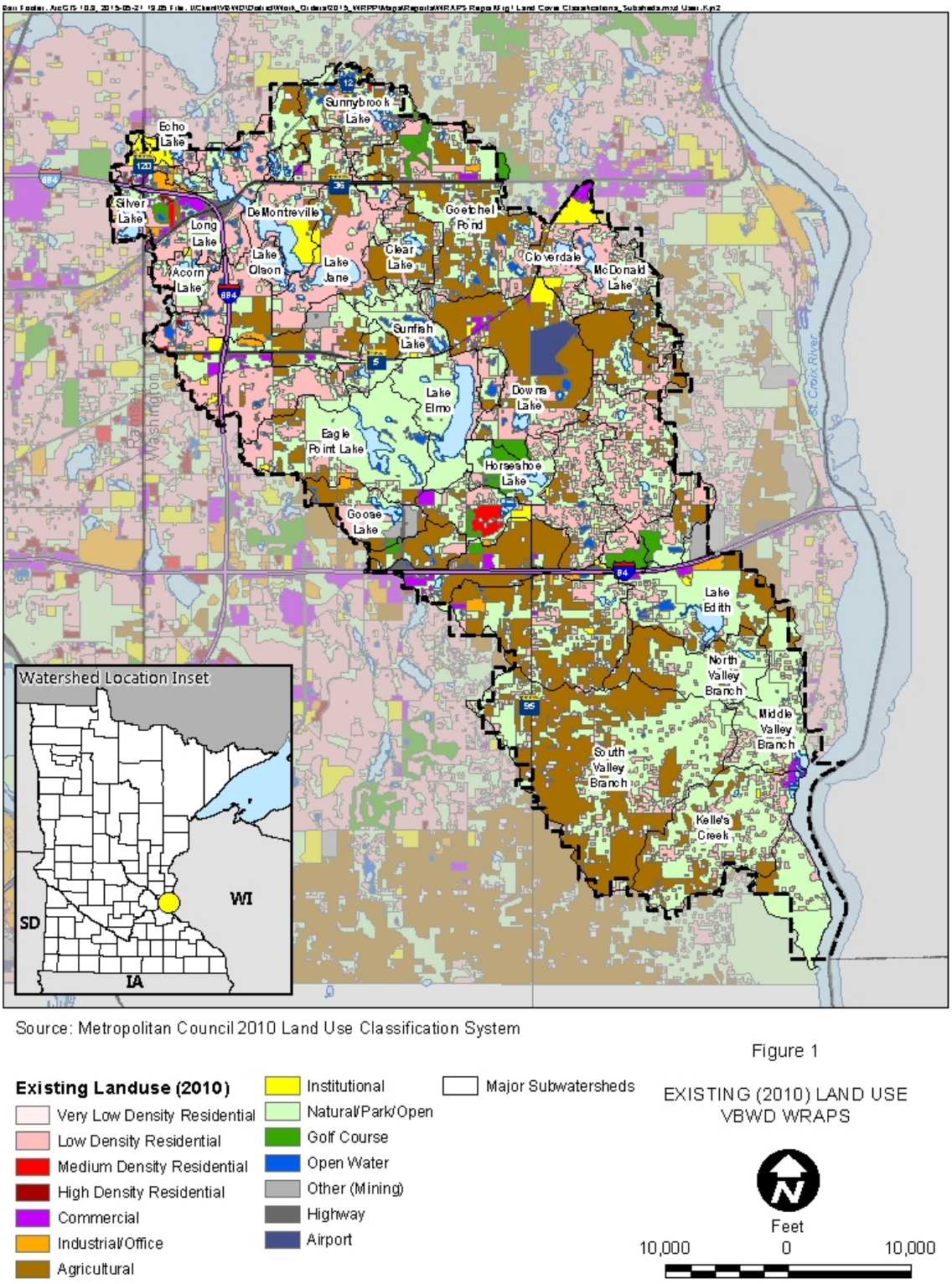


Figure 1. Existing Land Use

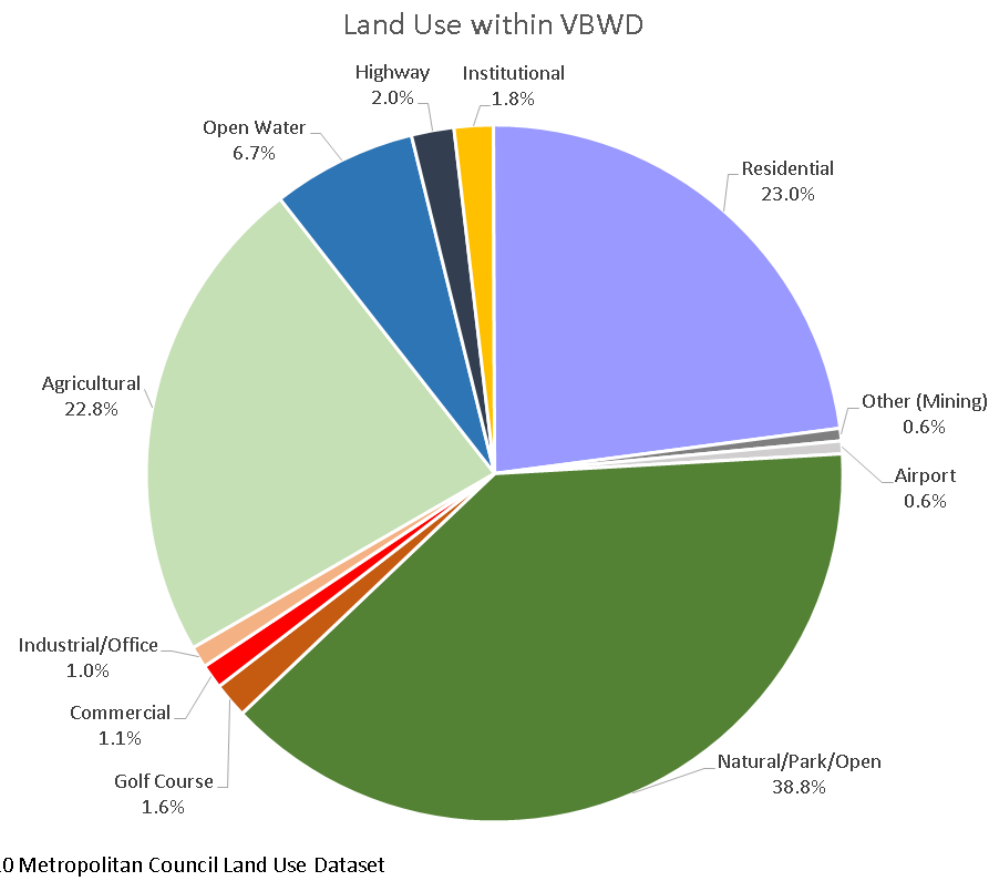


Figure 2. Current Land Use in the VBWD

The Twin Cities metropolitan region, particularly Washington County, is developing rapidly. In 2012, the Minnesota State Demographic Center (MSDC) released their population projections for 2015 to 2040; Washington County is expected to experience greater than 30% population growth during that time with over 64,000 new residents (MSDC 2015). Inevitably, some of this development will occur in the VBWD, which will impact water resources.

Topography affects the direction and the rate of runoff flows over land. Topographic mapping is used to determine the steepness of land and the elevations of features. Within the VBWD, the majority of the steep slopes (greater than 12%) are on the extreme east side (West Lakeland Township) and the southern third (city of Afton). The location of steep slopes within the watershed limits options for land development and these areas have a higher potential for erosion.

Additionally, soil classification in the VBWD plays a role in water quality. The USDA-NRCS Gridded Soil Survey Geographic Database (gSSURGO) for Ramsey and Washington County (2012) provides a comprehensive assessment of soils and soil complexes throughout the district. The soils are classified based on the infiltration capacity of the underlying soils (well drained, sandy soils are classified as "A" soils; poorly drained, clayey soils are classified as "D" soils). Soils with a higher infiltration rate have a lower runoff potential. Conversely, soils with low infiltration rates produce high runoff volumes and high peak runoff rates. More than half of the soils in the VBWD (62%) are hydrologic soil group A (high infiltration) or B (moderate to high infiltration). These soils are well distributed throughout the

watershed. Lower infiltration soils occur mostly in the southern part of the watershed district, in the South Valley Branch and Kelle's Creek subwatersheds (Figure 1).

For more information on the resources in the VBWD and its adopted rules, policies, and permitting program, see the VBWD Watershed Management Plan and the associated Implementation Program (Barr Engineering Co. 2015 http://www.vbwd.org/WMP/Index.html) and the permitting program information on the VBWD website (http://www.vbwd.org/permitting.htm).

Additional Valley Branch Watershed District Resources

- Valley Branch Watershed District
- Valley Branch Watershed District Watershed Restoration and Protection Webpage
- Valley Branch Watershed District Total Maximum Daily Load Study
- Lower St. Croix River Monitoring and Assessment Report
- Lower St. Croix River Watershed Webpage
- USDA Natural Resources Conservation Service (NRCS) Rapid Watershed Assessment for the Lower St. Croix and Twin Cities Watersheds
- Minnesota Department of Natural Resources (DNR) Watershed Assessment Mapbook

2. Watershed Conditions

Water quality in lakes, wetlands, and streams is closely linked to watershed conditions and internal waterbody processes. As urbanization continues and other land use changes occur in the VBWD, nutrient and sediment inputs (i.e., loadings) from stormwater runoff can far exceed the natural inputs to a lake, wetland, or stream. Stormwater runoff can carry significant amounts of phosphorus from the watershed into a waterbody. Land use changes resulting in increased imperviousness (e.g., urbanization) or land disturbance (e.g., urbanization, construction, or agricultural practices) also result in increased amounts of phosphorus carried in stormwater runoff. The increased runoff from urbanization can also lead to higher stream velocities, resulting in erosion and higher sediment loading to downstream waterbodies. In addition to watershed sources, other sources of phosphorus include atmospheric deposition, internal loading (e.g., release from anoxic sediments, algae die-off, aquatic plant die-back, and fish-disturbed sediment) and non-compliant subsurface sewage treatment systems (SSTS).

The majority of properties within the VBWD are adjacent to major waterbodies are served by SSTS or community sewage treatment systems. Non-compliant SSTS have the potential to add nutrients, bacteria, and other pollutants to VBWD waterbodies.

If loadings increase, it is likely that water quality degradation will accelerate, resulting in unpleasant consequences, such as profuse algae growth (algal blooms), reduced diversity of rooted aquatic plants, and fish kills.

To understand the water quality of its lakes and streams and whether the water quality meets goals, the VBWD, in partnership with Ramsey County, Metropolitan Council, and Washington Conservation District, routinely monitors water quality in lakes and streams within the watershed. The VBWD uses monitoring data to track water quality trends and make decisions about future monitoring programs and projects. Further detail on these monitoring programs is available in Section 4 of this watershed restoration and protections strategy (WRAPS) report and in the VBWD Plan (Barr Engineering Co. 2015): http://www.vbwd.org/WMP/Index.html.

Currently there are six lakes within the VBWD included on the proposed 2014 303(d) list of impaired waters (Figure 3): Lake Elmo, Lake Jane, Downs Lake, Goose Lake (South), Sunfish Lake, and Echo Lake. Lake Elmo is impaired due to elevated concentrations of mercury and perfluorooctane sulfonate (PFOS) in fish tissue. Jane Lake is impaired due to high concentrations of mercury in fish tissue. This report does not cover toxic pollutants. For more information on mercury impairments see the statewide mercury TMDL at: https://www.pca.state.mn.us/water/statewide-mercury-reduction-plan. The Minnesota Pollution Control Agency (MPCA) has not yet completed a TMDL report for PFOS.

Four VBWD waterbodies (Downs Lake, Goose Lake (South), Sunfish Lake, and Echo Lake) are impaired due to excess nutrients. Originally, Eagle Point Lake, Bay Lake, and Kramer Pond were also listed on the impaired waters list due to nutrients/eutrophication. However, in early 2015, these three waterbodies were removed from the list and were reclassified as wetlands due to their shallow depths and considerable aquatic vegetation. Kelle's Creek is also included on the impaired waters list as impaired due to bacteria (*Escherichia coli (E. coli)*). Sunfish Lake and Kelle's Creek have received TMDLs, which are summarized in Section 2.4.

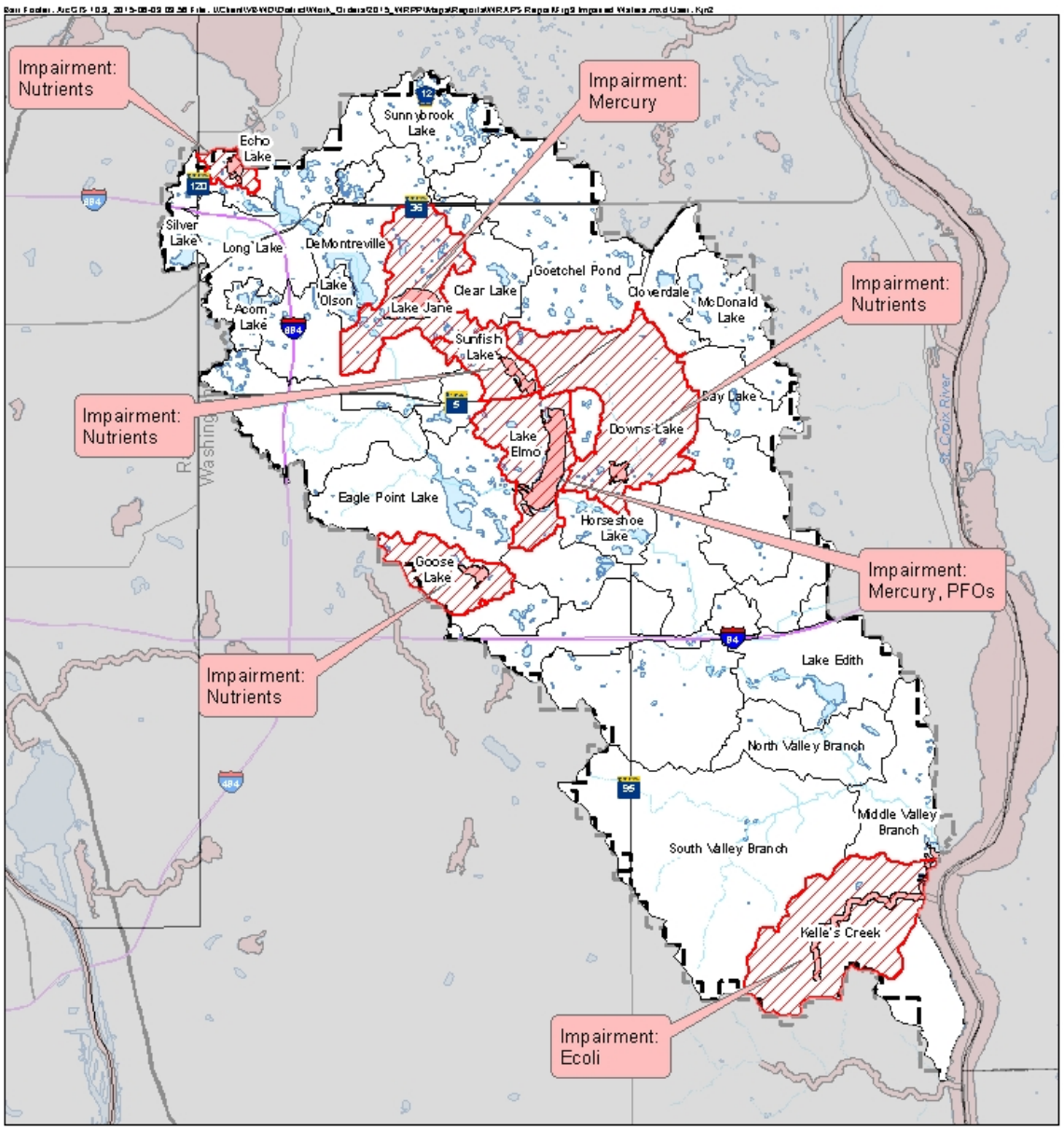


Figure 3. Impaired Waters in the VBWD

2.1 Condition Status

Section 303(d) of the federal Clean Water Act requires each state to identify and establish priority rankings for waters that do not meet the water quality standards. The list of impaired waters is updated by the state every two years. This section summarizes the impairment assessment for streams and lakes in the VBWD. Waters that are not listed as impaired will be subject to protection efforts (see Section 2.5 and Section 3.3). Table 1 summarizes the water quality standards that apply to the lakes and streams in the VBWD.

Table 1. MPCA Water Quality Standards Applicable to VBWD Waterbodies

MPCA Waterbody Category	Water Quality Standards[1, 2]							
	Total Phosphorus (ug/L)	Chlorophyll a (ug/L)	Secchi Disc (m)	Total Suspended Solids (mg/L)	Daily Dissolved Oxygen Flux (mg/L)	Biological Oxygen Demand (5-day) (mg/L)	*Escherichia coli* (#/100mL)[5]	Chloride (mg/L)
Streams	100	18	NA	30/10[4]	3.5	2.0	126/1,260	230
Deep Lakes[3]	40	14	1.4	NA	NA	NA	NA	230
Shallow Lakes[3]	60	20	1.0	NA	NA	NA	NA	230

1 – Standards are based on Minn. R. 7050 and revisions (2014) to those Rules.
2 – This table is a simplification of Minn. R. 7050. Refer to Minn. R. 7050 for more detailed information about standards, including calculation of time-average values, temporal applicability of standards, etc.
3 – For North Central Hardwood Forest Ecoregion
4 – Cold water streams TSS standard
5 – 126 cfu/100mL – chronic standard; 1,260 cfu/100mL – acute standard

Streams

Water quality of streams is assessed based on aquatic life and aquatic recreation uses. Aquatic life impairments include fish index of biotic integrity (Fish IBI), macroinvertebrate index of biotic integrity (Invert IBI), dissolved oxygen (DO), turbidity/total suspended solids (TSS), pH, and chlorides. Aquatic recreation use impairments include *E. coli*. There are several small streams within the VBWD; however, only four of the streams had sufficient data to assess their impairment statuses. Table 2 summarizes the beneficial use data for the streams that were assessed and Figure 4 shows the locations of all the streams in the VBWD with their associated AUID numbers.

Table 2. Assessment Status of Stream Reaches in the VBWD

HUC-10 Subwatershed	AUID (Last 3 digits)	Stream (Valley Branch Watershed District name is within parentheses)	Reach Description	Aquatic Life					Aquatic Recreation	Aquatic Consumption
				Fish Index of Biotic Integrity	Macroinvertebrate Index of Biotic Integrity	Dissolved Oxygen	Turbidity/TSS	Chloride	Bacteria	
Lake Saint Croix 0703000512	606	Unnamed Creek (Kelle's Creek)	Headwaters to St Croix River	IF	IF	IF	IF	IF	Imp	NA
	566	Valley Branch (Valley Creek North Fork)	Unnamed Creek to Valley Creek	Sup	Sup	Sup	Sup	Sup	NA	NA
	560	Valley Branch (Valley Creek Main Stem)	Valley Creek to St Croix River	Sup	Sup	Sup	Sup	Sup	IF	NA
	567	Valley Creek (Valley Creek South Fork)	Unnamed Creek to Valley Branch	Sup	Sup	Sup	Sup	Sup	NA	NA
	503	St. Croix River[1]	Willow River to Kinnickinnic River	NA	NA	NA	NA	NA	NA	Imp

Sup = found to meet the water quality standard
Imp = does not meet the water quality standard and, therefore, is impaired
IF = the data collected was insufficient to make a finding
NA = not assessed
[1] Impaired due to mercury and PCB in fish tissue

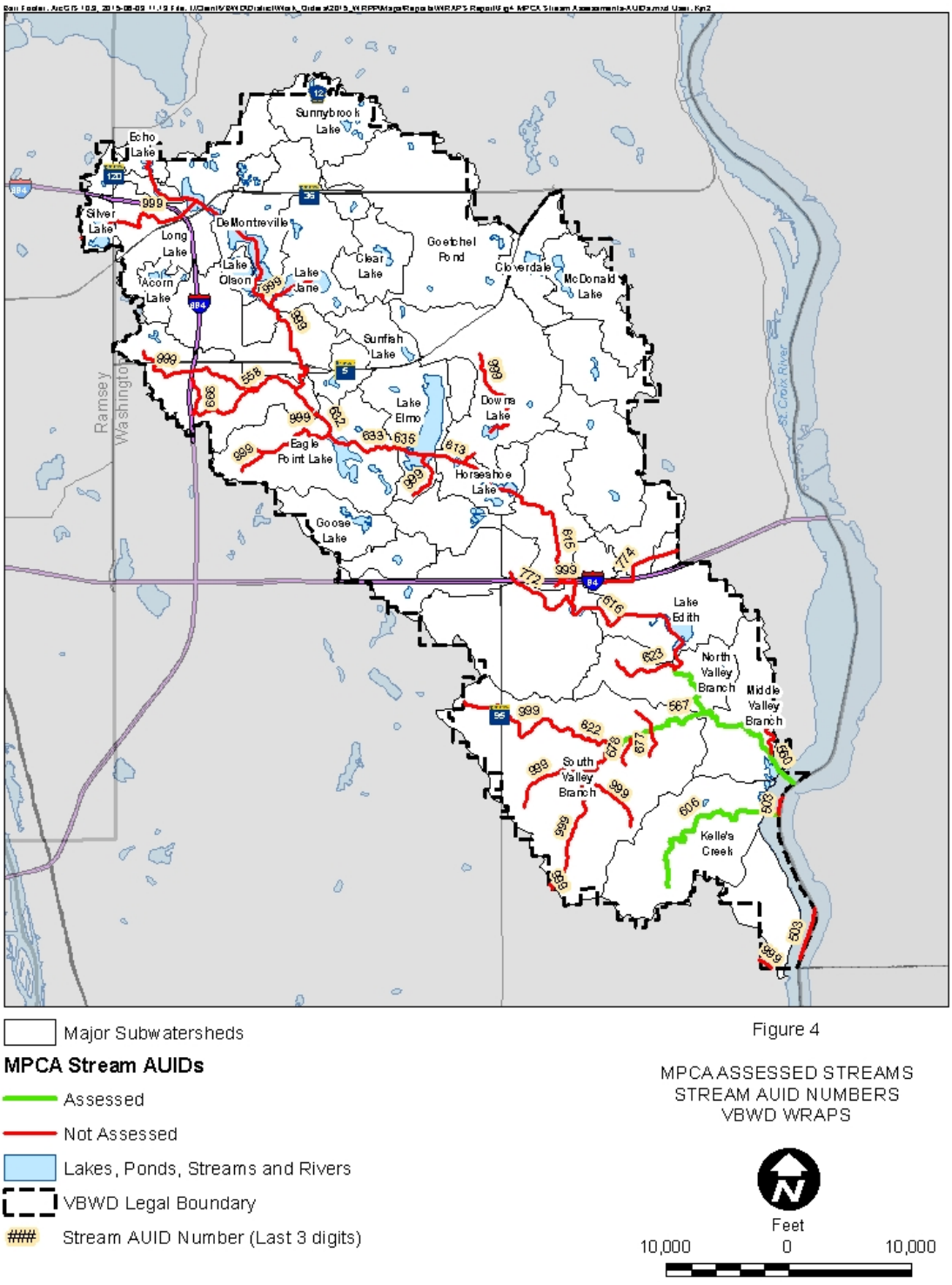


Figure 4. MPCA Assessed Streams

The following sections briefly discuss the characteristics of the assessed streams within the VBWD. Additional details can be found in Section 5 of the VBWD's Watershed Management Plan (Barr Engineering Co. 2015): http://www.vbwd.org/WMP/Index.html.

