2019 MONITORING REPORT

Pelican River Watershed District

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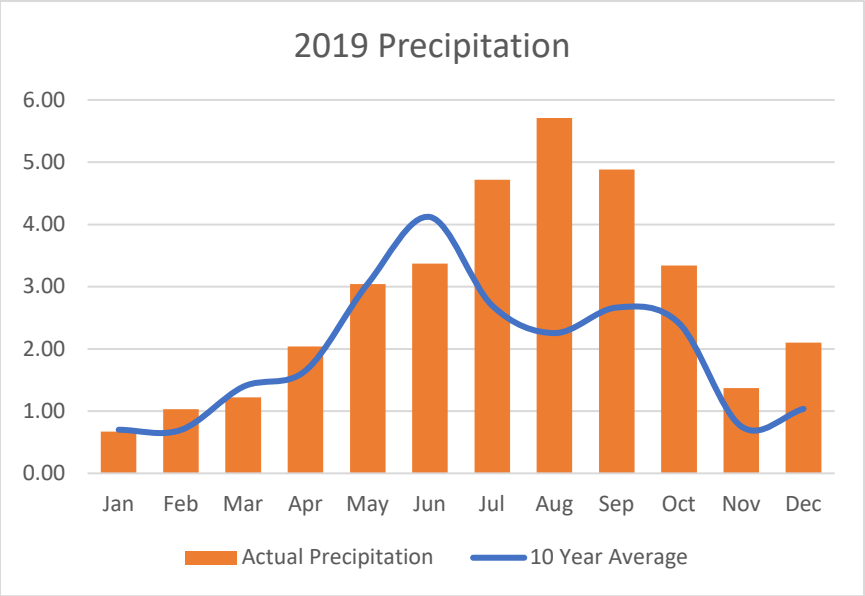
Water Resource Coordinator

2019 Weather

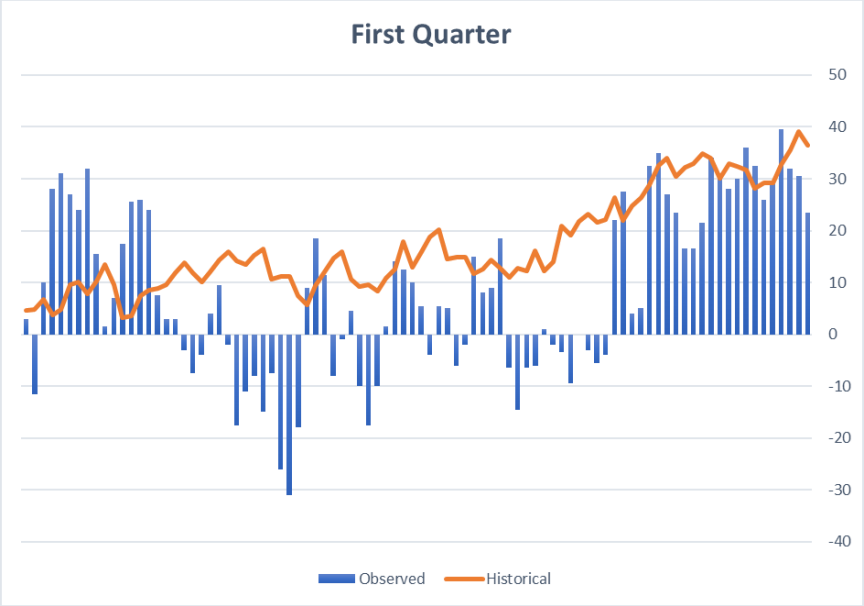


Leading into 2019, winter started early and quickly got worse. A 10-inch blast of snow hit the region in late December setting the scene for a wet year. In 2019 we experienced high rates of precipitation, finishing the year 10.07" of precipitation over the 10-year average of 23.42" and 8.3" of snowfall over the 10-year average of 48.27".

From July to the end of the year we fell into a wet cycle with 75% to 150% over the historic monthly averages of precipitation for July, August, and September. Precipitation came in large events throughout the summer, with 7 days experiencing >1" of rainfall. High rates of precipitation continued into the winter months as the region froze up. Starting in October, snow events blanketed the region with 42.25" of snow by the end of December. With soils saturated at freeze-up and water levels high, spring flooding in 2020 seems likely.

2019 Precipitation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Average Precipitation	0.70	0.70	1.39	1.65	3.05	4.12	2.69	2.25	2.66	2.41	0.75	1.04	23.42
Average Snowfall	8.15	8.49	9.27	4.28	0.01	0.00	0.00	0.00	0.00	0.84	3.95	13.29	48.27
2019 Precipitation	0.67	1.03	1.22	2.04	3.04	3.37	4.72	5.71	4.88	3.34	1.37	2.10	33.49
2019 Snowfall	13.20	23.10	14.80	11.50	0.00	0.00	0.00	0.00	0.00	3.20	9.25	29.80	104.85

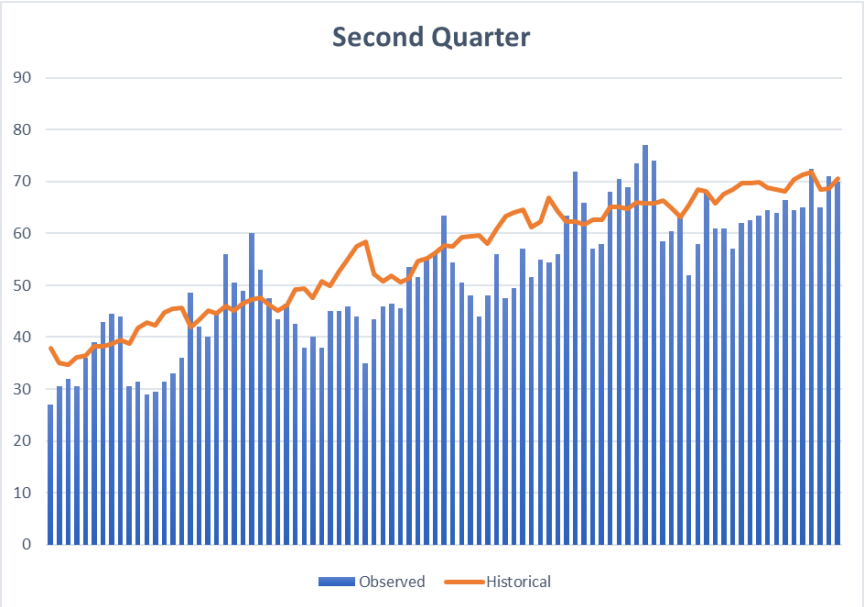
1st Quarter – Cold and Wet



The year started with a brief warm spell in January before cold air from the artic caused temperatures to crash in late January to early February. Temperatures in February were generally cold, with periods of warming to seasonal averages before plunging back to below zero temperatures, with 8 days of high temperatures below zero. The lowest recorded temperature during this period was -40° on the 31st of January (the recorded high for that day was -22°). This was about 40° below the historic average for that day and only 5 degrees warmer than the record low!

During this time, we also experienced excessive snowfall compared to the 10-year average for the area. All months experienced above-average amounts of snow accumulation. The water content of the snow was relatively similar to historic averages. Most precipitation events produced accumulations <5”, with the exception of one 13” event on March 10th.

2nd quarter – Calm Before the Storm



Once April rolled in, things started to calm down. Temperatures through this period remained around average with a fairly even distribution between above and below average waves. There was one warm spell in May where daily averages worked themselves ~20° above the average, but nothing as extreme as the lows observed in January.

Precipitation followed a similar trend of adhering to normal patterns. One snowfall event on the 12th of April dumped 10” of spring snow on the area, insulating ice cover on the lakes and delaying ice-off. The heavy snowfalls during the early winter months, coupled with a wet fall the previous year, caused high water in the region’s lakes and streams. Area streams flowed at or above bankful for most of the season

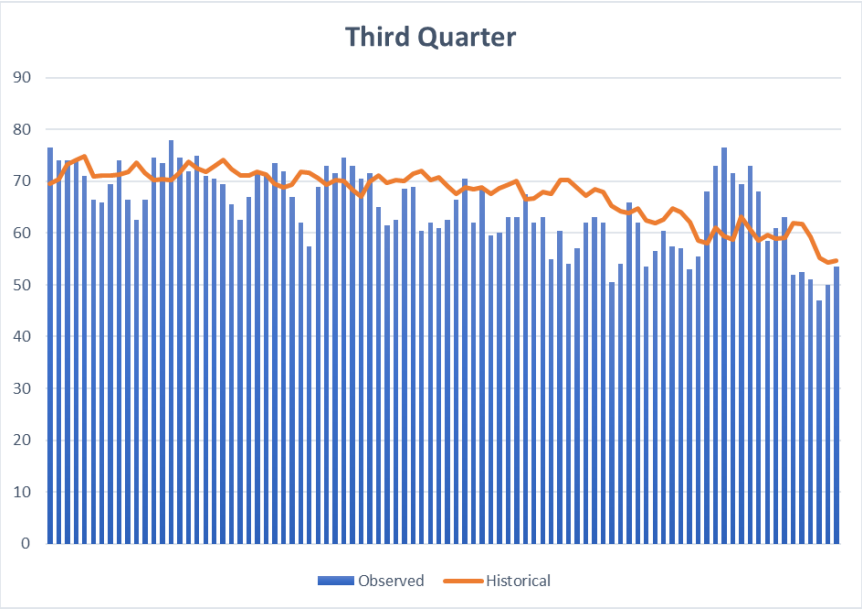
and area lakes stayed as much as 8-10"above 2018's averages. Campbell Creek opened on April 6th and Big Detroit opened on April 25th.

High water was observed throughout many lakes this year but was especially high on St. Claire Lake. One resident called the district to investigate water encroaching on his property. The District investigated and found several possible causes including: high water coming out of Detroit Lake (potentially causing a backup into St. Claire), sign of beaver, and debris slowing water into a culvert between St. Claire and the Pelican River. Water levels began to recede towards the end of April and the beginning of May.

A diatom bloom was observed on Long Lake driving water clarity down. The bloom was driven by the late ice-off and slow warming of the lake creating an ideal climate for the diatoms to increase their population at an exponential rate. As water temperatures increased at the end of the month, the populations died back to regular levels.

3rd Quarter – A Stormy Summer

July set a trend of heavy precipitation events that carried into the fall, with 4.72" of rain falling in July, 5.71" falling in August, and 4.88 inches falling in September. A large rain event July 9th and 10th saw 1.29" and 1.75" respectively for a total of 2.04". This large amount of precipitation led to lakes and streams maintaining levels near flood stage for most of the year, causing erosion to less resilient areas.

