PRIOR LAKE-SPRING LAKE WATERSHED DISTRICT LONG TERM MONITORING PLAN

December 10, 2019

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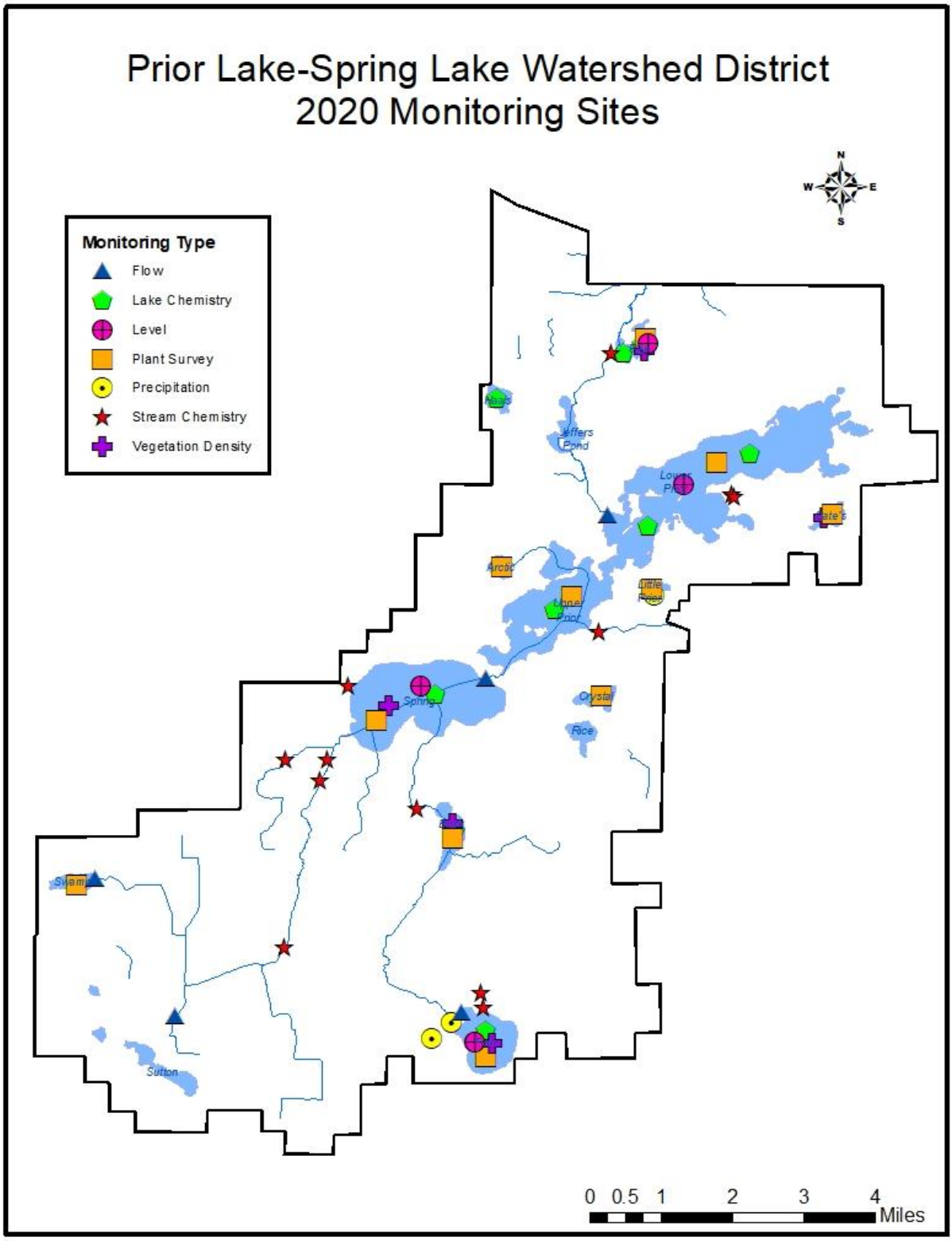
INTRODUCTION