Kelle's Creek

Kelle's Creek is located in a steep-sided ravine in the southern portion of the city of Afton. The creek is a spring-fed perennial creek that flows from the upper portions of the ravine to the St. Croix River, discharging into the river downstream (south) of downtown Afton.

Much of the Kelle's Creek Watershed is undeveloped and the land use is primarily rural residential in the lower portions of the watershed and agricultural uses in the uplands to the southwest. The downstream portion of the watershed includes a small portion of downtown Afton. Upstream of St. Croix Trail (CSAH 21), the riparian areas of the creek are primarily classified as forested wetlands, with upland forests on the ravine sides (EOR, 2007). There are also some unfragmented tracts of forest and grassland that provide valuable habitat in the watershed.

Valley Creek

Valley Branch Creek (called Valley Creek by local residents, other agencies, and hereinafter in this report) is another perennial stream within the VBWD. Much of the drainage from the VBWD watershed no longer discharges to Valley Creek as a result of the Project 1007 flood and water quality control project. Because of this project, the majority of the Valley Creek Watershed is located in the city of Afton and a small portion is located on the east edge of the city of Woodbury. The creek is comprised of three major branches: the North Fork, South Fork, and the Main Stem (Barr Engineering Co. 2015).

The Minnesota Department of Natural Resources (DNR) has designated the perennial reaches of Valley Creek as a trout stream. Valley Creek is one of only a few streams in the Twin Cities metropolitan area that has a naturally reproducing population of brook trout, the only trout species native to Minnesota. Valley Creek also sustains large populations of brown trout, rainbow trout, and native brook lamprey. Valley Creek is one of the best trout producing streams in the State of Minnesota, and is believed to be in the top 10% of trout streams in the world in terms of trout production (Tom Waters and Ray Newman, personal communication).

Based on the current land use plans for the cities of Afton and Woodbury, there does not appear to be a strong thermal impact threat to Valley Creek. The VBWD has developed stormwater volume control policies that consider thermal impacts in order to maintain water quality in the creek that is suitable for trout.

St. Croix River

Although the St. Croix River is technically not within the VBWD, the VBWD lies within the larger St. Croix River Watershed. The St. Croix River watershed is 7,760 square miles in size with the VBWD making up only 0.9% of this watershed. There are three discrete points where the VBWD flows into the St. Croix River. One point is the outlet of Minnesota Department of Transportation's Interstate 94 storm sewer

system, which carries flows from the VBWD's Project 1007 system. A second is the outlet of Valley Creek in Afton, and the third discharge point is the outlet of Kelle's Creek in Afton.

The St. Croix River has been federally-designated as a Wild and Scenic River. The Minnesota's Wild and Scenic Rivers Program was established in 1973 to protect rivers which have outstanding natural, scenic, geographic, historic, cultural, and recreational values. Each of the designated river segments in Minnesota have management plans which outline the rules and goals for that waterway. Its adopted rules work alongside local ordinances to protect the rivers from pollution, erosion, over-development and degradation (DNR, Wild & Scenic Rivers Program 2014).

The Lower St. Croix National Scenic Riverway includes the lower 52 miles of the St. Croix River between Taylor Falls and the confluence with the Mississippi River. The upper 10-mile stretch of the Lower St. Croix River is classified as scenic, while the lower 42 miles are classified as recreational. Scenic rivers are those rivers that exist in a free-flowing state and with adjacent lands that are largely undeveloped. Recreational rivers are those rivers that may have undergone some impoundment or diversion in the past and that may have adjacent lands which are considerably developed, but that are still capable of being managed so as to further the purposes of this act. The riverway is managed jointly by the National Park Service (NPS), the DNR and the Wisconsin DNR (WDNR) (DNR, Wild & Scenic Lower St. Croix River, 2014). The lower 25 miles of the St. Croix River, between Stillwater, Minnesota, and Prescott, Wisconsin, is called Lake St. Croix.

Lakes

Water quality of lakes is assessed based on several parameters. Table 3 summarizes the beneficial use data for the various lakes in the VBWD as well as the status of the TMDL for the various impairments (if applicable).

Lake impairments are based on an aquatic recreation-base standard (Class 2) centered on protecting the ability to recreate on and in Minnesota waters. Additionally, lakes can be listed as impaired based on aquatic consumption standards.

Several of the lakes are listed as impaired for aquatic recreation due to excess nutrients. The eutrophication standards are based on the ecoregion and lake depth. Minn. R. 7050.0222, subp. 4: Class 2B Waters outlines the water quality criteria by ecoregion. This rule establishes the eutrophication criteria for deep and shallow lakes (shallow lakes are lakes with a maximum depth of 15 feet or a littoral area of 80% or more). Class 2B lakes are assessed based on ecoregion specific numeric water quality standards for total phosphorus (TP), chlorophyll-*a* (chl-*a*), and Secchi transparency depth. To be listed as impaired, a lake must not meet water quality standards for TP and either chl-*a* or Secchi depth. The lakes included in the VBWD are all located within the North Central Hardwood Forest ecoregion (NCHF). The lake water quality standards are included in Table 1.

Not all of the waterbodies listed in Table 3 are impaired; however, this does not impact their protection status. Those that are currently meeting water quality standards should be protected so that their water quality is maintained or improved. To prevent degradation of existing water quality, the VBWD requires water quality treatment for development and redevelopment projects through it adopted Rules and Policies.

Within the VBWD, Lake Elmo and Lake Jane are impaired by toxic pollutants (mercury and PFOS). The mercury in Minnesota fish comes almost entirely from atmospheric deposition, with approximately 90% originating outside of Minnesota (MPCA 2007). Because the main source of mercury comes from outside the state and the atmospheric deposition of mercury is relatively uniform across the state, the MPCA developed a statewide TMDL, approved in 2007, and amended annually. However, beyond summarizing the lakes with mercury and PFOs impairments, the VBWD WRAPS report does not cover toxic pollutants. For information on mercury impairments see the statewide mercury TMDL at: https://www.pca.state.mn.us/water/statewide-mercury-reduction-plan. A TMDL for PFOS has not yet been developed and will be addressed at a later time.

For more information on the lakes, see Section 5 of the VBWD Management Plan (Barr Engineering Co. 2015): http://www.vbwd.org/WMP/Index.html.

Table 3. Assessment Status of Lakes in the VBWD

HUC-10 Subwatershed	Lake ID	Lake	Applicable Lake Depth Standard	Aquatic Recreation	Aquatic Consumption	VBWD Waterbody Priority Classification[1]
Lake Saint Croix 0703000512	82-0101	DeMontreville	Deep	Sup	NA	High
	82-0110	Downs[2]	Shallow	Imp	NA	High
	82-0004	Edith	Deep	Sup	NA	High
	82-0106	Elmo[3,4]	Deep	Sup	Imp	High
	82-0113	Goose (South)[2]	Shallow	Imp	NA	High
	82-0104	Jane[3]	Deep	Sup	Imp	High
	62-0001	Silver	Shallow	Sup	NA	High
	82-0107	Sunfish[2]	Shallow	Imp	NA	High
	82-0135	Unnamed[2] (Echo Lake)	Shallow	Imp	NA	High
	82-0102	Acorn	Shallow	Sup	NA	Medium
	82-0009	Cloverdale	Shallow	Sup	NA	Medium
	82-0099	Clear	Shallow	IF	NA	Medium
	82-0313	Goetschel Pond	Shallow	Sup	NA	Medium
	82-0074	Horseshoe	Shallow	IF	NA	Medium
	82-0118	Long	Deep	Sup	NA	Medium
	82-0010	McDonald	Shallow	IF	NA	Medium
	82-0103	Olson	Shallow	Sup	NA	Medium
	82-0133	Sunnybrook	Shallow	Sup	NA	Medium
	82-0001	Lake St. Croix	Deep	Imp	NA	-

Sup = found to meet the water quality standard
Imp = does not meet the water quality standard and, therefore, is impaired
IF = the data collected was insufficient to make a finding
NA = not assessed

[1] Waterbody priority classification is based on five criteria: (1) water quality, (2) the MPCA water body classification (deep, shallow, wetland, stream), (3) the DNR classification as a trout stream or outstanding resource value water (ORVW), or direct drainage to an outstanding resource value water (i.e., St. Croix River) or a trout stream (Valley Creek), (4) public access to the water body, and (5) construction or modification to perform as a stormwater pond. High Priority waterbodies have impaired or degraded water quality, MPCA "deep" classification, and/or the DNR classification as a trout stream or an ORVW. Medium Priority waterbodies have the MPCA "shallow" classification, some form of public access, and/or are directly upstream of an outstanding resource value water or trout stream.

[2] Impaired due to nutrient/eutrophication biological indicators

[3] Impaired due to mercury in fish tissue

[4] Impaired due to PFOs in fish tissue

2.2 Water Quality Trends

Streams

The VBWD, in partnership with the Metropolitan Council, operates a Watershed Outlet Monitoring Program (WOMP) monitoring station located near the convergence of Valley Creek to the St. Croix River. This station has collected flow and water quality monitoring data from 1999 to present. The Metropolitan Council has conducted trend analyses on the monitoring data (on data through 2012). The Metropolitan Council used QWTREND analysis (an R-based statistical program) from the United States Geological Survey (USGS) to evaluate water quality trends. The QWTREND analysis indicates whether the concentrations versus time are increasing (positive value) or decreasing (negative value). Red rows indicate a degrading trend; green rows indicate an improving trend.

The Metropolitan Council's assessment of the most recent concentrations trends from 2008 to 2012, data shows that sediment and phosphorus concentrations have significantly decreased in Valley Creek, resulting in improved water quality. However, nitrate concentrations are showing an increasing trend. The Metropolitan Council hypothesized that this is likely due to the high concentrations of nitrate in the groundwater that feeds the creek and the presence of karst features in the watershed. A summary of the concentration trends for the years of 2008–2012, can be seen in Table 4 (MCES 2014). For additional information refer to: www.metrocouncil.org/streams.

Table 4. Water Quality Concentration Trend Summary for Valley Creek

Water Quality Criteria	Water Quality Trend	Percent Change
Total Suspended Solids	Improving Trend	-1%
Total Phosphorus	Improving Trend	-46%
Nitrate	Degrading Trend	+28%

Lakes

Many of the major lakes and streams in the VBWD have long-term historical water quality and quantity records, due to the monitoring programs supported and encouraged by the District.

As part of the annual reporting each year, the VBWD performs trend analyses on the lake water quality data, focusing the trend evaluation efforts on the Secchi disc transparency depth measurements. Since Secchi disc transparency is a measure of water clarity and is inversely related to the abundance of algae, and can be used to define overall water quality. The trend analyses are used to determine if the lakes in the watershed have experienced significant degradation, improvement, or no trends during all (or a portion of) the years of record. Summer average values were calculated and analyzed to determine water quality trends. Long-term trends are typically determined using statistical methods.

The Mann-Kendall/Sen's Slope Trend Test was used to determine water quality trends and their significance ($p < 0.05$). To complete the trend test, the calculated summer average must be based on at least four measured values during the sampling season and at least five years of data are required. Table 5 summarizes the trend analysis information for the lakes in the VBWD conducted in the 2013 (Barr

Engineering Co. 2013). For additional information on lake water quality trends in the VBWD, refer to the VBWD annual reports: http://www.vbwd.org/annual.htm.

Table 5. Water Quality Trends in VBWD Lakes Based on Secchi Disc Transparency Depths

Water Body	Sampling Record Range	Trend Test Period	Recent Water Quality Trend (95% Confidence)
DeMontreville	1974-2013	2004 - 2013	No Trend[1]
Eagle Point	1980-2013	2007-2013	No Trend[1]
Edith	1961-2013	2005-2013	No Trend[1]
Elmo	1948-2013	2005-2013	No Trend[1]
Jane	1973-2013	1973 -2011	Improving Trend [2] (0.104 feet/year)
Silver	1973-2013	2004-2013	Degrading Trend [1] (-0.63 feet/year)
Sunfish	1977-2013	2005-2013	No Trend[1]
Unnamed (Echo Lake)	1973-2013	2005-2013	Improving Trend[1] (0.55 feet/year)
Horseshoe	1980-2013	2004-2013	No Trend[1]
Long	1972-2013	2004-2013	No Trend[1]
McDonald	1992-2013	2004-2013	No Trend[1]
Olson	1974-2013	2004-2013	No Trend[1]

[1]Trends are based on the 2013 VBWD Annual Report

[2]The VBWD has not computed recent trends for Lake Jane due to limited number of data points per growing season. Trend from the MPCA http://cf.pca.state.mn.us/water/watershedweb/wdip/details.cfm?wid=82-0104-00

No Trend = No discernable trend in water quality changes

Silver Lake was the only lake that had a statistically significant degrading trend in water quality from 2004-2013. Silver Lake's 2013 summer-average Secchi disc transparency of 0.94 meters (3.08 feet) is the poorest summer-average since 1977. The historic water quality data show a rapid decrease in water quality beginning in 2007. The degrading water quality conditions observed during the recent period from 2007-2013 are most likely due to the whole-lake aquatic plant treatment applied to the lake in 2007 and 2008 to manage Eurasian watermilfoil and CLP. One hypothesis is that the application of the herbicides was too late in the spring when the native plant communities were beginning to grow. The herbicides killed many of the native plants, and this change caused the poorer water quality.

In addition to poorer Secchi disc transparency, the 2013 summer-average TP concentration for Silver Lake was 114 µg/L, which is poorer than the VBWD goal of 40 µg/L and the MPCA TP criterion for shallow lakes of 60 µg/L or less. Additionally, Silver Lake's summer average for chlorophyll a was 42 µg/L, which is above the impaired water listing criterion (Barr Engineering Co. 2013).

Echo Lake and Lake Jane show improving trends in water quality in terms of Secchi disc transparency measurements. Echo Lake's 2013 summer-average Secchi disc transparency was 1.79 meters (5.87 feet), which is approximately 97.8% of the lake's maximum depth. The lake is currently improving at a rate of 0.551 feet per year (Barr Engineering Co. 2013). However, even with the improving trend in water clarity, the lake is on the impaired waters list. Lake Jane's 2013 summer-average Secchi disc transparency was 4.35 meters (14.3 feet). The lake is currently improving at a rate of 0.104 feet per year (Barr Engineering Co. 2013).

2.3 Stressors and Sources

In order to develop appropriate strategies for restoring or protecting waterbodies, the stressors and/or sources impacting or threatening them must be identified and evaluated. Biological stressor identification is done for streams with fish and/or macroinvertebrate biota impairments and encompasses both evaluation of pollutants and non-pollutant-related (e.g., altered hydrology, fish passage, habitat) factors as potential stressors. Pollutant source assessments are done where a biological stressor identification process identifies a pollutant as a stressor as well as for the typical pollutant impairment listings. Section 3 provides further detail on stressors and pollutant sources.

Stressors of Biologically-Impaired Stream Reaches

Three streams have been assessed in the VBWD and fully support aquatic life. The other streams in the watershed have not yet been assessed. Biotic stressors that have the potential to cause impairments or threats to fish and macroinvertebrates include DO, nitrate, phosphorus, chloride, TSS, dams, altered hydrology, habitat, and others. To ensure that the stream reaches in the VBWD do not become biologically impaired, monitoring efforts will need to continue and protection efforts will need to be implemented. The monitoring efforts and proposed protection strategies and projects are discussed in Sections 3 and 4.

Pollutant Sources

Stormwater runoff carries with it a number of contaminants affecting water quality, human health, recreation, habitat and aesthetics. The principal pollutants found in runoff include nutrients, sediments, organic materials, pathogens, hydrocarbons, metals, pesticides, chlorides, trash and debris. Additionally, non-compliant septic systems can also contribute pollutants such as nutrients and pathogens (e.g., bacteria) to resources.

Table 6, developed using information from the Minnesota Urban Small Sites Best Management Practice (BMP) Manual (Barr Engineering Co. 2001), summarizes the typical sources of these pollutants and their impacts. Of these pollutants, the VBWD recognizes that phosphorus and suspended sediment are particularly detrimental to the ecological functions and recreational use of lakes, streams, and wetlands. As a result, VBWD's permit program requires measures to reduce the influx of these pollutants to its water bodies.

Table 6. Principal Pollutants in Urban and Rural Runoff

Stormwater Pollutant	Examples of Sources	Related Impacts
Nutrients: Nitrogen, Phosphorus	Animal waste, fertilizers, failing septic systems	Algal growth, reduced clarity, other problems associated with eutrophication (oxygen deficit, release of nutrients and metals from sediments)
Sediments: Suspended and Deposited	Construction sites, other disturbed and/or non-vegetated lands, eroding banks, road sanding	Increased turbidity, reduced clarity, lower dissolved oxygen, deposition of sediments, smothering of aquatic habitat including spawning sites, sediment and benthic toxicity
Organic Materials	Leaves, grass clippings	Oxygen deficit in receiving water body, fish kill.
Pathogens: Bacteria, Viruses	Animal waste, failing septic systems	Human health risks via drinking water supplies, contaminated swimming beaches
Hydrocarbons: Oil and Grease, PAHs (Naphthalenes, Pyrenes)	Industrial processes; automobile wear, emissions & fluid leaks; waste oil.	Toxicity of water column and sediment, bioaccumulation in aquatic species and through food chain
Metals: Lead, Copper, Cadmium, Zinc, Mercury, Chromium, Aluminum, others	Industrial processes, normal wear of auto brake linings and tires, automobile emissions & fluid leaks, metal roofs	Toxicity of water column and sediment, bioaccumulation in aquatic species and through the food chain, fish kill
Pesticides: PCBs, Synthetic Chemicals	Pesticides (herbicides, insecticides, fungicides, rodenticides, etc.), industrial processes	Toxicity of water column and sediment, bioaccumulation in aquatic species and through the food chain, fish kill
Chlorides	Road salting and uncovered salt storage	Toxicity of water column and sediment
Polycyclic Aromatic Hydrocarbons (PAHs)	Tar based pavement sealant	Carcinogenic to humans
Trash and Debris	Litter washed through storm drain networks	Degradation of the beauty of surface waters, threat to wildlife

Based on Minnesota Urban Small Sites BMP Manual *(*Barr, 2001).

In general there are two forms of pollutant sources to a waterbody: non-point (non-permitted) sources and point (permitted) sources. Non-point pollution refers to water pollution from sources, such as land runoff, atmospheric deposition, drainage, seepage, and/or hydrologic modification. Point sources can be defined as any discernible, discrete conveyance (i.e., pipe, ditch, channel, etc.) from which pollutants are or may be discharged to a waterbody. In many situations, commercial or industrial companies that produce point source pollution require permits.

Point sources of phosphorus are those that require a National Pollution Discharge Elimination System (NPDES)/State Disposal System (SDS) permit and are referred to as permitted sources. Examples of typical permitted sources of phosphorus include the following:

- Phase II Municipal Stormwater NPDES/SDS General Permit - Includes coverage of municipal separate storm sewer systems (MS4s) which are publicly owned or operated stormwater infrastructure used solely for stormwater and often include cities, townships, and public institutions. The goal of the MS4 general permit is to improve the water quality of urban stormwater runoff and reduce pollutants in stormwater discharges.