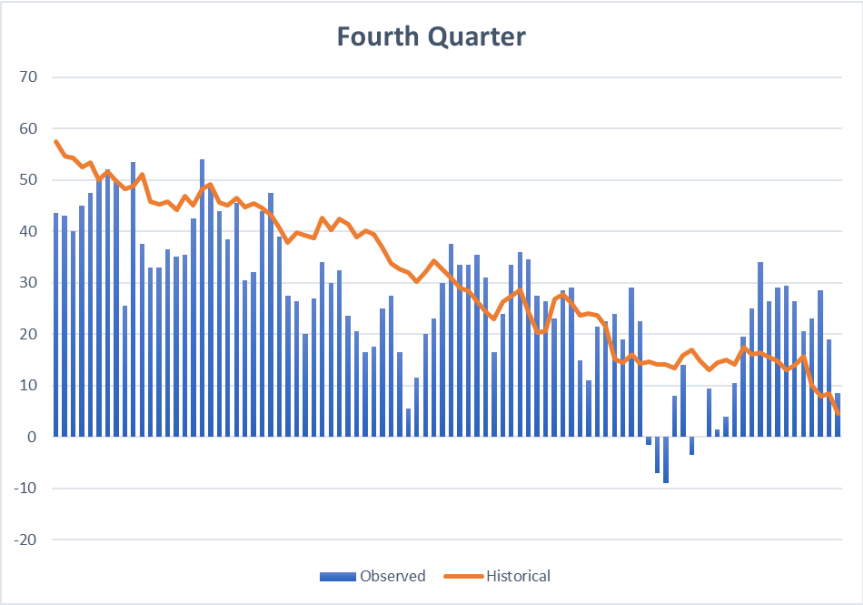


The trend of wet weather continued into August as well. August observed a total of 5.71" of precipitation, about 3.5" greater than the 10-year average. Three rain events producing >1" in 24 hours occurred in August, with several other events <1".

September also observed above average precipitation with a total of 4.88 inches of rain falling during the month, 2 inches greater than the 10-year average. We observed rain on 43 of the 93 days during the third quarter.

Temperatures remained fairly similar to averages if not trending a little cooler. A warm spell towards the end of September brought temperatures above the average for 7 days before returning to seasonable temperatures.

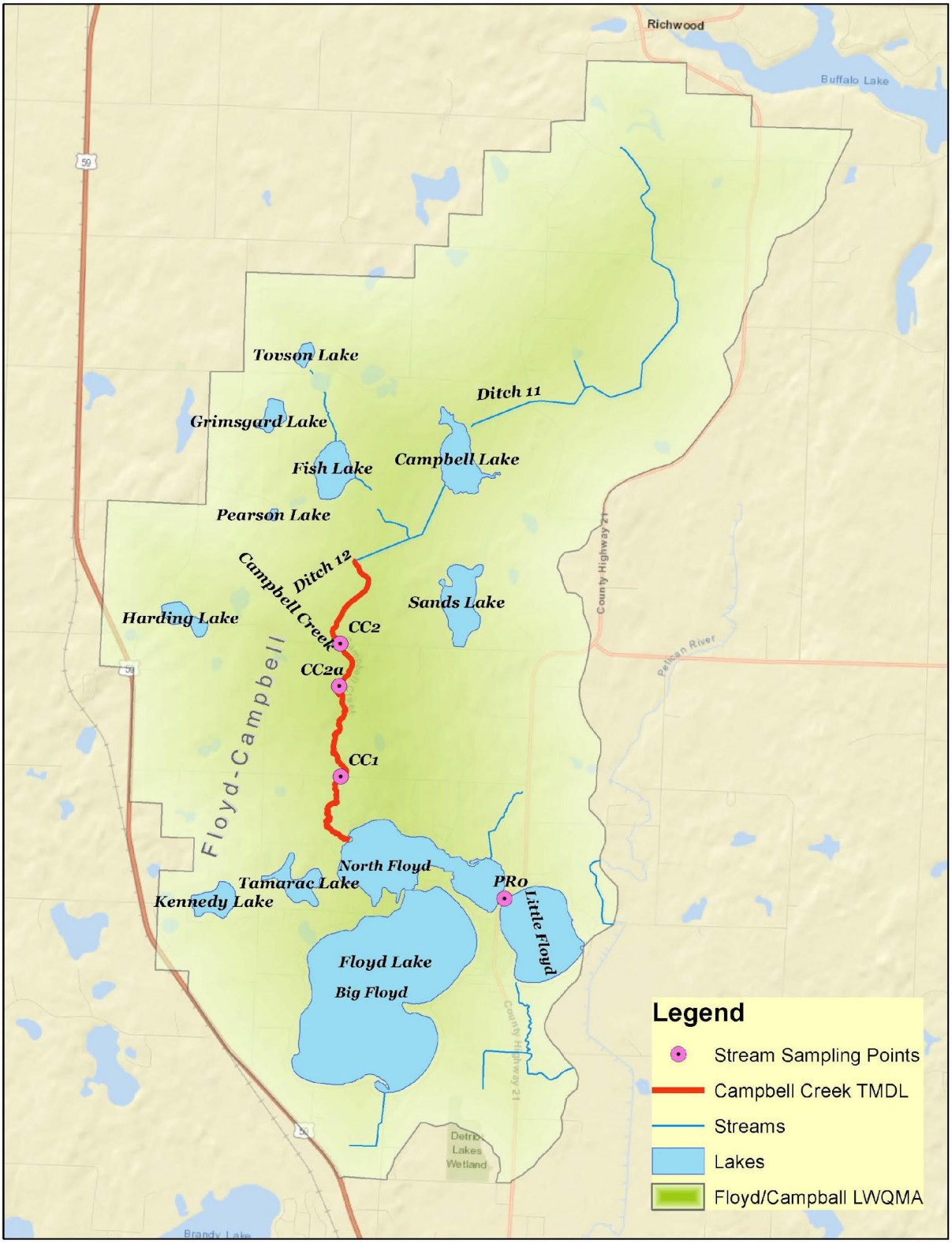
4th Quarter- Cold and Snowy



The first snowfall of the year occurred on October 10th with 3 inches falling in the region. The region observed multiple snowfall events in the last 3 months of the year. We received 8.5" on November 30th and 12" more on December 28th and 29th. There were several smaller events during this period that combined for a year- end total of 31.39".

Ice-on occurred on November 11th, 2 days earlier than last year, and 13 days earlier than the 10-year average of November 24th. Following the late ice out of 2019 on April 25th, (8 days later than the 10-year average) 2019 had 200 days ice free, 21 days less than the average for the last 10 years, and 26 less than the average for 2000-2009. Ice conditions for the season progress poorly. Thick snow cover shortly after ice-on insulated the ice, preventing it from gaining thickness.

Floyd/Campbell Lake Water Quality Management Area



Lakes Monitoring

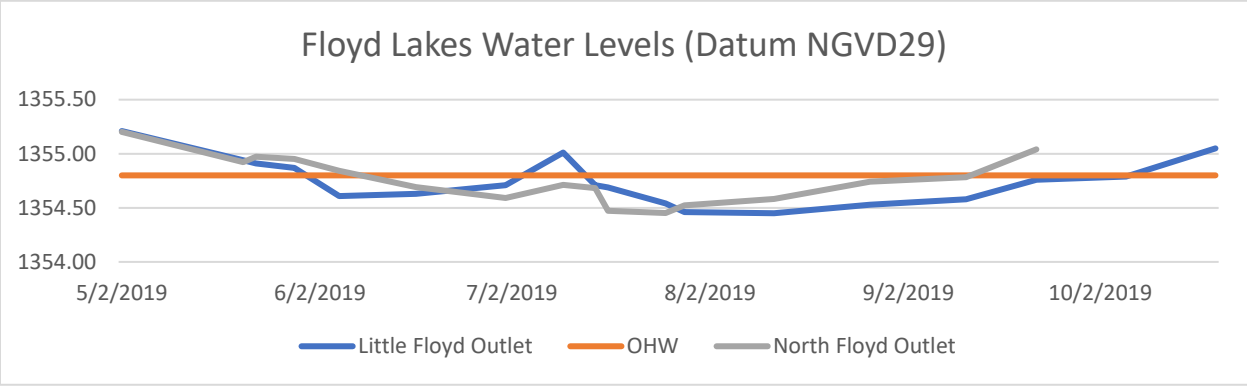
Water Quality

The largest lake in the Floyd/Campbell LWQMA is Floyd Lake. Big Floyd, Little Floyd, and North Floyd are 3 distinct basins of the larger Floyd Lake. North Floyd has historically acted as a "buffer, collecting heavy loads of sediment and phosphorous from Campbell Creek, a channelized drainage to the North. The Floyd Lakes have also been infested with Zebra mussels since 2018. Little Floyd is the natural outlet to the lakes where it drains into the Pelican River and the Detroit/Rice LWQMA.

Floyd/Campbell Sampling Cost			
Sample Type	# of Sample	Sample Cost	Total Cost
TP	77	$ 14.00	$ 1,078.00
OP	77	$ 10.50	$ 808.50
TSS	40	$ 9.00	$ 360.00
CHL-a	24	$ 18.00	$ 432.00
Nitrogen	12	$ 15.00	$ 180.00
Grand Total			$ 2,858.50

Water quality in 2019 continued to remain stable compared to historic averages, if not slightly improved. While loading of sediments and nutrients from Campbell Creek were increased in 2019, it is possible the effects of a growing population of Zebra mussels negated this, maintaining steady water quality. If loading from Campbell Creek decreases in 2020, water quality in the Floyd Lakes should improve.

