2023 Integrated Pest Management Plan (IPM Plan)

FOR COMMON CARP

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Integrated Pest Management Plan (IPM)
For Common Carp

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Table of Contents

2023 Integrated Pest Management Plan for Common Carp

Executive Summary

1.0 Description of Watershed

Located within Scott County, the Prior Lake-Spring Lake Watershed District (PLSLWD) lies in the Minnesota River Basin in the southwestern portion of the Twin Cities metropolitan area and covers roughly 42 square miles of land area with over 2,500 acres of open water (Figure 1). Spring Lake, Upper Prior Lake and Lower Prior Lakes are the largest waterbodies within the PLSLWD and provide boating, fishing and other recreational opportunities. Spring Lake is connected by a natural channel to Upper Prior Lake which discharges to Lower Prior Lake which then outlets through a channel to the Minnesota River. All three lakes receive intense recreational pressure year-round and are important recreational resources to the Twin Cities metro area.

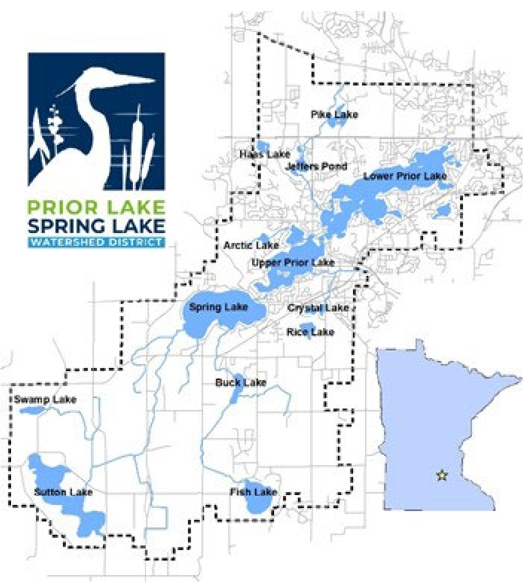


Figure 1. PLSLWD Map

The protection and restoration of Spring and Prior Lakes are high priorities for the PLSLWD and are considered Priority Lakes by the Metropolitan Council for their high regional recreation value. A DNR public boat landing is located on each of the lakes, in addition to winter access points. Sand Point, a swimming beach on the north shore of Lower Prior Lake, boasts as much as 48,000 visitors each year. Open water activities on the lakes include fishing, boating, paddling, water skiing, jet skiing, sailing, wake boarding, and swimming. During the winter when the lake is ice-covered, recreational activities include snowmobiling, ice fishing, skating, and cross-country skiing.

Since 1970, the PLSLWD has strived to conserve, protect, and manage the water resources within the PLSLWD and have implemented a variety of projects aimed to improve water quality.

The aerial map in Figure 2 and highlights the waterbodies and wetland areas that carp may be present and/or use as spawning areas.

1.1 Lakes

While there are 14 lakes within the PLSLWD, this IPM Plan is focused only on those eight connected waterbodies that are known carp migration routes and/or are suspected to contain common carp as shown in Figure 2 below (Fish, Buck, Spring, Arctic, Upper Prior, Lower Prior, Jeffers Pond & Pike Lakes). An overview of each carp management lake detailing the status of the water quality, fishery, and aquatic vegetation is listed below.

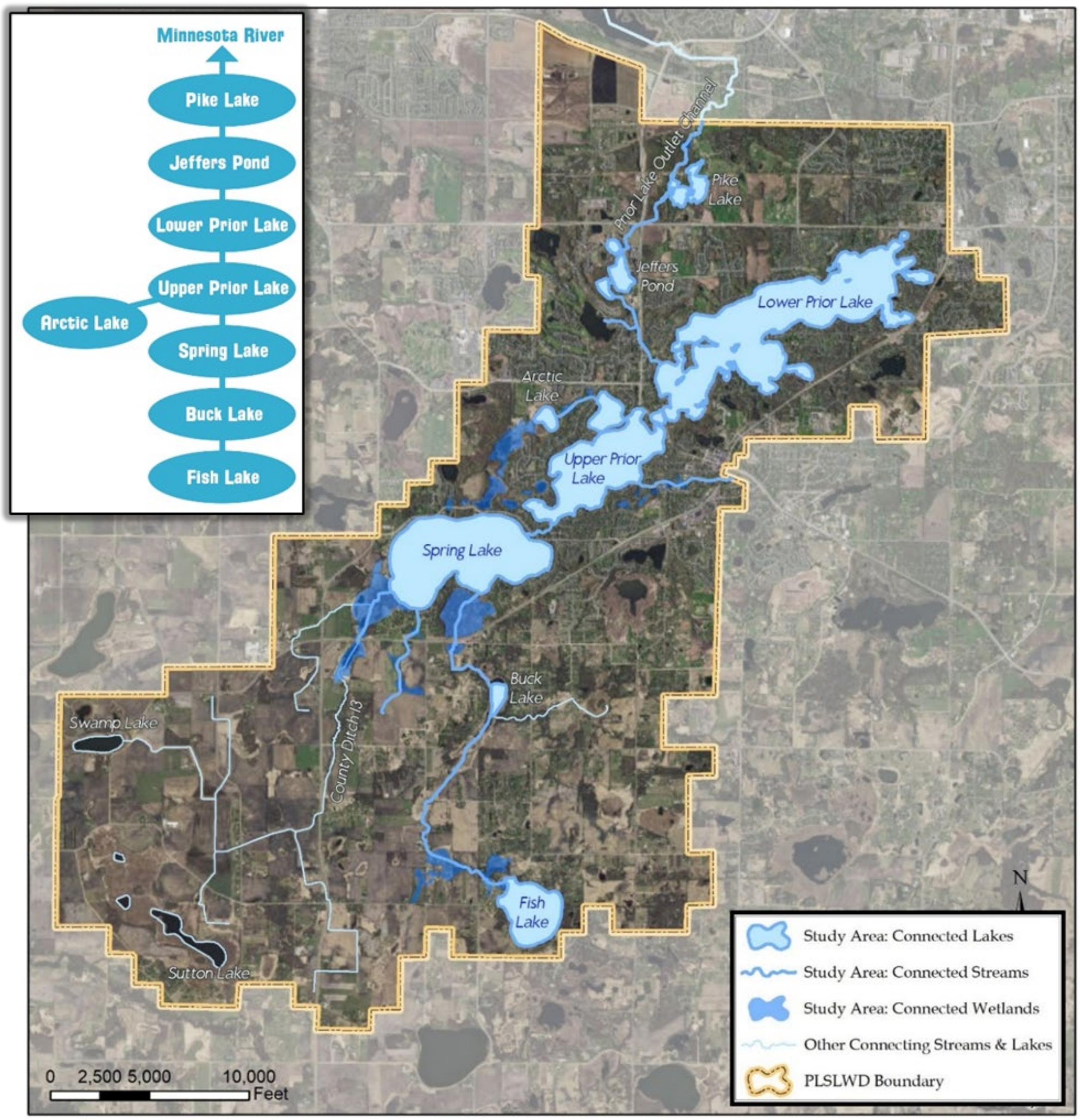


Figure 2. PLSLWD aerial boundary showing connected waterbodies

1.1.1 Fish Lake

Fish Lake is a relatively small lake found in the upper watershed. Fish Lake is approximately 173 acres, has an average depth of 14 feet, and a maximum depth of 28 feet. Roughly 74 acres or 43% of the lake is considered littoral. Fish Lake is a seepage lake, meaning that there is no direct inflow to Fish Lake; rather, the hydrologic contribution is from watershed runoff and groundwater which then flows out of Fish Lake to the north towards Buck Lake.

The watershed of Fish Lake is 699 acres in size, roughly four times the size of the lake, resulting in a watershed to lake ratio of 4:1, which is a relatively low ratio. The PLSLWD's 2006 Fish Lake Sustainable Management Plan shows that most of the land use within the watershed is either rural residential (29.6%) or row crop agriculture (27.6%).

Water Quality

Water quality shows that for the 19-year reporting period (2004-2022) Fish Lake has been hovering near state water quality standards for Secchi depth, total phosphorus (TP), and chlorophyll-a (Chl-A). The average TP concentration for Fish Lake between 2013 and 2022 was 42 µg/l, which is slightly above the state standard of 40 µg/l. The average Chl-A concentration for the same period was 23.8 µg/l. The state standard is 14 µg/l. The Secchi depth standard of 1.4 m was met in 5 of 10 years and averaged 1.39 between 2013 and 2022. Figure 3 below shows average annual growing season concentrations for TP, Chl-A, and Secchi depth.

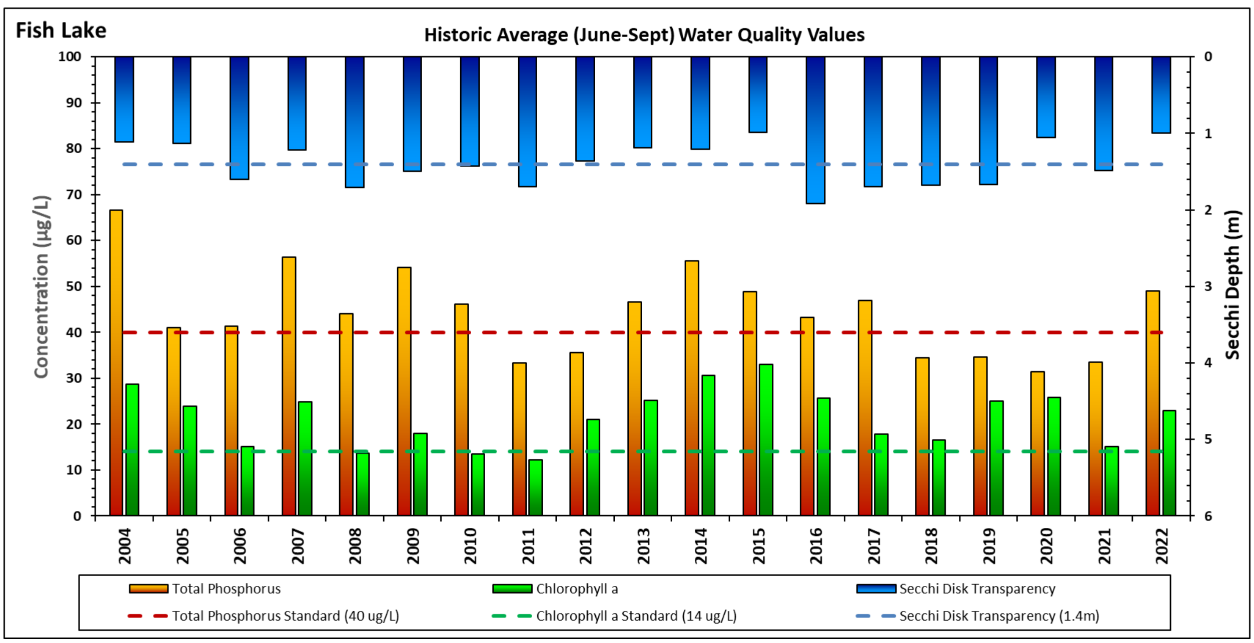


Figure 3. Fish Lake Seasonal Water Quality Results.

Fisheries

Public access is provided by a DNR-owned boat ramp located on the northwest side of the lake. Fish Lake is primarily managed for Walleye, but it includes catchable populations of Largemouth Bass, Bluegill, and Black Crappie. Management includes scheduled Walleye fingerling stocking in odd-numbered years at a rate of 1 pound per littoral acre (74 pounds), with other sizes, ages, and amounts substituted if insufficient fingerlings are available. Other fish species sampled in low abundances were Golden Shiner, Green Sunfish, Northern Pike, Pumpkinseed, White Crappie, White Sucker, Yellow

Bullhead, and Yellow Perch. During the fisheries survey, water clarity was poor with 2.75 feet of visibility and low oxygen below 16 feet.

Aquatic Vegetation

Point intercept surveys have been conducted in 2015, 2018, and 2020. In 2020, curlyleaf was found at 3 of the sample sites growing at light growth. Seven total native plant species were observed growing at 26 out of 32 sites. Coontail was the most common plant and was found at 24 out of 32 sample sites. A total of 8 submerged species were observed and plants grew out to a depth of 8 feet.

1.1.2 Buck Lake

Buck Lake is a small lake (23 acres) located downstream of Fish Lake in the upper watershed. The maximum depth is 9 feet; no numerical average depth given but average depth is noted as shallow. It is assumed, based on maximum depth, that the entire lake is littoral.

Buck Lake receives water from the connecting channel to Fish Lake and from the watershed to the East. Buck Lake then outflows to the north through a large wetland complex to Spring Lake. The watershed to lake ratio for Buck lake is quite high: approximately 837:1, which may result in a large amount of phosphorus loading to Buck Lake from the surrounding watershed.

Water Quality

Data for Buck Lake shows that Secchi depth and Chl-a seasonal concentrations are meeting state standards, while TP is not. TP is quite high when compared to results for Secchi depth and Chl-a. The average growing season TP concentration for Buck Lake between 2019 and 2021 was 143 µg/l, over twice the state standard of 60 µg/l. Secchi depth met the state standard of >1 m between 2019-2021, with an average depth of 1.24 m. Chl-a growing season concentrations were near the standard of 20 µg/l, averaging 17.54 µg/l between 2019 and 2021. Supplemental data collected in 2013 as part of a feasibility study for a chemical treatment system downstream of Buck Lake, indicate that dissolved oxygen levels in Buck Lake as well as its inflows and outflows are quite low (<1 mg/L). Figure 4 below shows average annual growing season concentrations for TP, Chl-A, and Secchi depth.

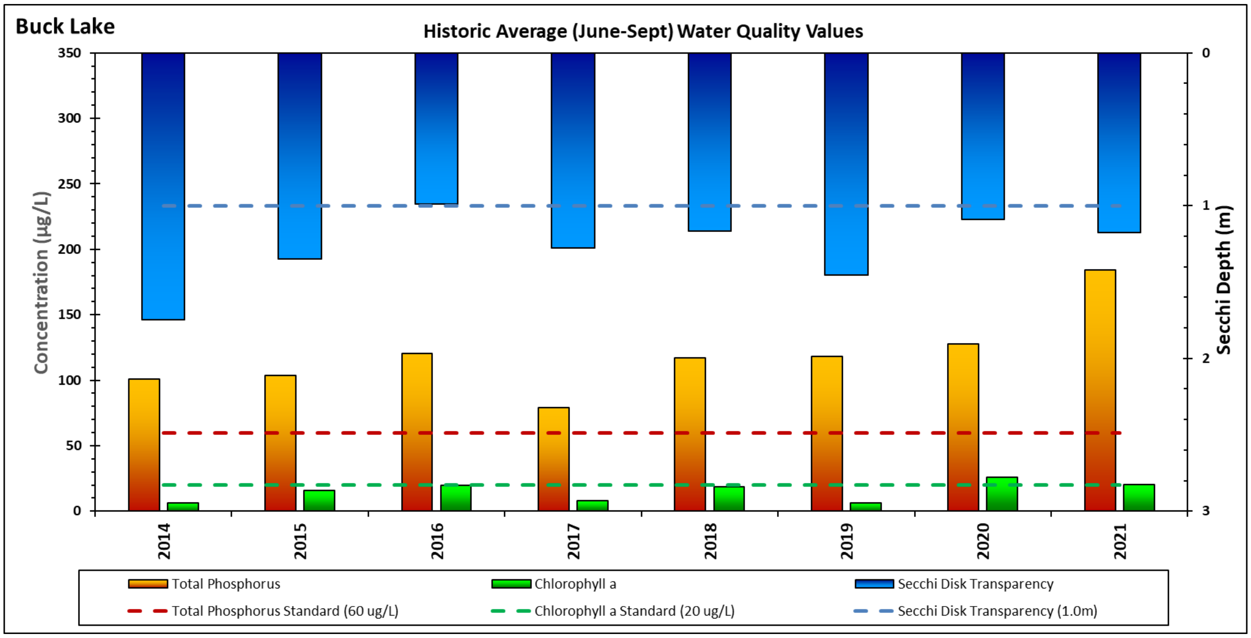


Figure 4. Buck Lake Seasonal Water Quality Results.