- Construction Stormwater NPDES/SDS General Permit – Includes coverage of any construction activities disturbing one acre of more of soil, less than one acres of soil when part of a larger development that is more than one acre, or less than one acre when the MPCA determines the activity to pose a risk to water resources. The goal of the construction stormwater permit is to control erosion and reduce the amount of sediments and other pollutants being transported by runoff from construction sites.
- Multi-Sector Industrial Stormwater NPDES/SDS General Permit – Includes coverage of stormwater discharges associated with a variety of industrial activities. The goal is to reduce the amount of pollution that enters surface and ground water from industrial facilities in the form of stormwater runoff.
- NPDES/SDS Permit – Includes coverage of facilities that discharge treated wastewater to surface or ground water of the state. The goal of the permit is to establish minimum effluent limits for a variety of constituents that protect the water quality and designated uses of waters of the state.

Table 7 lists the permit holders (NPDES, SDS, or MS4 permits) in the watersheds for the impaired resources in the VBWD that currently have final or draft TMDLs, including Lake St. Croix, Kelle's Creek and Sunfish Lake Watersheds. Figure 5 shows the locations of the MS4s in the Sunfish Lake Watershed.

Table 7. Permitted Sources in the VBWD Impaired Waters Watersheds

HUC-10 Subwatershed	Point Source			Notes
	Name	Permit #	Type	
Lake Saint Croix 0703000512	Tapestry WWTP	MN0067547	Municipal wastewater	No surface water discharge
	MN DOT (Metro)	MS400170	Municipal stormwater	Lake St. Croix TMDL (MPCA, WDNR, 2012)
	Lake Elmo City	MS400098	Municipal stormwater	Sunfish Lake TMDL (draft) and Lake St. Croix TMDL (MPCA, WDNR, 2012)
	Century College	MS400171	Municipal stormwater	Lake St. Croix TMDL (MPCA, WDNR, 2012)
	Cimarron Park WWTP	MN0050636	Municipal wastewater	
	Grant City	MS400091	Municipal stormwater	
	Mahtomedi City	MS400031	Municipal stormwater	
	Maplewood City	MS400032	Municipal stormwater	
	North St Paul City	MS400041	Municipal stormwater	
	Oakdale City	MS400042	Municipal stormwater	
	Pine Springs City	MS400044	Municipal stormwater	
	Ramsey County Public Works	MS400191	Municipal stormwater	
	Valley Branch Watershed District	MS400217	Municipal stormwater	
	West Lakeland Township MS4	MS400162	Municipal stormwater	
	White Bear Lake City MS4	MS400060	Municipal stormwater	
	Woodbury City MS4	MS400128	Municipal stormwater	
	Washington County MS4	MS400160	Municipal stormwater	Sunfish Lake TMDL (draft)

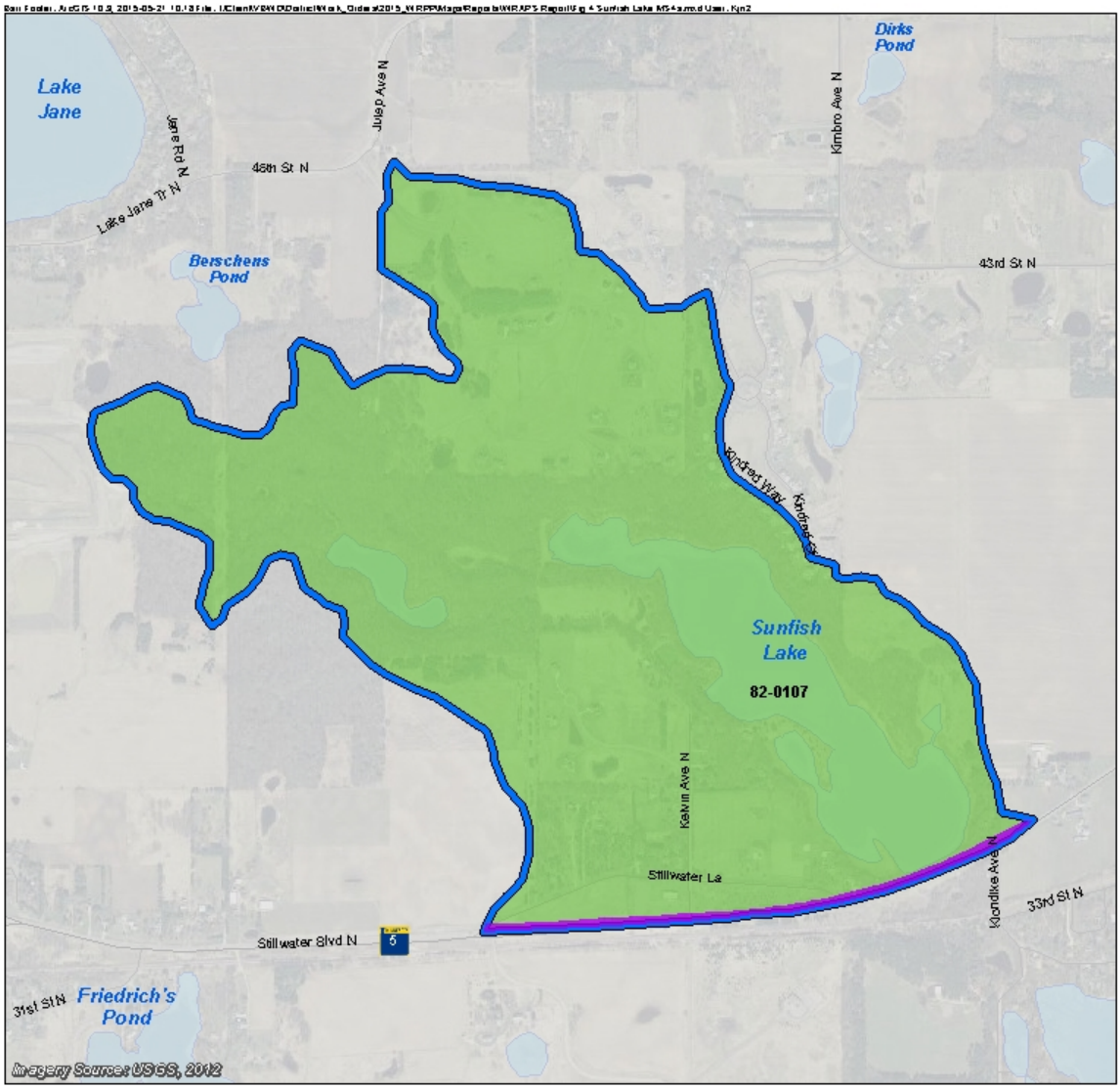


Figure 5

Sunfish Lake Watershed
82-xxxx DNR Protected Waters Designation
MS4 Area by Owner
Washington County Land and ROW
Lake Elmo Municipal Land

SUNFISH LAKE MS4s
VBWD WRAPS

N

Feet
1,200 0 1,200

Figure 5. Sunfish Lake MS4s

Kelle's Creek, Eagle Point, Edith, Horseshoe, Silver, and Sunfish Lakes were studied in depth as part of this project. Table 8 summarizes the nonpoint sources impacting the water resources studied in detail during the WRAPS study and indicates their relative magnitude of impact.

Table 8. Potential Nonpoint Sources in the VBWD for Resources Evaluated in the WRAPS Project Relative magnitudes of contributing sources are indicated.

HUC-10 Subwatershed	Stream/Reach (AUID) or Lake (ID)	Pollutant	Pollutant Sources											
			Fertilizer & manure run-off	Livestock in riparian areas	Failing septic systems	Wildlife	Poor riparian vegetation cover	Stream Bank Erosion	Upland Soil Erosion	Stormwater Runoff	Internal Loading (In Lakes)	Loads from Upstream Lakes	Groundwater	Atmospheric Deposition
Lake Saint Croix 0703000512	Kelle's Creek (606)	Bacteria	›	™	~	™				™			~	
	Eagle Point Lake (82-0109)	TP			™					›	~	™		™
	Edith Lake (82-0004)	TP			™					›	~		›	™
	Horseshoe Lake (82-0074)	TP			™					™	™	~		™
	Silver Lake (82-0001)	TP								›	~			™
	Sunfish Lake (82-0107)	TP			™					›	~			›

Key: ~ = High › = Moderate ™ = Low

2.4 TMDL Summary

States are required to set TMDLs for impaired waters in order to define the maximum amount of pollutant water can receive while maintaining water quality standards and to determine the load reductions necessary to achieve water quality standards. A TMDL is divided into a wasteload allocation (WLA) for point sources, a load allocation (LA) for nonpoint sources and natural background, and a margin of safety (MOS).

The final TMDL report includes a TMDL and allocations for excessive nutrient impairment at Sunfish Lake and elevated *E. coli* at Kelle's Creek. The VBWD TMDL Report is available at: https://www.pca.state.mn.us/water/tmdl/valley-branch-watershed-district-watershed-restoration-and-protection-strategy-project.

Kelle's Creek

Kelle's Creek was listed on the MPCA 303(d) Impaired Waters List in 2012 due to high levels of indicator bacteria (*E.coli*). Table 9 summarizes the bacteria budget for the critical conditions for Kelle's Creek, including the WLAs.

Table 9. Kelle's Creek TMDL Summary *(E. coli)*

	Flow Zone				
	Very High	High	Mid	Low	Very Low
	billion organisms per day (b-org/day)				
TOTAL MAXIMUM DAILY LOAD	3.12	1.89	1.29	1.01	0.77
Wasteload Allocation[1]	--	--	--	--	--
Load Allocation	2.81	1.70	1.16	0.91	0.69
Margin of Safety (10%)	0.31	0.19	0.13	0.10	0.08
Estimated Reductions Based on Daily Loadings					
Existing Load	63.08	2.55	2.30	3.65	--
Required Load Reduction	60.27	0.85	1.14	2.74	--
Required Load Reduction (%)	96%	33%	50%	75%	

[1] There are no permitted point discharges from industries, municipalities, waste water treatment plants, or individually permitted sources within the Kelle's Creek watershed.

Sunfish Lake

Sunfish Lake was originally listed on the MPCA 303(d) Impaired Waters List in 2008 due to high levels of nutrients, with the pollutant of concern being identified as phosphorus. Table 10 summarizes the growing season based TMDL for Sunfish Lake, including WLAs and LAs.

Table 10. Phosphorus TMDL Summary for Sunfish Lake

Total Phosphorus Source	Existing Conditions (lbs/GS[4])	Existing Conditions (lbs/day)	TMDL Allocation (lbs/GS[4])	TMDL Allocation (lbs/day)	Required Load Reduction (lbs/GS[4])	Percent Reduction (%)
Wasteload Allocation (Permitted Sources)						
City of Lake Elmo (MS400098)	6.0	0.0489	6.0	0.0489	0.0	0%
Washington County (MS400160)	0.1	0.0008	0.1	0.0008	0.0	0%
NPDES-Permitted Construction and Industrial Stormwater	0.3	0.0025	0.3	0.0025	0.0	0%
Total Wasteload Sources	6.4	0.0522	6.4	0.0522	0.0	0%
Load Allocations (Non-Permitted Sources)						

Total Phosphorus Source	Existing Conditions (lbs/GS[4])	Existing Conditions (lbs/day)	TMDL Allocation (lbs/GS[4])	TMDL Allocation (lbs/day)	Required Load Reduction (lbs/GS[4])	Percent Reduction (%)
SSTS	3.2	0.0266	0.0	0.0000	3.2	100%
Atmospheric Deposition	5.6	0.0461	5.6	0.0461	0.0	0%
Groundwater	0.2	0.0013	0.2	0.0013	0.0	0%
Internal Sources[3]	43.1	0.3533	37.3	0.3058	5.8	13%
Total Load Sources	52.1	0.4273	43.1	0.3532	9.0	17%
Margin of Safety[1]						
	N/A	N/A	5.5	0.0450	N/A	N/A
Overall Source Total	58.5	0.4795	54.9	0.4504	9.0[5]	16%

[1] A 10% explicit Margin of Safety is utilized for the Sunfish Lake TMDL

[2] Based on the 2006 Growing Season (June – September)

[3] Reflects the sum of all internal sources of phosphorus (e.g., curly-leaf pondweed, sediment release)

[4] GS: Growing Season

[5] The overall load reduction is the sum of the individual load reductions; it is also equal to the overall existing load minus the overall TMDL, plus the Margin of Safety.

Lake St. Croix

Lake St. Croix (the lower 25 miles of the St. Croix River) is not located within the VBWD; however, the VBWD discharges to Lake St. Croix. Lake St. Croix is a naturally impounded riverine lake located downstream of Stillwater, Minnesota. Over the years eutrophication has occurred in Lake St. Croix due to increasing amounts of phosphorus entering the system. The lake is currently impaired due to these high levels of phosphorus. A TMDL study and Implementation Plan were completed for Lake St. Croix in 2013 and are available at: https://www.pca.state.mn.us/water/tmdl/lake-st-croix-excess-nutrients-tmdl-project.

2.5 Protection Considerations

In addition to the topics and resource-specific items previously discussed in the preceding sections, the VBWD also considers areas with specific protection considerations such as stormwater management, land use changes, AIS, non-compliant septic systems, the presence of natural communities or rare species, and groundwater sensitivity to pollution.

Land Use Changes and Stormwater Runoff

Land use and land cover play a major role in determining what happens to precipitation in the hydrologic cycle. Vegetation intercepts precipitation, slows its movement, and returns moisture to the atmosphere via transpiration. Trees and native grasses, with their extensive root systems, encourage far more water to soak into the soil than pastures or lawns, which have very shallow roots and are more likely to allow water to run off quickly if the soil is compacted or saturated. Therefore, areas in the watershed that are forested or contain native grasses will have a greater capacity to infiltrate water than those areas that are cultivated or covered by lawns.

Within many areas of the watershed there are proposed developments, which will cause significant land use changes. Land development dramatically changes how stormwater runoff moves in the local watershed. The changes begin during construction, when clearing and grading of the site results in less infiltration, higher rates and volumes of stormwater runoff, and increased erosion. As construction continues, natural surfaces become covered with asphalt, concrete, and other materials that are impervious and prevent infiltration of water into the soil. Impervious surfaces greatly increase the rate at which water runs off the landscape and enters waterbodies, and can alter the hydrologic cycle. An increase in surface runoff to streams can result in bank erosion, increased pollutant loads, and increased temperatures.

As such, the quality and quantity of surface water is greatly influenced by stormwater runoff. As urbanization continues in the VBWD, nutrient and sediment inputs (i.e., loadings) from stormwater runoff can far exceed the natural inputs to a lake, pond, or stream. To accomplish the VBWD goals for maintaining and improving water quality and managing water quantity, stormwater runoff must be carefully and closely managed.

The VBWD manages stormwater runoff by carrying out its permit program, which includes preventive measures so that negative effects of stormwater runoff are addressed (and prevented) at the time of development or redevelopment, and not after problems develop. The VBWD also actively encourages developers to use new, innovative stormwater management technologies.

The VBWD also carries out an extensive monitoring program for its lakes and streams in order to assess their water quality and determine what protection measures need to be used to improve or maintain water quality.

Aquatic Invasive Species

Watershed management has historically focused on water quality as a function of land use activities and the resulting increase in loading of nutrients, sediment, and other chemicals. Changes in the ecology of aquatic plants, animals, and microorganisms may also result in the degradation of aquatic environments and negatively impact aesthetics, recreation, and environmental quality. Therefore, the VBWD conducts aquatic plant surveys to assess and prioritize the waterbodies within the watershed.

The term “invasive species” describes plants, animals, or microorganisms within lakes and streams that are non-native and that 1) cause or may cause economic or environmental harm or harm to human health, or 2) threaten or may threaten natural resources or the use of natural resources in the state

(Minn. Stat. § 84D.01). Aquatic invasive species (AIS) is a term given to invasive species that inhabit lakes, wetlands, rivers, or streams and overrun or inhibit the growth of native species. The AIS pose a threat to natural resources and local economies that depend on them.

Under direction from the Minnesota Legislature, the DNR established the Invasive Species Program in 1991. The program is designed to implement actions to prevent the spread of invasive species and manage invasive aquatic plants and wild animals (Minn. Stat. ch. 84D).

As part of its Invasive Species Program, the DNR maintains a list of waters infested with specific AIS (DNR Designation of Infested Waters 2013 as amended). The DNR list includes several VBWD waterbodies as infested with Eurasian watermilfoil, including:

- Lake DeMontreville
- Lake Elmo
- Lake Jane
- Horseshoe Lake
- Long Lake
- Lake Olson (not officially listed by the DNR, but Eurasian watermilfoil has been observed during lake monitoring efforts)

The DNR's list of AIS infested waterbodies does not include all known AIS occurrences within the VBWD. In addition, the VBWD has identified the presence of the following AIS in or in the riparian areas of the VBWD waterbodies:

- Eurasian watermilfoil (*Myriophyllum spicatum*)
- Purple loosestrife (*Lythrum salicaria*)
- Curlyleaf pondweed (*Potamogeton crispus*)
- Yellow iris(*Iris pseudacorus*)
- Narrowleaf cattail (*Typha angustifolia*)
- Hybrid cattail (*Typha glauca*)
- Reed canary grass (*Phalaris arundinacea*)
- Common carp (*Cyprinus carpio*)

Of these species, curlyleaf pondweed (CLP) is of special concern due to its shifted life cycle, ability to displace native vegetation and having the potential as a source of internal phosphorus loading during the growing season.

Zebra mussels have been identified in the St. Croix River downstream of the Boomsite Recreational Area at river mile 25.4 (just north of Stillwater). Zebra mussels can cause problems for lakeshore residents and recreationists by clogging water intakes and attaching to motors and possibly clogging cooling water areas. Zebra mussels can also attach to native mussels, killing them.

Common carp are also present in the St. Croix River. Common carp are typically spread between lakes by the accidental inclusion and later release of live bait, but can also migrate through natural or built channels as adults. Carp feeding techniques disrupt shallow-rooted plants, which can reduce water clarity and stir up the bottom sediments, which can potentially release phosphorus bound in sediments, leading to increased algal blooms and decline in native aquatic plants.

The VBWD limits its management of the AIS to instances where the AIS have a demonstrated negative effect on water quality. Planned AIS management actions for the major VBWD waterbodies are described in the VBWD's Watershed Management Plan (Barr Engineering Co. 2015): http://www.vbwd.org/WMP/Index.html.

Non-Compliant Septic Systems

Many residential sites within the VBWD are served by septic systems. Septic systems (SSTSs) that are not properly designed or maintained can allow untreated or partially treated sewage to flow into surface waters. Human waste can be a source of bacteria loading and nutrients to surface waters, especially during dry and low flow periods. Non-compliant SSTS are especially critical in areas with high groundwater levels or areas with karst topography. Karst features are formed from the dissolution of soluble rocks including limestone, dolomite, and gypsum. Rainwater and pollutants can easily flow through these networks and continue to erode and enlarge the passages. In areas with septic systems and karst topography, this can be a significant problem in relation to water quality. The presence of karst features suggests an area that is highly susceptible to groundwater pollution.

The Washington County Department of Public Health and Environment is the primary regulatory authority for all the SSTS in the VBWD. In addition to permitting and inspecting the installation of SSTS, the department also conducts soil reviews prior to issuing an installation permit. The current Washington County Groundwater Plan has identified SSTS financial assistance as a priority, and the County has several opportunities for financial assistance to upgrade or fix noncompliant SSTS (Barr Engineering Co. 2015). Washington County has State of Minnesota Clean Water Fund (CWF) funds available for SSTS Fix-Up Grants, available for low income residents only. These funds can only be used for SSTS that are determined to be non-compliant or pose an imminent threat to public health. Additionally, Washington County has established a low interest loan program for SSTS upgrades for home owners and rural business owners, regardless of income, whose systems have been identified as non-compliant. This program is administered through Washington County utilizing funds from the Minnesota Department of Agriculture AgBMP program. There is an opportunity to educate homeowners about the maintenance of SSTS and to target the Washington County financial assistance programs.

The VBWD is also interested in protecting groundwater quality, which includes areas with non-compliant SSTS. The VBWD has is working in cooperation with Washington County to address water quality issues stemming from non-compliant SSTS.

Natural Communities and Rare Species

Through its Natural Heritage and Nongame Research Program (NHNRP), the DNR collects, manages, and interprets information about rare natural features, native plants and plant communities, and nongame animals, including endangered, threatened, and special concern species. As part of the NHNRP, the DNR maintains the Natural Heritage Information System (NHIS) as a statewide database of these resources. The DNR limits publication of spatial attributes and locations of these items to protect rare features or species from damage or collection.

The VBWD contains 86 occurrences of 48 distinct types of natural communities noted in the NHIS database. Many of these communities are associated with protected natural areas such as Lake Elmo Regional Park or Afton State Park.

The Minnesota Biological Survey (MBS) studies natural resources throughout the state and contributes many findings to the NHIS database. As part of an MBS study, DNR staff assesses the quality and condition of native habitats at designated survey sites. At the end of the survey each site is assigned a biodiversity significance rank: Outstanding, High, Moderate, or Below. The MBS studied 2,164 acres of land within the VBWD, of which 14% is classified as "High" biodiversity significance and 46% as "Moderate" biodiversity significance (Barr Engineering Co. 2015).