Floyd/Campbell LWQMA	2019 Average			Historical Averages (1999-2018)			MNPCA Lake Standards		
	TP (Mg/L)	Chl-a (Mg/L)	Sechhi (feet)	TP (Mg/L)	Chl-a (Mg/L)	Sechhi (feet)	TP (Mg/L)	Chl-a (Mg/L)	Sechhi (feet)
Big Floyd	15	4	11.5	15.5	5	11.5	<40	<14	>4.6
North Floyd	28	11	11	32	14.5	8	<40	<14	>4.6
Little Floyd	20	6	11	23.5	9.5	9	<40	<14	>4.6



Stream Monitoring

Campbell Creek/Ditch 11/Ditch 12

Campbell Creek to the North of the Floyd Lakes was channelized form much of its reach in the early 1900's. Since then, channelization has taken its toll on the water quality of the Floyd Lakes through increases in sedimentation. Due to the wet cycle in 2019, Campbell Creek experienced an increase in flows (~125% greater) from 2018. On April 8th, water levels were almost 1ft above the stream gages. This increase of flows increased the loading of sediment and phosphorus to the stream. Phosphorous loads increased by as much as 150% on par with the increases in flows. These loads could be worse if not for the agricultural BMP's installed on farm fields around Campbell Creek through a collaborative project including Becker County Soil and Water Conservation District, National Resource

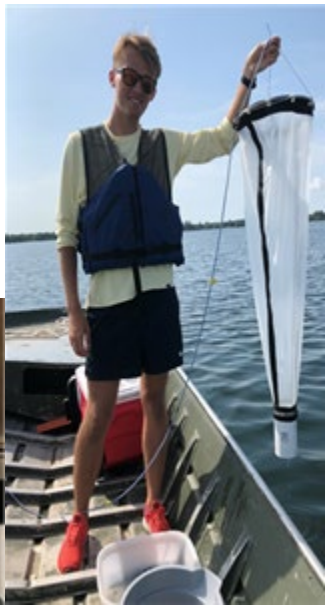
The Sampling at location CC2a occurred to capture the effectiveness of agricultural best management practices applied in the upland between CC2 and CC2a. Sampling at CC2a indicated little change between the two sites in 2019. Samples from previous years had indicated a decrease in TSS between sites, but data may have been skewed by persistent beaver activity and low flows. Data from 2019 generally reflects erosion from multiple large rainfall events correlated with high flows throughout the LWQMA. There may also be high concentrations of phosphorous originating from shallow wetlands in the upland overflowing to the stream from high water tables.

MPCA Intensive Watershed Study Results – TMDL on Campbell Creek.

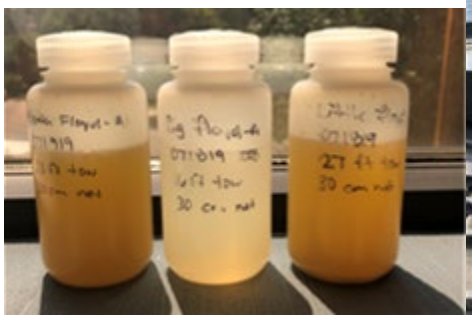
Through the MPCA's intensive watershed study in 2018 and 2019, an impairment due to high sediment loads was found on Campbell Creek. The District has suspected this issue for several years due to high TSS discharged to Floyd Lake. This loading of sediment was suspected to come from erosion on agricultural land in the Campbell Creek Drainage, but after further sampling and study, it was determined sediment was coming from erosion to bank areas due to high water velocity entering a natural meandered section of the stream after leaving ditched areas in the upper drainage. The MPCA will develop a TMDL (Total Maximum Daily Load) for Campbell Creek and work with the District to correct this issue. A TMDL is a document which outlines the source of pollution and what the goal is for the reduction of the pollutant.

Special Projects

Zooplankton Study.



Connor Haugrud was a summer intern in 2019 who was collecting water samples in an effort to investigate the changes in zooplankton populations and density in response to the introduction of Zebra Mussels in the Floyd Lakes. He collected zooplankton samples at three sites on Big Floyd, Little Floyd, North Floyd, and Long Lakes by lowering a net through the water column. Zooplankton are microscopic animals that comprise the base of the food chain for many types of other organisms, such as small fish. The hope of this research is to establish baseline zooplankton populations and see what impacts the introduction of Zebra Mussels has not only on zooplankton populations but on total lake ecology.

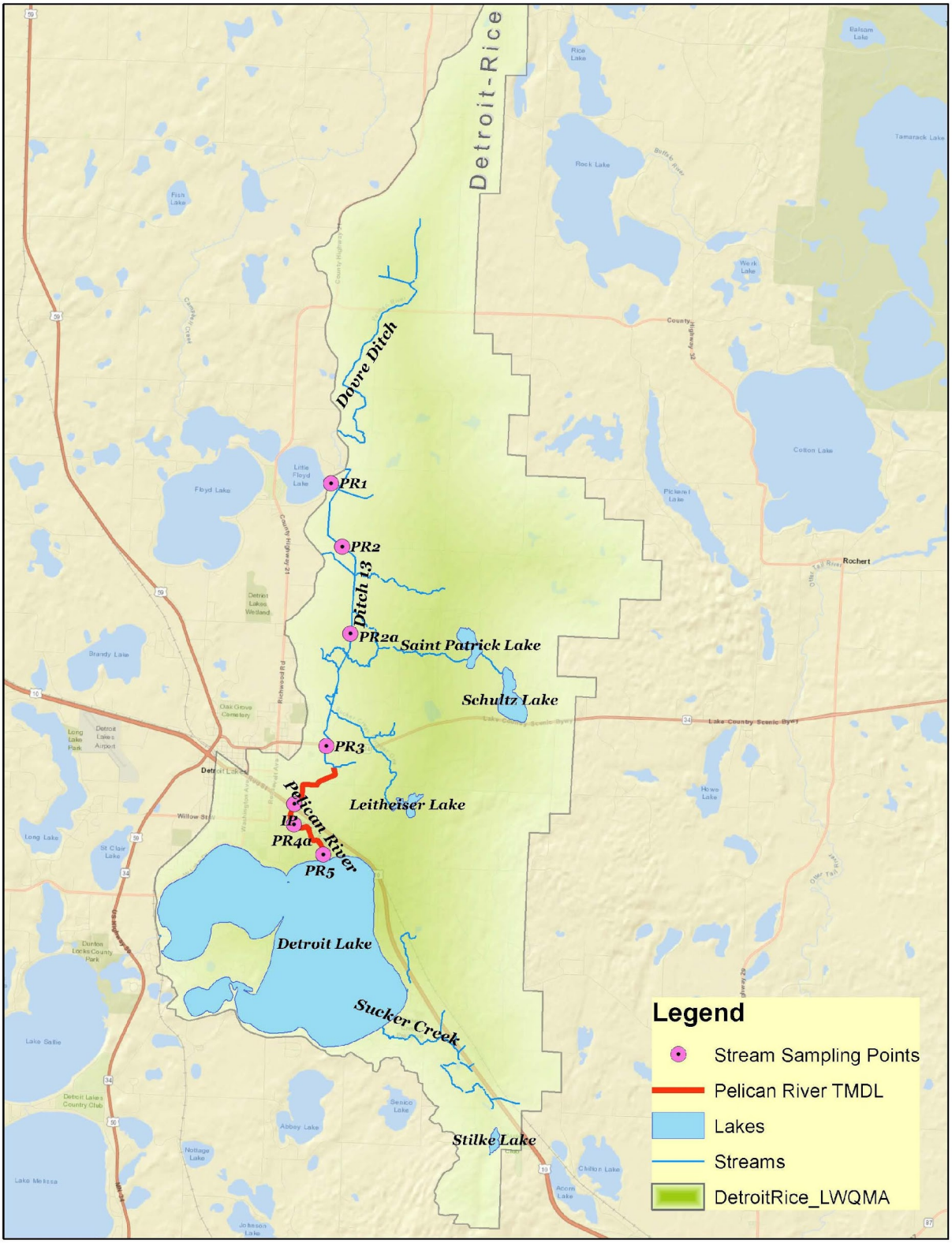


A Look Forward

In the coming years, sampling of the streams in the Floyd/Campbell LWQMA will remain the same. Historic sites will be maintained to track long term changes.. The aquatic vegetation community on the Floyd Lakes will be assessed in 2020 and 2025. Development of the shoreline of the Floyd Lakes will be surveyed in 2021 and 2026. Additional shoreline surveys on Tamarack, Kennedy, and Sands Lakes will occur in 2020 as opportunity arises. The long-term schedule for routine lake sampling will be:

- Floyd Lakes (Big Floyd, North Floyd, and Little Floyd) will be sampled every year.
- Campbell Lake will be sampled in 2020 and 2025;
- Kennedy Lake and Sands Lake will be sampled in 2022 and 2027;
- Tamarack Lake will be sampled in 2023 and 2028.

Detroit/Rice Lake Water Quality Management Area



Lakes Monitoring

Water Quality

Detroit Lake- Little Detroit, Big Detroit, and Curfman

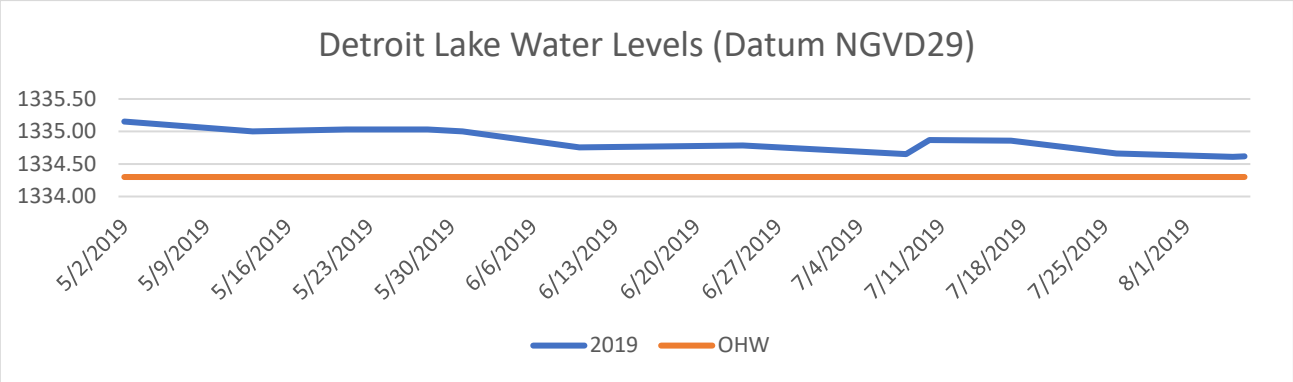
Detroit/Rice Sampling Cost			
Sample Type	# of Samples	Sample Cost	Total Cost
TP	99	$ 14.00	$ 1,386.00
OP	98	$ 10.50	$ 1,029.00
TSS	43	$ 9.00	$ 387.00
CHL-a	16	$ 18.00	$ 288.00
Chlorides	2	$ 10.00	$ 20.00
E-Coli	10	$ 13.00	$ 130.00
Grand Total			$ 3,240.00

Detroit Lake is the main waterbody in the LWQMA. Detroit Lake is divided into 3 distinct basins, Little Detroit, Big Detroit, and Curfman Lakes. Water quality on Detroit has improved in recent years due to an infestation of Zebra Mussels documented in 2016. Zebra mussels tend to increase water clarity while decreasing TP and Chl-a due to the immense amount of water they filter (zebra mussels filter up to 1L water/day/individual). Little Detroit is the shallower of the two Detroit's, with its deepest point at 16ft., Historically, Little Detroit has seen better water quality than Big Detroit, this year being no exception. TP, Chl-a, and secchi numbers were better than the 20-year average. Increases in water quality can be attributed to improvements in shoreline stormwater practices as well as the presence of Zebra mussels.