Fisheries

There is no DNR fisheries data for Buck Lake.

Aquatic Vegetation

Point intercept surveys have been conducted in 2010, 2016, 2019 and 2021. In 2021, Buck lake was found to have a low diversity of submerged aquatic plants, with 4 native species of rooted submerged plants observed, 4 less than 2019. Curlyleaf pondweed had died back by September 1st. Coontail was the most common plant followed by elodea. Coontail was observed growing at 44 out of 57 sites samples. The shoreline is mostly native and is reported to offer good wildlife habitat with the native plant community considered to be in good shape.

1.1.3 Spring Lake

Spring Lake is the second largest basin in the PLSLWD. The maximum depth is 34 feet with an average depth of 18 feet. Roughly half (49% or 290 acres) is identified as the littoral area.

The watershed is quite large (12,340 acres) with a watershed to lake ratio of 20:1, which is a moderate ratio. However, as the dominant land use is a mix of urban and agriculture, external loading of phosphorus may be elevated.

Spring Lake has three major inflows located primarily on its southern and western sides. The 12/17 wetland on the northwest side of the lake also contributes to the overall water budget. County Ditch 13 provides the largest contribution to external load. Spring Lake outlets on its eastern side via a natural channel, which connects to Upper Prior Lake.

Water Quality

Water quality shows that for the 19-year reporting period (2004-2022) Spring Lake has improved significantly and has been meeting state water quality standards for Secchi depth, TP, and Chl-a since 2020. The ten-year average for phosphorus levels on Spring Lake were 118 µg/l when the Spring Lake and Upper Prior Lake TMDL Implementation Plan was first completed in 2012. The plan recommended that an 83% reduction in phosphorus was necessary to meet in-lake water quality standards and suggested that an alum treatment would help temporarily reduce the internal loading in the lake. The treatment was intended to buy time until loading from the upper watershed could be better managed. The first phase of an alum treatment was completed in 2014 which helped Spring Lake reduce its total phosphorus levels to 86.7 µg/l on a ten-year average. However, the TP levels continued to increase each year following the treatment requiring subsequent alum treatments completed in 2018 and 2020. Alum treatments are not a permanent solution to the nutrient loading and eutrophication of Spring Lake though their effectiveness has shown successful.

In 2016, a revised site-specific standard of 60 µg/l of total phosphorus (vs. the original 40 µg/l) and 20 ug/l of Chl-a (vs. the original 14 µg/l) for Spring Lake was approved by the EPA. Ten years since the 2012 TMDL implementation, ongoing carp management, alum treatments, aquatic plant management, and upper watershed BMPS, the average 10-year phosphorus levels are now at 52.32 µg/l. The average Chl-a concentration for the same period was 31.7 µg/l. The Secchi depth standard of 1.4 m was met in 5 of last 10 years and averaged 1.52 between 2013 and 2022. Figure 5. below show average annual growing season concentrations for TP, Chl-a and Secchi depth.

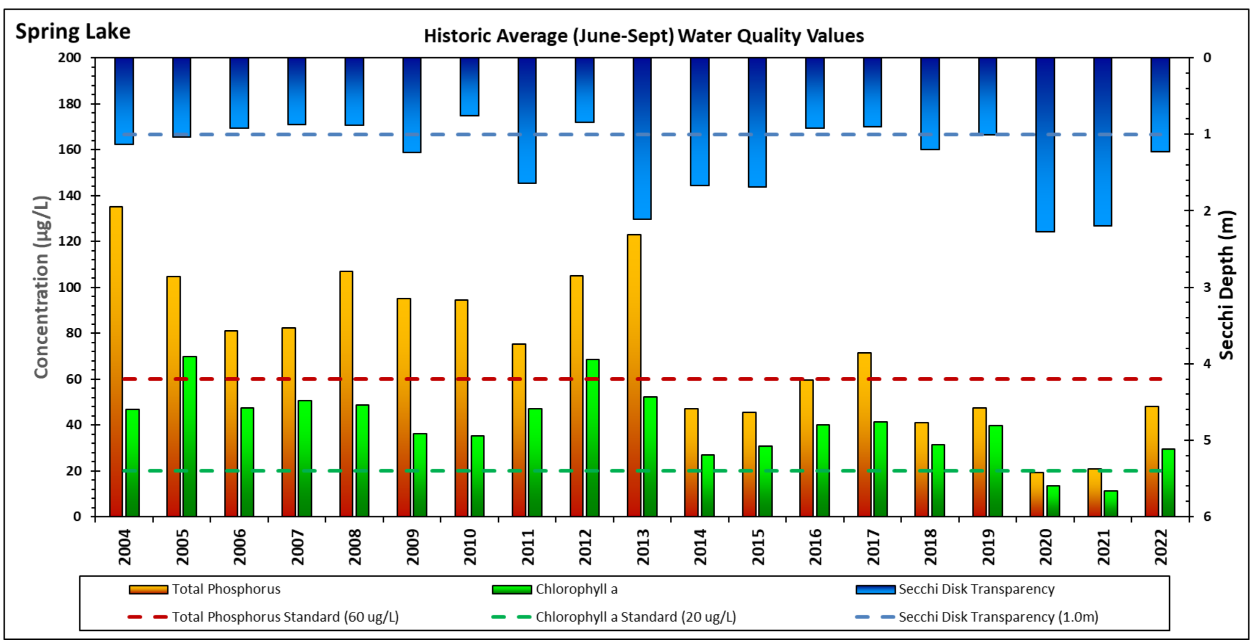


Figure 5. Spring Lake Seasonal Water Quality Results.

Fisheries

Public access is provided by a DNR-owned boat ramp on the southwest side of the lake. Spring is a fertile lake, and in the summertime, dissolved oxygen levels become depleted in deeper water and fish will avoid the area. In 2021 dissolved oxygen was low in depths greater than 16 feet.

Spring Lake is primarily managed for Walleye and holds healthy populations of Largemouth Bass, Northern Pike, Black Crappie, Bluegill, and Yellow Perch. Management includes Walleye stocking every other year. A Standard Survey, including trap nets, gill nets, and boat electrofishing, was conducted in 2021 to monitor the fishery. Bluegill numbers were about average for this area in 2021 and their size was modest. The average length was 5 inches, and only 9% of the sampled fish were larger than 7 inches. Although low water clarity benefits species such as Walleye, Bluegill populations are likely negatively affected by this factor. Other fish species sampled in low abundances were Black Bullhead, Brown Bullhead, Common Carp, Golden Shiner, Green Sunfish, Hybrid sunfish, Pumpkinseed, White Sucker, and Yellow Bullhead.

Aquatic Vegetation

Point intercept surveys and AIS assessment have been conducted regularly since 2008. In 2021, a total of 377 sites were sampled, plants were observed growing to a depth of 12 feet. Results of the summer aquatic plant point intercept survey conducted on July 12, 2021, found 15 submerged aquatic plant species with including CLP and Eurasian watermilfoil (EWM). Native plants were found around the perimeter of the basin of Spring Lake out to a water depth of 12 feet. Native aquatic plants were estimated to cover of the lake bottom (202 acres). Coontail was the dominant aquatic plant. The 15 aquatic plant species found in this survey represents a fair to good diversity for Spring Lake in late summer. Eurasian watermilfoil was found for the first time at 3 sites in the point intercept survey and at an additional 9 sites with a subsequent meander search. Spring Lake has seen CLP herbicide treatments from 2002-2006 and 2016-2022 apart from 2018. Since the introduction of EWM in 2021, additional EWM specific herbicide treatments have been conducted in 2021 and 2022.

1.1.4 Arctic Lake

Arctic Lake is 33 acres in size with a maximum depth of 30 feet and an average depth of 9.5 feet. Arctic Lake flows into Upper Prior Lake, entering a large shallow bay on the north side of the lake through a man-made channel.

Arctic Lake's watershed is 507 acres, resulting in a 15:1 watershed to lake ratio, which is relatively small. Most of the watershed (56%) is composed of wetlands and woodlands with the remaining portions of the watershed composed of residential, prairie, water, open space, and cropland.

Data provided by the Shakopee Mdewakanton Sioux Community (SMSC) Land Department shows that eutrophic conditions persist in Arctic Lake.

Water Quality

Data for Arctic Lake shows that no seasonal parameters have met seasonal state standards since at least 2010. The relatively small watershed to the lake has gained many new best management practices (BMPs) over the past few years to improve water quality through the effort of SMSC. The 2019 average growing season TP concentration for Arctic Lake between 2017 and 2019 was 144 µg/l, triple the state standard of 40 µg/l. Secchi depth has been measured at 0.54 meters, less than half the state standard of >1.4 m between 2017-2021. Chl-a growing season concentrations were well above the standard of 14 µg/l, averaging 57.9 µg/l between 2017 and 2019. Figure 6 below shows average annual growing season concentrations for TP, Chl-A, and Secchi depth.

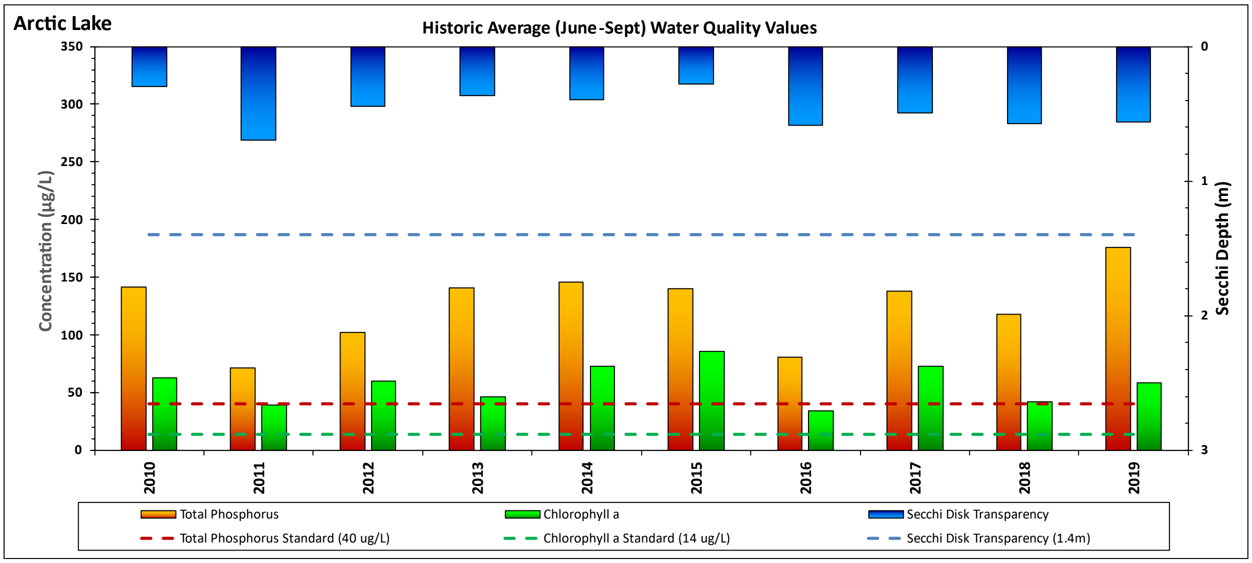


Figure 6. Arctic Lake Seasonal Water Quality Results.

Fisheries

A fish survey was conducted by Blue Earth Science 2012 (McComas and Stuckert, 2012b). Ten species of fish were sampled using standard trapnets with Bluegill sunfish and Yellow Bullheads being predominant. An average of 6.7 carp per net were sampled and was considered reflective of high abundance. Both Snapping and Painted Turtles were also sampled and considered common in the lake. Mini-trapnets were used to sample smaller fish. A total of eight species were sampled with Bluegills again representing the dominant species in terms of abundance. Fathead Minnows and Golden Shiners were also sampled, but at a slightly higher rate than found in the regular trap nets. Yellow and Black Bullheads were sampled at lower rates than Carp and Suckers, while no small Yellow Perch were captured. The report found that minnow populations were low within Arctic Lake for the year 2012. Updated fisheries information from a 2017 survey can be found in the linked 2017 Arctic Lake Fisheries Assessment found in Section 2.0.

Aquatic Vegetation

Point intercept surveys have been conducted in 2012, 2016 and 2019. In 2021, Arctic Lake was found to have a very low diversity of submerged aquatic plants, with 1 native species of rooted submerged plants observed. Sago Pondweed was observed growing at 1 out of 39 sites samples. The lone aquatic submerged plant sampled in 2019 marks the first rooted plant during a point intercept survey. The shoreline is mostly native and is reported to offer good wildlife habitat with the native plant community considered to be in very poor shape. SMSC has conducted seedbank analysis and have discovered a lack of aquatic seed in the sediments.

1.1.5 Upper Prior Lake

Upper Prior Lake is 416 acres in size with a maximum depth of 43 feet and an average depth of 10 feet. The littoral zone covers 329 acres or 79% of the basin.

The lake receives water from Spring and Arctic Lakes as well as from a small drainage area on the east side of the lake. The watershed is 16,038 acres resulting in a watershed ratio of 38:1, which is large considering that most of the watershed is urban and agriculture, like Spring Lake. Upper Prior is impaired for excess nutrients (listed in 2012) due to phosphorus levels.

Water Quality

Upper Prior Lake reflects a similar path to Spring Lake with regards to water quality and the steps taken in the past three years to improve it. Monitoring data shows that for the 18-year reporting period (2005-2022) Upper Lake has improved significantly and has been meeting state water quality standards for Secchi depth, TP, and Chl-a since 2020. The eight-year average for phosphorus levels on Upper Prior Lake were 78 µg/l when the Spring Lake and Upper Prior Lake TMDL Implementation Plan was first completed in 2012. The plan recommended that an 33-48%% reduction in phosphorus was necessary to meet in-lake water quality standards and suggested that managing rough fish populations would help control internal nutrient loading. In 2020, an alum treatment was completed, and water clarity results have improved dramatically.

Ten years since the 2012 TMDL implementation, ongoing carp management, alum treatments, aquatic plant management, and upper watershed BMPS, the average 10-year phosphorus levels are now at 55 µg/l. The average Chl-a concentration for the same period was 31 µg/l. The Secchi depth standard of 1.0 m was met in 9 of last 10 years and averaged 1.62 between 2013 and 2022. Figure 7. below show average annual growing season concentrations for TP, Chl-a and Secchi depth.

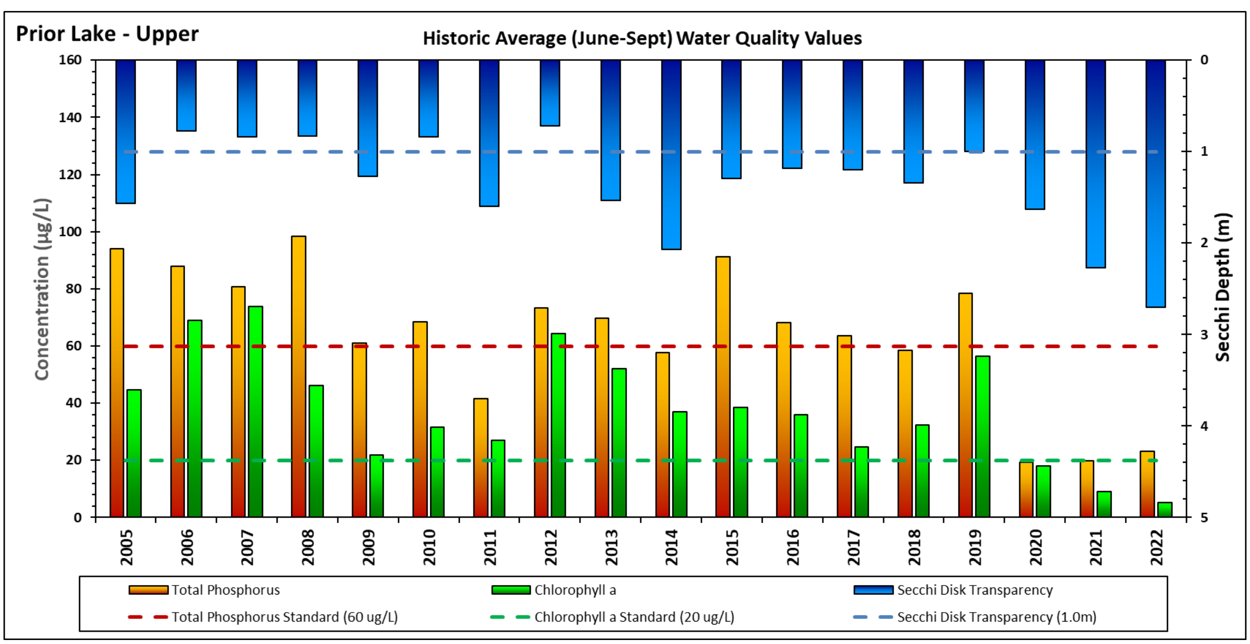


Figure 7. Upper Prior Lake Seasonal Water Quality Results.