Groundwater Sensitivity to Pollution

Information in relation to groundwater sensitivity to pollution from the DNR Geologic Survey for Washington County was utilized during the development of the TMDLs for the VBWD. The groundwater sensitivity to pollution assessments are based on geologic and hydrogeological factors that affect the ability of geologic materials to restrict the downward migration of contaminants to the groundwater of interest. Based on the estimated travel time, the sensitivity to pollution for various area, ranging from Very Low to Very High, were considered.

3. Prioritizing and Implementing Restoration and Protection

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

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

There are issues that are not addressed in the strategies tables, like limited local capacity and funding that can greatly affect the outcomes of this report. If resources like staff or funding are limited, or nonexistent, in the project area it is likely that the strategies and goals laid out in this report will take longer to achieve, if at all. Much of this work relies on reductions from non-regulated actions in the watershed, and in order to achieve those goals local relationships and trust need to be built where they may not currently exist. Therefore, it is important that as these actions are undertaken that all levels (federal government, state government, local government, non-profits, and landowners) continue to find ways to support local entities and individuals to ensure the waterbodies in the Valley Branch Watershed are restored and protected. If this support does not happen, achieving the TMDL reductions and strategies in this report are unlikely.

3.1 Targeting of Geographic Areas

To improve and/or maintain water quality in the VBWD, it is important to identify nonpoint sources of pollution and prioritize and geographically locate restoration and protection areas within the VBWD. This section describes the strategies and tools the VBWD uses to prioritize waterbodies and target geographic areas for water quality improvement.

Regional and Statewide Nutrient Concerns

The Minnesota Nutrient Reduction Strategy was developed in response to concern about excessive nutrient levels that pose a substantial threat to Minnesota's lakes and rivers, as well as downstream waters including the Great Lakes, Lake Winnipeg, the Mississippi River, and the Gulf of Mexico. In recent decades, nutrient issues downstream of Minnesota have reached critical levels, including the effect of nutrients in the Gulf of Mexico which resulted in a dead zone, eutrophication issues in Lake Winnipeg, and algal blooms in the Great Lakes. Several state-level initiatives and actions highlighted the need for a statewide strategy that ties separate but related activities together to further progress in making nutrient reductions. Minnesota conducted both nitrogen and phosphorus assessments to identify nutrient source contributions. The main nutrient sources to the Mississippi River are phosphorus from agricultural cropland runoff, wastewater, and streambank erosion, and nitrogen from agricultural tile drainage and water leaving cropland via groundwater. The national goals for phosphorus and nitrogen loading to the Gulf of Mexico is a 45% reduction respectively relative to baseline average conditions from 1980-1996. Minnesota's goal for nitrogen reduction in the Mississippi, using the national baseline is 45% by 2040 and a milestone target of 20% reduction of nitrogen by 2025. It is important to note that there has been little progress toward nitrogen reduction in the Mississippi Basin since the national baseline period. The Minnesota goal for phosphorus reduction is 45% by 2025. Unlike the lack of a positive trend in nitrogen loading there has been a substantial loading reduction of phosphorus in the Mississippi since the turn of the century due to reductions in agriculture and even greater reductions in point source phosphorus. The Minnesota Nutrient Reduction Strategy notes that a 33% reduction in phosphorus loading to the Mississippi River Basin has been credited so that overall the remaining reduction needed to reach the Minnesota reduction goal for loading to the Mississippi leaving Minnesota is 12% which may be less than the reduction needed for local lakes and streams.

The Nitrogen in Minnesota Surface Waters Strategy was developed in response to a concern of the toxic effects on nitrate on aquatic life, the increasing nitrogen loads in the Mississippi River and nitrogen's role in causing a large oxygen-depleted (hypoxic) zone in the Gulf of Mexico, and for human health concerns related to elevated nitrogen levels in drinking water supplies,. The 10 mg/l nitrate-N drinking water standard established for surface and groundwater drinking water sources is exceeded in numerous wells and streams. The purpose of this study was to characterize nitrogen loading to Minnesota's surface waters, and assess conditions, trends, sources, pathways, and potential BMP to achieve nitrogen reductions in our waters. The Nitrogen study contains a spreadsheet tool called the NBMP tool (NBMP is described in more detail in the Nitrogen Study Report).

Water Quality Diagnostic Studies

The VBWD has performed water quality diagnostic studies of several water bodies, including a 2007 water quality assessment study for Acorn Lake, Long Lake, and Sunfish Lake. In 2009, the VBWD also completed water quality assessments of Eagle Point Lake, Horseshoe Lake, and Lake DeMontreville. These efforts have informed projects that have been incorporated into the Implementation Plan in the VBWD Watershed Management Plan.

As part of this WRAPS study, the VBWD performed water quality studies and analyses of several lakes within the district along with Kelle's Creek, including development of the TMDLs for Sunfish Lake and Kelle's Creek. Lakes that have shown declining water quality in recent years or have the potential to be listed on the impaired waters list were targeted during the WRAPS project.

The goal of these water quality studies was to understand the impact of both point and non-point sources of pollution on the water quality in the resources in the VBWD and identify restoration and protection strategies. Watershed and in-lake water quality modeling for the lakes was used to identify and quantify pollutant sources and to identify, target, and prioritize water quality improvement actions.

As part of the VBWD WRAPS, water quality modeling was performed on several lakes to evaluate nutrient loading including:

- Sunfish Lake (impaired)
- Eagle Point Lake
- Edith Lake
- Silver Lake
- Horseshoe Lake

The water quality analyses for the lakes included compilation of all historic water quality and lake level data, bathymetric and outlet rating curves, updates to existing and/or development of new watershed pollutant loading models, and development of in-lake water quality mass balance models for each lake to identify and quantify the contributing sources of nutrients (phosphorus) to the water body. For the protection resources (non-TMDL), the water quality models were developed for the critical water quality conditions (or the worst observed water quality conditions in the past 10-years). For the TMDLs, the water quality modeling was performed for several climatic and water quality conditions, with the TMDL being established for the critical water quality condition.

The P8 (Program for Predicting Polluting Particle Passage through Pits, Puddles and Ponds) Urban Catchment Model was used to estimate watershed runoff and TP loads from each lake's tributary watershed. The P8 is a useful diagnostic tool for evaluating and designing watershed improvements and the BMPs because it can estimate the treatment effect of several different kinds of the potential BMPs. The P8 tracks stormwater runoff as it carries phosphorus across watersheds and incorporates the treatment effect of detention ponds, infiltration basins, etc. on the phosphorus and sediment loads that ultimately reach downstream water bodies. The P8 accounts for phosphorus attached to a range of particulate sizes, each with their own settling velocity, tracking their removal by treatment features accordingly.

Figures 6 through 10 display the watershed pollutant loading results for the water bodies analyzed in the P8 through the WRAPS process, showing the estimated contributions of the phosphorus load from different portions of the watershed.

During the WRAPS process the VBWD and the MPCA worked to determine the classification of several waterbodies as either shallow lakes or wetlands. Bay Lake, Kramer Lake, and Eagle Point Lake were reclassified as wetlands due to their shallow depths and considerable aquatic vegetation and were removed from the MPCA 303(d) list of impaired waters. Downs Lake, Echo Lake, and Goose Lake (South) were confirmed to be shallow lakes and remain on the impaired waters list. These lakes will have TMDLs completed when the watershed is assessed in 2019, if water quality does not improve.

Barr Footer: ArcGIS 10.3, 2015-05-21 09:57 File: I:\Client\WBWD\District\Work_Orders\2015_WRPP\Maps\Reports\WRAPS Report\Fig5 Sunfish Lake\WatershedContributions.mxd User: Kin2

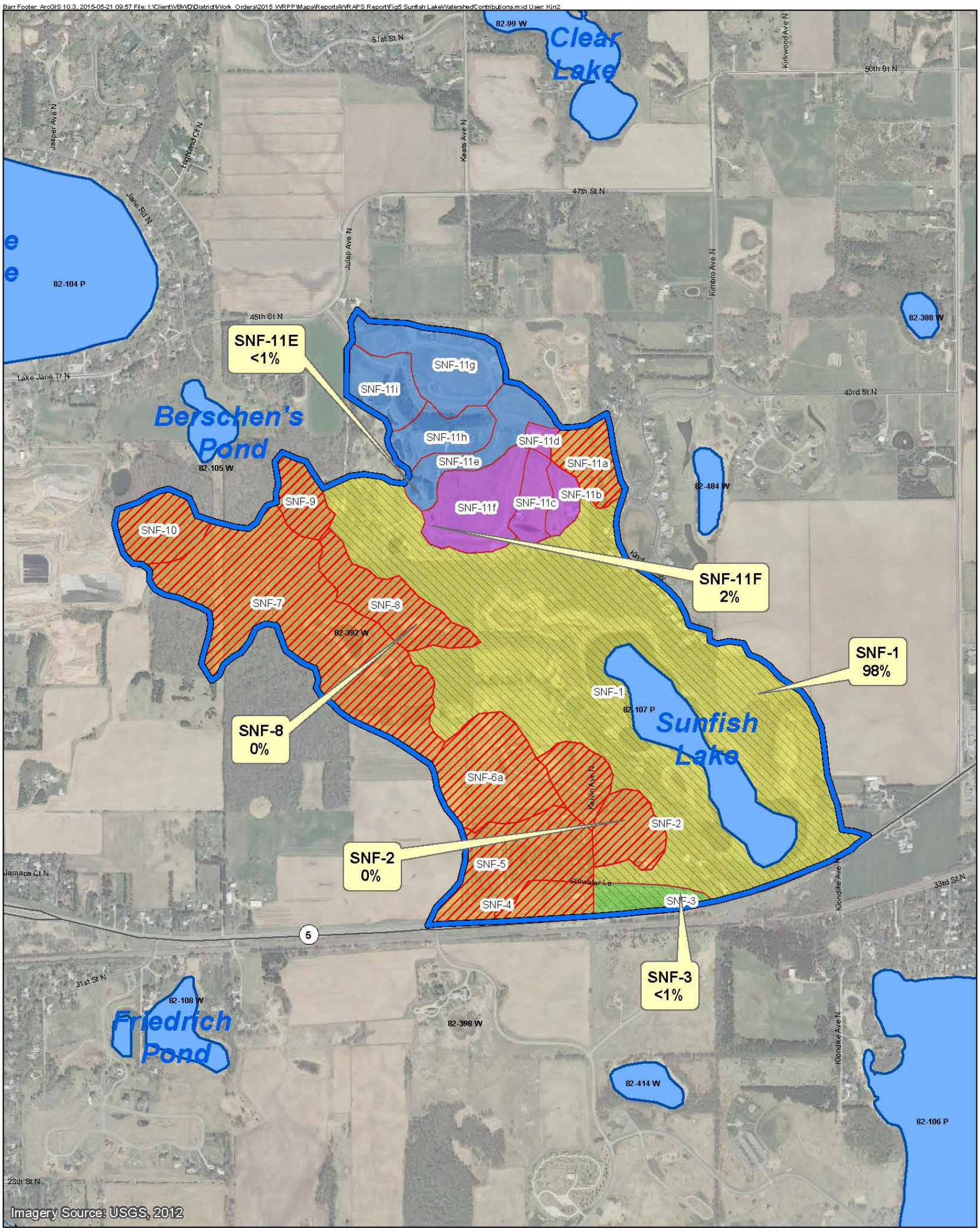


Figure 6

Sunfish Lake Watershed
Subwatershed Divide
Landlocked Subwatershed
Untreated Subwatershed
SNF-1 Subwatershed Designation
62-1P DNR Protected Waters Designation
Lakes, Ponds, Wetlands
SNF-3 4% Percentage of Total GS Subwatershed Load

Project 1007 (Flood Protection System)
Catch Basin
Manhole Cover
Open Channel
MN-DOT Pipe
Pipe
VBWD Legal Boundary
Municipal Boundary
County Boundary

SUNFISH LAKE ESTIMATED GROWING SEASON WATERSHED PHOSPHORUS CONTRIBUTIONS
VBWD WRAPS

N

Feet
1,000 500 0 1,000

Landlocked: Basin does not overflow using VBWD simplified method for calculating its 100-year flood level or using a more detailed analysis, such as the 1% probability flood level.

Semi-Landlocked: Basin does not overflow in the 100-year 24-hour rainfall total or the 100-year 10-day snowmelt event, but does overflow when calulating its 100-year flood level based on the VBWD simplified method or the 1% probablility flood level.

Figure 6. Sunfish Lake Estimated Growing Season Watershed Phosphorus Contributions

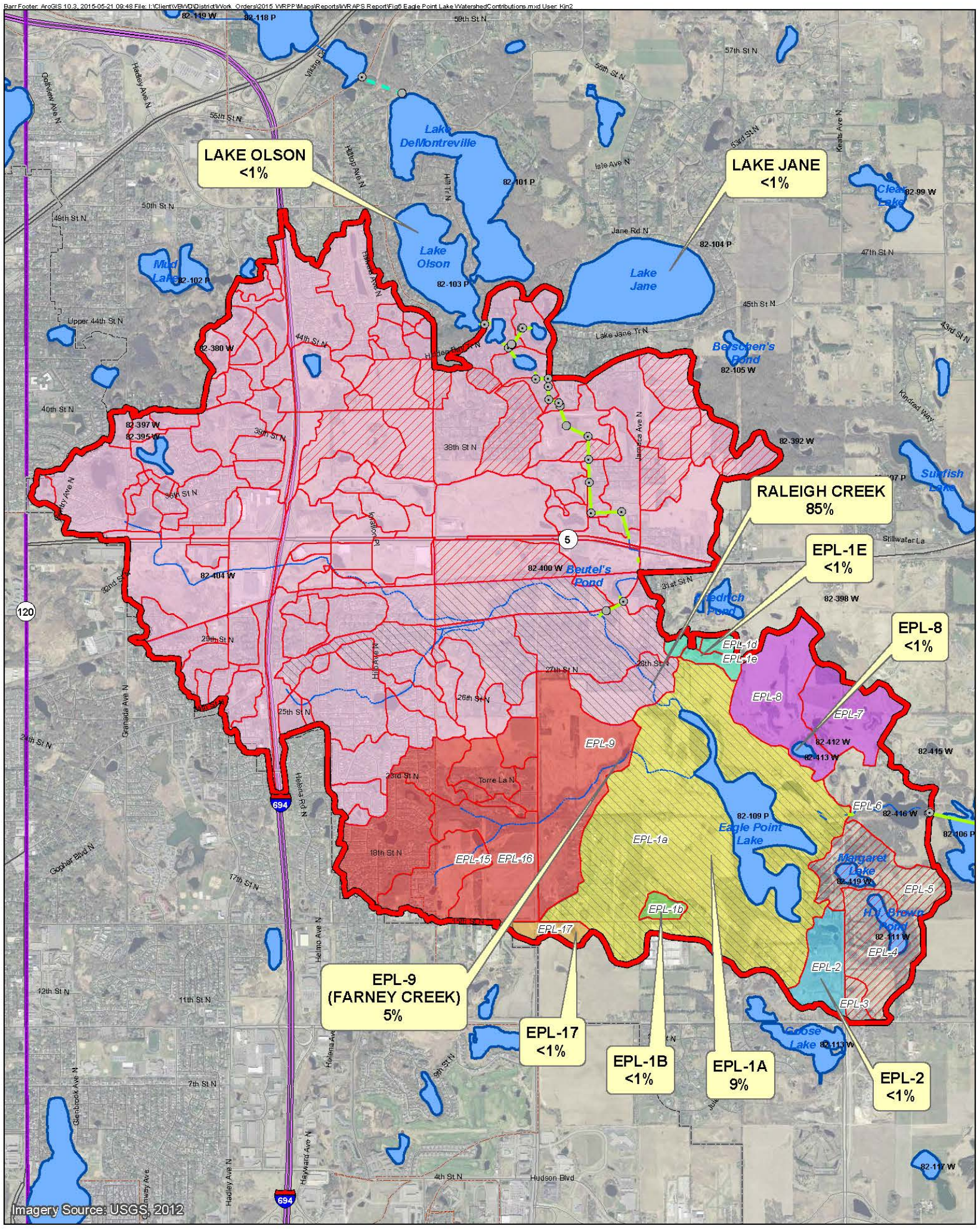


Figure 7

EAGLE POINT LAKE ESTIMATED GROWING SEASON WATERSHED PHOSPHORUS CONTRIBUTIONS
VBWD WRAPS

- Eagle Point Lake Watershed
- Subwatershed Divide
- Landlocked Subwatershed
- Untreated Subwatershed
- EPL-1 Subwatershed Designation
- 62-1P DNR Protected Waters Designation
- Lakes, Ponds, Wetlands
- EPL-9 6% Percentage of Total GS Subwatershed Load

Project 1007 (Flood Protection System)

- Catch Basin
- Manhole Cover
- Open Channel
- MN-DOT Pipe
- Pipe
- VBWD Legal Boundary
- Municipal Boundary
- County Boundary

Feet
2,400 0 2,400

Landlocked: Basin does not overflow using VBWD simplified method for calculating its 100-year flood level or using a more detailed analysis, such as the 1% probability flood level.

Semi-Landlocked: Basin does not overflow in the 100-year 24-hour rainfall total or the 100-year 10-day snowmelt event, but does overflow when calulating its 100-year flood level based on the VBWD simplified method or the 1% probablility flood level.

Figure 7. Eagle Point Lake Estimated Growing Season Watershed Phosphorus Contributions