Sampling on Curfman Lake was limited to a few secchi readings for water clarity. Although not enough data to confidently create a trend for the year, it is worth noting all four observations exceeded the 10-year average, most likely influenced by the effects of Zebra mussels.

Similar to other District lakes, Detroit Lake experienced higher water levels when compared to previous years. The water level of Detroit Lake remained above the OHW for the duration of the sampling season. Excessive rainfall also triggered a spike in bio-available phosphorus (orthophosphate or OP) from the Rice Lake Wetland Complex in early July. A total of 2.04" of rain fell in a 48-hour timeframe triggering a slight decrease in total phosphorous and a slight rise in OP. Heavy rain throughout the summer maintained water levels above the OHW for the entire sampling season.

Detroit/Rice LWQMA	2019 Average			Historical Averages (1999-2018)			MNPCA Lake Standards		
	TP (Mg/L)	Chl-a (Mg/L)	Sechhi (feet)	TP (Mg/L)	Chl-a (Mg/L)	Sechhi (feet)	TP (Mg/L)	Chl-a (Mg/L)	Sechhi (feet)
Big Detroit	17	4	15	25	9	10	<40	<14	>4.6
Little Detroit	15	2.5	15	19.5	5	11	<40	<14	>4.6



Stream Monitoring

Pelican River/Ditch 13

Large amounts of precipitation for the 2019 field season greatly increased stream discharges within the LWQMA. Throughout the seven stream sampling points between Little Floyd Lake and Big Detroit Lake, discharges were 80%-100% higher than years past. These higher discharges tended to flush nutrients throughout the system, and elevated loads were recorded.

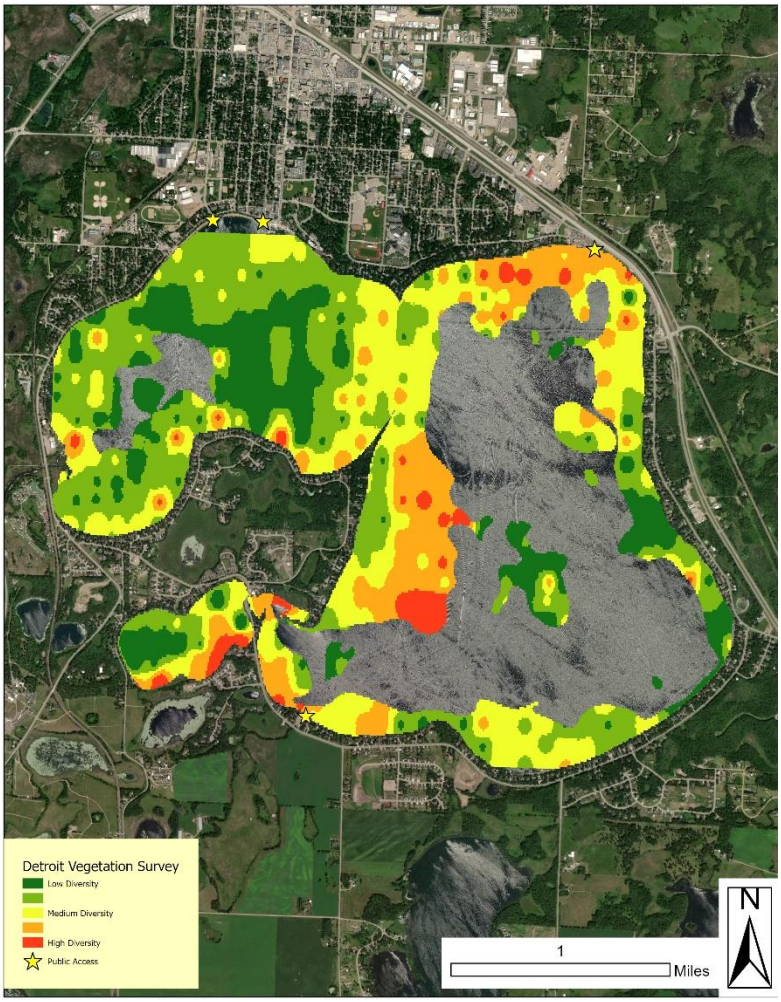
MPCA Intensive Watershed Study Findings – TMDL on Pelican River

A notable finding in 2019 was the Impairment of the Pelican River from Highway 34 to Detroit Lake. After completion of the intensive watershed study conducted by the MPCA in 2018-2019, the MPCA found the waters of the Pelican River were impaired for aquatic life due to a reduction in benthic macroinvertebrates and fish populations. They also found low DO levels and high E. coli loads in this reach. This may be due to extensive alterations to the Pelican River in these areas as well as influences from the drained Rice Lake Wetland Complex. A TMDL (Total Maximum Daily Load) for these pollutants will be developed in 2020 and the District will manage to limit the effects of these impairments. A TMDL is a document which outlines the source of pollution and what the goal is for the reduction of the pollutant.

Special Projects

Vegetation Survey

A vegetation survey of Detroit Lake was performed in early August 2019. A total of 400 data points were sampled and District Staff analyzed the composition of the aquatic vegetation communities. A total of 20 different species were found across the lake. Areas along the North and West Shore of Big Detroit had the most vegetative diversity. The area between Curfman and Big Detroit was also found to have high diversity. As dock density increased, species diversity decreased, while diversity tended to increase as water level decreased. Another notable point is the general lack of diversity across much of Little Detroit, a relatively shallow area. This decrease in productivity may be related to excess recreation throughout the summer months. Little Detroit is heavily utilized for pleasure boating and high impact recreation such as tubing and water skiing. These forms of recreation disturb plant growth and sediments. It may be pertinent to survey lake use to correlate high rates of recreation with decreases in aquatic vegetation.



The District does perform extensive treatments on Curly-leaf Pondweed and Flowering Rush, both aquatic invasive species in Detroit Lake. The low densities in this survey are likely due to the timing of the survey. This survey occurs after the early summer chemical treatments, therefore limiting the occurrence of these species.

Site Diversity		AIS Present	
Diversity	Sites	Species	Sites Present
0-2 Species	189	Curly-Leaf Pondweed	3
3-5 Species	171	Flowering Rush	0
6-8 Species	39		
>9 Species	1		

Species/Site		Most Common Species	
Species Present	# of Sites	Species	Sites
0	18	Chara	325
1	77	Common Bladderwort	144
2	94	Northern Watermilfoil	120
3	64	Water Celery	109
4	58	Water Moss	88
5	49		
6	23		
7	9		
8	7		

Zooplankton Study

In cooperation with the MNDNR, the District participated in a study of the effects of Zebra mussels on the populations of zooplankton in Lake Detroit as well as several other District Lakes. Information in this study must be compared to several years of data to determine any trends in populations. After 5+ years of data, trends will be extrapolated to assess the effects of Zebra mussels (sampling began in 2016).

Chloride Sampling

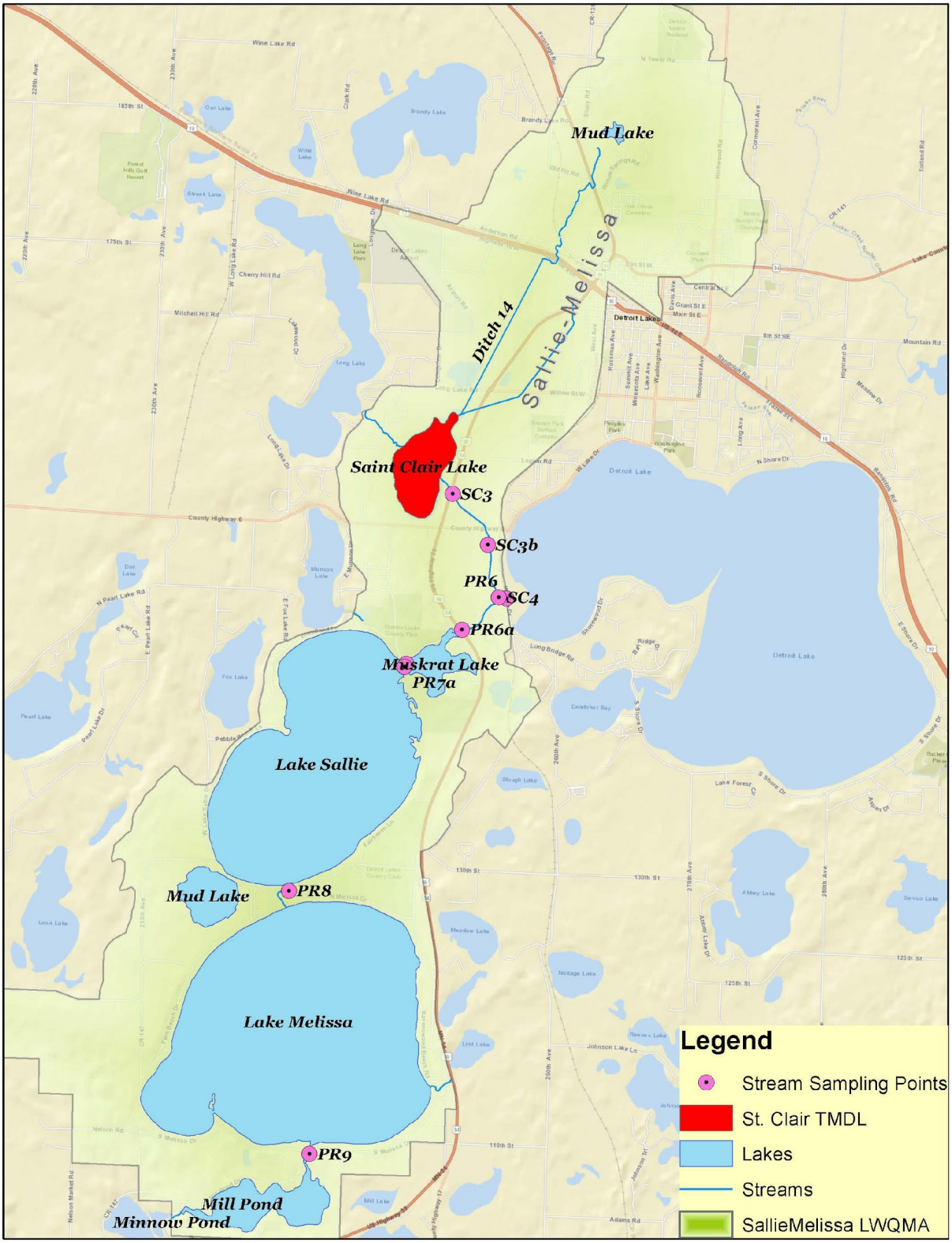
During spring melt, the District sampled for chlorides (salt) from the Pelican River to Detroit Lake. Samples were collected on May 2 and 21st, with concentration results of 18.3 ppb and 5.9 ppb respectively. Both results were well below impairment levels and no further tests were collected.