Fisheries

Public access is provided by a DNR-owned boat ramp located on the south side of the lake off of Dewitte Ave. Upper Prior is primarily managed for Walleye, but also holds populations of Largemouth Bass, Northern Pike, Black Crappie, and Bluegill. White Bass are also present in low numbers. Management includes Walleye stocking every other year, and a special regulation for sunfish and Crappie. A new possession limit of 5 sunfish and 5 Crappies is in place on Upper Prior. A Standard Survey was conducted on Upper Prior Lake in 2021 to assess the status of the fishery.

Walleye numbers in Upper Prior were moderate, with a broad range of sizes present. Fish were between 12 and 28 inches, with an average size of 18 inches. Over the next couple of years those fish should attain a good harvestable size. Despite modest abundance, Walleye do well in Upper Prior, and management will continue to focus on this species. Bluegill were sampled in high numbers in 2021, and size was modest. The fish were between 3 and 8 inches long, with only 6% of the trap net catch exceeding 7 inches. A new regulation took effect in 2021 for sunfish and Crappies on Upper Prior. Only 5 Bluegill and 5 Crappie may be harvested per angler. Upper Prior was chosen for this regulation because panfish grow fast in the lake, and the lake has a history of producing large Bluegill and Crappie. The goal of the regulation is to limit harvest in order to give fish a chance to grow to large sizes. Other fish species sampled in low abundances were Black Bullhead, Brown Bullhead, Common Carp, Hybrid Sunfish, Pumpkinseed, White Bass, White Sucker, Yellow Bullhead, and Yellow Perch.

Aquatic Vegetation

Aquatic plant point intercept surveys for Upper Prior Lake were conducted in the summers of 2015, 2018, 2020, and 2021. Results of the 2021 summer aquatic plant point intercept survey found 9 submerged aquatic plant including CLP and EWM. Native plants were found around the perimeter of the basin of Upper Prior Lake. Aquatic plants were estimated to cover 30% of the lake bottom (116 acres). Coontail and Eurasian watermilfoil were the dominant aquatic plants. The 7 native aquatic plant species found in this survey represents a fair diversity for Upper Prior Lake in late summer. Since 2019, the percent area of lake vegetation growing on the lake bottom has increased from about 8% to over 50%.

1.1.6 Lower Prior Lake

Lower Prior Lake is the largest basin in the watershed at 940 acres. It has a maximum depth of 56 feet and an average depth of 13 feet; roughly 39% of the lake or 373 acres is in the littoral zone.

Water flows into Lower Prior from Upper Prior under the County Highway 21 Bridge and is the only major inflow; the remaining hydrology is derived from direct drainage from adjacent upland areas. The lake's outlet is the Prior Lake Outlet Channel (PLOC) located along the western portion of the lake. The watershed of Lower Prior is 18,904 acres, resulting in a moderately sized 20:1 watershed to lake ratio.

Water Quality

Lower Prior Lake has had excellent water quality for at least 25 years. Data for the lake shows that TP, Chl-a, and Secchi depth have been meeting state standards since 2008. The average growing season TP concentration for Lower Prior Lake over the past 10 years was 22.4 µg/l, nearly half the state standard of 40 µg/l. Secchi depth during the same time has an average depth of 4.05 m. Chl-a growing season concentrations were below half the standard of 14 µg/l, averaging 6.9 µg/l between 2011 and 2022. Figure 8 below shows average annual growing season concentrations for TP, Chl-A, and Secchi depth.

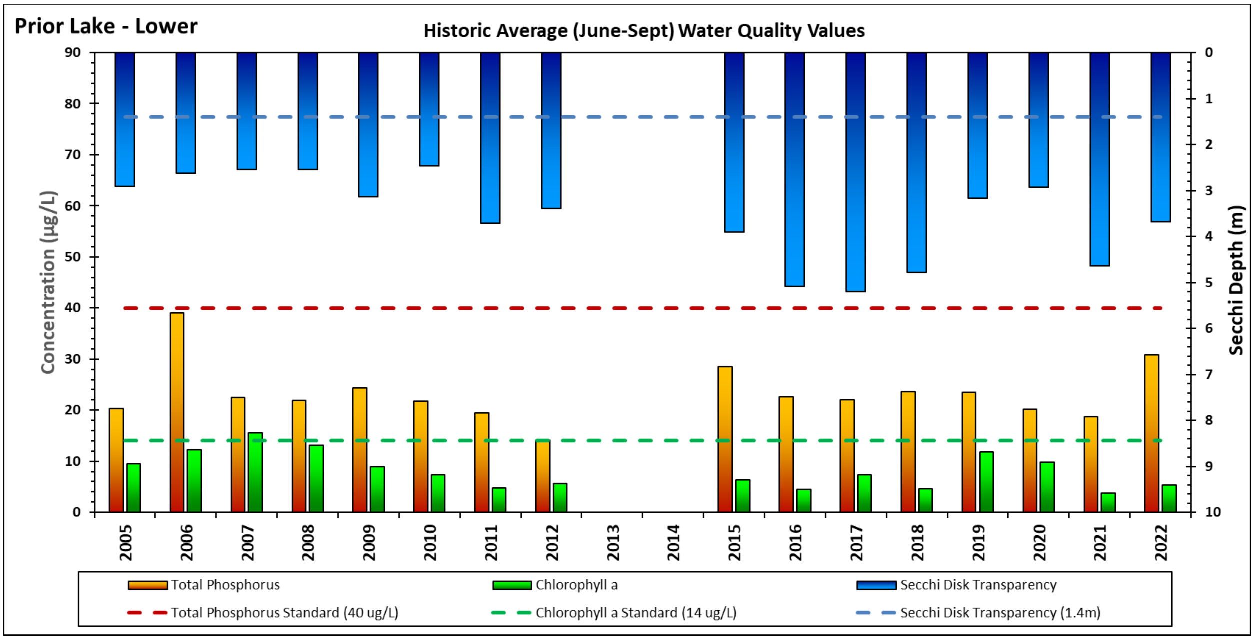


Figure 8. Lower Prior Lake Seasonal Water Quality Results.

Aquatic Vegetation

Aquatic plant point intercept surveys for Pike Lake were conducted in the summers of 2015, 2018, 2020, and 2021. Results of the 2021 summer aquatic plant point intercept survey found 15 submerged aquatic plant species in Lower Prior and 6 species in Upper Prior including CLP. Native plants were found around the perimeter of the basin of Prior Lake. Native aquatic plants were estimated to cover 27% of the lake bottom (358 acres). Coontail was the dominant aquatic plant. The 10 aquatic plant species found in this survey represents a fair to good diversity for Prior Lake in late summer.

1.1.7 Jeffers Pond

Jeffers Pond is located downstream of Lower Prior along the PLOC. Jeffers Pond is divided into two basins (East and West Jeffers) separated by a narrow land bridge. The Prior Lake Outlet Channel (PLOC) flows into the south side of West Jeffers and flows out on the north side of East Jeffers. The basins are connected by a series of cascading streams. Jeffers is 39 acres in size with a maximum depth of 70 feet (no average depth listed, and the total acreage includes both basins).

Water Quality

No water quality data has been collected from Jeffers Pond.

Fisheries

No fisheries information is available for Jeffers Pond; however, carp and goldfish have been trapped in Jeffers Pond during District surveys.

Aquatic Vegetation

Coontail and Eurasian watermilfoil were dominant plants and were present at most sites around the Jeffers ponds. Coontail has been the dominant native plant in surveys for 2016, 2017, and 2018. Results of the summer aquatic plant survey conducted in 2018 found 6 submerged plant species with coontail being the dominant species. Coontail was found at 95% of the sites in Jeffers Pond growing at light to heavy densities. Eurasian watermilfoil was present in Jeffers pond in 2018 but not as abundant and widespread as 2017, EWM was found at 44% of the sample sites.

1.1.8 Pike Lake

Pike Lake is the downstream-most basin in the watershed; located along the PLOC at the northern end or bottom of the watershed. Pike is 50 acres in size with a maximum depth of 9 feet and an average depth of 7 feet, resulting in the entire basin being littoral. The west side of Pike Lake is part of the PLOC and receives constant flow through the system. The east side of Pike Lake is more stagnant and receives runoff from the nearby feedlot and agricultural lands across the road to the east, creating a contrast in water quality compared to the west side.

The contributing watershed to Pike Lake is 21,770 acres resulting in a watershed to lake ratio of 435:1, which is quite large and most of the watershed is composed of urban or agricultural use.

Water Quality

The water quality in each bay is very different, however neither bay meets state water quality standards, and they are listed as impaired for nutrients. Water quality in the west bay is much better than the east, and trends are showing dramatic improvements in the west bay. Although the water quality of the west bay is relatively good, the east bay of Pike Lake has been significantly worse because it does not mix well with the west bay. The water quality in the Prior Lake Outlet Channel is very good, which helps the quality of the west bay as the channel flows through it. Factors affecting the water quality include runoff from surrounding land use and an overpopulation of carp.

The average TP concentration for in the west bay between 2013 and 2022 was 86 µg/l while 125 µg/l in the east. Both TP concentrations are above the state standard of 60 µg/l. The average Chl-A concentration for the same period was 26.4 µg/l in the west bay and 90.3 µg/l in the east bay. The state standard is 14 µg/l. The Secchi depth standard of 1.4 m was met in 5 of 10 years and averaged 1.39 between 2013 and 2022. Figure 3 below shows average annual growing season concentrations for TP, Chl-A, and Secchi depth.

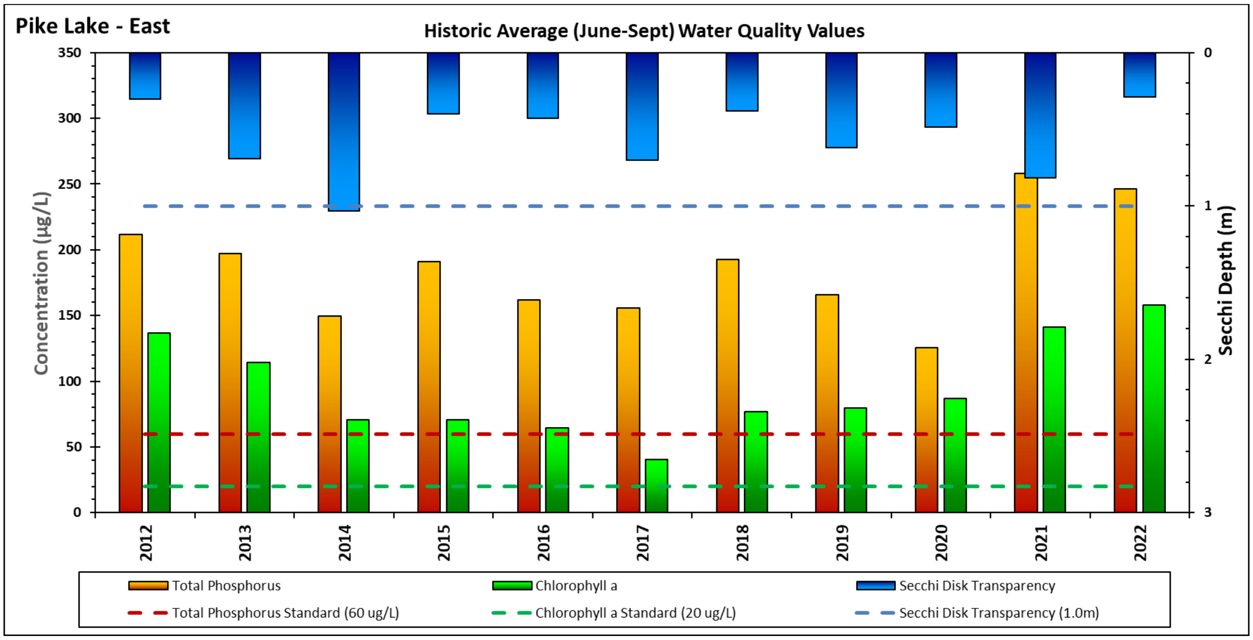


Figure 9. Pike Lake-East Seasonal Water Quality Results.

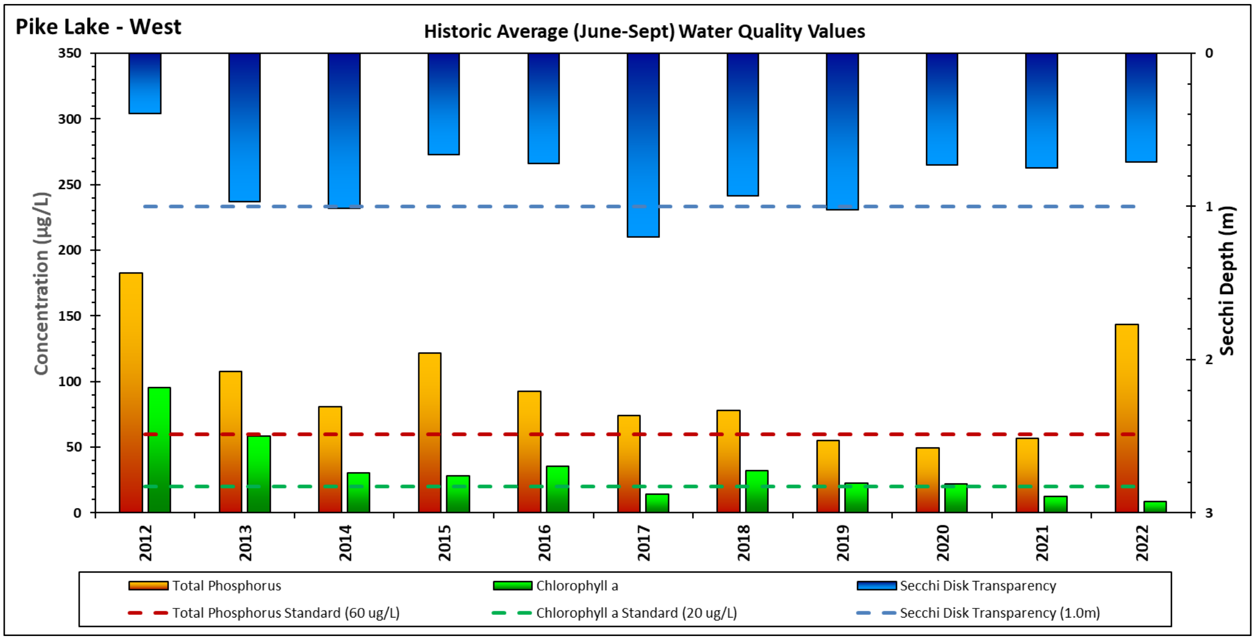


Figure 10. Pike Lake - West Seasonal Water Quality Results.

Fisheries

Fisheries information can be found in the linked 2020 Pike Lake Fisheries Assessment found in Section 2.0.

Aquatic Vegetation

Aquatic plant point intercept surveys for Pike Lake were conducted in the summers of 2012, 2013, 2015, 2017, 2019, and 2021. Coontail has been a common native plant in the surveys, but Eurasian watermilfoil was the most abundant plant in 2015 and 2017. In the summer plant surveys, submerged aquatic plants are often not found deeper than 5-6 feet of water depth due to low light penetration and elevated algae growth. Initially, EWM was first found only at one spot in the west basin in 2012 but results from additional surveys indicate Eurasian watermilfoil have expanded its range. Since 2012 EWM occurrence has ranged from 16 to 65% of the sample sites.