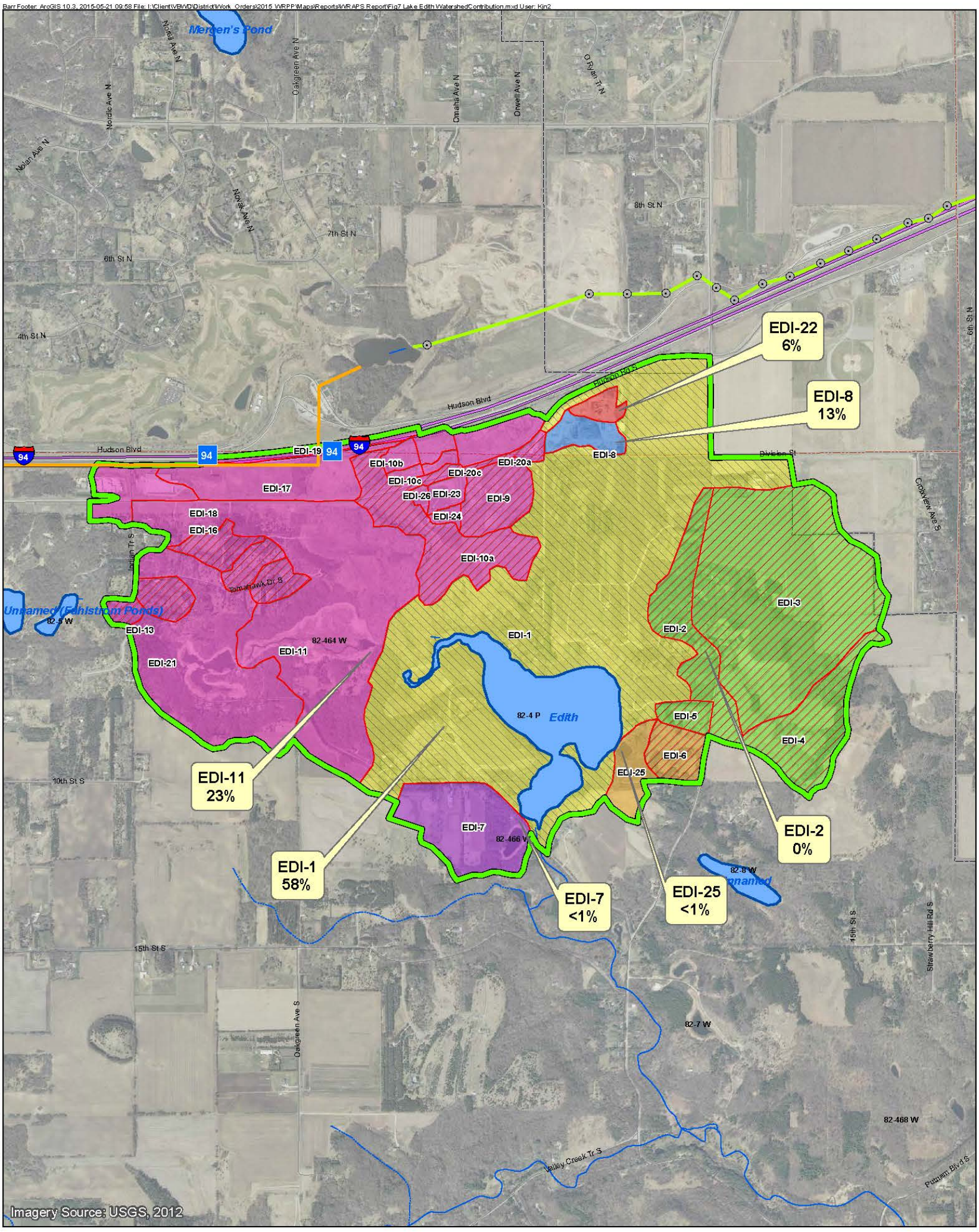


Figure 8. Lake Edith Estimated Growing Season Watershed Phosphorus Contributions

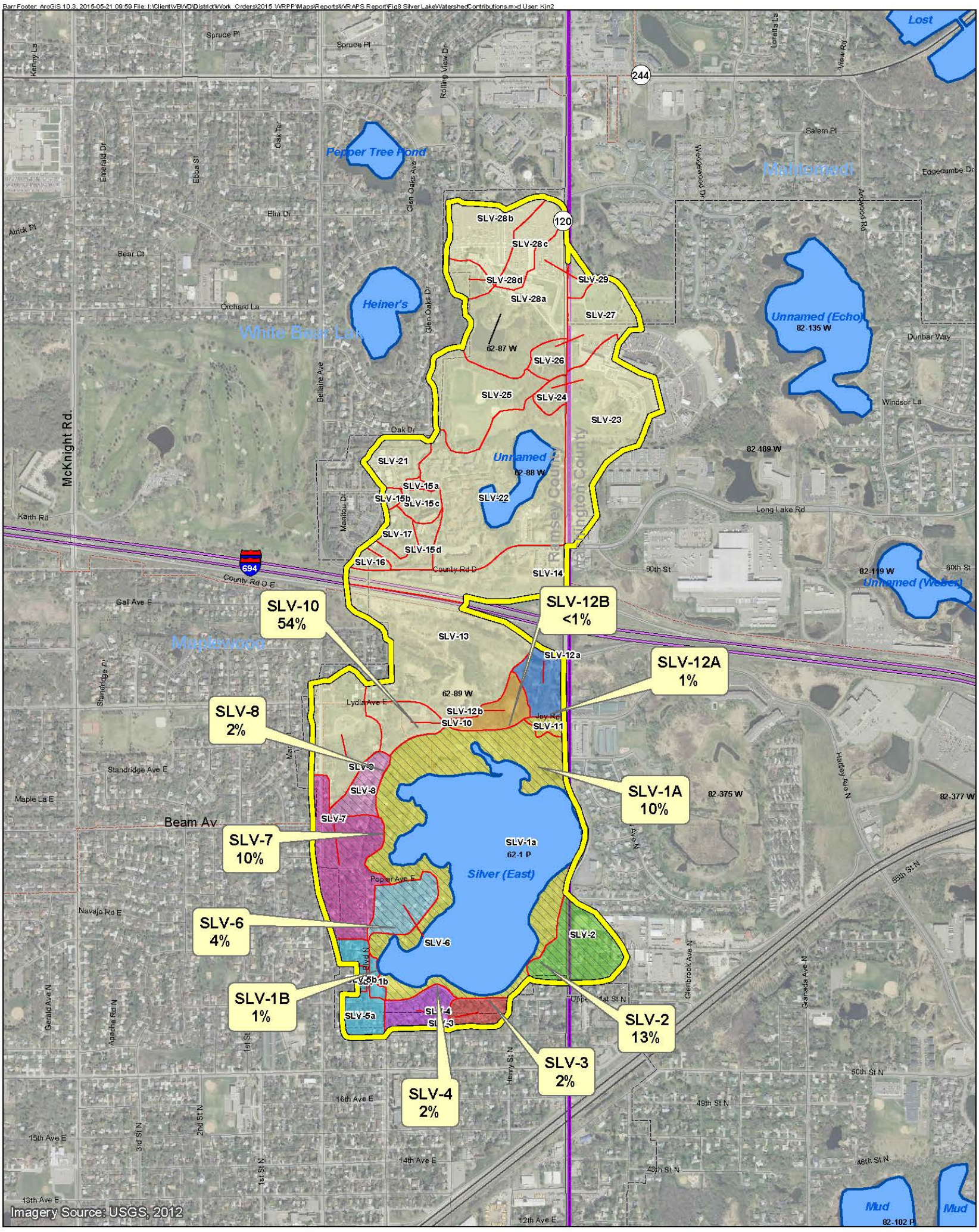


Figure 9. Silver Lake Estimated Growing Season Watershed Phosphorus Contributions

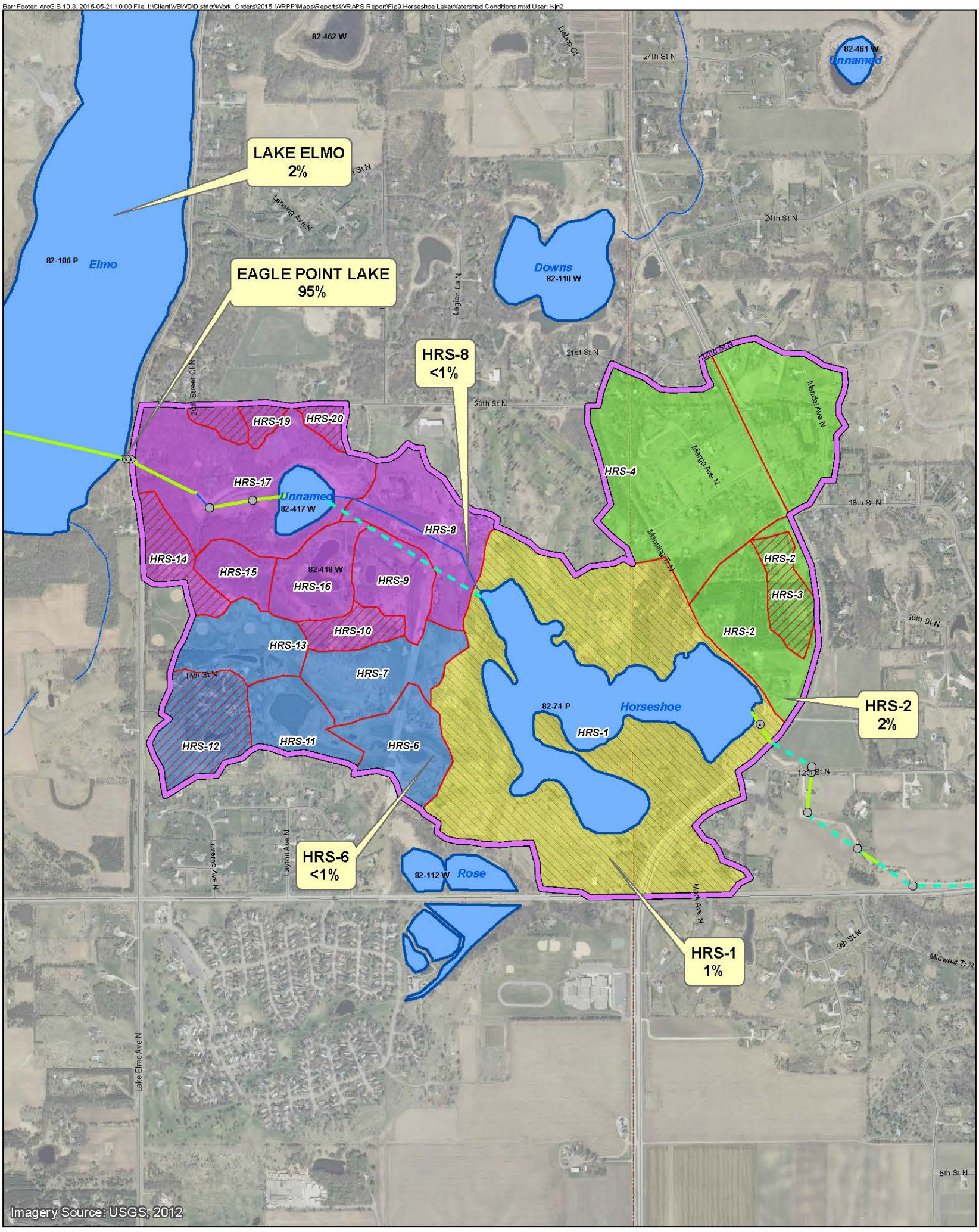


Figure 10

Figure 10. Horseshoe Lake Estimated Growing Season Watershed Phosphorus Contributions

In-lake water quality modeling for the VBWD lakes was accomplished through the creation of a mass balance models that track both the flow of water and phosphorus through the lakes during the growing season (as defined by the MPCA). The in-lake mass balance models included both a water balance as well as a phosphorus balance.

The in-lake model results summarizing the growing season (June-September) internal and external sources of phosphorus are summarized in Figures 11 through 15.

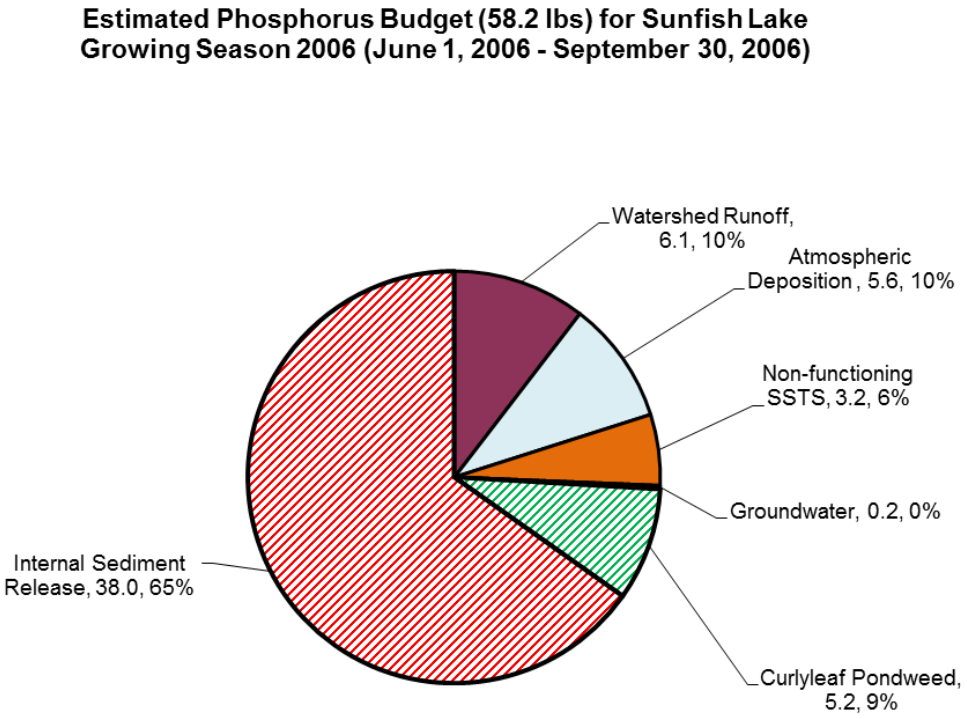


Figure 11. Sunfish Lake Estimated Phosphorus Growing Season Budget

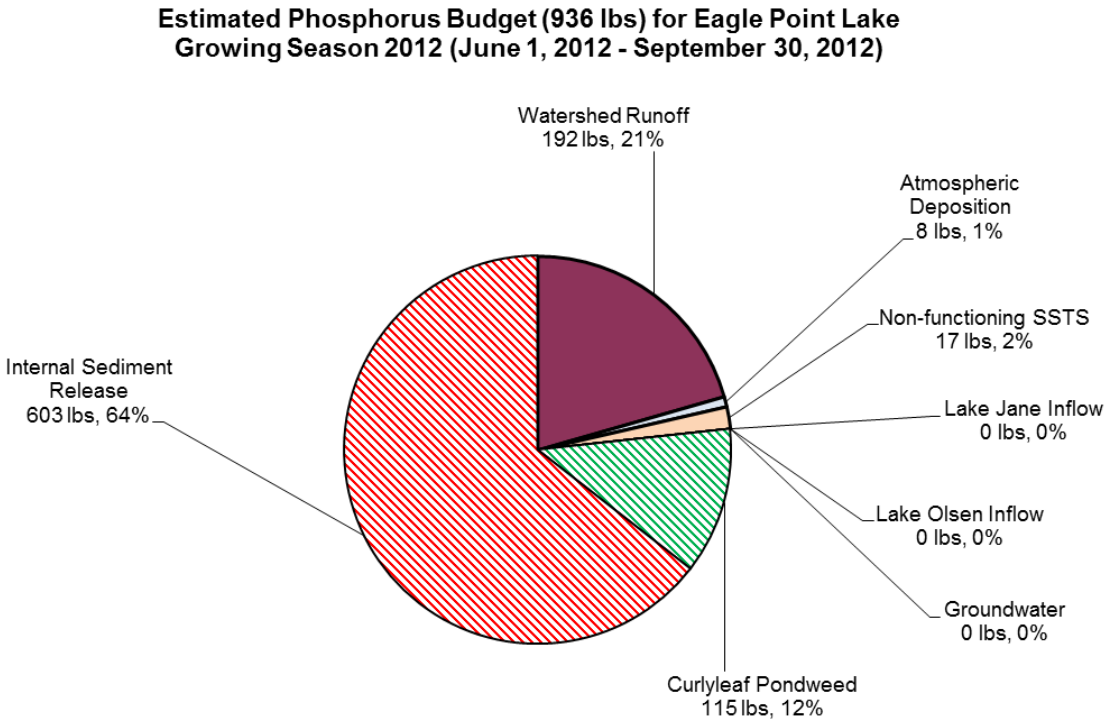


Figure 12. Eagle Point Lake Estimated Phosphorus Growing Season Budget

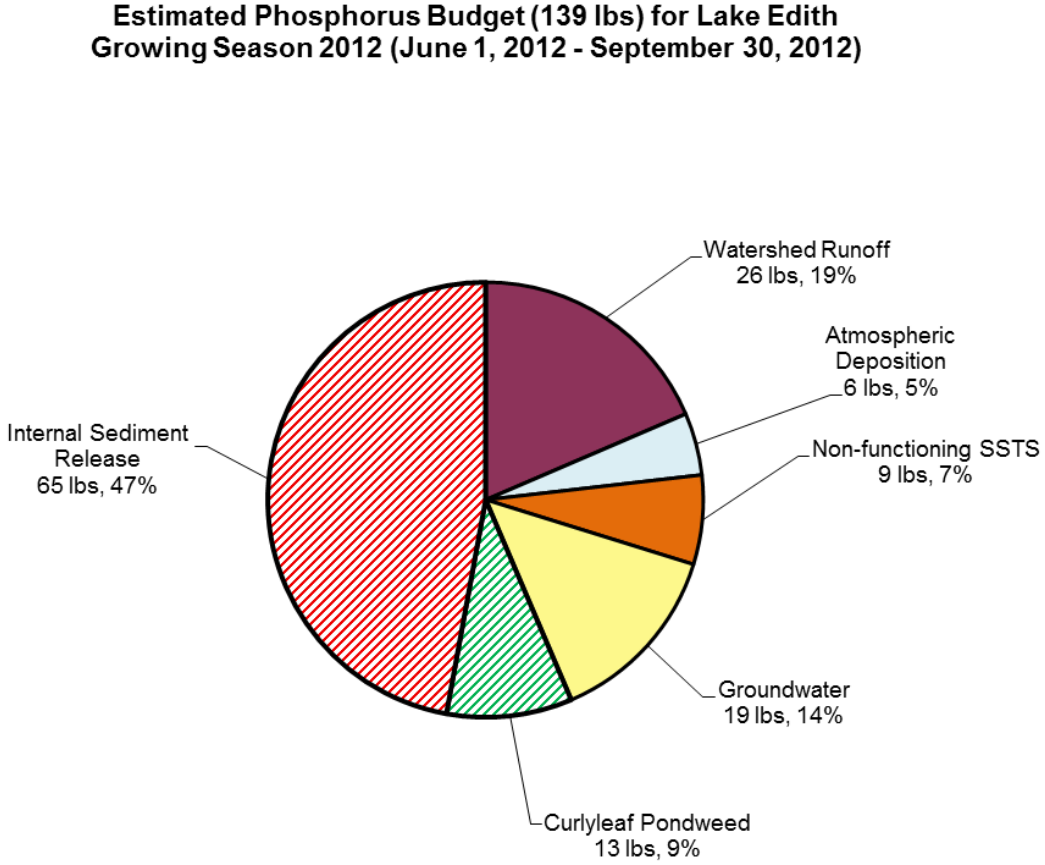


Figure 13. Lake Edith Estimated Phosphorus Growing Season Budget

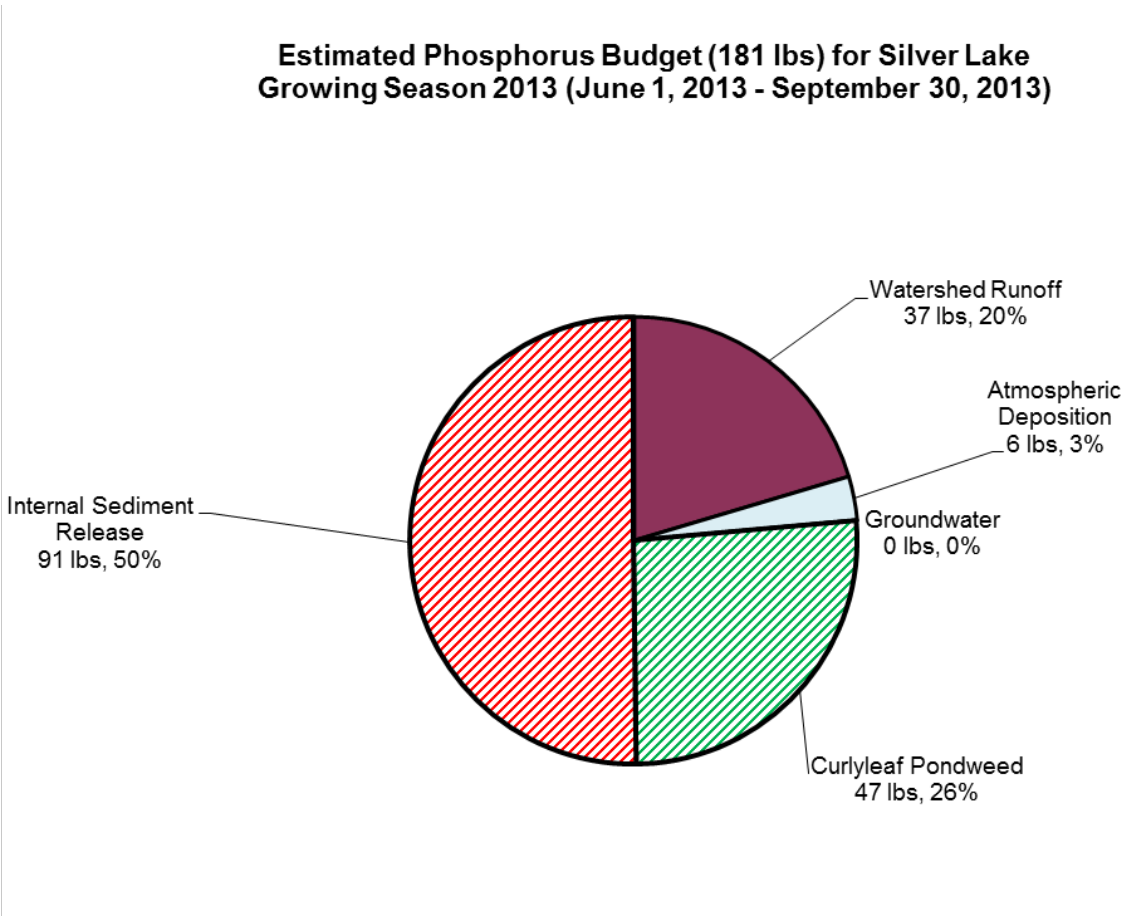


Figure 14. Silver Lake Estimated Phosphorus Growing Season Budget

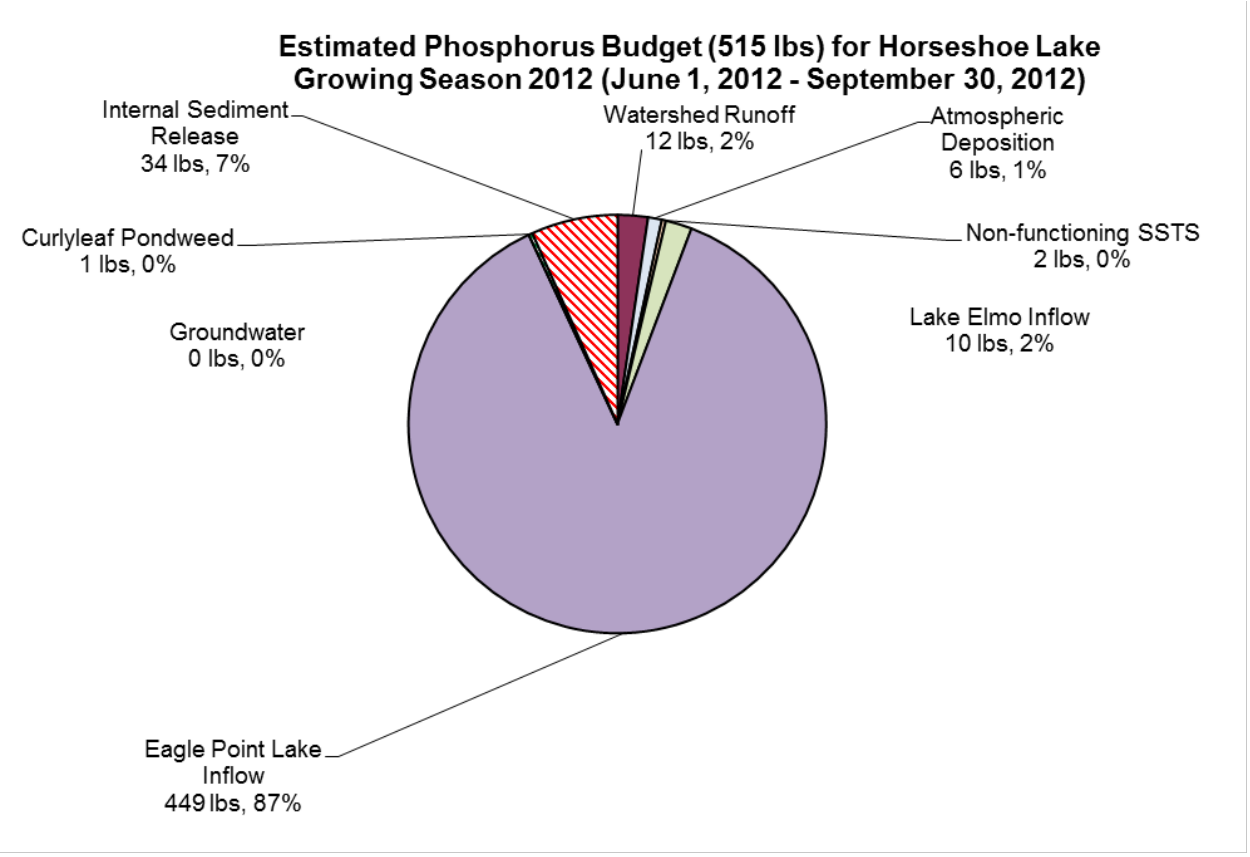


Figure 15. Horseshoe Lake Estimated Phosphorus Growing Season Budget

Additionally, a bacteria source assessment and load duration analyses were performed for Kelle's Creek as part of the TMDL development to help identify bacteria sources to the creek and identify and prioritize water quality improvement strategies. Data analysis indicated that bacteria levels were elevated under both high and low flow conditions. Also, monitoring completed during the WRAPS study indicated that elevated levels of bacteria were observed along the length of Kelle's Creek. These results along with the Kelle's Creek source assessment concluded that the primary source of bacteria to the creek is from inadequately treated human wastewater (non-compliant SSTS) throughout the watershed. Figures 16 and 17 show additional sources of bacteria to the creek.