A look Forward

Historic stream sampling sites will be maintained to track long term trends. A few sampling sites will be added in 2020 to more closely track changes to District Waters. A site will be added on Dovre Ditch (North of Rice lake and Floyd Lake to replace the abandoned site on Anchor Road (Anchor Road will be abandoned due to flooding issues from Rice Lake Project), and a site will be added on Sucker Creek to act as a reference point for other District Streams. The aquatic vegetation community on the Detroit Lakes will be assessed in 2024 and 2029. Development of the shoreline of the Detroit Lakes will be surveyed in 2023 and 2028. The long-term schedule for routine lake sampling will be:

- Detroit Lake (Big Detroit, Little Detroit) will be sampled every year
- Curfman Lake will be sampled in 2020 and 2025;
- Saint Patrick Lake will be sampled in 2022 and 2027;
- Schultz Lake will be sampled in 2023 and 2028.

Sallie/Melissa Lake Water Quality Management Area



Lakes Monitoring

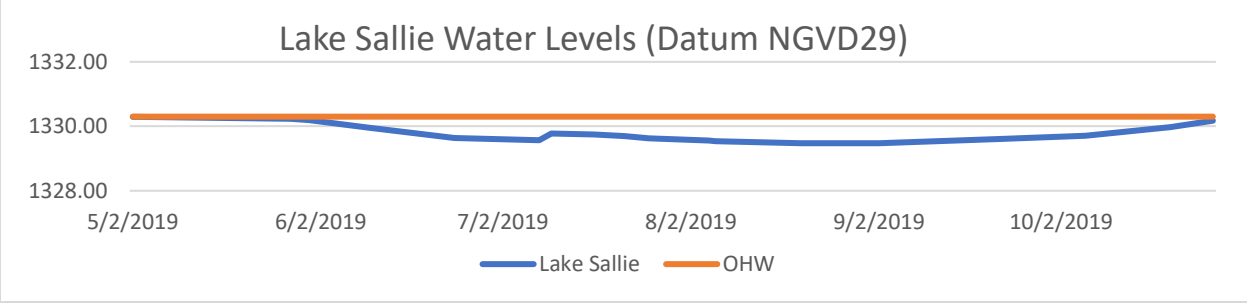
Water Quality

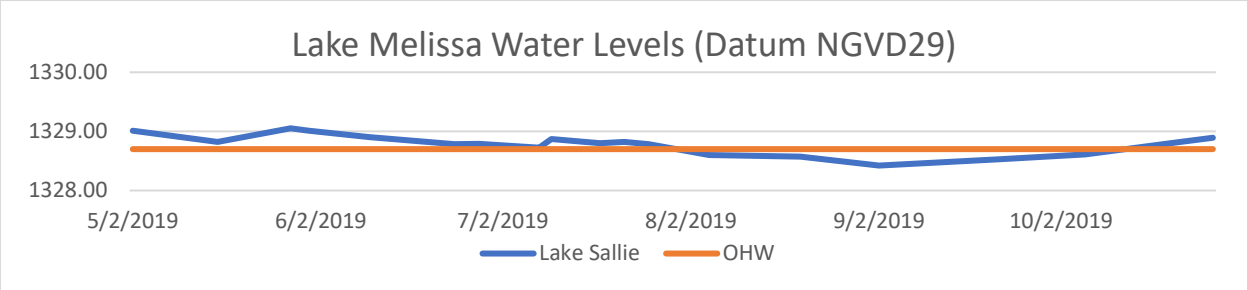
Sallie/Melissa Sampling Cost			
Sample Type	# of Sample	Sample Cost	Total Cost
TP	101	$ 14.00	$ 1,414.00
OP	101	$ 10.50	$ 1,060.50
TSS	13	$ 9.00	$ 117.00
CHL-a	32	$ 18.00	$ 576.00
Chlorides	14	$ 10.00	$ 140.00
Grand Total			$ 3,307.50

Water quality in the Sallie/Melissa LWQMA continues to follow the trends observed in the other District lakes infested with Zebra Mussels. Average secchi depth for both Lake Sallie and Lake Melissa increased by as much as 7 ft when compared to 2018 averages. The average reading on Lake Sallie (14.5') marks the deepest average secchi depth in the last 20 years. The same can be said for Melissa, (17') save for a similar reading in 2017. Phosphorous in these lakes follows a similar trend, with readings well below the 20-year average.

Although concentrations are much higher, Lake St. Clair still observed an improvement in water quality compared to the 20-year average. St. Clair has been listed as an impaired water since 2016. The long history of pollution in St. Clair creates a unique set of issues for the PRWD and local partners to manage. Historically, Alum treatments has controlled internal loading of phosphorous, with periodic treatments required. With a new wastewater treatment plant constantly discharging into the lake, there are concerns of mixing and flushing of sediments. Complaints of high water in 2019 led the district to observe rates of discharge from the treatment facility. It was determined the high water levels were not from the treatment facility, but due to high precipitation amounts.

Sallie/Melissa LWQMA	2019 Average			Historical Averages (1999-2018)			MNPCA Lake Standards		
	TP (Mg/L)	Chl-a (Mg/L)	Sechhi (feet)	TP (Mg/L)	Chl-a (Mg/L)	Sechhi (feet)	TP (Mg/L)	Chl-a (Mg/L)	Sechhi (feet)
Sallie	21.5	4.5	14.5	34	14.5	7.5	<40	<14	>4.6
Melissa	15.5	3.5	17	21	7.5	10.5	<40	<14	>4.6
St. Clair*	82	42.5	3	88	43	3	<60	<20	>3.3





Stream Monitoring

Discharge of nutrients from Lake St. Clair has concerned the District for many years, but due to a lack of knowledge on overall discharge from Ditch 14 to the Pelican River, PRWD is unable to accurately calculate loading from Lake St. Clair to the Pelican River and beyond. Channel and flow regime characteristics (back flows and flows inconsistent with level) make estimating flow from water level difficult. Concentrations of phosphorous from Ditch 14 remain elevated but are relatively stable compared to previous years. It may be theorized with an increase in water levels and maintenance of concentrations, loads to the Pelican River would be increased 2019, but we are unsure of how much.

Special Projects

Zooplankton Study

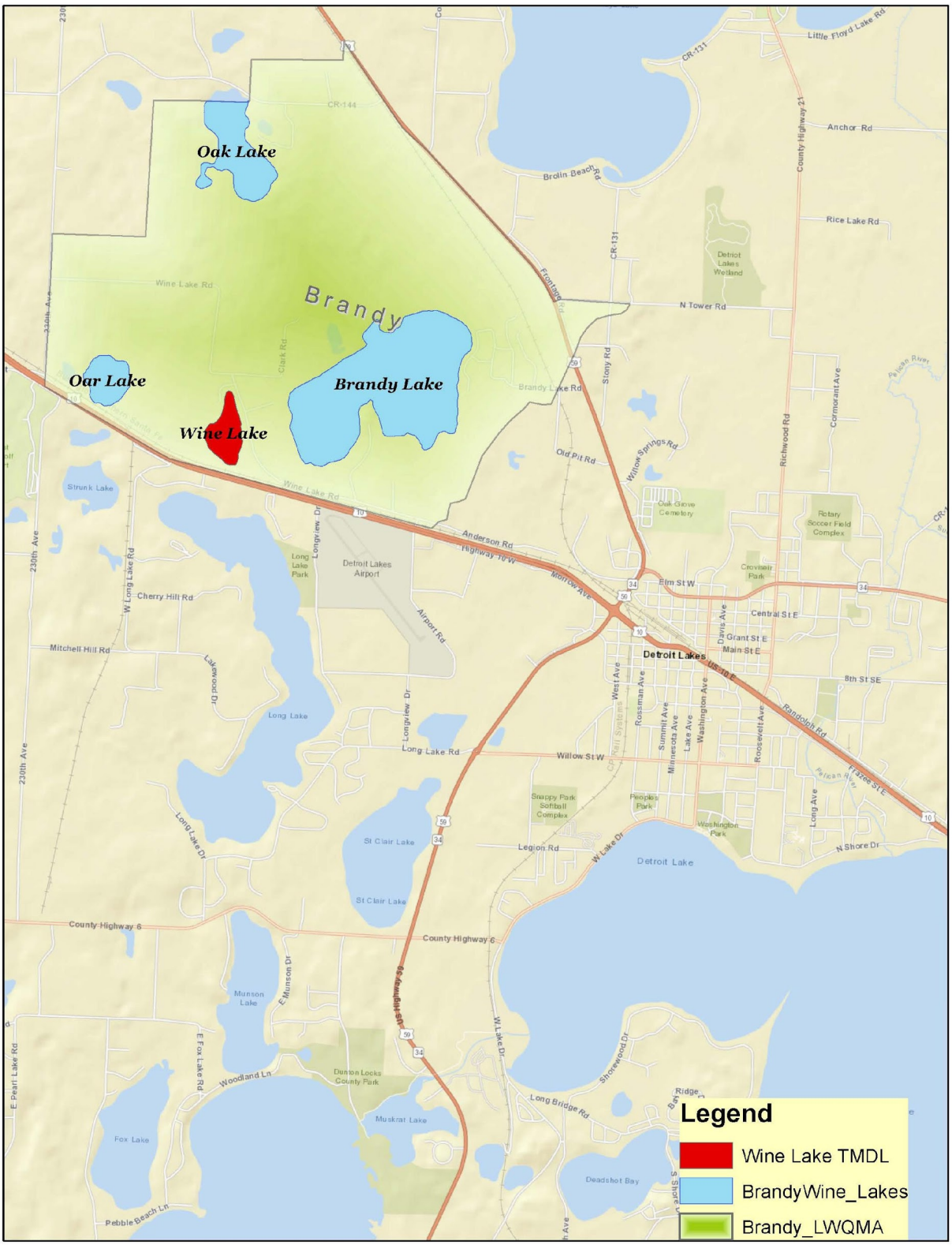
In cooperation with the MNDNR, the District participated in a study of the effects of Zebra mussels on the populations of zooplankton in several District Lakes, including Lake Sallie and Lake Melissa. Information in this study must be compared to several years of data to determine population trends. After 4-5 years of data, trends will be extrapolated to assess the effects of Zebra mussels (sampling began in 2017).