To ensure that the District monitors water quality on a time and cost basis, a long-term monitoring plan has been created. The long-term monitoring plan covers lakes, streams, Best Management Practices (BMPs), precipitation, wetlands, and groundwater. Prior Lake-Spring Lake Watershed District (PLSLWD) monitors water resources for multiple reasons:

- Maintain baseline data
- Diagnose water quality problems
- Track progress and efficiency of projects
- Detect trends
- Compare to state water quality standards
- Enable best management decisions

The District's monitoring plan and goals are reliant on partnerships with various public agencies, private consultants such as, City of Prior Lake, Shakopee Mdewakanton Sioux Community (SMSC), Spring Lake Township, Metropolitan Council Environmental Services, Three Rivers Park District, Scott Soil and Water Conservation District, Blue Water Science, Emmons and Olivier Resources, and volunteers. This plan will be used as a guideline, but will be a living, working document and will be amended or updated as needed.



Source: PLSLWD Files

LAKE MONITORING

This section describes the different types of lake monitoring performed within the PLSLWD. The prioritization of monitoring District lakes is based on several factors but will be broken down into three tiers.

Tier 1 Lakes: Those lakes within the District that receive the most public use and have historically received the greatest amount of prior investment.

- Lower Prior Lake
- Upper Prior Lake
- Spring Lake
- Fish Lake

Tier 2 Lakes: Those lakes within the District that have a TMDL and/or that have received significant recent/planned investment into the resource.

- Pike Lake
- Arctic Lake
- Buck Lake
- Sutton Lake

Tier 3 Lakes: Those lakes that have no known water quality impairment and have limited need for more information to make management decisions.

- Haas Lake
- Crystal Lake
- Rice Lake
- Cates Lake
- Jeffers Pond
- Swamp Lake

LAKE WATER QUALITY (LWQ)

Description:

Monitoring includes one sample in March and/or April, bi-weekly sampling from May through September, and one sample in October. All physical measurements and water samples for chemical analyses are obtained from a point directly over the deepest point in the lake. A multiprobe sonde is used to record temperature, pH, conductivity, and dissolved oxygen profiles at 1-meter intervals. Secchi disk transparency is determined with a black and white 20-cm diameter disk on the shady side of the boat. Total phosphorus (TP), soluble reactive phosphorus (SRP), total nitrogen (TN), Chloride (Cl), and chlorophyll-*a* (Chl-A) concentrations are determined from the surface composite sample for all sampling events. Additional sampling for deep lakes includes: TP and SRP collected in the "middle" of the water column directly above the thermocline and a "bottom" sample is collected for TP, SRP, and Cl below the thermocline while remaining above the bottom 0.5 meters to prevent disturbing the sediment.

Frequency:

Annually for Lower Prior, Upper Prior, Spring, Fish, and Pike. Arctic is monitored by SMSC.

Annual Cost per Lake (Three Rivers Park District):

	Shallow	Deep
Labor	$1000	$1500
Lab Analysis	$1000	$1750
Analysis	$100	$150
Total	$2100	$3400

Approximate cost per year: $20,000

CITIZEN-ASSISTED MONITORING PROGRAM (CAMP & CAMP-L)

Description:

The Metropolitan Council Environmental Services' (MCES) Citizen Assisted Monitoring Program (CAMP) has been collecting water quality data on several Twin Cities metropolitan area lakes since 1980. The District has sponsored CAMP on multiple lakes for 15 years. On a biweekly basis (April - October), citizen volunteers collect a surface water sample for laboratory analysis of total phosphorus, total Kjeldahl-nitrogen, and chlorophyll-a, obtain a Secchi transparency measurement, and provide some user perception information about each lake's physical and recreational condition. Laboratory analysis of collected samples will be performed consistent with CAMP protocols, as determined by the Metropolitan Council Environmental Services. When volunteers aren't available, the PLSLWD staff will monitor those lakes. Tier 2 Lakes will be using the same methodology of CAMP but will be sampled less frequently (monthly instead of bi-weekly) and will be referred to as CAMP-Light (CAMP-L).