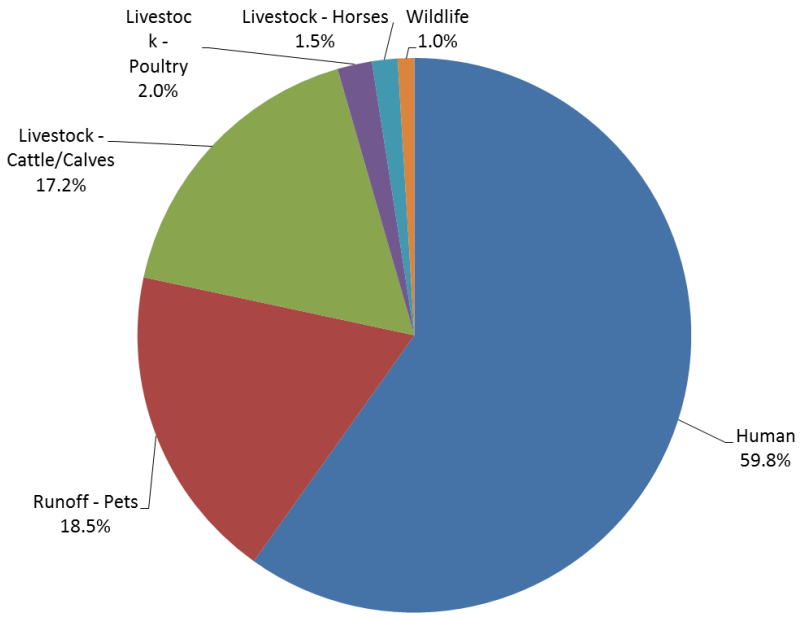


Figure 16. Estimated Bacteria Loading to Kelle's Creek by Source for Wet Weather Conditions

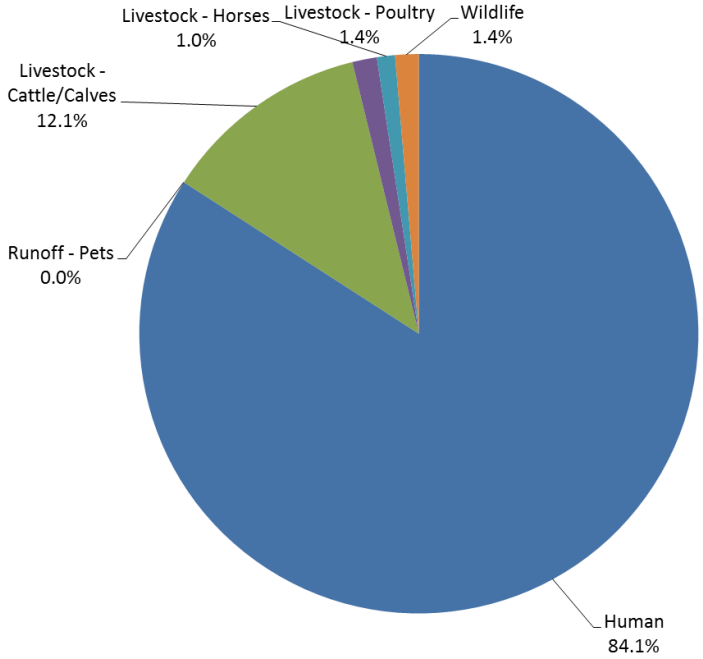


Figure 17. Estimated Bacteria Loading to Kelle's Creek by Source for Dry Weather Conditions

Pollutant source assessments were not conducted for other streams in the VBWD as they are currently not listed as impaired.

These efforts allow the VBWD to target the BMPs in various geographic areas around the district and prioritize their implementation based on pollutant loadings/sources and existing treatments.

Washington County Land and Legacy Program

Washington County, through its Land and Water Legacy Program (LWLP), works with landowners and organizations to purchase land or interests in land to keep them in their natural condition. Washington County prepared the LWLP Conservation Priorities Plan (Washington County, 2010) to guide the implementation of the program. The goal of the plan is to help the county to be more strategic in its project selection and to direct the program's efforts to land protection that is most critical and that maximizes the ecological benefits of the program expenditures.

In 2012, Washington County adopted the LWLP Conservation Priorities Top 10 Conservation Priorities (Washington County 2012). Several resources in the VBWD were identified in this plan including:

- Valley Creek Corridor
- Sunfish Woods
- Metcalf Marsh
- Kelle's Coulee (Kelle's Creek)

St. Croix Basin Subwatershed Prioritization Map

The DNR developed a St. Croix Basin Subwatershed Prioritization Map using system-based models and value-based models. The goal of the modeling was to optimize environmental benefits while minimizing work in areas that were not likely to contribute to surface water quality problems. Through their work they were able to identify candidate areas for targeting protection and restoration implementation within the St. Croix Basin subwatershed. There exist four key areas in the priority map in which local implementers may wish to focus conservation efforts:

- Catchments from the city of Hastings to the city of Marine
- Riparian areas of the St. Croix, Snake, and Kettle Rivers
- The Rush Creek catchment at Rush City
- South Fork of the Groundhouse River, east of the city of Milaca

Outside of these four key areas, there are areas within the VBWD that were deemed as Medium – High priority areas on the Prioritization Map indicating that restoration projects in these areas would also have environmental benefits. To see the Prioritization Map and read additional information on the modeling methods and results, refer to the *Description of Prioritization Approach and Methods use for the Saint Croix Basin Conservation Planning and Protection LCCMR Project* Report (Radomski & Carlson 2013).

Board of Water and Soil Resources (BWSR) Environmental Benefits Index (EBI)

The Environmental Benefits Index (EBI) dataset was developed by the BWSR and the University of Minnesota. This dataset was developed through the use of raster based spatial data to identify lands that have high potential for precipitation runoff and soil erosion impacts to surface waters, due to relatively large catchment areas, steep slopes, highly erodible soils, and close proximity to surface waters. The high biological habitat scores for these lands also suggest that they are, in some cases, high value areas for conservation, and in other cases, areas with good recovery potential and thus strong candidates for restoration projects.

Figure 18 shows the top 5% of the priority sites within the VBWD based on the EBI data.

Additional Tools

The following is a summary of additional tools and strategies used by the VBWD to prioritize geographic areas for restoration:

- Characterization of opportunity areas (i.e., public land, known and/or proposed redevelopment areas, etc.)
- Past studies on select water bodies and physical inventories to identify areas of concern (e.g., erosion inventories of Valley Creek and Kelle's Creek Watersheds)
- Development plans of the VBWD
- Potential partnership opportunities for water quality implementation projects
- Solicitation input from technical stakeholders

Additional tools for prioritization and targeting are in Table 11.

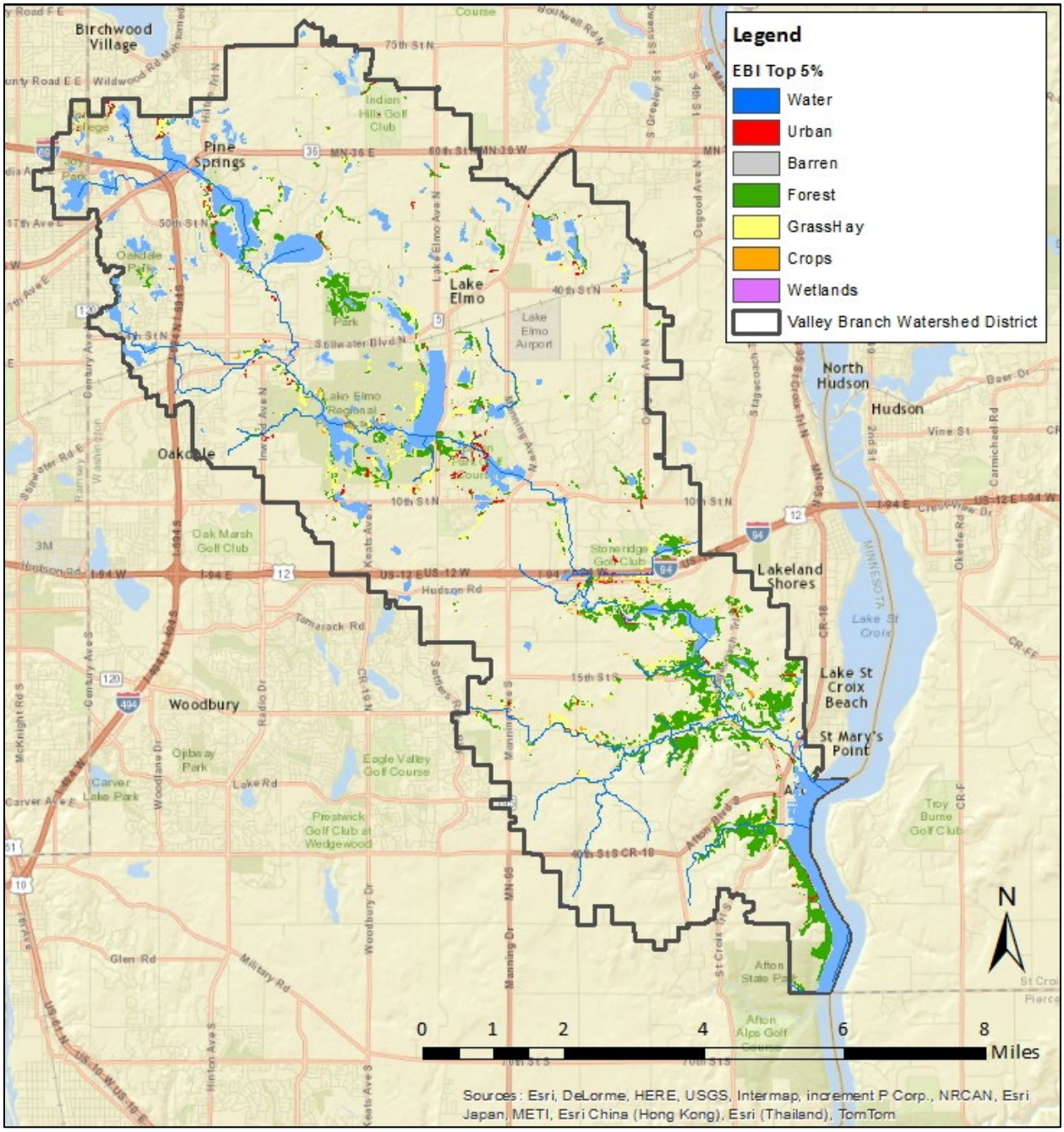


Figure 18. BWSR's EBI Tool Top 5% Priority Areas based on Soil Erosion, Water Quality Risk, and Wildlife Habitat Quality

Table 11. **Prioritization and Targeting Tools available in the VBWD**

Tool	Description	How can the tool be used?	Notes	Link to Information and data
P8 and/or other urban watershed models	The P8 is a model for predicting the generation and transport of stormwater runoff pollutants in urban watersheds. Continuous water-balance and mass-balance calculations are performed on a user-defined system, and routes flow, TSS, and TP through networks of wet detention ponds.	The P8 models have been developed for several of the subwatersheds in the VBWD. These models, or other urban watershed models such as Pondnet or WinSLAMM, could be used to determine high potential TSS and TP loading areas in the urban portions of the watershed for BMP planning.	The P8 models have not been developed for all of the subwatersheds in the VBWD.	PONDNET P8 WinSLAMM
BWSR Septic System Improvement Estimator	The Septic System Improvement Estimator (SSIE) is a spreadsheet-based model that calculates annual pollutant loads from problematic septic systems and accounts for the benefits of a range of septic system improvements, educational efforts and programs to identify the problematic systems.	The SSIE can provide a standardized approach for estimating the potential impacts of upgrading or replacing noncompliant septic systems by quantifying pollutant load removals.	This tool was used to determine the availability of bacteria to Kelle's Creek and was used to develop grant applications for funding to help replace non-compliant systems.	BWSR
Revised Universal Soil Loss Equation (RUSLE) and Soil Erosion Risk Tool	The RUSLE predicts the long term average annual rate of erosion on a field slope based on rainfall pattern, soil type, topography, land use and management practices. A soil erosion risk (similar to RUSLE) tool is available through the Ecological Ranking Tool (EBI) website and uses a subset of RUSLE to determine relative soil erosion risk values on a 0-100 point scale.	The RUSLE model provides an assessment of existing soil loss from upland sources and the potential to assess sediment loading through the application of BMPs. The Soil Erosion Risk Tool provides users with a general sense of the highest potential areas of soil loss in a given watershed/subwatershed.	The RUSLE results present maximum amount of soil loss that could be expected under existing conditions and do not represent sediment transport and loading to receiving waters.	UMD
Ecological Ranking Tool (Environmental Benefit Index - EBI)	The EBI was developed using three GIS layers: soil erosion risk, water quality risk, and habitat quality. Locations on each layer are assigned a score from 0-100. The sum of all three layer scores (max of 300) is the EBI score. The higher the score, the higher the value in applying restoration or protection.	Any one of the three layers can be used separately or the sum of the layers (EBI) can be used to identify areas that are in line with local priorities. Raster calculator allows a user to make their own sum of the layers to better reflect local values. This layer was created with the intention to rank CRP and other critical lands on multiple ecological benefits simultaneously.	GIS layers are available on the BWSR website.	BWSR

Tool	Description	How can the tool be used?	Notes	Link to Information and data
Watershed Nitrogen Reduction Planning Tool (NBMP)	The NBMP is an Excel spreadsheet tool that can be used to develop a framework to compare and optimize selection of BMPs for reducing nitrogen loads from the highest contributing sources and pathways.	This tool is intended to compare the effectiveness and cost potential of nine different BMPs that could be implemented to reduce nitrogen loading from cropland. The tool can be used by local resource managers to better understand the feasibility and cost of these BMPs.	Excel spreadsheet and information are available on the University of Minnesota Extension website	Extension
Restorable Wetland Prioritization Tool	A GIS-based tool developed by the University of Minnesota Duluth and other agencies and uses readily available GIS data consisting of 5 primary layers.	The tool helps prioritize areas for maximizing water quality improvements, in the form of N or P removal, and/or habitat and for restoring or protecting high functioning sustainable wetlands.	Tool and GIS layers are available on the Restorable Wetland Prioritization Tool website	UMD, MPCA
MDA Agricultural BMP Handbook of Minnesota	A literature review of empirical research on the effectiveness of 30 conservation practices and agricultural BMPs	Intended as a reference to help management professionals and producers prioritize practices that would have the greatest impact in reducing loading pollutants of concern.		MDA

Table 12 Strategies and Actions Proposed for the VBWD

HUC-10 Subwatershed	Waterbody and Location: Waterbody (ID)	Waterbody and Location: Location and Upstream Influence Counties	Parameter (including non-pollutant stressors)	Water Quality: Current Conditions 10-Year Averages (2004-2013)	Water Quality: Goals/ Targets and Estimated Percentage Reduction	Strategies (See Key in Table 13)	Strategy Types and Estimated Scale of Adoption Needed to Meet Final Water Quality Target	Interim 10-Year Milestones	Governmental Units with Primary Responsibility[2]: Watershed District	University of MN	BWSR	MPCA	MDA	MDH	Metropolitan Council	Ramsey County	Ramsey Conservation District	Washington County	Washington Conservation District	DNR	MnDOT	EMWREP[4]	Cities/Townships	3M	Lake/Homeowner Associations	Estimated Year to Achieve Water Quality Target
Watershed Wide																										
Lake Saint Croix 070300512	All	Ramsey and Washington Counties	**Nitrogen (TN) or Nitrate**	--	45% Load Reduction/ Nutrient Reduction Strategy	**Improve Stormwater Management**	Provide educational materials to residents regarding appropriate lawn care, fertilizer use, and agricultural runoff management	Ongoing (with additional emphasis in next 3 years)	S													P				2040 per Nutrient Reduction Strategy
			All Conventional Pollutants	--	--	**Improve Education and Outreach**	Increase awareness and support of VBWD through coordinated education efforts with other entities, tours, events, and/or orientation meetings for interested citizens, continue to work with a watershed[5]	Ongoing	P													S				Ongoing
						Improve Coordination/ Collaboration	Recruit/train volunteers for monitoring and other programs/projects, maintain and develop meaningful responsibilities for the VBWD Citizen Advisory Committee, develop stormwater management trainings for city and township staff and identify ways to assist cities with MS4 compliance, and cooperate with local and state agencies on efforts to improve water quality[5]		P												S				
						Implement Policies and Rules	Perform 5-year reviews of TMDL and WRAPS studies to evaluate progress towards meeting water quality goals, administer VBWD permit program, and administer the Minnesota Wetland Conservation Act (VBWD is the Local Government Unit)[5]		P			S			S		S		S		S	S		S		

HUC-10 Subwatershed	Waterbody and Location		Parameter (including non-pollutant stressors)	Water Quality		Strategies (See Key in Table 13)	Strategy Types and Estimated Scale of Adoption Needed to Meet Final Water Quality Target	Interim 10-Year Milestones	Governmental Units with Primary Responsibility[2]																	Estimated Year to Achieve Water Quality Target
	Waterbody (ID)	Location and Upstream Influence Counties		Current Conditions 10-Year Averages (2004-2013)	Goals/ Targets and Estimated Percentage Reduction				Watershed District	University of MN	BWSR	MPCA	MDA	MDH	Metropolitan Council	Ramsey County	Ramsey Conservation District	Washington County	Washington Conservation District	DNR	MnDOT	EMWREP[4]	Cities/Townships	3M	Lake/Homeowner Associations	
Lake Saint Croix 070300512	All	Ramsey and Washington Counties	**All Conventional Pollutants**	--	--	**Inventory Stormwater Assets**	Operate, inspect, maintain, modify, and repair all existing and future water quality improvement and flood control systems[5]	Inventory/Assessment completed (3-5 years)	P												S		S			Ongoing
			--			**Improve Invasive Species Management**	Perform aquatic invasive species management projects where diagnostic studies have indicated negative water quality impacts from aquatic invasive species		S											S			S		P	
			Parameters Cited in Permit			**Permit Compliance**	Ensure wastewater facilities comply with NPDES permits	Ongoing				P											S			
							Ensure Construction and Industrial Stormwater permittees comply with general permits					P											S			
							Ensure MS4s comply with permits		S			P				S		S			S		S	S		
			All Conventional Pollutants			**Improve Groundwater Management**	Monitor groundwater quality and levels, report results, and cooperate with other agencies on groundwater issues[5]		S			S		S				S		P			A			
							Implement the Washington County Groundwater Plan & Septic System Ordinance											P					A			
						Improve Stormwater Management	Implement cost-share programs, encourage implementation of BMPs in the watershed[5] See MPCA Stormwater Manual: http://stormwater.pca.state.mn.us/index.php/Information_on_pollutant_removal_by_BMPs		P							S	S	S			A	S		A	