A Look Forward

Stream sampling will remain the same except the abandonment of 1 site on the Pelican River (PR7) due to redundancy. No additional sites will be added. The aquatic vegetation community of Sallie and Melissa lakes will be assessed in 2021 and 2026, and Mill Pond and Muskrat will be assessed in 2022 and 2027. Development of the shorelines of Sallie and Melissa Lakes will be surveyed in 2022 and 2023, and Muskrat will be surveyed in 2020 and 2025. The long-term schedule for routine lake sampling will be:

- Sallie, Melissa, and St. Clair Lakes will be sampled every year;
- Muskrat Lake will be sampled in 2021 and 2026;
- Mill Pond will be sampled in 2023 and 2028.

Brandy/Wine Lake Water Quality Management Area



New TMDL for 2020

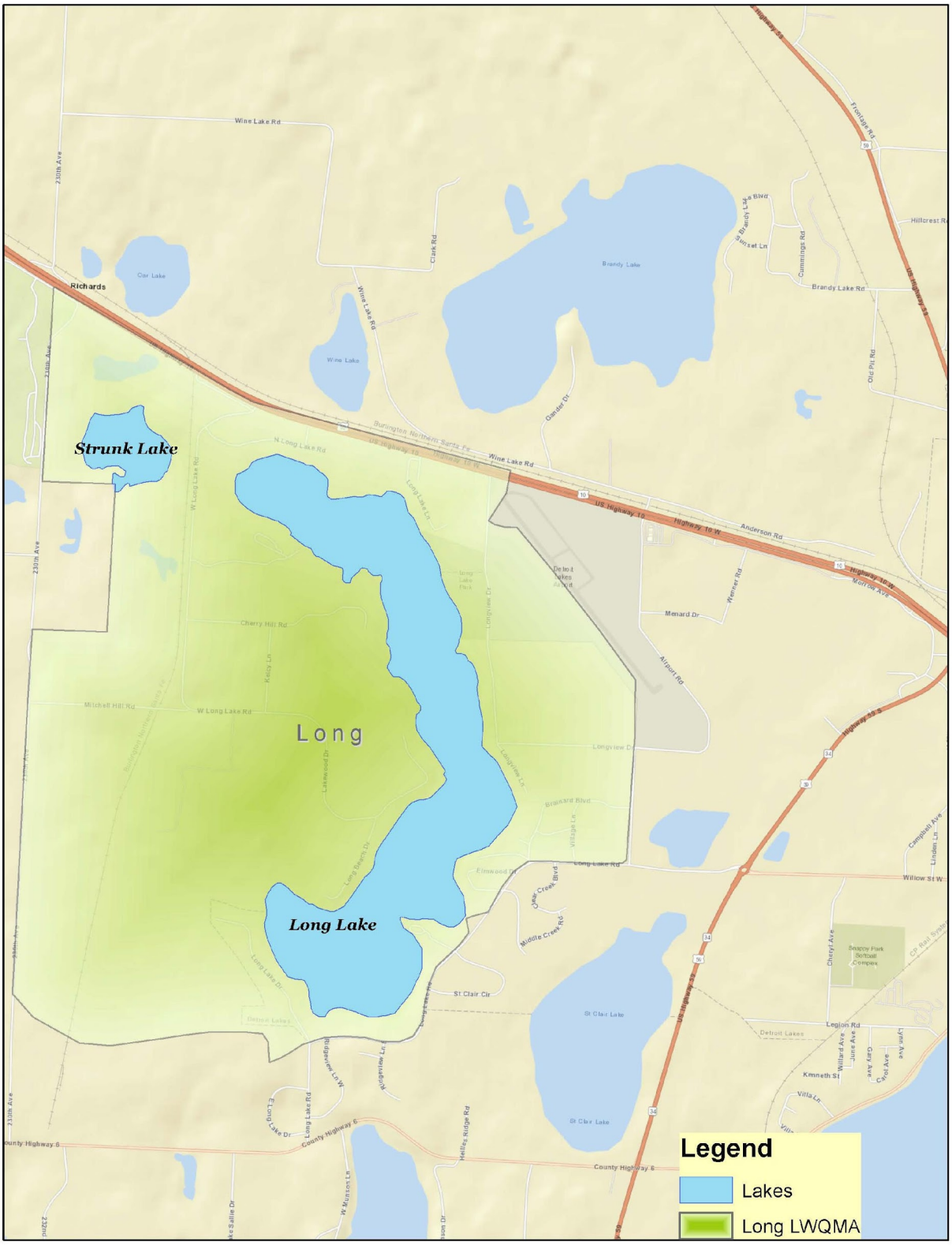
While the District did not complete any water quality sampling for Wine Lake in 2019, The MPCA did compile historic data and analyzed the condition of the lake. This study revealed the Lake was in exceedance of the standards set for water quality for lakes in the State of Minnesota. The MPCA will compile a TMDL for Wine lake in 2020 and publish the reduction goals for nutrients in the system. A TMDL (Total Maximum Daily Load) is a document which outlines the source of pollution and what the goal is for the reduction of the pollutant.

Looking Forward

There are no streams sampled in this LWQMA. The long-term schedule for routine lake sampling will be:

- Oak Lake will be sampled in 2020 and 2025;
- Brandy Lake will be sampled in 2022 and 2027;
- Wine Lake will be sampled in 2023 and 2028.

Long Lake Water Quality Management Area



Lakes Monitoring

Long Sampling Cost			
Sample Type	# of Sample	Sample Cost	Total Cost
TP	8	$ 14.00	$ 112.00
OP	8	$ 10.50	$ 84.00
CHL-a	8	$ 18.00	$ 144.00
Nitrogen	4	$ 15.00	$ 60.00
Grand Total			$ 400.00

Water Quality

Long lake experienced a similar trend of other District lakes of slightly improved water quality in 2019. Phosphorous values decreased from the 20-year average slightly while secchi depth increased by almost 5 feet. Long lake has historically experienced better water quality than other District Lakes. It's long and narrow shape, orientated North to South, limits wind mixing from prevailing Westerly Winds. The lake stayed stratified for the entire 2019 sampling season with anoxic conditions persistent in the deepest parts until the middle of August when sampling ceased. This intense stratification limits mixing of phosphorous rich bottom sediments into the water column during warm water months, limiting algal growth. An increase of chlorophyll-a was observed in mid-September, but the temperature/dissolved oxygen profile was not sampled. This may indicate the approximate timing of the fall turnover, but we cannot be completely sure when this happened. This spike in chlorophyll at the end of the year raised the seasonal average slightly above the 20-year average (0.5 Mg/L).

Long LWQMA	2019 Average			Historical Averages (1999-2018)			MNPCA Lake Standards		
	TP (Mg/L)	Chl-a (Mg/L)	Sechhi (feet)	TP (Mg/L)	Chl-a (Mg/L)	Sechhi (feet)	TP (Mg/L)	Chl-a (Mg/L)	Sechhi (feet)
Long	10	4.5	18	13.5	4	13.5	<40	<14	>4.6

Diatom Bloom.

Long Lake experienced a diatom bloom in the early months of the year. Diatoms are cold water algae which grow in the winter months in contrast to the green algae seen in summer algal blooms, which grow in warmer water. A diatom bloom is similar to an algal bloom in that microscopic organisms experience a period of exponential growth triggered by an excess of resources and little competition. Residents reported brownish water and decreased clarity for a period of time. District staff investigated the bloom but did not take any water quality samples. The Diatom bloom did not have any immediate effects to the biotic community but may have led to decreased dissolved oxygen in the lake throughout the summer. When compared to the last temperature/dissolved oxygen profile for the lake in 2017, dissolved oxygen was slightly decreased in 2019.

Zooplankton Sampling

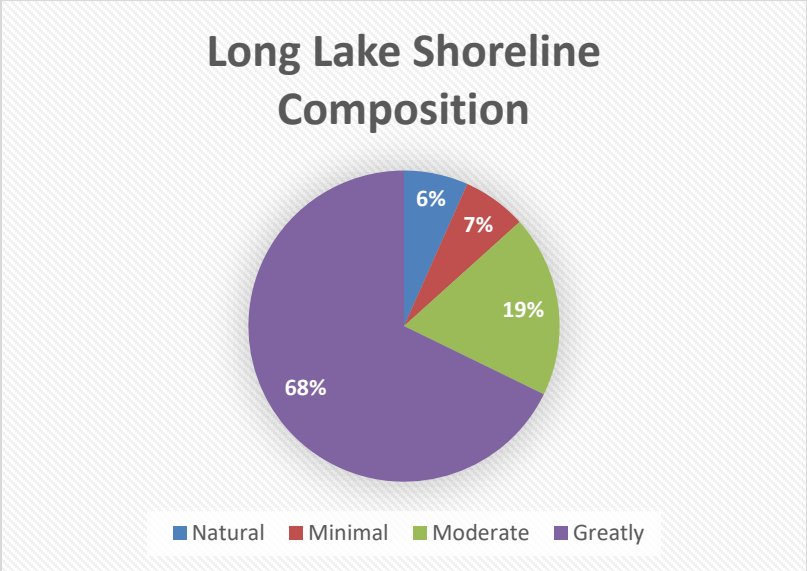
Connor Haugrud was a summer intern in 2019 who was collecting water samples in an effort to investigate the changes in zooplankton populations and density of a lake not infested with zebra mussels. Zooplankton are microscopic animals that comprise the base of the food chain for many types of other organisms, such as small fish He collected zooplankton samples at three sites on Long Lake by lowering a net through the water column.