Frequency:

Annual CAMP program for any lakes that have willing volunteers and no LWQ monitoring already conducted on the lake.

Annual CAMP-L program by staff for lakes that have no volunteers. If not possible to access a lake with boat/kayak, consider monitoring outlet of lake (Sutton, Swamp, Rice).

Annual Cost per Lake:

	Fees
CAMP Annual Fee	$800
CAMP-L Annual Fee	$400
Monitoring Equipment (new site only)	$250

Approximate cost per year: $5,000

LAKE LEVEL MONITORING (LEVEL)

Description:

Automatic Level Data Loggers (Level loggers) and staff gauges will be used to monitor lake levels. Level loggers will transmit real-time data to the website. Staff gauge data will be provided to the MN DNR Staff Gauge Program and will also be used to calibrate the auto-loggers. Staff gauges are surveyed in annually by the MN DNR for an accurate elevation.

Frequency:

Level loggers will transmit data at least 4x/day and up to 1x/hour. Lakes with level loggers include:

- Prior Lake
- Spring Lake
- Pike Lake
- Fish Lake

Staff gauges will be recorded at least 1x/month (lakes with level loggers) and up to 1x/week on lakes with no logger. Currently (2019), all lakes with staff gauges have auto-loggers, except Cate's Lake. That is monitored by City of Savage. The Districts current fleet of Level Loggers are operating on 2G cellular networks. Alas, 2G cellular coverage is nearing its lifespan and the district plans on updating its equipment to reflect newer advancements.

Cost:

Level loggers - $3,000 each

Maintenance/Replacement - $1,000/year

Phone Line for data transmission: $1,000/year

Approximate cost per year: $3,000

PLANT SURVEYS (PLANT)

Description:

Plant surveys will assess the distribution, type, and growth density of all plants. The PLSLWD may contract with a private consultant (currently Blue Water Science) to perform macrophyte surveys. Staff may also conduct plant surveys, such as meander surveys or point-intercept surveys. Lakes with potential nuisance Curlyleaf Pondweed (CLP) will be surveyed every year just after ice out to determine the potential need for treatment. If CLP is treated, an assessment will be done post-treatment to determine effectiveness of treatment. This data informs the District's Aquatic Plant Management Program including when and where to treat for invasive plant species and the effectiveness of any performed treatments.

Frequency:

Summer point intercept surveys will be completed on Tier 1 lakes every other year. Plant surveys will be completed on Tier 2 lakes every 3 years. Plant surveys will be completed on Tier 3 lakes every 5 years. The District will complete additional surveys, as needed, to support lake diagnostic studies.

Cost: $20,000/year

Lake	CLP Assessment	CLP Delineation & Assessment	Summer Point-Interpoint Survey
Fish	$800	$1400	$1700
Spring		$2300	$2000
Upper Prior		$700	$2200
Lower Prior		$1550	$2400
Upper and Lower Prior		$3000	
Pike	$700		$1300
Cates			$1400
Arctic			$1200
Crystal			$1400
Swamp			$1500
Sutton			$1800
Buck			$1200
Haas			$1400
CD13 Wetland			$900
Jeffers Pond			$1000
Jeffers Fish Pond			$750
Jeffers Wildlife Pond			$800
Little Prior			$900
Rice			$1400

VEGETATION DENSITY MAPPING (BIOBASE)

Description:

The program maps lake plant biomass densities, bathymetry, and bottom hardness using sonar. The goal of the program is to capture a long-term dataset on lake plant density and growth to monitor the health of District's lakes. District staff will work in combination with volunteers to collect comprehensive maps on lakes. The final maps will be helpful for planning future projects, assessing the health of the lakes in the District, defining locations needed for Curly-leaf Pondweed (CLP) treatment, and confirming effectiveness of CLP treatments.

Frequency: Every year for Tier 1 lakes, every 3 years for Tier 2 lakes, every 5 years for Tier 3 lakes. BioBase may be used on occasion to monitor other waterbodies and/or for special projects.