HUC-10 Subwatershed	Waterbody and Location		Parameter (including non-pollutant stressors)	Water Quality		Strategies (See Key in Table 13)	Strategy Types and Estimated Scale of Adoption Needed to Meet Final Water Quality Target	Interim 10-Year Milestones	Governmental Units with Primary Responsibility[2]																		Estimated Year to Achieve Water Quality Target
	Waterbody (ID)	Location and Upstream Influence Counties		Current Conditions 10-Year Averages (2004-2013)	Goals/ Targets and Estimated Percentage Reduction				Watershed District	University of MN	BWSR	MPCA	MDA	MDH	Metropolitan Council	Ramsey County	Ramsey Conservation District	Washington County	Washington Conservation District	DNR	MnDOT	EMWREP[4]	Cities/Townships	3M	Lake/Homeowner Associations	
Lake Saint Croix 070300512	All	Ramsey and Washington Counties	**Chloride**	--	<230 mg/L	**Road Salt Management**	Promote and adopt strategies in the TCMA Chloride Management Plan http://www.pca.state.mn.us/r0pgb86	Ongoing	A	A		A				P	A	P	A		P	A	P		A	Ongoing
Streams																											
Lake Saint Croix 070300512	Kelle's Creek (606)	Washington County	**Total Suspended Solids (TSS)**	-	<30 mg/L	**Stream Restoration and Ravine Stabilization**	Identify and implement stream stabilization projects based on the Kelle's Creek Erosion Inventory	Complete review every 2-3 years	P																		2025
			E. coli	104 – 909 cfu/100mL (chronic – geomean range April –October)	<126 cfu/100mL (chronic) <1,260 cfu/100mL[1] (acute) 33% - 96% reduction	**Address Non-Compliant Septic Systems**	Construct the City of Afton Community Septic System	Construction between 2015-2020															P				
							Implement the Washington County Septic System Ordinance	Ongoing										P					A			
							Promote Washington County financial assistance programs for non-compliant SSTS		S									P				S	A		A	
							Inspect (voluntary) and replace (or fund through cost-share programs) non-functional or non-compliant SSTS systems	Inspect up to 160 septic systems from 2015-2017 Complete by end of 2017	P	S	A							S			S	A			
						Improve Stormwater Management	Provide outreach and educational materials on nonriparian[3] pasture and manure management and look for opportunities to implement improved pasture and manure management	Ongoing (with additional emphasis in next 3 years)	S				A						S		P	A			
							Provide educational materials to residents regarding appropriate pet waste management		S												P	A			

HUC-10 Subwatershed	Waterbody and Location		Parameter (including non-pollutant stressors)	Water Quality		Strategies (See Key in Table 13)	Strategy Types and Estimated Scale of Adoption Needed to Meet Final Water Quality Target	Interim 10-Year Milestones	Governmental Units with Primary Responsibility[2]																	Estimated Year to Achieve Water Quality Target
	Waterbody (ID)	Location and Upstream Influence Counties		Current Conditions 10-Year Averages (2004-2013)	Goals/ Targets and Estimated Percentage Reduction				Watershed District	University of MN	BWSR	MPCA	MDA	MDH	Metropolitan Council	Ramsey County	Ramsey Conservation District	Washington County	Washington Conservation District	DNR	MnDOT	EMWREP[4]	Cities/Townships	3M	Lake/Homeowner Associations	
Lake Saint Croix 070300512	Valley Creek (622, 567)	Washington County	**TSS, Chloride, TP, Nitrogen**	14 mg/L (TSS), 19 mg/L (Cl), 47 ug/L (TP), 4.5 mg/L (NO_3)	<30 mg/L (TSS), <230 mg/L (Cl), <100 ug/L (TP)	**Stream Restoration and Ravine Stabilization**	Implement stream stabilization and restoration projects to address identified stream degradation problems from Valley Creek Erosion Inventory	Complete 1-2 projects in next 5 years	P		A													A			Ongoing
						Maintain/ Improve Water Quality	Maintain/improve water quality through implementation of the VBWD and other agencies' rules and policies	Ongoing	P			P						P		P			P			
Lakes																										
Lake Saint Croix 070300512	Silver (62-0001)	Ramsey County	**TP**	64 ug/L (TP)	<60 ug/L (TP)	**Improve Stormwater Management**	Evaluate opportunities for enhanced treatment of discharge from subwatershed SLV-10	Complete feasibility study in next 5 years	P																	2020
							Target the installation of small scale BMPs in direct watershed	Ongoing	P								S								
						Reduce In-Lake Loading	Promote voluntary wake restrictions during early part of season to allow native plants to establish																	P	
							In-lake alum treatment	Will consider if water quality does not improve	P														S			
			Fish	--	--	**Manage Fish**	Fish survey	Complete in next 5 years												P						
							Operate the lake aeration system	Ongoing								P										
						Improve Invasive Species Mngt.	Develop a plan to improve native plant communities and manage aquatic invasive species	Develop plan in next 5 years	S											S			S		P	

HUC-10 Subwatershed	Waterbody and Location		Parameter (including non-pollutant stressors)	Water Quality		Strategies (See Key in Table 13)	Strategy Types and Estimated Scale of Adoption Needed to Meet Final Water Quality Target	Interim 10-Year Milestones	Governmental Units with Primary Responsibility[2]																Estimated Year to Achieve Water Quality Target
	Waterbody (ID)	Location and Upstream Influence Counties		Current Conditions 10-Year Averages (2004-2013)	Goals/ Targets and Estimated Percentage Reduction				Watershed District	University of MN	BWSR	MPCA	MDA	MDH	Metropolitan Council	Ramsey County	Ramsey Conservation District	Washington County	Washington Conservation District	DNR	MnDOT	EMWREP[4]	Cities/Townships	3M	Lake/Homeowner Associations	
Lake Saint Croix 070300512	Sunfish (82-0107)	Washington County	**TP**	61 ug/L (TP)	<60 ug/L (TP) 16% Reduction (TMDL)	**Stream Restoration and Ravine Stabilization**	Complete erosion inventory along ravines to Sunfish Lake (Sunfish Lake Park) and implement identified restoration projects.	Complete survey in 2016; Projects in next 10 years	P														S			2020
						Improve Upland Vegetation	Target efforts to establish buffers along shoreline where there is currently pasture/turf to the lake	Ongoing	P			A							A	A		S				
						Reduce In-Lake Loading	In-lake alum treatment	Complete alum treatment between 2016 - 2021	P														S			
							Manage aquatic plants	Only if lake not meeting water quality standards after alum treatment	P											S			S			
						Address Non-Compliant Septic Systems	Implement the Washington County Septic System Ordinance	Ongoing										P					A			
							Promote Washington County financial assistance programs for non-compliant SSTS	Replace at least two failing septic systems by 2020	S									P				S	A			
	Downs (82-0110)			182 ug/L (TP)	<60 ug/L (TP)	**Reduce In-Lake Loading**	Collect sediment cores to evaluate phosphorus availability from sediments	Collect sediment cores and evaluate internal loading (10 years)	P			S													2035
	Echo (82-0135)			62 ug/L (TP)					P			S													

HUC-10 Subwatershed	Waterbody and Location		Parameter (including non-pollutant stressors)	Water Quality		Strategies (See Key in Table 13)	Strategy Types and Estimated Scale of Adoption Needed to Meet Final Water Quality Target	Interim 10-Year Milestones	Governmental Units with Primary Responsibility[2]																Estimated Year to Achieve Water Quality Target
	Waterbody (ID)	Location and Upstream Influence Counties		Current Conditions 10-Year Averages (2004-2013)	Goals/ Targets and Estimated Percentage Reduction				Watershed District	University of MN	BWSR	MPCA	MDA	MDH	Metropolitan Council	Ramsey County	Ramsey Conservation District	Washington County	Washington Conservation District	DNR	MnDOT	EMWREP[4]	Cities/Townships	3M	Lake/Homeowner Associations	
Lake Saint Croix 070300512	Goose (82-0113)	Washington County	**TP**	231 ug/L (TP)	<60 ug/L (TP)	**Reduce In-Lake Loading**	Aquatic plant survey to evaluate curlyleaf pondweed	Survey every 3 years	P																	2035
							Collect sediment cores to evaluate phosphorus availability from sediments	Collect sediment cores and evaluate internal loading (10 years)	P			A													
	Long (82-0118)			24 ug/L (TP)	<40 ug/L (TP)	**Improve Stormwater Management**	Assess sedimentation in Long Lake at the Highway 36 crossing, VBWD to work with MNDOT/surrounding cities to assess sedimentation sources and potential restoration strategies based on assessment.	Complete within 2 years	P												S		S		A	
	DeMontreville (82-0101)			28 ug/L (TP)	<40 ug/L (TP)	**Maintain/ Improve Water Quality**	Maintain/improve water quality through continued monitoring and implementation of VBWD and other agencies' rules and policies	Ongoing	P			P						P			P		P		P		A	Ongoing
	Olson (82-0103)			25 ug/L (TP)	<60 ug/L (TP)																						
	Lake Jane (82-0104)			15 ug/L (TP)	<40 ug/L (TP)																						
	Elmo (82-0106)			21 ug/L (TP)	<40 ug/L (TP)	**Improve Upstream Water Quality**	Maintain or improve water quality in upstream lakes to avoid impairment of Lake Elmo		P						A			S					S			
						Maintain/ Improve Water Quality	Maintain/improve water quality through continued monitoring and implementation of VBWD and other agencies' rules and policies		P			P						P			P		P		A	

HUC-10 Subwatershed	Waterbody and Location		Parameter (including non-pollutant stressors)	Water Quality		Strategies (See Key in Table 13)	Strategy Types and Estimated Scale of Adoption Needed to Meet Final Water Quality Target	Interim 10-Year Milestones	Governmental Units with Primary Responsibility[2]																		Estimated Year to Achieve Water Quality Target
	Waterbody (ID)	Location and Upstream Influence Counties		Current Conditions 10-Year Averages (2004-2013)	Goals/ Targets and Estimated Percentage Reduction				Watershed District	University of MN	BWSR	MPCA	MDA	MDH	Metropolitan Council	Ramsey County	Ramsey Conservation District	Washington County	Washington Conservation District	DNR	MnDOT	EMWREP[4]	Cities/Townships	3M	Lake/Homeowner Associations	
Lake Saint Croix 070300512	Horseshoe (82-0074)	Washington County	**TP**	47 ug/L (TP)	<60 ug/L (TP)	**Maintain/ Improve Water Quality**	Support redevelopment activities and/or changes in land ownership of Tartan Park focusing on protection of water resources and open space conservation	Ongoing	P									S					S	S		Ongoing
							Maintain/improve water quality through continued monitoring and implementation of VBWD and other agencies' rules and policies		P			P						P		P		P			
						Improve Upstream Water Quality	Maintain or improve water quality in upstream lakes to avoid impairment of Horseshoe Lake		P						A			S				S			
						Address Non-Compliant Septic Systems	Implementation of the Washington County Septic System Ordinance											P				A			
							Promote Washington County financial assistance programs for non-compliant SSTS		S									P				S	A		
			Fish	--	--	**Manage Fish**	Conduct fish survey of Horseshoe Lake	Complete within next 5 years												P						
	Edith (82-0004)		**TP**	23 ug/L (TP)	<40 ug/L (TP)	**Maintain/ Improve Water Quality**	Maintain/improve water quality through continued monitoring and implementation of VBWD and other agencies' rules and policies	Ongoing	P			P						P		P		P			
						Address Non-Compliant Septic Systems	Implement the Washington County Septic System Ordinance											P				A			
							Promote Washington County financial assistance programs for non-compliant SSTS		S									P				S	A		

HUC-10 Subwatershed	Waterbody and Location		Parameter (including non-pollutant stressors)	Water Quality		Strategies (See Key in Table 13)	Strategy Types and Estimated Scale of Adoption Needed to Meet Final Water Quality Target	Interim 10-Year Milestones	Governmental Units with Primary Responsibility[2]																	Estimated Year to Achieve Water Quality Target
	Waterbody (ID)	Location and Upstream Influence Counties		Current Conditions 10-Year Averages (2004-2013)	Goals/ Targets and Estimated Percentage Reduction				Watershed District	University of MN	BWSR	MPCA	MDA	MDH	Metropolitan Council	Ramsey County	Ramsey Conservation District	Washington County	Washington Conservation District	DNR	MnDOT	EMWREP[4]	Cities/Townships	3M	Lake/Homeowner Associations	
Lake Saint Croix 070300512	Edith (82-0004)	Washington County	**TP**	23 ug/L (TP)	<40 ug/L (TP)	**Reduce In-Lake Loading**	Perform study to determine carp density, movement, and impact on lake water quality	Complete only if water quality shows decline	P																	Ongoing
							In-lake alum treatment		P														S			
	Acorn (82-0102)			41 ug/L (TP)	<60 ug/L (TP)	**Maintain/ Improve Water Quality**	Maintain/improve water quality through implementation of VBWD and other agencies' rules and policies	Ongoing	P			P						P		P			P			
	Cloverdale (82-0009)			30 ug/L (TP)					P			P						P		P			P			
	Clear (82-0099)			246 ug/L (TP - north basin) 450 ug/L (TP - south basin)					P			P						P		P			P			
	Goetschel (82-0313)			40 ug/L (TP)					P			P						P		P			P			
	McDonald (82-0010)			60 ug/L (TP)					P			P						P		P			P			
	Sunnybrook (82-0133)			23 ug/L (TP)					P			P						P		P			P			
	Lake St. Croix (82-0001)	Washington County, MN and St. Croix and Pierce Counties, WI	**TP**	--	40 ug/L	Detailed strategies have been developed for Lake St. Croix through the Lake St. Croix Nutrient TMDL and Implementation Plan (2012). These documents are available at: http://www.pca.state.mn.us/gp0r9fc																			

HUC-10 Subwatershed	Waterbody and Location		Parameter (including non-pollutant stressors)	Water Quality		Strategies (See Key in Table 13)	Strategy Types and Estimated Scale of Adoption Needed to Meet Final Water Quality Target	Interim 10-Year Milestones	Governmental Units with Primary Responsibility[2]																	Estimated Year to Achieve Water Quality Target
	Waterbody (ID)	Location and Upstream Influence Counties		Current Conditions 10-Year Averages (2004-2013)	Goals/ Targets and Estimated Percentage Reduction				Watershed District	University of MN	BWSR	MPCA	MDA	MDH	Metropolitan Council	Ramsey County	Ramsey Conservation District	Washington County	Washington Conservation District	DNR	MnDOT	EMWREP[4]	Cities/Townships	3M	Lake/Homeowner Associations	
Wetlands																										
Lake Saint Croix 070300512	Eagle Point (82-0109)	Washington County	**TP**	302 ug/L (TP)	--	**Reduce In-Lake Loading**	Manage aquatic plants (e.g., herbicide or drawdown)	Evaluate management opportunities (5-10 years)	P						S			S					S			Ongoing
							Implement projects to control nutrient release from sediments (e.g. , alum treatment)	Evaluate management opportunities (5-10 years)	P						S			S					S			
						Improve Stormwater Management	Potential BMPs in RLE-3 & RLE-1-1 to treat portions of Raleigh Creek inflows to Eagle Point Lake	Complete feasibility study within the next 5 years	P									S					S	S		
							Install enhanced stormwater treatment or infiltration in EPL-9 subwatershed	Complete feasibility study within the next 2-3 years with construction in the next 10 years	P									S								
						Address Non-Compliant Septic Systems	Implement the Washington County Septic System Ordinance	Ongoing										P					A			
				302 ug/L (TP)	--	**Address Non-Compliant Septic Systems**	Promote Washington County financial assistance programs for non-compliant SSTS		S									P				S	A			
			Vegetation	Oak Forest and Buffer Decline	Oak Forest and Buffer Protection	**Improve Upland Vegetation**	Protect oak forest areas and upland buffers in parkland around Eagle Point Lake											P							

HUC-10 Subwatershed	Waterbody and Location		Parameter (including non-pollutant stressors)	Water Quality		Strategies (See Key in Table 13)	Strategy Types and Estimated Scale of Adoption Needed to Meet Final Water Quality Target	Interim 10-Year Milestones	Governmental Units with Primary Responsibility[2]																Estimated Year to Achieve Water Quality Target
	Waterbody (ID)	Location and Upstream Influence Counties		Current Conditions 10-Year Averages (2004-2013)	Goals/ Targets and Estimated Percentage Reduction				Watershed District	University of MN	BWSR	MPCA	MDA	MDH	Metropolitan Council	Ramsey County	Ramsey Conservation District	Washington County	Washington Conservation District	DNR	MnDOT	EMWREP[4]	Cities/Townships	3M	Lake/Homeowner Associations	
Lake Saint Croix 070300512	Eagle Point (82-0109)	Washington County	**Invasive Species**	--	--	**Improve Coordination/ Collaboration**	Eradicate reed canary grass	Provide assistance in 2016	S									P								Ongoing

[1] The geometric mean of at least 5 samples per month should not exceed the chronic standard of 126 organisms per 100 mL, and no more than 10 percent of all samples within a month may exceed the acute standard of 1,260 organisms per 100 mL

[2] P – Primary; S – Secondary; A – Assist

[3] Non-riparian pasture management targeted because there are no pastures located adjacent to or on Kelle's Creek

[4] EMWREP = East Metro Water Resource Education Program

[5] See the Valley Branch Watershed District Watershed Management Plan for more details.

Restoration

Protection

Strategies to address downstream impairments

Multiple water bodies

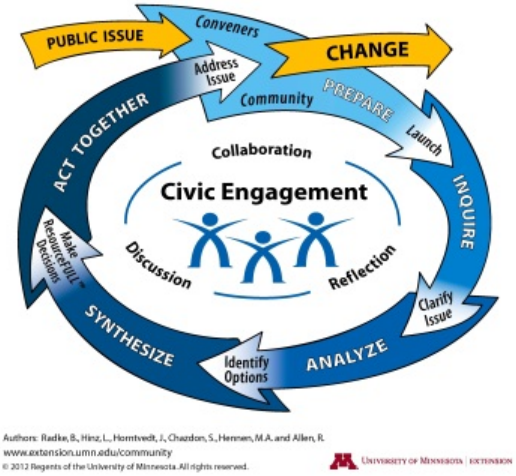
Table 13 Key for Strategies Column in Table 12

Parameter (including non-pollutant stressors)	Strategy Key	
	Description	**Example BMPs/actions**
General/All Conventional Pollutants	Education and Outreach: Includes efforts to inform the public and other stakeholders about the water management efforts within the watershed, resulting in greater support for and greater compliance with these efforts.	Increasing awareness and support of VBWD through VBWD actions and coordinated education efforts with other entities (e.g., signage, watershed tours)
		Holding tours, events, and/or orientation meetings for interested citizens,
		Continuing to contract with a watershed educator to assist in VBWD education efforts
	Improve Coordination/Collaboration: Includes activities that bring together stakeholders throughout the watersheds and working together to address water resource issues	Recruiting and training volunteers for monitoring and other programs/projects, maintain the VBWD Citizen Advisory Committee and seek to develop meaningful responsibilities for committee
		Developing stormwater management trainings for city and township staff and identify ways to assist cities with MS4 compliance
		Cooperating with local and state agencies on efforts to improve water quality
	Implement Policies and Rules: Includes continued implementation of the VBWD rules and policies (as outlined in the VBWD Watershed Management Plan) along with the rules and policies of other agencies	Performing five year reviews of the TMDL and WRAPs studies to evaluate progress towards meeting water quality goals
		Conforming to NPDES Phase II MS4 requirements
		Implementing Stormwater Pollution Prevention Plan (SWPPP), including activities related to public education and outreach, illicit discharges, construction site stormwater runoff management, and post-construction stormwater management, such as implementation of conventional and green infrastructure BMPs and targeted street sweeping programs.
		Administering VBWD permit program
		Administering Wetland Conservation Act (VBWD is Local Government Unit)
	Permit Compliance	Compliance with NPDES, Construction and Industrial Stormwater, and MS4 permit requirements
	Improve Groundwater Management: Includes efforts to improve groundwater management	Groundwater level and quality monitoring & reporting
		Cooperating with other agencies on groundwater issues
		Implementation of the Washington County Groundwater Plan & Septic System Ordinance
	Improve Stormwater Management: Includes implementation of projects to improve stormwater runoff quality through the implementation of watershed best management practices (BMPs)	Implementing various cost share programs encouraging implementation of best management practices in the watershed
		Identifying, inventorying, prioritizing, and monitoring erosion and sedimentation problems that arise outside of VBWD permit program and implement correction measures
		Implementing of water quality improvement project recommended by water quality studies
	Improve Invasive Species Management: Preforming active management of invasive species, if diagnostic studies have indicated negative water quality impacts	Surveys of aquatic plants(to help direct management efforts)
		Mechanical harvesting
		Herbicide treatments
		Drawdown
Nitrogen (TN) or Nitrate	Improve Stormwater Management: Includes implementation of projects to improve stormwater runoff quality through the implementation of watershed best management practices (BMPs)	Provide educational materials to residents regarding appropriate lawn care, fertilizer use, and agricultural runoff management

Parameter (including non-pollutant stressors)	Strategy Key	
	Description	**Example BMPs/actions**
Phosphorus	Stream Restoration and Ravine Stabilization: Reduce collapse of bluffs and ravines and erosion of streambank by reducing peak flows and using vegetation or other measures to stabilize these areas.	Complete assessments to determine locations of bank/ravine erosion
		Implement stabilization measures based on the results of the assessments
	Improve upland vegetation: Use soil and water conservation practices that reduce soil erosion and field runoff, such as vegetated buffers along shorelines and vegetated swales and grassed waterways	Develop buffers along shorelines and streambanks
	Address noncompliant septic systems: Addressing septic systems so that on-site sewage is not released to surface waters. Includes straight pipes.	Implementation of the Washington County Septic System Ordinance
		Promote Washington County financial assistance programs for non-compliant SSTS
	Reduce in-lake loading: Minimizing the internal release of phosphorus within lakes	Rough fish management
		Curly-leaf pondweed management
		Alum treatment
		Lake drawdown
		Hypolimnetic withdrawal
	Monitoring: Collection of data beyond the normal monitoring program, such as lake sediment cores, that will be useful in future water quality studies or TMDLs	Analysis of sediment cores to determine potential contribution to phosphorus loads from sediments
	Watershed Assessment: Evaluated sources of pollutant loads and perform water quality studies to determine management efforts to meet water quality standards	Completion of water quality/TMDLs for impaired resources
	Improve stormwater management: Retrofitting of stormwater BMPs to improve runoff water quality	See MPCA stormwater manual: http://stormwater.pca.state.mn.us/index.php/Information_on_pollutant_removal_by_BMPs
	Improve Invasive Species Management: Includes management of invasive aquatic plants and riparian vegetation	Surveys of aquatic plants(to help direct management efforts)
		Management of invasive riparian vegetation
	Fish Management: Develop understanding of current fishery	Conducting surveys to evaluate current condition of the fishery
		Continued operation of aeration systems
		Perform studies to understand carp populations and movement
	Maintain/Improve Water Quality: Maintain/improve water quality through continued monitoring and implementation of the District and other agencies' rules and policies	Administering VBWD permit program

Parameter (including non-pollutant stressors)	Strategy Key	
	Description	**Example BMPs/actions**
Total Suspended Solids (TSS)	Stream Channel Restoration	Large-scale restoration – channel dimensions match current hydrology & sediment loads, connect the floodplain, stable pattern, (natural channel design principals)
		Stream channel restoration using vertical energy dissipation: step pool morphology
	Stabilize ravines: Reducing erosion of ravines by dispersing and infiltrating field runoff and increasing vegetative cover near ravines. Also, may include earthwork/regrading and revegetation of ravine.	Diversions
		Water and sediment control basin
	Improve urban stormwater management [to reduce sediment and flow]	See MPCA Stormwater Manual: http://stormwater.pca.state.mn.us/index.php/Information_on_pollutant_removal_by_BMPs
E. coli	Improve stormwater management: Limiting exposure of pet waste to rainfall and management of non-riparian pasture runoff.	Provide outreach and education on pet waste management
		Provide outreach and education on non-riparian pasture management (filter strips, buffers) and look for opportunities to implement improved pasture management
		See MPCA Stormwater Manual: http://stormwater.pca.state.mn.us/index.php/Information_on_pollutant_removal_by_BMPs
	Address noncompliant septic systems: Addressing septic systems so that on-site sewage is not released to surface waters. Includes straight pipes.	Implementation of the Washington County Septic System Ordinance
		Promote Washington County financial assistance programs for non-compliant SSTS
		Inspect (voluntary) and replace (or fund through cost share) non-functional or non-compliant SSTS systems
Chloride	Road salt management	Strategies currently under development within Twin Cities Metro Area Chloride Management Plan: http://www.pca.state.mn.us/r0pgb86

3.2 Civic Engagement



A key prerequisite for successful strategy development and on-the-ground implementation is meaningful civic engagement. This is distinguished from the broader term 'public participation' in that civic engagement encompasses a higher, more interactive level of involvement. Specifically, the University of Minnesota Extension's definition of civic engagement is "Making 'resourceFULL' decisions and taking collective action on public issues through processes that involve public discussion, reflection, and collaboration." A resourceFULL decision is one based on diverse sources of information and supported with buy-in, resources (including human), and competence. Further information on civic engagement is available at: http://www1.extension.umn.edu/community/civic-engagement/.