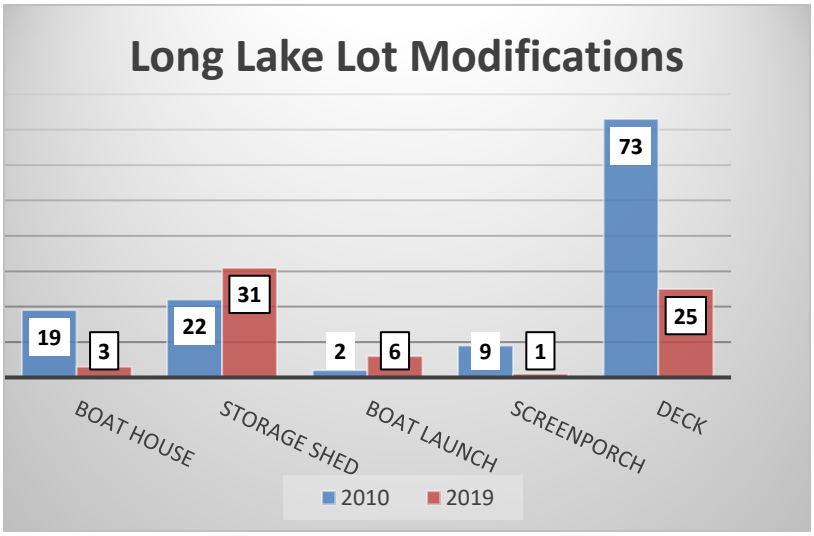
Special Projects

Shoreline Survey- 180 Parcels

The last shoreline survey on Long Lake was completed in 2010, and due to the tremendous amount of development, the number of "greatly modified" lots has jumped 230%. With increased development, comes increased equipment, signifying increased recreational use of the lake. Fortunately, development is progressing in a sustainable manner, indicating that the District's permitting program is effective. Structures in the SIZ have decreased since 2010, of note is the large decrease of decks, while only storage sheds and boat launches have increased slightly.

Development on Long Lake has increased for a few reasons. Resorts and campgrounds closing on the lake have led the way for residential development. The City of Detroit Lakes has also since annexed Long Lake into the City, bringing City Utilities and sewer systems to the region, allowing for easier development.



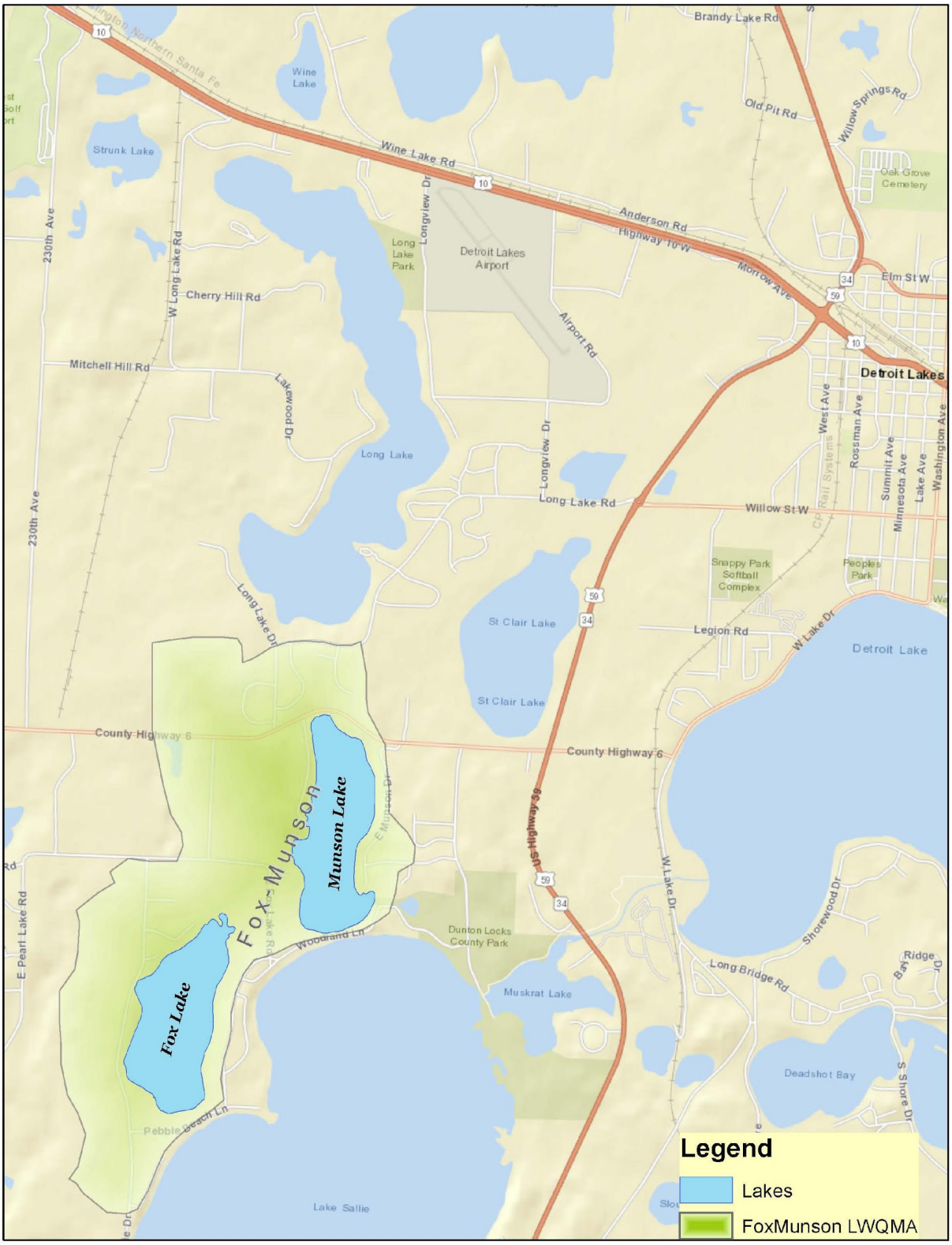


Looking Forward

No streams are sampled in the Long LWQMA, but water quality on Long Lake will be sampled in 2023 and 2028. The aquatic vegetation community will also be sampled in 2023 and 2028. Development of the shoreline will be sampled in 2024 and 2029.

Alteration of Shoreline by lot				
	Natural	Minimal	Moderate	Greatly
2019 Lots	13	12	34	121
Percentage of total	7%	7%	19%	68%
2010 Lots	23	64	59	37
Change from 2010	-48%	-81%	-42%	230%

Fox/Munson Lake Water Quality Management Area



Lakes Monitoring

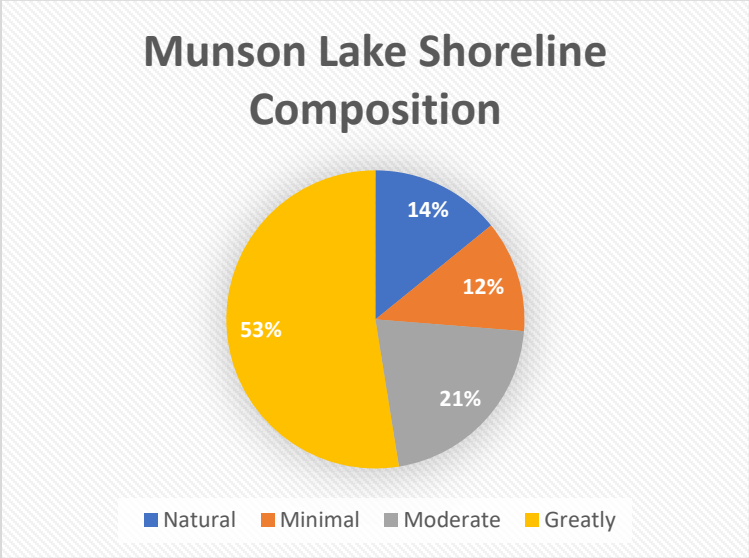
Fox/Munson Sampling Cost			
Sample Type	# of Sample	Sample Cost	Total Cost
TP	14	$ 14.00	$ 196.00
OP	14	$ 10.50	$ 147.00
CHL-a	14	$ 18.00	$ 252.00
Grand Total			$ 595.00

Water Quality

Water quality in Munson and Fox Lakes improved slightly in 2019. When compared to the 20-year average, TP values decreased by about one to five Mg/L while secchi depth increased. A few different factors may have influenced this increase in water quality. Munson and Fox lakes are relatively small lake sheds with little to no surface connection to other waters, meaning runoff is not a large contributor of nutrients. Even with the large rainfall events of 2019, there are enough natural areas around the lakes to buffer potential pollutants.

Fox/Munson LWQMA	2019 Average			Historical Averages (1999-2018)			MNPCA Lake Standards		
	TP (Mg/L)	Chl-a (Mg/L)	Sechhi (feet)	TP (Mg/L)	Chl-a (Mg/L)	Sechhi (feet)	TP (Mg/L)	Chl-a (Mg/L)	Sechhi (feet)
Fox	12	4.5	13.5	13.5	4	12.5	<40	<14	>4.6
Munson	15.5	7	11	20	6	10.5	<40	<14	>4.6