In 2021, seven aquatic plant species were observed, which is the highest number of plant species of the 6 surveys conducted since 2012. Coontail growth in 2021 was heavy in some areas, especially in the shallower western basin where heavy Coontail growth appears to have displaced much of the Eurasian watermilfoil. Eurasian watermilfoil growth and occurrence increased in the deeper eastern basin Lower water levels may have contributed to higher establishment of plants especially in the western basin.

2.0 Planning Documents and Management Plans

One of the first steps in building and revising the IPM plan is to look at the information, issues, and goals established in previous studies and plans. Information generated over the last ten years has allowed PLSLWD and WSB to adapt to changing conditions and take a comprehensive approach to carp management. The following planning documents (hyperlinked) are as follows:

PLSLWD Integrated Pest Management Plan 2021-2022

2018 PLSLWD Carp Management Feasibility Study

2020-2030 Water Resources Management Plan

Spring Lake and Upper Prior TMDL

Arctic Lake Subwatershed Analysis

Fish and Pike Lakes P Release Study

Arctic Lake Fishery Assessment Report (2017-2018)

Pike Lake Fishery Assessment (2020)

Arctic Lake Fisheries Assessment (2017)

Lower Prior Lake Diagnostic Study and Implementation Plan

319 Final Report

3.0 Ecological Impacts of Carp

A large population of carp is known to degrade the environment due to the nature of their feeding habits and excretion rates. Accordion like mouthparts are designed to dig into the mud and their diet of plant material often uproots native and non-native vegetation and disturbs bottom sediment, releasing excess phosphorus to further feed algal growth. This results in less diversity of plants in the lake and reduces overall plant biomass results in higher chlorophyl and algae in the lake and the disturbance of bottom sediment releases excess phosphorus to further feed algal growth. The **Minnesota Department of Natural Resources lists common carp as a regulated invasive species**. The United States Geological Survey lists common carp as a non-indigenous aquatic species. Both agencies and collective research have shown that carp impacts water quality, aquatic vegetation, and native fisheries.

By managing common carp abundance, lake ecology can be improved. A reduction in internal phosphorus loading may reduce algal growth and a reduction in uprooting of vegetation can improve habitat for other fish species as well as waterfowl.

An internal load calculation for phosphorus can be done using the carp population estimate and methodology described in LaMarra (1975) from experiments completed in Minnesota. LaMarra calculated TP loading rates (1.07-2.18 mg P/m²/day) from carp using carp biomass density (200 kg/ha). For these calculations we use the more conservative factor of 1.07 mg P/m²/day and carp biomass estimate developed for the lake in question.

4.0 Carp Life History

4.1 Life Cycle

Shallow lake basins in the Upper Midwest are prone to low oxygen levels that lead to winterkill events. These basins can support reproductive success in a variety of fish species because of low predator abundance resulting from such events. Carp commonly use migration routes in the springtime to access shallow lake basins to exploit the absence of predator species to hatch young that recruit to the adult population. The process of young fish growing into adulthood is known as recruitment.

Carp are highly fecund and long lived. An adult female can have between 300,000 to 500,000 eggs per year and live upwards of 60 years. Combined with their ability to withstand low oxygen levels, this makes carp highly invasive under the right conditions. Carp are quick to grow in warm water and within 2-3 months of hatching can grow to nearly 0.5 pounds. In Minnesota, carp can grow to be greater than ten inches in length after their first year and quickly grow to a size that is too large for predator species to pray on them.

Carp have a homing instinct and will return to the basin they were hatched to complete their reproductive cycle. They typically leave these basins when they are one (1) to two (2) years in age and return during the spawning migration the following year as adult with reproductive capabilities.

Recruitment may happen in a deeper main basin if conditions allow, i.e. high vegetative abundance and low predator abundance. This occurrence is limited with an abundance of predator species such as bluegill sunfish, who are known to predate on carp eggs and larvae. Bass and pike predate upon young carp fingerlings.

4.2 Diet

Carp are benthivores meaning they feed on material on the bottom of the lake. Food sources include plants, insects and crustaceans, while they are also known to feed on fish eggs and larvae as well as smaller fish. Carp feed when water temperatures are above 64°F and feeding is greatly reduced or even stops when water temperatures dip below 45°F.

4.3 Habitat & Behavior

Carp can inhabit a variety of lake basins and use stream connections to migrate between waterbodies. In the springtime, carp are often found to be migrating en masse through stream connections to shallow lake or wetland basins to reproduce and return to deeper more stable basins for summer through winter. In these “main basins” Carp typically use the shoreline and shallow water habitat to feed in the summer through fall and overwinter in a variety of habitat types within these basins. In the winter, carp tend to school together, sometimes forming dense aggregations.

5.0 Introduction to Carp IPM

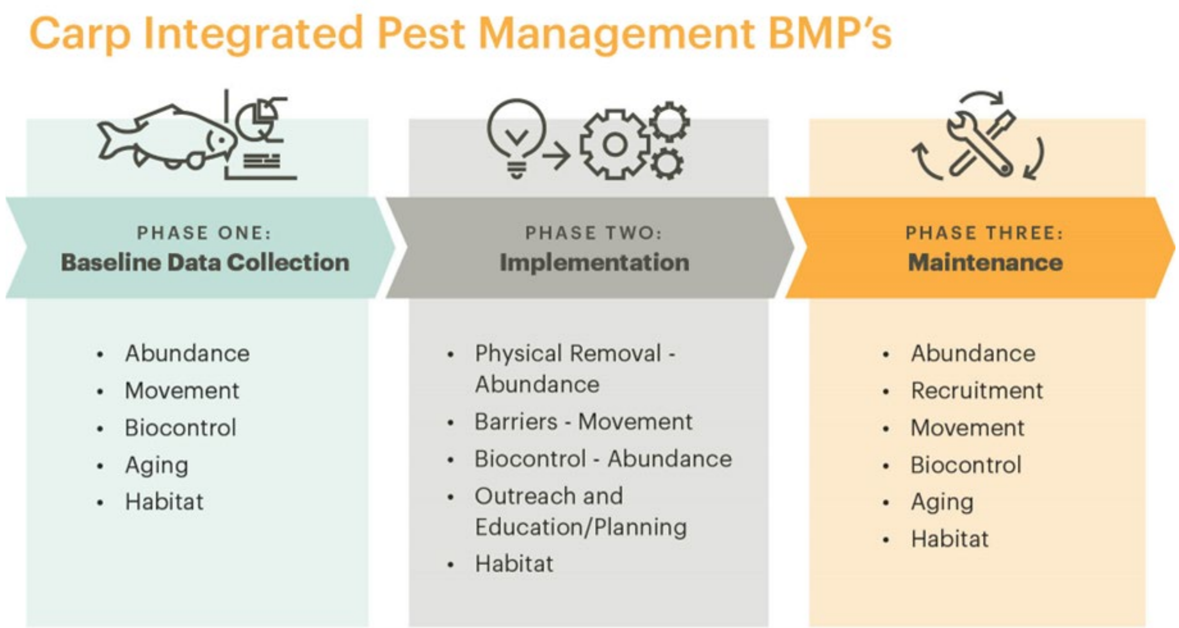


Figure 11. IPM Phases

By addressing different life stages and developing an understanding of the spatial usage of the system or watershed, it is possible to control the carp population sustainably. An integrated Pest Management (IPM) Plan is meant to guide carp mitigation techniques through gathering baseline data and implementing a variety of control and reduction techniques after the extent of the problem is better understood. These management actions are meant to be followed by regular maintenance that includes monitoring and adapting these actions to the most up to date conditions (Figure 11).

5.1 Data Collection Tools & Techniques

Before management tools are put into practice, it is important to understand the extent of the problem. Capturing carp for the purpose of estimating the population size, employing marks or tracking devices, developing a size or age structure, and finally to reduce the population, is done with a variety of tools and techniques.

The following sections describe the data collection tools and techniques that are commonly used in carp management. These are followed by results of data collection and analysis in PLSLWD to date. These results are being used to recommend further management action to reduce the carp population and biomass and sustain progress towards carp management goals.

5.1.2 Electrofishing

Boats and backpack electrofishing units can be employed to sample fish for tagging purposes, estimating population, and in some cases, removing fish from the system. These tools apply a pulsed DC electric field between an anode and cathode that are placed in the water. The electric current temporarily paralyzes fish and attracts them to the field where they can be captured by a net. The effective range of these units is between 0 and 6 feet from the anode, making this tool most effective in shallow water. Stunned fish recover quickly and can be released back to the basin, often with no harm done.

5.1.3 Gill Netting

Gill nets are part of the MN DNR standard sampling gear and can be effectively used to capture carp for sampling purposes or for large scale removal. They consist of a net panel made from monofilament and can be sized according to the target species. This type of net captures fish by entangling them behind the gill plate when they attempt to move through the material. Care must be taken with this type of sampling gear because a fish left too long or in warm water temperatures can experience damage to the gills, killing the fish in some cases. Coordination for the use of these nets for removal is required through the DNR and allowed only on a case-by-case basis.

5.1.4 Fyke-nets

This type of net is standard sampling gear for the MN DNR. They consist of a vertical net section that extends to and is anchored to shore that guides fish into the trap. The trap has a rectangular frame with hoops containing narrowing throats to effectively trap fish inside. These nets are typically set for one to two overnight periods and checked daily and are helpful to assess the assemblage of fish species in a waterbody. They are not very effective at capturing large carp but are particularly useful in sampling small carp within their first year of life. Using fyke nets to sample main basins and shallow connected basins can help to inform managers if these basins are supporting carp recruitment.

5.1.5 Large Scale Removal events

Large scale removal events are designed to remove carp biomass but can also be used to collect fish for sampling purposes. As fish are being sorted and moved off the lake, managers can scan fish for tags or marks and get an exact or estimated number of total fish removed from the lake. The ratio of marked to unmarked fish are used to refine population estimates while the number and biomass of carp removed tracks progress towards meeting management goals. It is sometimes useful to use these events to employ additional marks to complete population estimates in the future.

5.2 Carp Spatial Usage

Understanding movement patterns helps to identify potential migration routes and basins used for spawning, and winter aggregation areas. These can be targeted for removal operations or to block movement that is associated with spawning migration.

5.2.1 Radio Tags

Radiotelemetry is widely used to track animal movements and some tags are specifically designed for use in water. These can be used to implant into Carp so that movement in lake and through the watershed can be tracked. Tracking using this method can be done with a stationary antenna but is mostly collected using manual survey data where tags are located by boat or land. This information can be used to describe aggregation areas or movement that can be associated with springtime spawning migration. Both behaviors may be targeted for removal operations.

5.2.2 Passive Integrated Transponder (PIT) tags

Passive Integrated Transponder (PIT) tags can be implanted into a subset of carp to aid in a mark-recapture estimate and/or to be used in conjunction with stationary antennae that are designed to capture movement of tags. Stationary antenna can be installed in strategic locations in connecting streams to capture movement data on a 24/7 basis. Other species could be tagged with PIT tags and tracked with the use of stationary antennae's as well. This would help to understand movement patterns and how blocking or removal techniques can be altered to avoid impact to native species.

5.2.3 Remote cameras

In some cases, it is advantageous to begin monitoring carp movement through stream connections before or during carp tagging efforts. Remote cameras that are connected through wi-fi or cellular connections can provide an opportunity to support tag movement data with ocular recordings. These cameras can be accessed at any time or triggered to record at intervals to catch potential carp movement. In the springtime, recordings or viewing would be most important after rain events as these are known to spur carp movement.

5.2.4 Acoustics

Acoustic telemetry provides another option for monitoring absence/presence or fine scale fish movements using low frequency signals to monitor fish populations. Acoustics use an active signal the same as radio, while PIT is passive. The signal is received by a hydrophone which can be connected to a data logger to capture movement past a "gate" along a waterway. Acoustics may be used in place of a PIT system in locations where water depth and channel width limit the use of PIT as the detection range for acoustics is much larger.

5.3 Population Estimate Techniques

A variety of methods are available for estimating fish abundance. Any singular method used may accurately over, or underestimate the actual population based on sampling error and bias, the size of the population (large), level of effort in sampling, or other factors. The reader should approach the estimates presented with caution and within the context of sampling design, project area, and confidence interval generated with the estimate, and understand that estimates may be adjusted, validated, or simply changed with additional data or improved methodologies. Estimates generated may be thought of in a qualitative fashion i.e., is the population high, moderate, or low. Common carp management uses a biomass density (lbs./acre) unit to quantify and assess the level of potential degradation to the aquatic environs which are/is the subject of the planning document(s). This concept is presented graphically in section 5.2.1.

5.3.1 Catch Per Unit Effort (CPUE) Estimate of Population

Population estimates have been developed by using a boat electrofishing catch per unit effort (CPUE) model of estimation, a model that was developed at the University of Minnesota in 2009 (Bajer, 2009). This model uses the number of carp captured standardized by time spent electrofishing to estimate density of carp per hectare in a waterbody (Equation 1).

$$\text{Density/hectare} = 4.71 * \text{carp captured per hour} + 3.04$$

Equation 1: Electrofishing catch per unit effort (CPUE) equation of estimating density of carp within a basin.

Using this model gives researchers a chance to get a snapshot of carp relative abundance in a basin at the time of the survey. Multiple surveys are completed in one season between August and October when water temperatures are between 59-77 °F. Multiple surveys are completed to reduce the bias due to environmental conditions and the density is averaged and multiplied by average weight of fish to report a biomass estimate in kilograms per hectare in that year. The standard deviation from the mean value represents the variation in catch rates per survey in a given year.

5.3.2 Mark-Recapture Estimate of Population

This method uses a ratio of marked to un-marked fish to estimate the number of individuals in a waterbody. Accuracy of this method rests on the following assumptions being met: 1) no individuals immigrate or emigrate during the sampling period, 2) each individual has an equal chance of being captured, 3) sufficient time between initial marking period and recapture is allowed for individuals to disperse throughout the population, and 4) marks remain distinguishable throughout the sampling period (Chapman, 1951).

5.4 Block

5.4.1 Biological Controls

A robust panfish and gamefish population can act as a biological control, especially when the carp biomass has been suppressed or movement into spawning grounds has been mostly eliminated. Bluegill sunfish are known to be the main predator of carp eggs and larvae and it can be beneficial to support their population in areas where carp spawning occurs. This can be done by routine stocking and/or aeration in basins that experience low oxygen conditions in the winter or summer.

5.4.2 Carp Barriers

Carp barriers can be employed to protect sensitive areas from the destructive foraging behavior of carp or to prevent carp from exploiting migration routes. Barrier placement should be balanced with the potential need for native fish passage who employ these same migratory behaviors, like the northern pike. To address the concern for native fish species, barriers can be designed as temporary or movable to block carp movement but allow for native fish movement if these occur at different times. Data would need to be collected on native fish movement to determine the correct time and placement of barriers if this is a concern.

Another consideration to have when placing a barrier in a connecting waterway is the maintenance associated with the structure. In some cases, traditional grate style barriers to movement are not feasible due to the flow conditions, inaccessibility, and/or time constraints for managers to complete this maintenance. In some cases, a design can take into account these constraints and mitigate for them.

For example, a self-cleaning barrier could be place in a stream that has high level of debris, this type of barrier may be expensive and require a power source.

5.5 Carp Biomass Removal Methods

5.5.1 Seine Netting

Large groups of carp known as aggregations, can be targeted with large seine nets, under ice or in open water. Seine nets are often 1,000 – 3,000 feet in length and strung around an aggregation of carp. To identify aggregations, radio telemetry can be used to improve effectiveness of netting the most carp possible, this is known as the “judas technique”. This technique uses radio telemetry to identify aggregations of carp and guides an accurate area to net when communicated to the commercial fishing crew.

Limitations to seine netting are often times obstructions on the lake bottom. Rocks, logs, or even dense vegetation can limit the effectiveness of a seine netting attempt. These can be alleviated with reconnaissance of known aggregation sites with the use of side scan sonar, dragging chain, and divers that can target and remove obstructions. The MUM technique (described below) can be used in combination with seine netting to move aggregations of carp away from obstructions that have been identified but cannot be moved.