Public education and public involvement are critical to the VBWD accomplishing its mission to protect and manage its water resources. It is through education and involvement efforts that the VBWD increases the public's understanding of water resource management and issues in the watershed, and fosters long-term public commitment to protecting these resources through individual or group actions.

Government Collaboration

Part of the VBWD's mission is to promote communication and collaboration with its residents, communities and governmental units Because the VBWD is only one of several units of government that are directly or indirectly responsible for managing water resources – both water quality and water quantity – this communication and collaboration is needed. Other entities with a role in water quality protection include, but are not limited to:

- VBWD cities and townships
- Washington Conservation District and Ramsey Conservation District
- Minnesota Department of Natural Resources
- Minnesota Pollution Control Agency
- Minnesota Board of Water and Soil Resources
- Minnesota Department of Health
- Minnesota Department of Agriculture
- Washington County and Ramsey County.

Public Involvement and Education

Past and current VBWD public education and public involvement efforts include the following:

- **Website** (www.vbwd.org) – The VBWD website includes organizational information as well as technical documents, beyond the minimum required by the BWSR. Throughout the process of updating the watershed management plan or performing plan amendments, the VBWD also posts information related to revising the Plan on the website, including opportunities for stakeholder input.
- **Volunteer monitoring efforts** – The VBWD participates in the Metropolitan Council's Citizen Assisted Monitoring Program (CAMP), which relies on citizen volunteers to collect data for the VBWD's lakes. The VBWD also financially supports a stream monitoring program where Stillwater Area High School students collect and identify macroinvertebrates from Valley Creek. The VBWD will consider implementing a similar volunteer monitoring program at Kelle's Creek. Lake water levels are also recorded by resident volunteers.
- **Citizen Advisory Committee (CAC)** – The VBWD maintains a CAC that is comprised of interested individuals who are appointed by the Managers, after nomination by their communities. The committee is responsible for assisting in the planning and development of VBWD policies and activities, as requested by the Managers. One member of the CAC also performs lake level monitoring.
- **Technical Advisory Committee (TAC)** – The VBWD maintains a TAC. The Committee consists of representatives from the cities and townships, counties and Soil and Water Conservation Districts within VBWD. The committee is responsible for advising the Managers on technical matters, as requested by the Managers.
- **Cooperative Educational Outreach Efforts** – The VBWD cooperates with other groups to inform the public about watershed issues. Past examples include participation in the Neighborhood Wilds Program (the program is no longer sponsored by the DNR), participation with other Washington County watershed districts in developing and staffing a booth at the Washington County Fair, participation in the Afton Citizens' Forum, and participation in the Washington County Groundwater Open House. The VBWD was a founding member of the East Metro Watershed Resource Education Program (EMWREP), which was established in 2006. EMWREP is a partnership of east metro watershed management organizations, Washington County, cities, and a township designed to provide education about various water resource issues and to engage the public in projects to improve regional water quality. Through its participation in EMWREP, the VBWD supports full time education staff.
- **Cost Share Program** - The VBWD developed a cost share program in 2007 intended for the implementation of stormwater BMPs (or other associated practices) on private property with the focus of the projects being on water quality improvement

- **2015-2025 Watershed Management Plan, Planning Process** – As part of the plan update process, the VBWD held an issue identification and prioritization workshop on October 30, 2013. The workshop was attended by over 40 participants (not including VBWD Managers or consultant staff) including city and township staff, elected officials, agency staff, and watershed residents. In preparation for the workshop, the VBWD:
  - § solicited input from city and township staff via a mailed survey
  - § solicited input from residents via an online survey at the VBWD website
  - § requested input from plan review agencies via a plan update notification letter
  - § advertised the workshop at the VBWD website, via local media, and through correspondence with targeted stakeholders
- **VBWD WRAPS Process** – The development of the WRAPS report included several technical stakeholder (seven meetings) and public meetings (four meetings) to discuss the specific resources evaluated in the WRAPS process:
  - § Discussions of the water quality issues
  - § Presenting results of the technical analyses
  - § Discussions on the potential implementation strategies and projects

Future Plans

The VBWD plans to continue its various civic engagement programs as outlined above. In general, to continue to manage and protect the VBWD water resources in the future, the district wants to (1) continue to promote communication and collaboration with residents, communities, and pertinent government units, (2) understand and respond to the effects of community growth and related activities on groundwater and surface water resources, and (3) educate and inspire residents, communities, and government units to participate in the protection and improvement of water resources.

Public Notice for Comments

An opportunity for public comment on the draft WRAPS report was provided via a public notice in the State Register from September 28, 2015 through October 27, 2015. Three comment letters were received.

3.3 Restoration & Protection Strategies

The mission of the VBWD includes managing and protecting the water resources within the limits of the VBWD jurisdiction including lakes, ponds, creeks, streams, wetlands, drainages, and groundwater. To support this mission, the VBWD has adopted rules, implemented policies, developed education, monitoring, and maintenance programs, performed studies, and constructed projects that support the mission. These actions are reflected in the VBWD Watershed Management Plan Implementation Program (Barr Engineering Co. 2015), and those activities supporting water quality are summarized in this section of the WRAPS.

The MPCA promotes runoff retention as a water quality treatment option, as demonstrated in its Minimal Impact Design Standards (MIDS) guidance, which the VBWD recently adopted in its 2013 rule revision. The benefits of infiltration as a BMP include volume reduction, complete removal of most pollutants from the infiltrated water (with respect to downstream loading to surface waters), and recharge of groundwater.

The VBWD and other cities, townships, and property owners have implemented several stormwater runoff management projects and water quality improvement projects. In addition, hundreds of water quality improvement projects have been constructed in the VBWD as part of the VBWD-permitted projects. After implementation of the projects, it is essential that these projects be operated and maintained so that they continually provide their designed benefits.

Water quality improvement projects and management activities implemented by the VBWD are based on feasibility, prioritization, and available funding. Prioritization will be based on the VBWD management classification (High, Medium, Low, Stormwater Pond). The VBWD will place the highest implementation priority on water quality improvement projects that target High Priority waterbodies. However, the VBWD will also take into account the order in which projects need to be undertaken in the tributary watershed, because water quality of upstream water bodies may significantly impact downstream water quality. The VBWD will also give higher priority to water quality improvement projects that are the most effective at achieving water quality goals. Additionally, the VBWD is open to partnering with other agencies (e.g., cities, county) to implement water quality improvement projects as these opportunities arise.

Specific strategies have been developed to restore the impaired waters within the VBWD and for protecting/maintaining the quality of the waters within the watershed that are not impaired. The watershed wide and the subwatershed-based implementation strategy table that follows outlines the strategies and actions that could be capable of improving water quality (Table 12).

The table was developed by reviewing the specific conditions affecting each of the waterbodies, targeting geographic areas through modeling and monitoring procedures, and collecting input from watershed stakeholders. Many of the strategies included in this table have already been incorporated into the VBWD's Watershed Management Plan (Barr Engineering Co. 2015): http://www.vbwd.org/WMP/Index.html.

The VBWD is unique in that they are a permitted MS4 and a watershed district. Because the VBWD owns and operates a conveyance system (Project 1007) they must maintain and comply with the requirements of the MS4 General permit (See Section 2.3). Since they are also a watershed district, they are the local unit of government that manages water resources within the Valley Branch Watershed jurisdiction. Watershed districts within the Twin Cities Metropolitan Area must follow the guidance of both the Watershed Act (Minn. Stat. ch. 103D) and the Metropolitan Surface Water Management Act (Minn. Stat. ch. 103B). Minn. Stat. chs. 103B and 103D require watershed district to prepare watershed management plans and follow the plan requirements of Minn. R. ch. 8410. Because of their role as a watershed district, the VBWD will be taking primary responsibility for the majority of the implementation strategies listed in Table 12.

It is important to note that loading reduced from some implementation actions listed in Table 12 is creditable to the LAs and some to the WLAs. Examples of non-WLA-creditable projects include strategies aimed at reducing in-lake loading (e.g., alum, aquatic plant management). For clarification on a particular project proposers should contact the MPCA Stormwater Program.

Funding Opportunities

There are many available sources of money to help cover some of the cost to implement practices that reduce pollutants from entering our surface waters and groundwater. There are several programs listed below that contain web links to the programs and contacts for each entity. The contacts for each grant program can assist in the determination of eligibility for each program as well as funding requirements and amounts.

On November 4, 2008, Minnesota voters approved the Clean Water, Land & Legacy Amendment to the constitution to:

- *protect drinking water sources;*
- *protect, enhance, and restore wetlands, prairies, forests, and fish, game, and wildlife habitat;*
- *preserve arts and cultural heritage;*
- *support parks and trails;*
- *and protect, enhance, and restore lakes, rivers, streams, and groundwater.*

The Clean Water, Land, and Legacy Fund has several grant and loan programs that could be used for implementation of the BMPs, education and outreach, and the WWTP modifications. The various programs and sponsoring agencies related to clean water funding and others are:

- Agriculture BMP Loan Program (Minnesota Department of Agriculture)
- Clean Water Fund Grants (BWSR)
- Clean Water Partnership (MPCA)
- Environment and Natural Resources Trust Fund (Legislative-Citizen Commission on Minnesota Resources)
- Environmental Assistance Grants Program (MPCA)
- Phosphorus Reduction Grant Program (Minnesota Public Facilities Authority)
- Section 319 Grant Program (MPCA)
- Small Community Wastewater Treatment Construction Loans & Grants (Minnesota Public Facilities Authority)
- Source Water Protection Grant Program (Minnesota Department of Health)
- Surface Water Assessment Grants (MPCA)
- TMDL Grant Program (Minnesota Public Facilities Authority)
- Wastewater and storm water financial assistance (MPCA)

The Minnesota Local Road Research Board's Local Operational Research Assistance (OPERA) Program helps to develop innovations in the construction and maintenance operations of local government transportation organizations and share those ideas statewide. The OPERA program encourages maintenance employees from all cities and counties to get involved in operational or "hands-on" research. The program funds projects up to $10,000 through an annual request-for-proposal process. (www.mnltap.umn.edu/about/programs/opera/).

The Water Environment Research Foundation (WERF) funds water quality research that is funded through a competitive process. There may be opportunities to apply for grants for research related projects at: www.werf.org.

There are several grant and loan programs through the federal government that could be used for education and outreach as well as purchasing equipment and implementation of the BMPs. A list of federal grant programs can be found at: http://www.epa.gov/water-research/grants-and-funding-water-research.

4. Monitoring Plan

The VBWD has a comprehensive monitoring program and the district has collected a large amount of water quality data over its history. The district has also collected lake level, stream flow, and groundwater level data. In addition, other agencies have collected data for the VBWD waterbodies, including the MPCA and Metropolitan Council. The amount of data currently available varies by waterbody.

Continued water quality data collection is necessary for the VBWD to track water quality improvement or degradation, detect trends, and better understand water quality processes, and ultimately determine if there are water quality problems (e.g., impaired uses). This information is critical for the VBWD to identify and prioritize water quality improvement projects, and to determine appropriate methods for preventing water quality degradation (e.g., to inform the ongoing WRAPS project). Detection of trends, specifically improvements, is critical to determining the effectiveness of actions implemented by the VBWD.

The Metropolitan Council enters water quality data collected as part of the Metropolitan Council's CAMP into the Environmental Quality Information System (EQuIS) database. Water quality data collected by the VBWD is reported in the VBWD's annual report submitted to the BWSR and DNR and posted on the VBWD website; however, the data area not currently within EQuIS, with the exception of data collected as part of the WRAPS study.

The VBWD regularly monitors the major waterbodies in the district. The objective of the monitoring is to detect changes or trends in the water quality or habitat over time, thereby determining the impact of changing land use patterns in the watershed (i.e., pollutant loading), internal loading, and the effectiveness of the VBWD's efforts to protect or improve water quality. The type of water chemistry monitoring recommended for each waterbody varies according to its classification. The VBWD may perform more frequent or intensive monitoring, on a case-by-case basis, depending on the results of the regular monitoring, inclusion of a waterbody on the impaired waters 303(d) list, or other drivers. The

VBWD reviews the recommended monitoring program as part of its annual implementation plan review, and may alter the program as necessary with consideration for past monitoring results, changes in land use (or planned changes in land use), and available budget. The VBWD performed habitat monitoring from 2005 to 2009; the VBWD will consider updating and reestablishing its habitat monitoring program.

This section describes waterbody monitoring programs currently utilized by the VBWD:

Survey Level/CAMP Water Quality Monitoring— This monitoring is performed as part of the CAMP, which uses volunteers to collect surface water temperature and transparency data on a bi-weekly basis from mid-April to mid-October.

Supplemental Water Quality Monitoring— In addition to Survey Level Monitoring, this program collects additional samples and data once in April, June, July, and twice in August. This program studies phosphorus concentrations in greater depth than the Survey Level Monitoring.

Intensive Water Quality Monitoring— This level of monitoring is triggered if a waterbody displays a decline in water quality, and involves developing a monitoring plan specific to the waterbody.

Aquatic Plant Monitoring— This program monitors the presence and abundance of aquatic plants in VBWD waterbodies, usually focusing on management of both native and invasive aquatic plants.

Phytoplankton and Zooplankton Monitoring— This program monitors the microbiotic communities in VBWD waterbodies. The monitoring results track the relative distributions of phytoplankton and zooplankton and identify the presence of phytotoxins.

Stream Water Quality Monitoring— The VBWD monitors Kelle's Creek, Raleigh Creek, and Valley Creek for changes in water quality, flow regime, and physical conditions. Biological indicators, macro invertebrates, physical condition, and flow monitoring of VBWD streams are completed (including participation in the WOMP).

The VBWD compiles an annual report summarizing the water quality, habitat, phytoplankton/zooplankton, and stream monitoring results for all waterbodies monitored. All of the water quality monitoring results for that year will be consolidated into a single report that includes data analysis, a narrative data summary, and calculation of water quality trends. The VBWD uses the annual monitoring report, and historic data, to determine needed monitoring and other water quality management actions for the next year. The annual reports are posted to the VBWD website: http://www.vbwd.org/annual.htm.

The VBWD acknowledges that on-site monitoring of implementation practices is essential to assess the BMP effectiveness in improving water quality and reducing loading.

The VBWD will share water quality data via public databases (e.g., EQuIS, MPCA's Environmental Data Access) to the extent possible within the constraints of funding. The VBWD recognizes the benefits of data sharing for multi-jurisdictional water quality studies (e.g., the WRAPS and TMDLs), and will pursue options that are not cost-prohibitive.

5. References and Further Information

Barr Engineering Company. 2015. Valley Branch Watershed District Watershed Management Plan. Prepared for Valley Branch Watershed District.

Barr Engineering Company. 2015 (draft). Valley Branch Watershed District Watershed Total Maximum Daily Load Summary. Prepared for Valley Branch Watershed District.

Barr Engineering Company. 2013. Valley Branch Watershed District 2013 Annual Report. Appendix D Water Quality Program. Prepared for Valley Branch Watershed District.

Barr Engineering Company. 2012. Valley Branch Watershed District 2012 Annual Report. Appendix D Water Quality Program. Prepared for Valley Branch Watershed District.

Barr Engineering Company. 2005 (as amended (2011)). Valley Branch Watershed District Watershed Management Plan. Prepared for Valley Branch Watershed District.

Barr Engineering Company. 2001. Minnesota Urban Small Sites BMP Manual. Stormwater Best Management Practices for Cold Climates. Prepared for the Metropolitan Council, with guidance and support from the city of Minneapolis, Minnehaha Creek Watershed District, Rice Creek Watershed District, and Six Cities Watershed Management Organization.

Barr Engineering Company. 1976. Geology of Valley Branch Watershed District.

City of Minnesota. Minnesota Statutes Chapter 84D.

Emmons and Olivier Resources. 2007. "Karst Feature Inventory and Management Plan." Prepared for the Lower St. Croix Watershed Management Organization.

Metropolitan Council (MCES). 2014. Valley Creek Water Quality Summary. Valley Branch Watershed District Board Meeting.

Metropolitan Council (MCES). 1983. Diagnostic-Feasibility Study of Seven Metropolitan Area Lakes, Park Two: Lake Elmo.

Minnesota Department of Agriculture (MDA). 2012. The Agricultural BMP Handbook for Minnesota.

Minnesota Department of Natural Resources (DNR). 2015. Lake information reports from "Lakefinder" website: http://www.dnr.state.mn.us/lakefind/index.html

Minnesota Department of Natural Resources (DNR). 2014. Wild & Scenic Lower St. Croix River. http://www.dnr.state.mn.us/waters/watermgmt_section/wild_scenic/wsrivers/stcroix_lower.html

Minnesota Department of Natural Resources (DNR). 2014. Wild & Scenic Rivers Program. http://www.dnr.state.mn.us/waters/watermgmt_section/wild_scenic/index.html

Minnesota Pollution Control Agency. 2015. Environmental Data Access website: http://www.pca.state.mn.us/data/index.html

Minnesota Pollution Control Agency. 2013. Minnesota Rules Chapter 7050: Standards for Protection of Water of the State.

Minnesota Pollution Control Agency. 2014. Guidance Manual for Assessing the Quality of Minnesota Surface Waters for Determination of Impairment: 305(b) Report and 303(d) List (2014 Assessment Cycle.

Minnesota Pollution Control Agency. 2007. Minnesota Statewide Mercury Total Maximum Daily Load.

Minnesota State Demographic Center. 2015. County population projections accessed from the following website on 4/28/2015: http://mn.gov/admin/demography/data-by-topic/population-data/our-projections/index.jsp

National Resources Conservation Service (NRCS). United States Department of Agriculture. 2015. Conservation Practices. http://www.nrcs.usda.gov/wps/portal/nrcs/detailfull/national/technical/references/?cid=nrcs143_026849

Radomski, J. & Carlson, K., DNR. 2013. Description of Prioritization Approach and Methods used for the Saint Croix Basin Conservation Planning and Protection LCCMR Project.

Washington County. 2012. Land and Water Legacy Program Conservation Priorities. Top 10 Priority Conservation Areas. http://www.co.washington.mn.us/documentcenter/view/771

Washington County. 2010. Land and Water Legacy Program Conservation Priorities Plan. http://www.co.washington.mn.us/documentcenter/view/132

Waters, T. & Newman, R. Personal Communication. Professors, Department of Fisheries, Wildlife and Conservation Biology, University of Minnesota.

Valley Branch Watershed District Reports

The Valley Branch Watershed District Watershed Management Plan and annual reports referenced in this watershed report are available at the Valley Branch Watershed District webpage: http://www.vbwd.org/index.html