Annual Cost:

Equipment Maintenance/Replacement	$1000
BioBase Subscription	$2500
Your Boat Club Subscription	$1000
Total	$4500

LAKE ICE MONITORING (ICE)

Lake ice on/off dates for watershed lakes will continue to be recorded in District records. To determine ice-on and ice-off dates, volunteer ice observers (typically lakeshore owners) will inform the District when lake ice is at least 90% on or off.

Frequency:

2x/year

Cost:

$0

ZOOPLANKTION AND PHYTOPLANKTON (ZOO)

Description:

Samples of phytoplankton, microscopic aquatic plants, will be collected to evaluate water quality and the quality of food available to zooplankton (microscopic animals). The presence and health of these organisms are essential to the well-being of all aquatic species.

Phytoplankton are the autotrophic (self-feeding) components of the plankton community and a key part of oceans, seas and freshwater basin ecosystems. The name comes from the Greek words *phyton*, meaning "plant", and *planktos*, meaning "wanderer" or "drifter".[1] Most phytoplankton are too small to be individually seen with the unaided eye. However, when present in high enough numbers, some varieties may be noticeable as colored patches on the water surface due to the presence of chlorophyll within their cells and accessory pigments (such as phycobiliproteins or xanthophylls) in some species. About 1% of the global biomass is due to phytoplankton.[2]

Phytoplankton will be sampled as a single 0-2 meter composite sample at the location of water quality sampling. Zooplankton will be sampled using a bottom to surface tow with a zooplankton net at the location of water quality sampling.

Info on Phytoplankton: https://en.wikipedia.org/wiki/Phytoplankton

Zooplankton are microscopic animals that play an important role in lake food chains. They feed on algae to keep lakes clear and provide food for newly hatched young-of-the-year sports fish. The type of zooplankton in a lake remain relatively stable over time. A sudden appearance of new kinds or changes in the relative numbers of different kinds can be caused by changes in nutrient inputs, types of fish that are dominant, new aquatic invasive species like zebra mussels or spiny waterflea, or toxic substances. Zooplankton are to lakes what the canary is to the coalmine. When monitored monthly throughout the summer, community dynamics can be tracked. In lakes infested with spiny waterflea or zebra mussels, relative densities of the invasive zooplankton versus the native zooplankton can be evaluated to see the impact from infestation.

Zooplankton Communities in MN: https://www.pca.state.mn.us/sites/default/files/wq-nlap1-11.pdf

Zooplankton Fact Sheet: https://clp.indiana.edu/doc/fact-sheets/zooplankton.pdf

Zooplankton analyses will be completed using the Sedgwick Rafter procedure described in Standard Methods. Zooplankton shown in Table MP-4 will be identified to the species level and other zooplankton will be identified to the genus level. Results will be expressed as number of zooplankton per square meter.

Frequency:

Tier 1 lakes will be monitored on six occasions from April through September once every 3 years (4 lakes, monitored 3 times in 10 years = $12-24k).
Tier 2 lakes will be monitored on six occasions from April through September once every 6 years ($3-6k).
Tier 3 lakes will be monitored on six occasions from April through September once every 9 years ($3-6k).

Lakes will be monitored concurrent with water quality sampling events.

Cost:

Zooplankton: $1000-2000 per lake for sample analysis if sampled 6 times/year.
Phytoplankton: $600 per lake if sampled 3 times/year.
$500 per year (all sites) in shipping, maintenance, equipment, other)

Total of $18-36k over 10 years
Average cost per year over 10 years: Range of $1,800-$3,600 or ~$2,700

STREAM AND DITCH MONITORING

Streams/Ditches/Tributaries:

1. County Ditch 13
2. Buck Lake Channel
3. Outlet Channel
4. Cates Creek

5. Spring West Tributary
6. Spring Lake Outlet
7. Fish Lake Inlet
8. Fish Lake Outlet
9. Sutton Lake Outlet
10. 12/17 Wetland Outlet
11. Swamp Lake Outlet
12. Arctic Lake Outlet
13. East Rice Tributary
14. Your Boat Club Creek
15. Spring Lake East (inlet to Buck Lk)
16. Crystal Lake Outlet
17. Spring Central Tributary

Stream monitoring is prioritized by the amount of impact a stream may have on District lakes. The goal is to understand what is coming into and out of each lake, especially what is going into the Tier 1 lakes.