5.5.2 Targeted Electrofishing

Boat electrofishing is used to sample carp and at most times is not considered a removal tool. However, in certain conditions, it can be effectively used as a removal activity. Conditions that might trigger electrofishing to capture and remove fish are when aggregations exist in open water, often in the springtime or late fall, and/or carp are trapped near a barrier in a stream setting. Radio tags are a useful tool in identifying aggregations in open water. These aggregations can then be targeted with boat electrofishing to remove carp biomass. This is especially helpful as the biomass is nearing the critical threshold and seine netting is not as effective.

5.5.3 In-Stream Trapping Techniques

A variety of methods can be used to trap and remove fish during spawning migration through streams. Examples of these methods could include the push trap (described below), or other trap designs that are specific to the stream reach. This type of operation would require a significant effort April through June to check traps daily and remove carp that are trapped in or around them.

The push trap, a modified pen is installed in the channel with a one-way set of tines that allow a migrating carp to push the tine up and enter the pen but is unable to lift the tine to escape the pen. During periods of high carp movement, this pen can accumulate and hold large number of carp which can be immobilized with a backpack electrofisher and removed from the trap easily.

Figure 12. View of push trap during low water

Vertical grates or other barriers to stream movement can be used to stop or slow movement of carp, causing them to aggregate out front. Carp can then be trapped in a section of the stream by erecting a barrier behind the aggregation and individuals can be removed using nets and electrofishing (backpack and/or boat).

5.5.4 Baited Traps

Baited traps can include a variety of sizes and shapes including hoop style nets and box nets. A box net trap refers to a mesh net that lays on the lake bottom with net walls around the outside. These walls are attached with ropes to vertical metal pipes that extend above the water surface. These ropes are then run to shore so they can be pulled to raise the net walls, trapping the fish inside. The fish are then corralled to a corner and rolled into a holding tank, usually a large flat bottom boat, to be removed from the lake.

A hoop net is a passive capture device that can be checked daily for the presence of carp once the baiting has begun. Carp can swim into an open hoop in the net and get caught after traveling through a throat or restricted portion of the net towards the back as they seek out the bait inside.

Carp are trained to aggregate in these trap areas over a number of days by providing bait on a daily basis. The bait can be broadcast by a resident or deposited in a mesh bag that allows for carp to pull the bait through the bag. This method based on carp research and has been found to be over 98% selective for carp when comparing percentage of non-carp species also captured. All fish captured could be counted and a sample measured. All carp would be removed from the lake and all non-target species would be returned to the lake.

Figure 13. View of Hoop Net Deployed in Spring Lake

5.5.5 Chemical

A chemical treatment known as a Rotenone treatment can be applied to a lake in certain situations. This method is meant to kill all the fish in the system before re-stocking and other restoration efforts are pursued. This method is not recommended for PLSLWD waterbodies as the native fish community is heathy and is expected to strengthen as carp management and reduction using other methods is pursued.

5.6 Innovative techniques

As techniques are explored to remove carp biomass, adjustments or new techniques may be necessary to improve efficiencies. PLSLWD has incorporated USGS vetted methods including the Modified Unified Methodology (MUM) of herding and removing carp biomass. This method had been used by the USGS to move and target Asian carp species in riverine systems and includes the use of speaker systems to exploit carps' sensitivity to noise. Aggregations of carp can be moved using speaker systems and strategic net sets help to guide them in direction that is advantageous for capturing carp. This has been especially useful in seine netting attempts that try to avoid known obstructions in the lake.

Innovative techniques are continually being developed as carp management evolves. System specific methods may be developed as a waterbody is explored or more broadly used devices may become important tools.

6.0 Prior Lake Spring Lake Watershed District IPM Planning and Development

Through this IPM Plan, the District has developed a holistic approach to carp management, treating the entire connected watershed system as a whole. While it is the long-term goal of the District to see all of its lakes reach the water quality goal of 100 kg/ha of carp, the lakes must be prioritized and management focused to address the most imperative concerns first. As carp management information on the lakes and new techniques are always changing, this IPM Plan will address meeting goals of its priority lakes and assuring the efforts achieved through state and federal grants continue to support overarching TMDL goals.

6.1 Priority Lakes

While it is the District's long-term goal to maintain carp populations below the water quality management level on all waterbodies, this IPM Plan prioritizes those lakes that receive the most public use and those that are most affected by poor water quality, as well as their associated waterbodies that may harbor or support carp recruitment.

6.1.1 Public Access Lakes

The four lakes in the PLSLWD with public access are listed below with highest public use listed first:

1) Lower Prior Lake
2) Upper Prior Lake
3) Spring Lake
4) Fish Lake

Of these four, only Upper Prior Lake and Spring Lake have documented detrimental levels of carp.

6.1.2 TMDL Lakes

The Minnesota Pollution Control Agency's (MPCA) 2020 Impaired Waters List (wq-iw1-65k) shows the list of impaired waters located within the PLSLWD as identified in Table 1 below. The list is approved as of March 26, 2021. Of these lakes, only Spring and Upper Prior have approved total maximum daily load (TMDL) reports and an associated TMDL implementation plan completed. Pike Lake and Fish Lake TMDL reports were completed in 2020 as part of the Lower Minnesota River Watershed TMDL.

Table 1. District Lakes Identified on the MPCA 2020 Impaired Waters List

WATER BODY	YEAR LISTED	AFFECTED USE	POLLUTANT OR STRESSOR
Fish Lake	2002	Aquatic recreation	Nutrient/eutrophication biological indicators
	2006	Aquatic consumption	Mercury in fish tissue
Lower Prior Lake	2002	Aquatic consumption	Mercury in fish tissue
	2018	Aquatic life	Fish bioassessments
Pike Lake	2002	Aquatic Recreation	Nutrient/eutrophication biological indicators
Spring Lake	1998	Aquatic Consumption	Mercury in fish tissue
	2002	Aquatic Recreation	Nutrient/eutrophication biological indicators
	2018	Aquatic life	Fish bioassessments
Upper Prior Lake	2002	Aquatic Consumption	Mercury in fish tissue
	2002	Aquatic Recreation	Nutrient/eutrophication biological indicators

6.1.3 Priority Lakes Determination

As they are listed as Tier 1 Lakes in the PLSLWD's 2020-2030 Water Resources Management Plan, these lakes receive the highest public use, and are currently on the *state's impaired waters list.* The District has established the following two lakes as its **top carp management priority:**

- **Upper Prior Lake**
- **Spring Lake**

In addition, the PLSLWD supports the efforts of SMSC as the lead partner on tracking and reducing carp populations in Arctic and Pike Lakes. Arctic Lake is directly connected to Upper Prior Lake and Pike Lake has a current TMDL that has identified rough fish as a major contributor to internal loading. As such, the PLSLWD has established the following two lakes as its secondary supportive carp management priority:

- **Arctic Lake**
- **Pike Lake**

The PLSLWD attempts to be as cost-effective as possible in all of its practices. In 2020, the PLSLWD completed a cost-benefit analysis comparison (Table 2) on its carp program compared to other District projects (see Appendix A). A 10-year annualized cost was used to compare the carp management program results on Upper Prior Lake to other projects in the District.

Based on this analysis, the PLSLWD concluded that carp management was indeed cost-effective. However, all the different carp removal tools do not always produce the same result. To that effect, the PLSLWD will also consider cost-benefit when choosing carp management goals and tools. At some point, the PLSLWD may decide that reducing carp populations below 100kg/ha would not be worth the cost, as it is increasingly more expensive to reduce carp populations when the existing biomass is already low similar to the law of diminishing returns. This will be assessed during each annual update of the IPM Plan.

Table 2. Per Pound Costs of TP Load Reduction by BMP (2020 Calculations)

$ / lb TP Removed	Project
$31	Cover Crops
$81	Upper Prior Lake Alum Treatment
$97	Carp Management Project
$202	Ferric Chloride System
$252	Fish Point Park Iron-Enhanced Sand Filter
$1,131	Indian Ridge Biofiltration Basin
$1,136	Fairlawn Shores Biofiltration Basin

6.2 Carp Management Strategies & Goals

The PLSLWD has three distinct overarching strategies for carp management. At the direction of the Board of Managers, there are two accelerated carp management goals for Upper Prior and Spring Lakes to reduce and maintain overall carp populations to below the water quality threshold to 30 kg/ha identified in the WRMP. Before the ambitious above-mentioned goals can be achieved, an ecological goal is first set which will help dictate near term management strategies. To help achieve successful long-term management without carp population rebound, it is important to also take steps to determine carp movement, block recruitment and to understand how the connected system works as a whole to better management the carp population.

Carp Management Strategies:

1) **Comprehensively TRACK carp to improve the understanding of carp dynamics, behavior, and movement that will inform effective management decisions.**
2) **Effectively BLOCK all identified carp spawning areas connected to Upper Prior & Spring Lakes.**
3) **REDUCE carp down to management goal levels in priority lakes:**

Table 3: Current Biomass and Goals

PRIORITY	WATER BODY	CURRENT CARP BIOMASS	CARP BIOMASS GOAL	TIMELINE / NOTES
#1	**Upper Prior Lake**	**189 kg/ha**	**100 kg/ha**	**Achieve goal by 2026**
#1	**Spring Lake**	**223 kg/ha**	**100 kg/ha**	**Achieve goal by 2027**
#2	*Pike Lake**	*~0 kg/ha*	*< 100 kg/ha*	*SMSC is the lead; Achieved goal in 2021. Efforts focused on preventing reestablishment*
#2	*Arctic Lake**	*62.0 kg/ha*	*< 100 kg/ha*	*SMSC is the lead; Maintain levels*

Previous studies demonstrate that carp biomass densities > 100 kg/ha are ecologically damaging. To effectively manage and maintain carp below this threshold, an initial reduction to a density of 100 kg/ha has been recommended by the District board of managers for the two top priority lakes (Table 3). Once the initial biomass goal is achieved, the district may adjust the biomass goal to a lower density. By managing at a lower density, early detection of potential recruitment events may provide managers with an opportunity to address the increase in carp population and biomass before it returns to a damaging level. Once this milestone has been achieved and recruitment has been managed, the PLSLWD may consider working towards the 100 kg/ha goal for all lakes in the District.

- **Goal #1: Reduce carp populations to 100 kg/ha in Upper Prior Lake by 2026.**
- **Goal #2: Reduce carp populations to 100 kg/ha in Spring Lake by 2027.**

6.3 IPM Structure

The PLSL WD Carp IPM plan is structured as a three-phase approach in Sections 7.0 (Baseline Data Collection) through Section 9.0 (Maintenance). Within each section, core elements or subphases are listed and described in detail as to how and why they relate to carp management within the Prior Lake Spring Lake Watershed District. Lastly, tasks or objectives to support the rationale for each subphase and objective are listed with an abbreviation and sequential number within each phase. These are collated in the tables found in Section 10.

7.0 IPM Phase 1- Baseline Data Collection

The key to making informed and effective decisions in carp management is to have a robust baseline dataset. This includes data about carp population size, location, and behavior as well as migratory routes and spawning locations. Establishing this baseline data over the course of several years has given the District a known set of patterns and a better understanding of which management tactics to use at any given time (blocking, tracking, removal, which removal techniques to use, etc.).

Baseline datasets are also instrumental in determining the effects of carp presence and carp removal on water quality. By routinely monitoring key water quality parameters such as phosphorus and clarity, it is possible to establish the baseline trends and therefore see how they change as carp management activities continue.

Additionally, the District monitors dissolved oxygen and water levels in carp spawning locations, which helps determine the likelihood of winter fish kills and success of spawning activities as well as where and when it may be appropriate to utilize biocontrols such as Bluegill stocking.

7.1 Carp Abundance Estimates

Carp biomass estimates give managers a way to track progress towards the biomass reduction goal in each waterbody. As with all methods of estimating population abundance, CPUE estimates have error associated with them. To compensate for this error but also to accurately describe carp removal efforts, two estimates are presented. The first is a CPUE carp biomass estimate that was used to develop a proposal for internal load management under the Section 319 Clean Water Act grant and subsequent carp biomass reduction goals. For Upper Prior Lake we used a 2018 CPUE estimate and for Spring Lake we used a 2019 estimate and subtracted the total pounds of carp removed during each removal event. We then recalculated the carp biomass density after each event and then annually at the end of each calendar year to track carp biomass reductions. This gives us the ability to track progress using a fixed number, but does not account for immigration, emigration, or changes in average weights from the basin. The second method and estimate listed shows the most current CPUE estimate calculated based on the year for reporting as CPUE are completed annually for the TIER 1 lakes. The calculation method averages all CPUE estimates minus carp removed to date from each year a CPUE estimate was completed in the following lakes: Upper Prior Lake (2018, 2021, 2022) and Spring Lake (2018, 2019, 2021, 2022).

Table 4: Carp biomass estimates in priority lakes

Lakes in Order of Priority	**Year**	**CPUE Carp Biomass Estimate (kg/ha)**	**2018/2019 CPUE Carp Biomass Estimate minus Carp Removed (kg/ha)**	**Goal Biomass (kg/ha)**
Upper Prior Lake*	**2022**	**138.9 ± 56.3**	**189.9 ± 60**	**100**
Spring Lake*	**2022**	**170.1 ± 81.9**	**223.3 ± 45**	**100**
*Pike Lake***	2021	*0****	*Na*	*50*
*Arctic Lake***	2018	62.0	*Na*	*50*
Fish Lake	2019	88.7 ± 69.2	*Na*	*TBD*
Lower Prior Lake	2018	8.9	*Na*	*TBD*
Jeffers Pond	-	*unknown*	*Na*	*TBD*
Buck Lake	-	*unknown*	*Na*	*TBD*

**** Carp Management Top Priority Lakes. CPUE Carp biomass given as an average of available CPUE values: Upper Prior Lake, 2018, 2021, 2022 and Spring Lake 2018, 2019, 2021, 2022.***

*** Carp Management Secondary Priority Lakes (supportive role only)*

**** Pike Lake Estimate based on winterkill in winter 2021. NOTE: Presence of carp or carp-goldfish hybrids detected in 2022. A follow-up CPUE survey is scheduled to be completed in 2023.*

In Table 4 above and in Figures 14 and 15 below, current estimates are shown using two (2) methods which are discussed in **Section 5.3.1** of this document. The estimates are also plotted with the carp biomass goal shown for both Upper Prior and Spring Lakes.

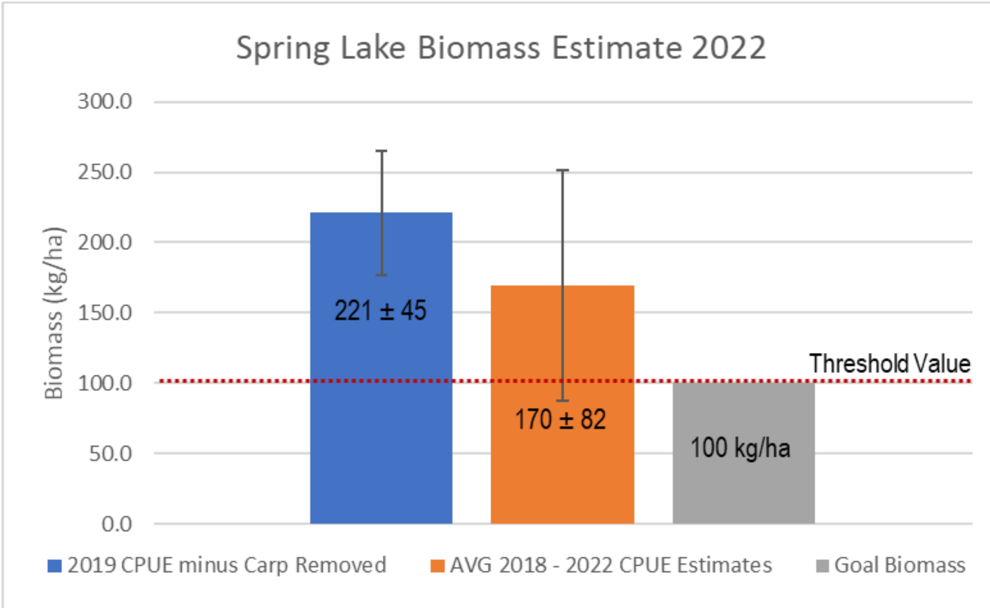


Figure 14: Spring Lake Biomass Estimate end in 2022. The Ecological Threshold is Depicted by the Dotted Red Line.