Shoreline Survey – Munson Lake – 93 Parcels



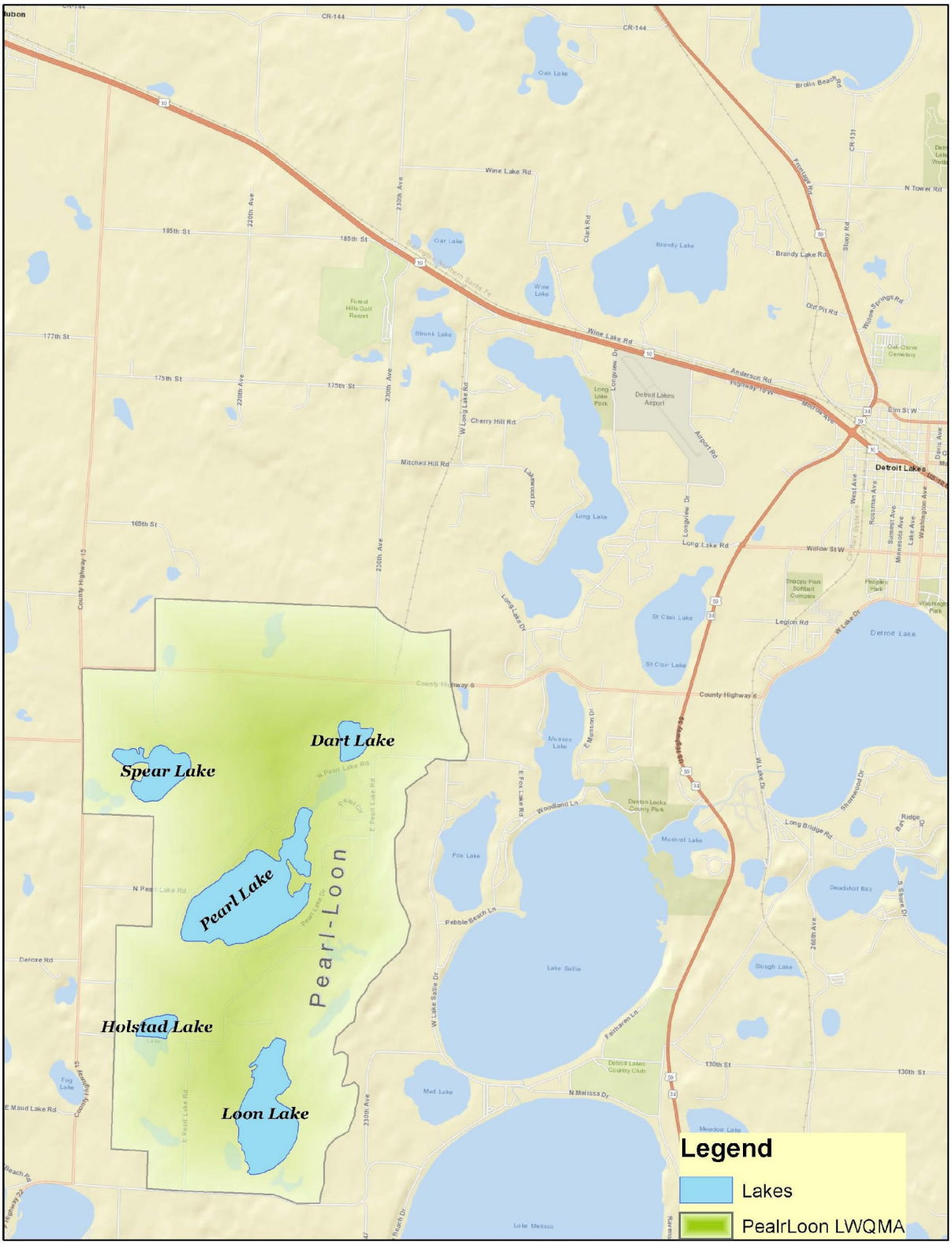
A shoreline survey was completed on Munson in 2019, but the most recent one before this was in 2004. Because of the different sampling protocols established in the past 15 years, the data was non-comparable. The 2019 survey data will serve as a baseline going forward.

Munson has been highly developed, with 53% of sites being "greatly modified". Like other District lakes, development on Munson has increased greatly. Development has focused on the Northern part of the lake, with some on the isthmus between Munson and Sallie. A large natural area has been left undeveloped on the West side of the lake due to a large wetland found there.

Looking Forward

No streams are sampled in the Fox/Munson LWQMA. The vegetative community of Fox Lake will be assessed in 2022 and 2027, and Munson will be done in 2023 and 2028. The shoreline of Fox Lake will be surveyed in 2020 and 2025, and Munson will be surveyed in 2024 and 2029. Water quality testing of Fox and Munson will occur in 2024 and 2029.

Pearl/Loon Lake Water Quality Management Area



Shoreline Survey- Pearl Lake- 92 Parcels

Pearl Lake is a relatively small lake on the Western peripheral of the District. Since the last survey in 2010, development has increased. The number of greatly modified lots has increased by 54% while the number of natural lots has decreased by 5%. That being said, Pearl lake still retains 35% of its lots as minimally modified. The Lake also experienced an increase in non-motorized watercraft and a decrease in motorized watercraft, signifying more low-impact recreation such as paddleboards and kayaks.

Water Quality

No Lakes in the Pearl/Loon LWQMA were sampled in 2019. *This speaks to the importance of expanding the Citizen Monitoring Program.*

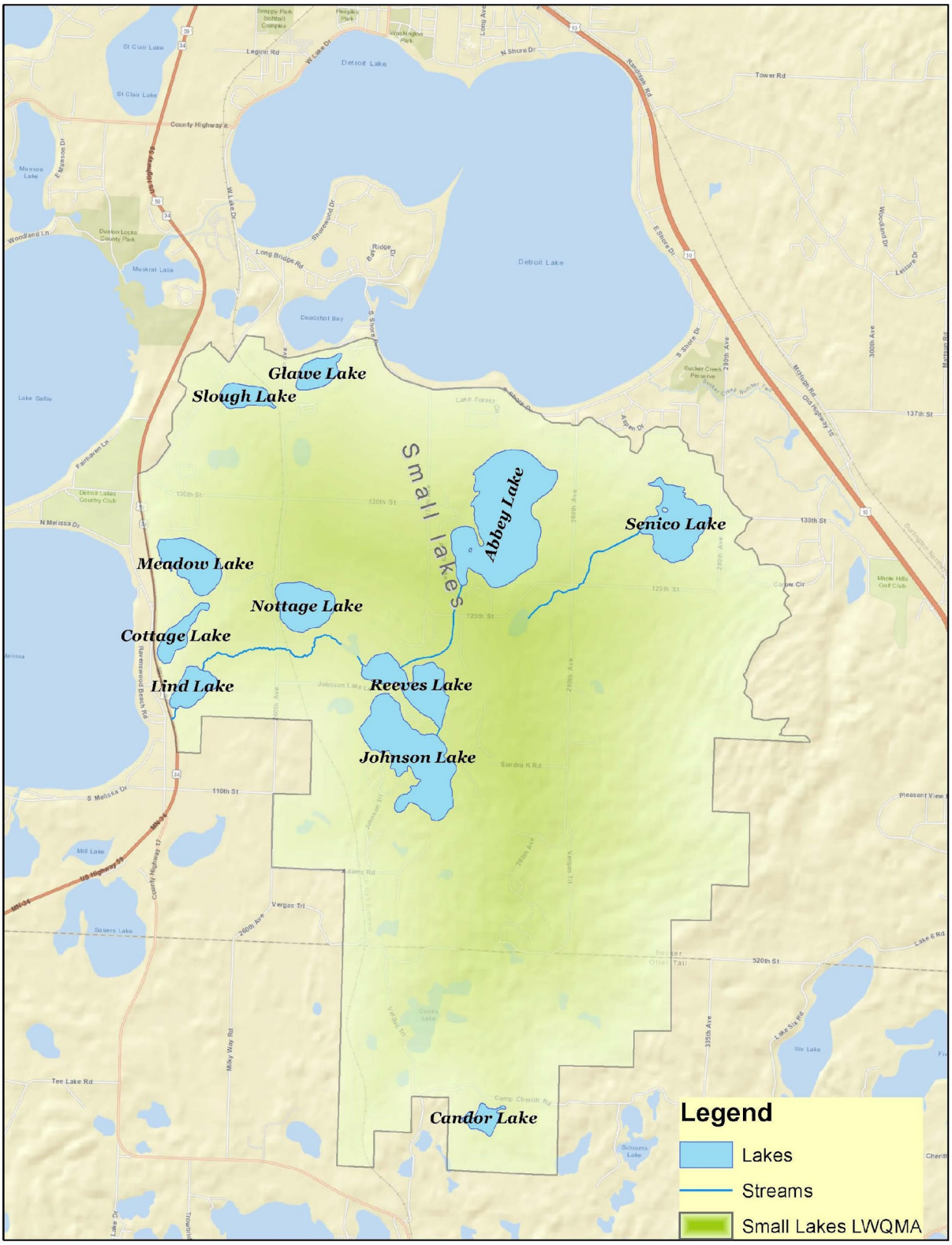
Pearl – CLP

Looking Forward

No streams are sampled in the Pearl/Loon LWQMA. The aquatic vegetative community of Pearl Lake will be assessed in 2023 and 2028. Development of the shoreline of Pearl Lake will be surveyed in 2024 and 2029. The long-term schedule for routine lake sampling will be:

- Loon and Spear Lakes will be sampled in 2020 and 2025;
- Pearl and Dart will be sampled in 2021 and 2026.

Small Lakes Lake Water Quality Management Area



Lakes Monitoring

Small Lakes Sampling Cost			
Sample Type	# of Sample	Sample Cost	Total Cost
TP	24	$ 14.00	$ 336.00
OP	24	$ 10.50	$ 252.00
CHL-a	24	$ 18.00	$ 432.00
Grand Total			$ 1,020.00

Water Quality

Abbey Lake experienced a great year for water quality. With TP and Chl-a nearly half the 20-year average. Secchi depth was also improved, but not as much as TP and Chl-a. Water quality has greatly improved in the lake over the last 10 years from nearly impaired status. The District is unsure what is causing this and will investigate in the coming years.

Johnson and Reeves Lakes are two connected lakes to the Southwest of Abbey Lake. They are relatively natural lakes that historically have good water quality, which did not change in 2019. Johnson and Reeves follow the general trend seen in the other lakes of slightly improved water quality, with secchi depth remaining constant. With little development around these lakes and no inlet, this is expected to continue.

Small Lakes LWQMA	2019 Average			Historical Averages (1999-2018)			MNPCA Lake Standards		
	TP (Mg/L)	Chl-a (Mg/L)	Sechhi (feet)	TP (Mg/L)	Chl-a (Mg/L)	Sechhi (feet)	TP (Mg/L)	Chl-a (Mg/L)	Sechhi (feet)
Abbey	24	8	7	50	15.5	4.5	<60	<20	>3.3
Johnson	20.5	7	9	24.5	7.5	8.5	<40	<14	>4.6
Reeves	23	9	10	26.5	9	10	<40	<14	>4.6

Looking Forward

No streams are sampled in the Small Lakes LWQMA. The aquatic vegetation community of Meadow Lake will be sampled in 2022 and 2027. Development of the shorelines of lakes in the LWQMA will be surveyed as opportunity arises. The long-term schedule for routine lake sampling will be:

- Meadow Lake will be sampled in 2020 and 2025
- Glawe Lake will be sampled in 2021 and 2026
- Lind Lake will be sampled in 2023 and 2028
- Abbey, Johnson, and Reeves Lakes will be sampled in 2024 and 2029