Characteristics that prioritize stream site monitoring include high flow, high pollution potential, inlets to a lake, and natural systems.

STREAM SAMPLING (STREAM)

Description:

The PLSLWD conducts a stream water quality monitoring program to monitor the chemistry of its streams. Some sites are monitored every year and are considered "base" sites. Ferric Chloride Sites are monitored every week, due to a requirement by the NPDES permit for the Ferric Chloride Treatment System. On occasion, special studies will arise and will be added to the matrix (i.e., tile monitoring).

Frequency:

Annually for base sites, every two weeks routinely during ice-out conditions (end by Nov 1). Annually for Ferric Chloride sites, every week that ferric is dosing. As needed for projects and studies.

Base Sites include: ST_19, ST_14, FC_CD1, ST_24, ST_26A

Ferric Chloride Sites include: FC_CD2, FC_CD3

Special Study sites include (See Effectiveness/BMP Monitoring): ST_40 (outlet of 12/17 wetland), ST_S3P, ST_S3PP (S3P and S3PP are Fish Point Park sites), B3, T3 (tile outlet), B3 (inlet to Fish Lake), and 2 PCSWMM model calibration sites, Crystal Lake Outlet, Spring Lake East

Parameters:

Base Sites: Chloride, E. Coli, Nitrate and Nitrite Nitrogen, Total Kjeldahl Nitrogen, Orthophosphate, Total Phosphorus, Total Suspended Solids, Volatile Suspended Solids

Ferric Chloride Sites: Chloride, E. Coli, Hardness, Total Iron, Dissolved Iron, Nitrate and Nitrite Nitrogen, Total Kjeldahl Nitrogen, Orthophosphate, Total Phosphorus, Total Suspended Solids, Volatile Suspended Solids

Cost:

Base Sites Analysis: $1800/site/year

Ferric Sites Analysis: $4500/site/year

Equipment Maintenance/Replacement (sonde, calibration standards, etc): $5000/year

Approximate cost per year: $20,000

FLOW MEASUREMENTS (FLOW)

Description:

Flow measurements (flows) are a critical piece of monitoring. Flows are taken at key spots within the watershed which is necessary to inform flood forecasting and determine annual pollutant loading. By collecting flows at different stages of the hydrograph, a relationship is formed – called a "Rating Curve." A rating curve is applied to the water level which can determine the amount of discharge at any given water level. The flow measurements are often located at chemistry monitoring sites that have automated level loggers. By combining the water chemistry, water level, and flow, the annual pollutant load can be calculated. Flow is also important to know during high water levels in order to forecast the water levels of downstream water bodies.

Frequency:

At least 7 flows per year for new sites or sites with poor rating curves. Established rating curves should have at least 3 flow measurements/year. Flow and level monitoring should be conducted at all chemistry sites.

Cost:

$9,000/year

MACROINVERTEBRATE AND HABITAT ASSESSMENTS (BIO)

Description:

With interns and volunteers (if available), the SHEP (Stream Health Evaluation Program) and/or Minnesota Pollution Control Agency (MPCA) Invertebrate Sampling Procedures (EMAP-SOP4, Rev. 0) will be used to collect macroinvertebrate samples. The MPCA multihabitat method will be used to collect a composite sample from up to five different habitat types to get a sample representative of the invertebrate community at each sample location. Physical habitat will be assessed using the MPCA method (i.e., physical habitat and water chemistry assessment protocol for wade-able stream monitoring sites).

Frequency:

Once every 3 years for priority sites and once every 6 years for lower priority sites.