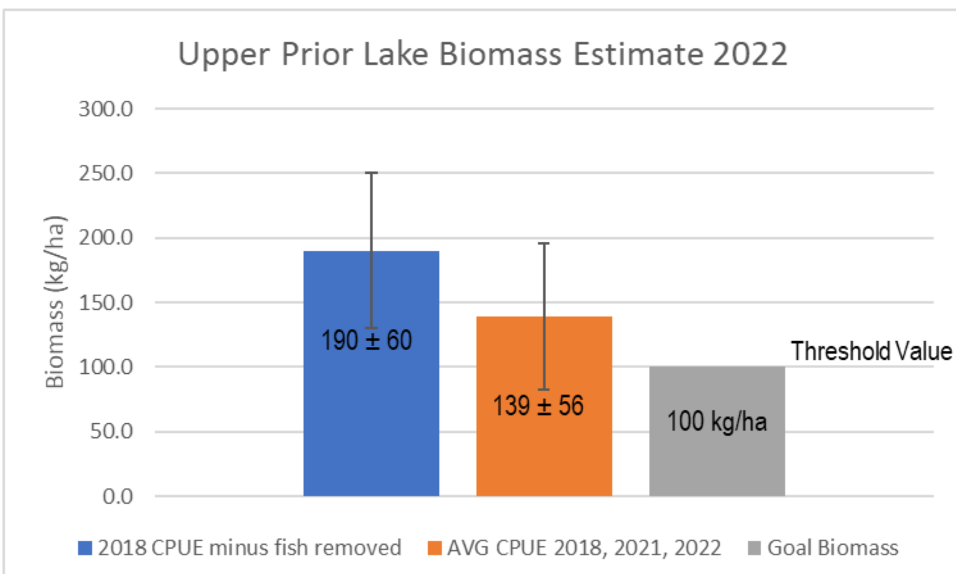


Figure 15: Upper Prior Lake Biomass Estimate ending in 2022.

Table 5 below gives a summary of carp biomass that was removed from Upper Prior Lake and Spring Lake from 2018 to 2022. About 143.4 kg/ha of biomass was removed from Upper Prior Lake, which brought the population from about 333.3 kg/ha in 2018 down to 189.9 kg/ha in 2022. Roughly 45.2 kg/ha were removed from Spring Lake, which decreased the population estimate from 266.2 kg.ha in 2019 to 221.0 kg/ha in 2022.

Table 5: Summary of biomass removal from 2018 to 2022

Year	**Lake**	**Total Weight Removed (kg)**	**Kilograms per Hectare Removed**	**Population Estimate Year Ending (kg/ha)**
2018	Upper Prior Lake	18,787	95	333.3
	Spring Lake	*na*	*na*	*na*
2019	Upper Prior Lake	4,564	29	304.8
	Spring Lake	0	0	266.2
2020	Upper Prior Lake	8,433	54	250.4
	Spring Lake	4,953	24	242.4
2021	Upper Prior Lake	6,242	39	211.0
	Spring Lake	3,735	16	226.0
2022	Upper Prior Lake	3,355	21	189.9
	Spring Lake	864	3.6	221.0

Once it has been determined that a lake has met the biomass goal, a mark and recapture (MR) estimate may be completed. This method is more time consuming and therefore more expensive, but it may provide a more accurate estimate if enough fish are recaptured. The MR estimate can be used to validate the CPUE estimate to ensure that additional carp removal efforts are not warranted and should be considered a best practice. Meeting established biomass goals will be a trigger point for the district to move from the implementation phase to a maintenance phase for a particular waterbody which underscores the necessity for a high level of certainty in the estimate.

Task BDC1. Complete a boat electrofishing CPUE estimate for Fish Lake

Task BDC2. Complete a boat electrofishing CPUE estimate for Spring Lake.

Task BDC3. Complete a boat electrofishing CPUE estimate for Arctic Lake.

Task BDC4. Complete a boat electrofishing CPUE estimate for Upper Prior Lake.

Task BDC5. Complete a boat electrofishing CPUE estimate for Lower Prior Lake.

Task BDC6. Complete a boat electrofishing CPUE estimate for Jeffers Pond.

Task BDC7. Complete a boat electrofishing CPUE estimate for Pike Lake.

Task BDC8. Generate an MR estimate for Upper Prior Lake.

Task BDC9. Generate an MR estimate for Spring Lake.

7.2 Internal TP Load Calculations

Using the abundance estimates from the previous sections, we have developed an internal TP load estimate for each of the PLSLWD carp management lakes where an estimate is available Table 6.

Table 6: Phosphorus load in district lakes attributed by carp

LAKES IN ORDER OF PRIORITY	YEAR	PHOSPHORUS LOADING RATE (LBS/YEAR)
Upper Prior Lake*	**2022**	**1,086**
Spring Lake*	**2022**	**1,114**
*Pike Lake***	2021	*unknown*
*Arctic Lake***	2018	7.24
Fish Lake	2019	46.89
Lower Prior Lake	2018	23.71
Jeffers Pond	-	*unknown*
Buck Lake	-	*unknown*

**** Carp Management Top Priority Lakes. Phosphorus loading based on 2018 estimate minus carp removed.***

*** Carp Management Secondary Priority Lakes (supportive role only)*

Internal loading constitutes the bulk of the total phosphorus load to Spring Lake at 5,161 lbs/year or 49% according to the 2012 TMDL completed for the lake. Internal loading may be from anoxic sediment release of phosphorus, senescence of aquatic vegetation during the growing season, and overabundant rough fish. The TMDL attributed the entire internal load to anoxic release; however subsequent fisheries surveys documented elevated carp biomass which may be heavily influencing the internal phosphorus load and subsequently, water quality in Spring Lake.

The 2012 TMDL indicates that 50% of the total phosphorus budget comes from internal loading. The TMDL assigns the entire internal load to anoxic sediment release; however, Upper Prior supports elevated carp biomass as well as CLP and Eurasian water milfoil (EWM) growth which may contribute and/or exacerbate internal loading.

Task BDC10. Calculate internal phosphorous load for each carp management lake as needed or as biomass estimates are updated.

7.3 Movement

Determining how carp use the system is critical to the development of the carp IPM plan. Understanding movement patterns will allow PLSLWD staff to identify potential nursery sites, migration routes, and wintering areas where carp may be vulnerable to large scale biomass removal or prevented from reaching nursery sites along migration routes, therefore limiting recruitment.

To track movement, the PLSLWD has deployed several high frequency radio tags implanted in carp (Judas fish) as well as passive integrated transponder (PIT) tags with seven (6) PIT tag monitoring stations in 2022. Table 7 and table 8 below list the active remaining PIT tags and Radio tags as of December 2022. A seen in Table 7, no new PIT tags were implanted in 2022, and 11 Radio tags were implanted between Upper Prior and Spring Lake.

Table 7: Summary of PIT tags remaining December 2022. NOTE: this does not account for mortality or movement from the basin originally tagged.

Lake	2022 PIT Tags	2022 Removed	2022 Implant	Tags Remaining December 2022
Spring Lake	122	7	0	115
Upper Prior Lake	221	17	0	204
Arctic Lake	25	0	0	25
Geis Wetland (Carp)	103	0	0	103
Geis Wetland (White Sucker)	9	0	0	9
Fish Lake	0	0	0	0
Pike Lake	0	0	0	0

Table 8: Radio tags active as of December 2022.

Lake	Tag No.	Implant Date	Lake	Tag No.	Implant Date
Upper Prior Lake	149.605	9/3/2021	Spring Lake	149.564	10/1/2021
	149.944	10/8/2021		149.613	10/1/2021
	149.595	10/8/2021		149.515	10/1/2021
	149.554	10/8/2021		149.544	10/1/2021
	149.475	10/21/2022		149.572	10/1/2021
	149.497	10/27/2022		149.535	11/19/2021
	149.455	10/27/2022		150.733	10/27/2022
	149.442	11/10/2022		150.762	10/27/2022
	149.385	11/10/2022		150.703	10/27/2022
	149.485	11/10/2022		150.722	10/27/2022
	149.423	11/10/2022			

7.3.1 Radio Telemetry

PLSLWD and WSB staff have actively tracked radio-tags using a 3-element Yagi antennae since 2015. Survey frequency was greatest during the spring spawning period (1-2/week) and during the winter aggregation period when ice conditions were safe enough for foot travel. The remainder of the year, radio telemetry surveys were completed on a once per week basis.

The District also uses two stationary cameras to be placed at strategic locations to confirm carp migration routes and/or aggregations of carp during spawning season. These cameras are set up wirelessly and transmit real-time information so that staff can move quickly to coordinate carp removals at optimal times.

Winter-time telemetry surveys and past studies have proven that carp tend to aggregate together in large groups during the winter (Johnsen, 1977; Penne, 2008). This phenomenon allows for these aggregations to be targeted for removal using under ice netting techniques, thus the identification of carp wintering areas on Spring Lake and Upper Prior Lake was determined to be a main objective in the 2015 carp management project.

Radio-tagged carp have been periodically monitored since 2015 to identify winter and spring carp aggregation areas that could be targeted for carp biomass removal. Four (4) full winters of telemetry data are available to identify winter and spring aggregation areas on Upper Prior Lake and Spring Lake.

Two (2) distinct winter aggregation sites were identified on Spring Lake, both of which commercial netters have been able to pull a seine net through shown below in Figure 16.

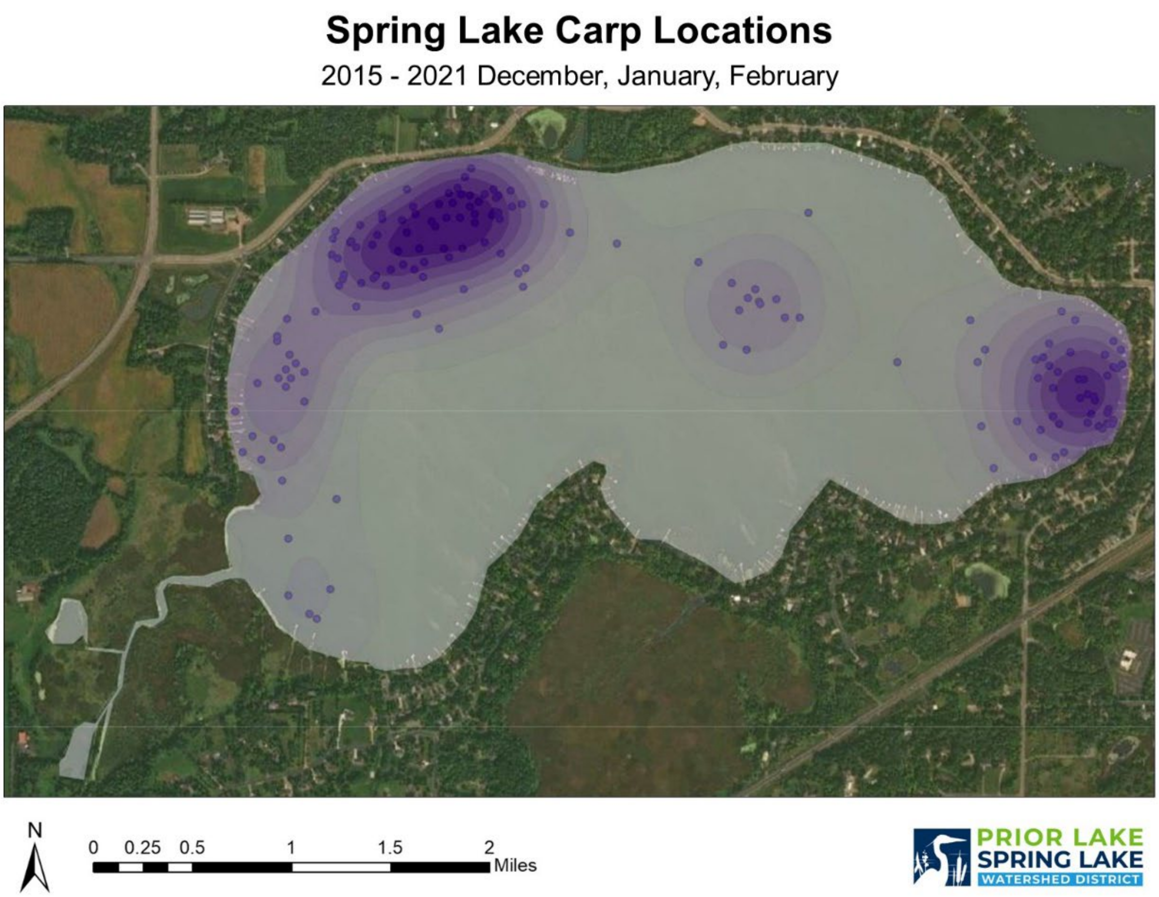


Figure 16: Spring Lake Winter Aggregations 2015 to 2022

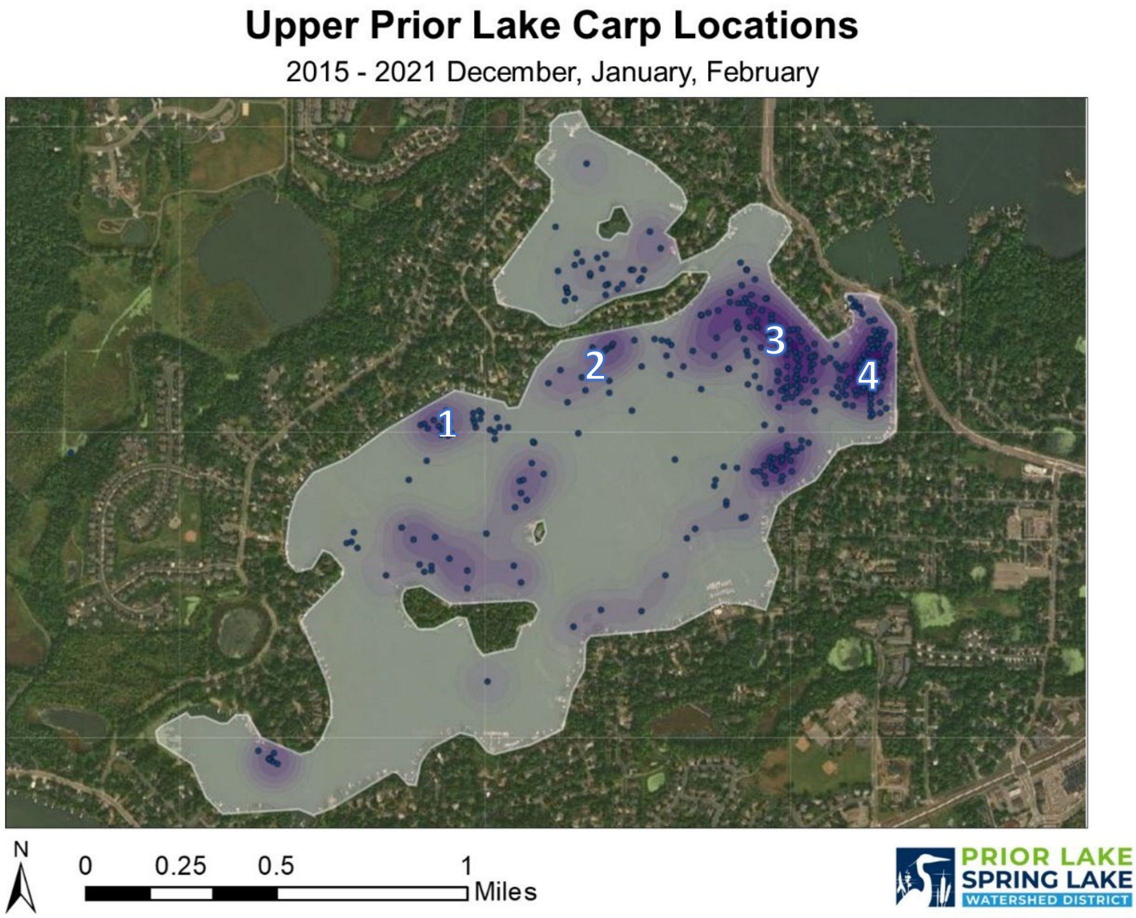


Figure 17: Upper Prior Lake Winter Aggregations 2015 to 2022

While on Upper Prior Lake, four (4) distinct winter aggregation sites have been identified (Figure 17). Locations 1-3 depicted have been successfully seined in both open water and under ice. Location 4 poses a significant risk of snagging lake bottom rocks and is not suitable for netting. In 2020 and 2021 when carp were located near the rocks at location 4, the district utilized underwater speakers to herd carp from the undesirable seining location. Additionally, all 4 locations have been targeted with gill nets during the Gill Netting

Aggregations persist into early spring on both Upper Prior and Spring Lakes during the spawning period and have offered additional opportunities for removal through netting and targeted electrofishing.

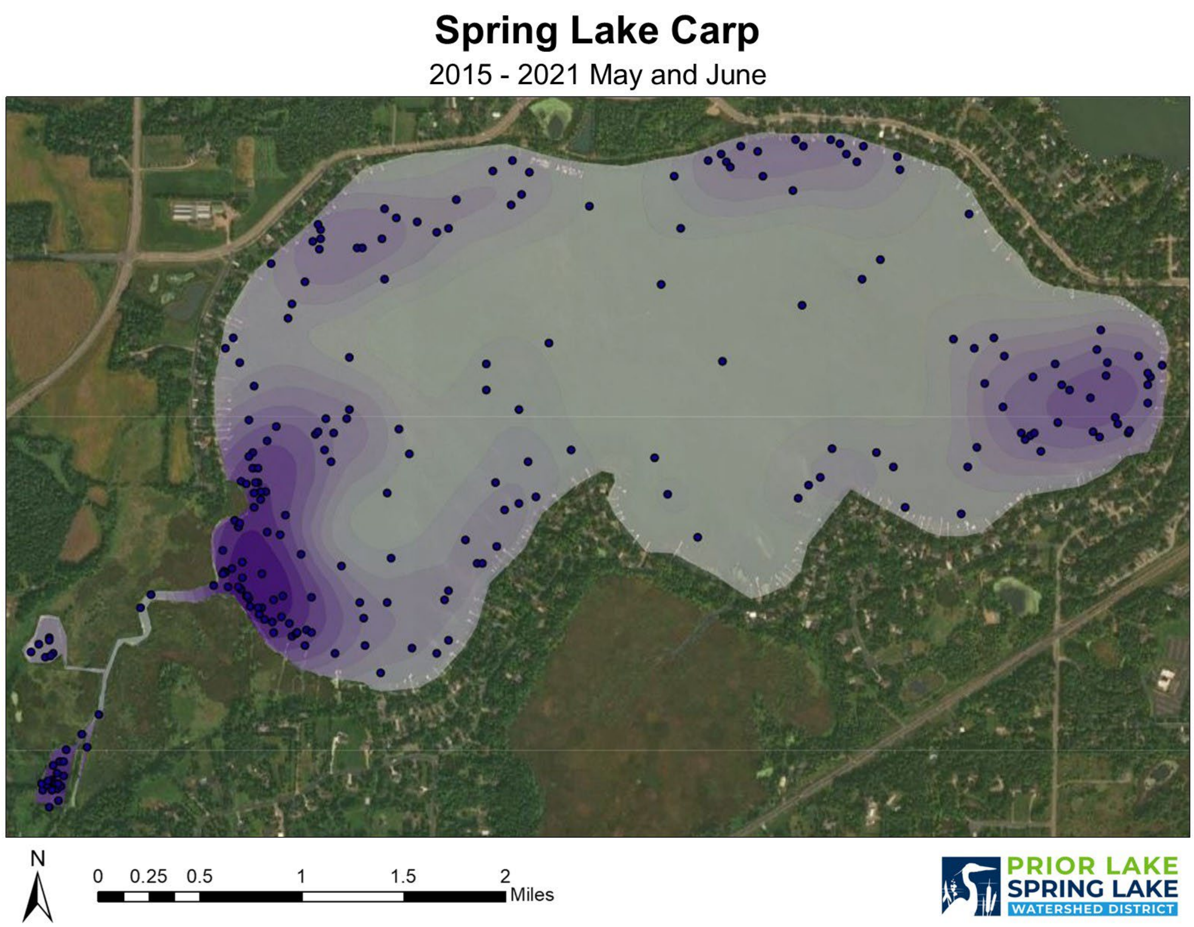


Figure 18: Spring Lake Spring-Time Aggregations 2015 to 2022

There are two (2) springtime aggregation areas on Spring Lake (Figure 18). One is located at the east end of the lake near the outlet to the Spring-Prior connecting channel. This aggregation is weaker, smaller, does not last long, and may be influenced by a culvert that outlets from a small wetland that drains into Spring Lake. The primary aggregation on Spring Lake in the spring season is found near the outlet of CD 13 into Spring Lake on the west end (Figure 18). Carp tend to stage in this area before moving upstream into CD 13 to access historical nursery sites along CD 13 which include Tadpole Wetland, the Desiltation

Pond, and Geis Wetland. All these nurseries have had barriers installed and are considered “off-line” for carp spawning. This is discussed later in **Section 8.0**.

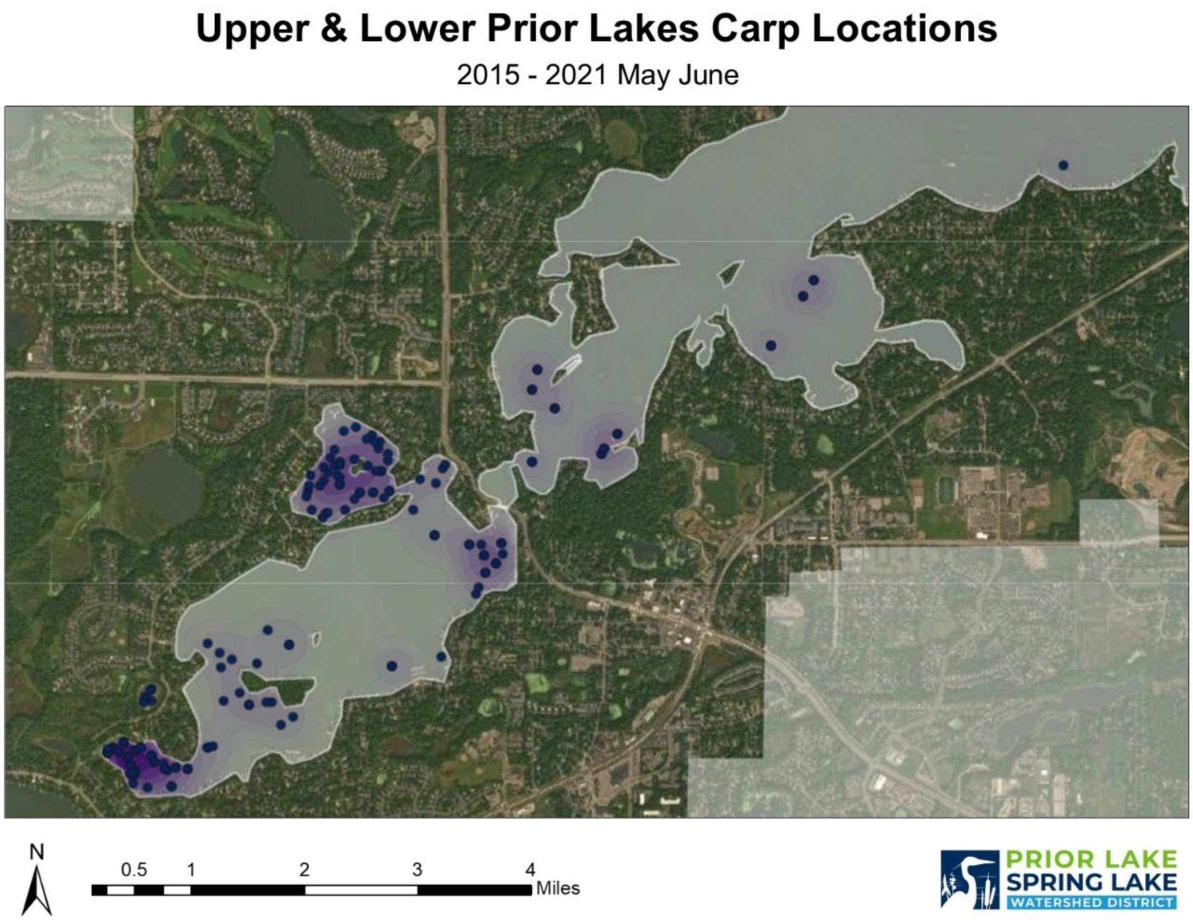


Figure 19: Upper Prior Lake Spring-Time Aggregations 2015 to 2022

In Upper Prior Lake (Figure 19), there are two (2) locations that have been targeted for removal based on radio tag indicated aggregations in early spring. One is in “Mud Bay” and the other near the Spring-Prior connecting channel. The Mud Bay aggregation may have been enhanced by the installation of a barrier at the Fremont Avenue crossing that connects to Arctic Lake, which is believed to be a historic nursery.

Task BDC11. Implant 10 adult carp with radio tags in Spring Lake.

Task BDC12. Implant 10 adult carp with radio tags in Upper Prior Lake.

Task BDC13. Implant radio tags (unassigned #; determined by budget) in connected Tier 2 and 3 Lakes.

Task BDC14. Complete weekly telemetry surveys in winter to identify timing and location of carp aggregations on Spring Lake.

Task BDC15. Complete weekly telemetry surveys in winter to identify timing and location of carp aggregations on Upper Prior Lake.

Task BDC16. Complete weekly surveys during the carp spawning period throughout the watershed to determine the location of each active radio tag if possible.

Task BDC17. Complete monthly surveys during the post carp spawning period (feeding) until ice on throughout the watershed to locate each individual radio tag if possible.

Task BDC18. Transfer all field location data to GIS (create shapefiles).

7.3.2 Identify Migration Routes and Potential Nursery Sites

Migration routes that allow access to shallow basins that carp exploit for use as nursery sites are the support mechanism for carp recruitment in those systems where carp spawn outside the main basins. Carp have evolved to seek out these sites since hard winters in Minnesota periodically freeze shallow basins resulting in winterkill of most or all fish species. Absence of predator species, such as bluegill sunfish, greatly increase the chance for survival of carp eggs and larvae. Radio-tags and passive integrated transponder (PIT) tags and stationary receivers are currently being used to track the movement of carp each season (Appendix B).

Task BDC19. Using radio tag and PIT tag data list and map migration routes (in GIS).

7.3.2.1 PIT Stations and Data Summary

Carp movement out of the Spring Lake and Upper Prior Lake system is being studied using the same radio-tags used in the Judas fish technique used to find carp winter aggregations. Several apparent surface connections exist on Spring Lake and Upper Prior Lake and in some cases, anecdotal information suggests that carp are using a connection even though no radio-tags have been detected moving. In response to this, the PLSLWD initiated a study using Passive Integrated Transponder (PIT) tags unmanned receivers/loggers placed in streams to detect movement and quantify the extent of movement in locations of highest priority. Five of the sites are using solar powered PIT Stations which allows for a more complete data set at remote locations where frequent battery swapping is difficult. PIT station locations and carp movement throughout the watershed are shown below in Figure 20 and Figure 21.

PIT station data suggests that when water levels are high enough (around 900.25’), carp are able to jump over the weir (902.5’) located south of Spring Lake (Figure 22.) Also shown is Figure 22. Is the tendency for carp to be most likely to make this crossing during rain events.