High Priority:

1. Ditch 13
2. Buck Lake Channel
3. Cates Creek
4. Outlet Channel (DLO because it doesn't stop flowing and may have had biomonitoring done here by PCA in the past)
5. Spring Lake East (inlet to Buck Lk)

Lower Priority:

1. Spring West Tributary
2. Spring Lake Outlet
3. Fish Lake Inlet
4. Fish Lake Outlet
5. Sutton Lake Outlet
6. Arctic Lake Outlet
7. Your Boat Club Creek
8. Spring Central Tributary

Cost:

$100-$400 per site per year for identification
$1000 per year (all sites total) for equipment, shipping, waders, etc.
Average approximate cost per year over 10 years: $2,200

Effectiveness/BMP Monitoring (BMP)

Description:

Monitoring will be done to assess the effectiveness of projects completed within the District. When possible, monitoring will be done before the project has begun to get baseline data. Some potential projects include: Fish Point Park, Sand Point Park, CR 12-17 Wetland, Fairlawn Shores, and Indian Ridge.

Frequency: Will be determined for each project.

Cost: $7,000/year

Wetland Monitoring (WET)

Description:

Trained volunteers and/or staff collect data on the macroinvertebrates (insects and other small animals without backbones) that live in the wetlands as well as the vegetation in the wetlands. The invertebrates and vegetation identified by the volunteers will then be used to calculate an Index of Biotic Integrity (IBI). This IBI can be used to estimate the health of each wetland.

Potential wetlands to be monitored may include; Trillium Cove, Rice Lake Park, Frog Farm (DU), Sutton Lake, and CR 12/17. Wetlands that have been restored in the past may be good candidates as well, such as Robling and Sandey wetlands. Whenever possible, wetlands will be monitored before a potential project, such as the Sutton Lake storage project. Wetlands that have little alteration or influence from humans would be good to have as an indicator wetland, or "best case" scenario.

Frequency:

Wetlands will be monitored for 3-year cycles. 3 years on, 3 years off. Up to 6 wetlands will be monitored every year.

Cost:

$3,000 per year

PRECIPITATION AND WEATHER (WX)

Volunteers, staff, and weather stations will be used to collect precipitation. Precipitation data collected by volunteers and staff is submitted to the State Climatologist. Volunteers melt snow to provide melted precipitation amounts (snow depth not required).

A weather station was installed at the Spring Lake Townhall and is providing real time data on Weather Underground.

Frequency:

Manual precipitation readings will be recorded daily and the weather station will record data in 15 minute increments.

Cost:

$200/year for Davis (transmitting data)

$500/year for maintenance or replacement

GROUNDWATER (GW)

Groundwater monitoring is not planned in the District's future, but as more information becomes available, the District may decide to add monitoring sites. Additional flow and level data may help characterize groundwater recharge/discharge per PCSWMM model recommendation by installing level loggers in areas in need of more data.

Cost: $0

REPORTING AND RECORDING (R&R)

The District's database is antiquated. One option for upgrading is WISKI as other monitoring organizations are using this. WISKI database has many features and can store continuous and discrete data. It is capable of processing large amounts of data in seconds, rather than something that could take staff weeks/months to complete. WISKI can analyze baseflow vs storm event samples, statistics, and loads. Quality assurance and coding is also included. The software can make the data visually appealing and available to the public with a mapping feature, allowing the public to click on a site and review any/all data that is associated with that site. (Mapping features would come later)
http://waterdata.capitolregionwd.org/applications/login.html?publicuser=Guest#waterdata/stationoverview

The District will summarize water quality for all monitoring activities. Streams will be summarized by analyzing annual pollutant loading (FLUX). Lakes will have summaries similar to a report card, assigning "grades" to each lake (Monitoring Report Cards). General monitoring results will also be available for the public on the website.

Average Annual Cost over ten years: $11,400 per year

$30,000 for 2021
$6,000/year for maintenance
$30,000 for mapping features (2022)

AIS

See AIS section of WRMP for monitoring activities associated with AIS.