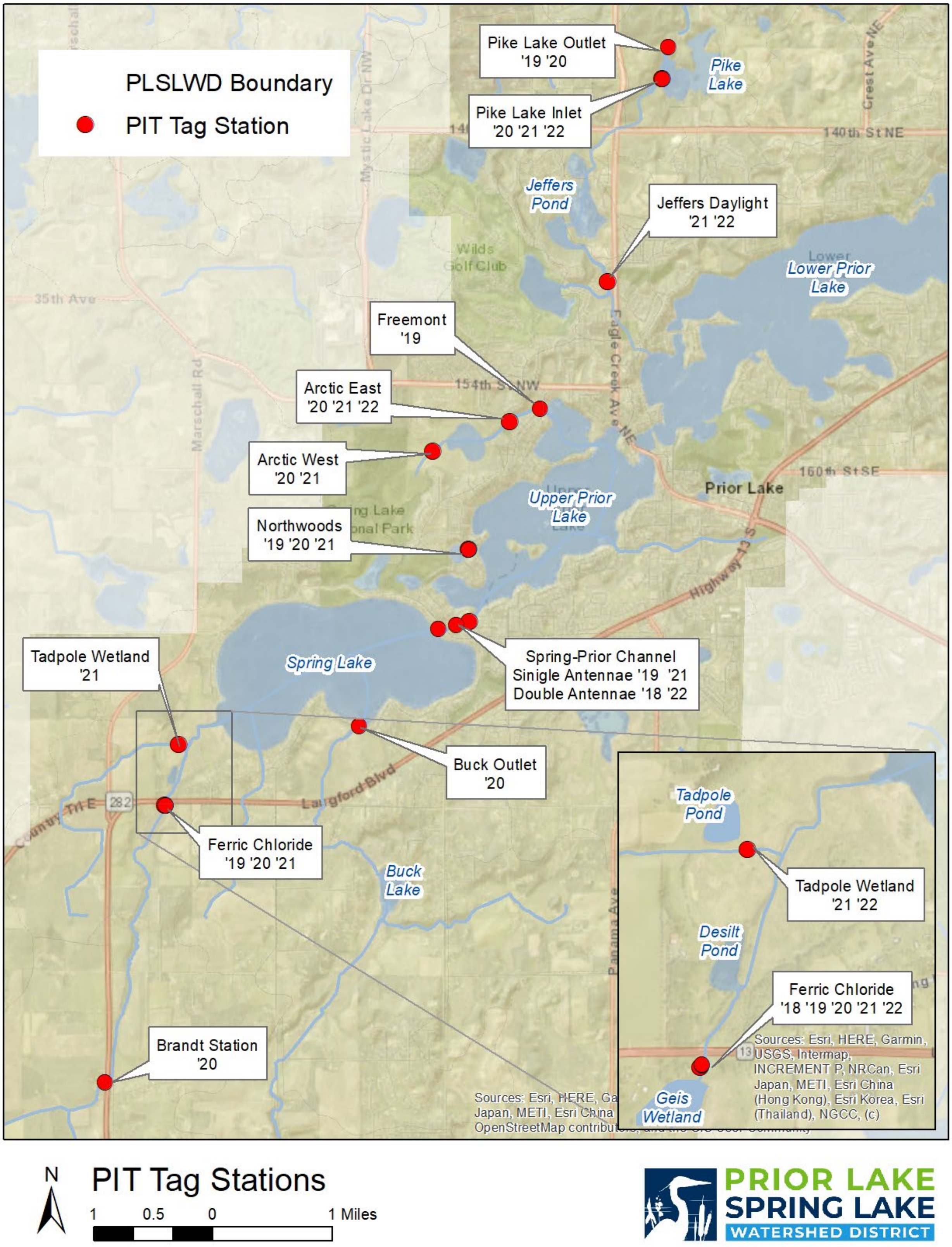


Figure 20. PIT Station Located Throughout the District between 2018-2022

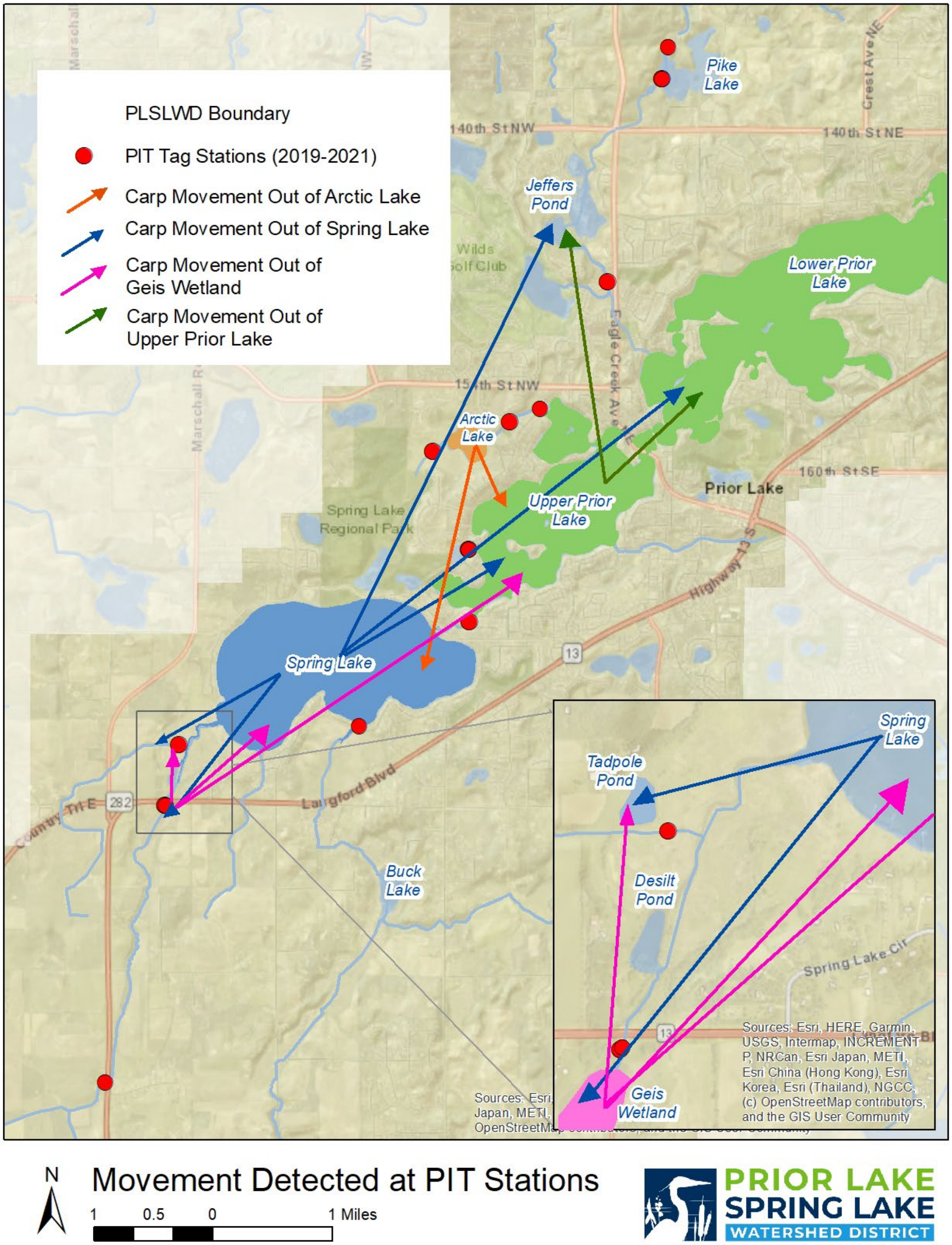


Figure 21. PIT Station Locations and Carp Movement Detections Between 2019-2021

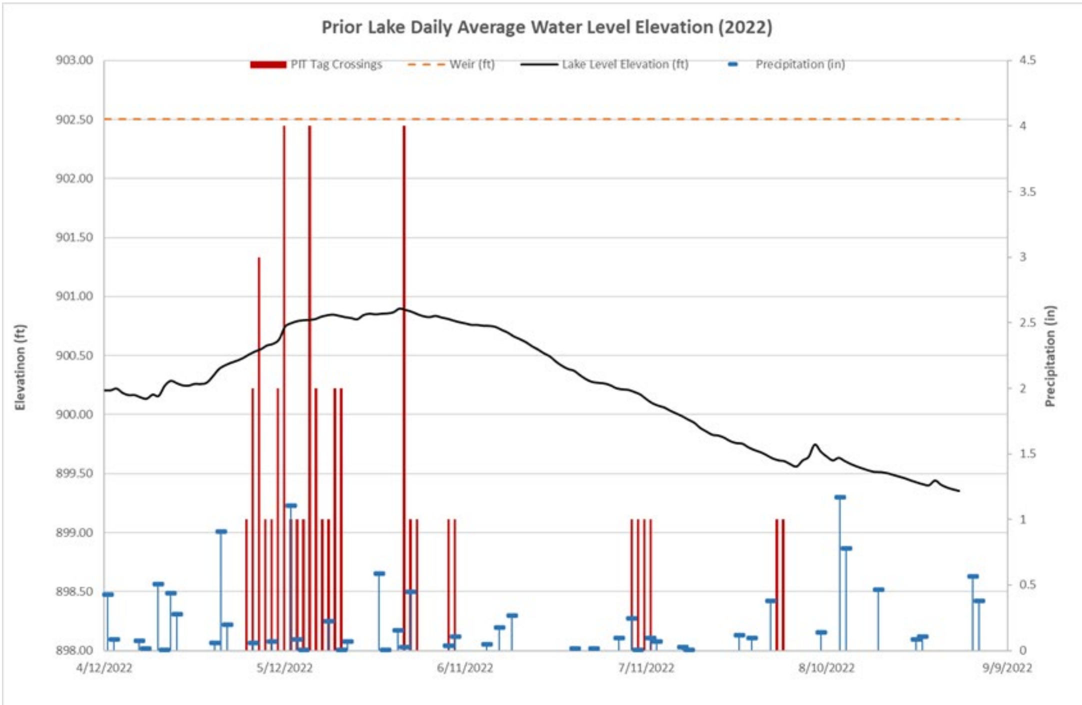


Figure 22. 2022 Water level and precipitation totals with number of PIT tag crossings per day. NOTE: tag crossings are a total across all PIT stations collecting data in 2022

Task BDC20. Identify location for PIT stations based on movement observations and radio tag data.

Task BDC21. Install PIT stations at selected location.

Task BDC22. Maintain PIT stations (field checks) and download data throughout the field season.

Task BDC23. Remove PIT stations from the field for storage.

Task BDC24. Download and assess PIT station data.

7.3.3 Remote Camera Monitoring

The District uses two stationary cameras to be placed at strategic locations to confirm carp migration routes and/or aggregations of carp during spawning season. These cameras are set up wirelessly and transmit real-time information so that staff can move quickly to coordinate carp removals at optimal times. Cameras are most commonly stationed at carp barriers and inside traps where carp tend to build up. Results from remote camera monitoring show that during the springtime, recordings are most important after rain events and when water is flowing as these are known to spur carp movement. These cameras also help staff know when a trap or barrier may require maintenance.

Figure 23 (left) Motion camera at the Arctic Lake outlet barrier. Figure 24 (right) Motion camera at the Anderson/Push trap.

Task BDC25. Install Remote cameras.

Task BDC26. Maintain remote cameras.

Task BDC27. Uninstall remote cameras and process data.

7.3.4 Carp Espionage

A volunteer carp sighting program was developed to better understand where carp could be found throughout the watershed. This program utilized residents who had the ability to view the waterbodies and/or connecting channels at all hours of the day to identify and report carp sightings to District staff. Volunteers were recruited by word of mouth and through an outreach campaign on social media. In this program, volunteers fill out a short form with basic information regarding the sighting and place a pin on a map to indicate where the carp sighting took place. Carp sightings could be categorized as spawning, migration, or groups/clusters. Sightings from this program proved valuable when much of the early spawning activity occurred before or after work hours and into the night. Having insider knowledge to the times and locations of carp spawning, PLSLWD and WSB were able to take action to perform removal activities. The Carp Espionage program can be found here: https://carp-espionage-plslwd.hub.arcgis.com/.

Task BDC28. Create data collection survey in Survey123.

Task BDC29. Publish and share survey online (District website).

Task BDC30. Create automatic connection between survey submission and email updates.

Task BDC31. Review and aggregate data on an annual basis.

Task BDC32. Maintain online form.

7.4 Carp and Bluegill Young of Year Surveys

Although spawning observations can suggest areas for recruitment, the strength of these recruitment events is not known without sampling using nets or electrofishing in these basins. To help determine priority waterbodies to block movement to or from, it is recommended that steps be taken to sample basins suspected for recruitment. Radio-tags and PIT tags can be used to help document springtime movement by adults. Trap netting can be used for small sampling efforts. Another tool for determining potential spawning sites is observing spawning behavior of carp.

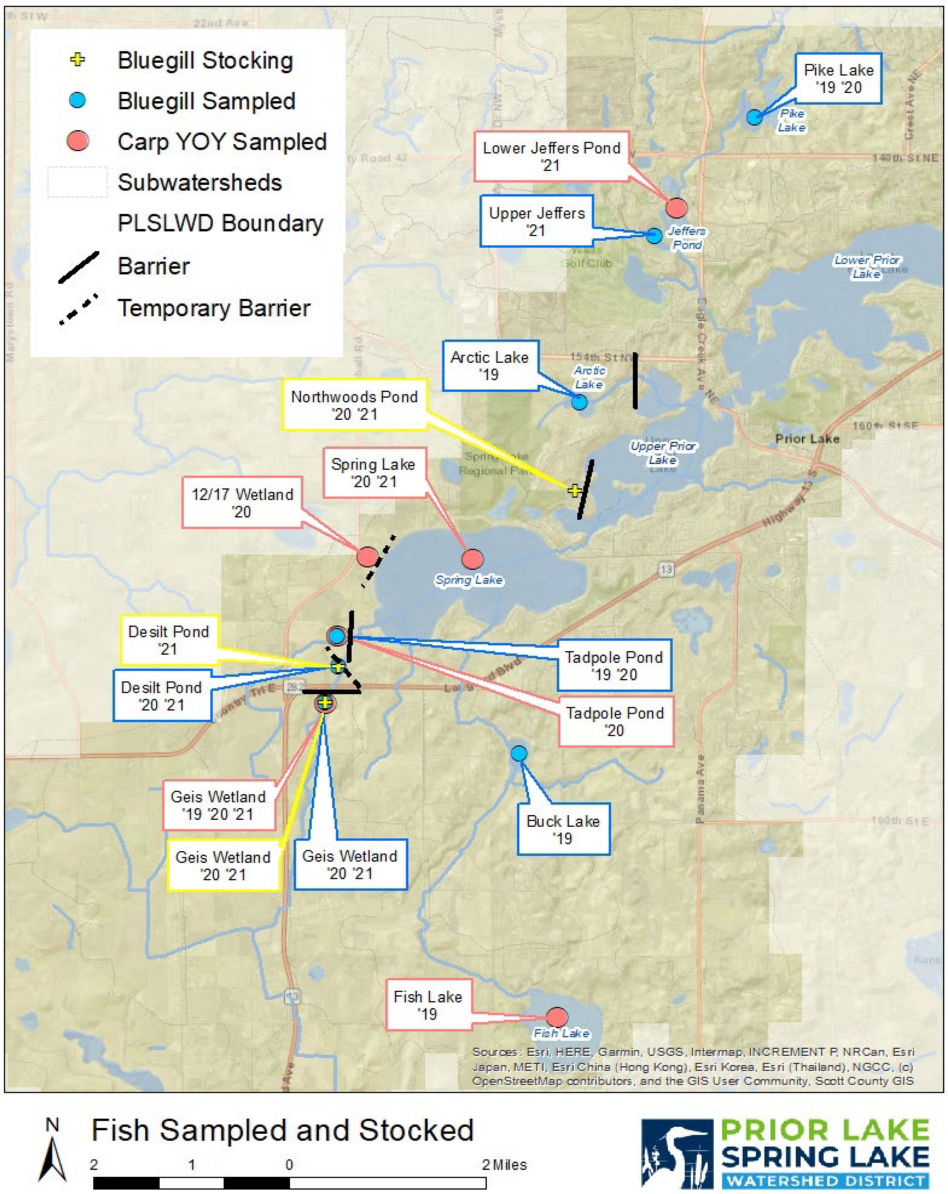


Figure 25. Sampling and stocking summary from 2019 to 2021

*Table 9: Summary of trap net or electrofishing surveys conducted in connected basins that are suspected to be carp nurseries. *Desilt pond barrier is temporary and replaced each springtime. **Historic observations of carp spawning behavior in pond. *** Spring and Upper Prior Lakes Survey Data include DNR Fisheries data. Additional Waterbodies with absence of YOY carp and blue without stocking are not shown in the table*

Key - Presence (P), Absence (A), Trap Netting (TN), Electrofishing (E) Bluegill Stocking (B)

Waterbody	**Year**	**Common Carp**	**Bluegill**	**Sample Method**	**Barrier In Place/Year Installed**
*Geis Wetland ** *	2019	P	P	E, TN	Yes/2020
	2020	P	P	E, TN	
	2021	P	P	TN	
	2022	A	A	TN	
*Tadpole Pond ** *	2019	P	P	TN	
	2020	P	P	TN	Yes/2021
Pike Lake	2019	A	P	TN	No
	2020	A	P	TN	
	2021	A	P	TN	
	2022	A	A	TN	
Lower Jeffers Pond	2021	P	P	TN	
Upper Jeffers Pond	2021	A	P	TN	
Arctic Lake	2019	A	P	TN	
*Northwoods Pond** *	2020	A	A	TN	Yes/2020
	2021	A	A	TN	
*Spring Lake*** *	2019	A	P	E	
	2020	P	P	E	
	2021	P	P	E	
*Upper Prior Lake*** *	2019	A	P	E	
	2020	A	P	E	
	2021	A	P	E	
12/17 Wetland	2020	P	P	TN	
	2021	A	P	TN	
Desilt Pond	2020	A	P	TN	Yes/2022*
	2021	A	P	TN	
	2022	A	P	TN	
Buck Lake	2019	A	P	TN	
Fish Lake	2022	A	P	TN	

Targeted surveys for carp young of the year and bluegill have not been conducted in the main basins of Spring Lake and Upper Prior Lake. However, carp young of the year have been sampled in boat electrofishing surveys conducted in the fall of 2021 and the fall of 2022 in Spring Lake. Since it is believed that carp young do not migrate into the main basins until one or two years old, these fish are suspected to have been spawned in the main basin of Spring Lake. This hypothesis is strengthened by the fact that barriers have been placed in known migration routes connected to Spring Lake and young of the year have not been sampled in these locations in the most recent survey.

Collecting aging data can help to determine the frequency of recruitment to each basin. This task is described in detail in section 7.8.1.

Task BDC33. Set mini trap nets in suspected carp nurseries based on PIT and radio tag data.

TaskBDC34. Enter and assess all YoY data and create maps showing net set locations.

7.5 Characterize Fishery Assemblage (species and size) and identify any trends

General fisheries data collected by MN DNR as part of the standard fishery assessment protocol is presented in section 1.0 on an individual lake basis where current data is available. A baseline assessment of the fishery is important so as to identify and understand any impacts to the species assemblage and size/age structure as management is carried out, determine if biological control may be an option, and to set goals in regard to fisheries.

Current datasets are available and are updated regularly for Upper and Lower Prior Lakes, Spring Lake, and Fish Lake, but Arctic, Pike, Geis, Jeffers East, and Buck Lake do not have current or any data at all for fish surveys to make these determinations.

Fishery surveys have been complete for most of the water bodies described above with the exception of Jeffers East.

The Arctic Lake fishery is composed of largemouth bass and bluegill which are both abundant, as well as common carp. Common carp biomass has been reduced through removal efforts from the original estimate of 743 kg/ha to 465 kg/ha (2018 Arctic Assessment Report) and other surveys show it may be lower. The installation of the Freemont barrier and removal work, along with external BMPs installed by the SMSC and the aerator are most likely working to improve the fishery and sustain reduced carp biomass.

The Pike Lake fishery assemblage was relatively diverse prior to the winterkill event of 2020 consisting of northern pike, bluegill, largemouth bass, yellow perch, carp, bullhead, and black Crappie. Since the winterkill the SMSC have been working to restore the fishery through stocking black Crappie, bluegill, yellow perch, and largemouth bass and installing an aerator as dissolved oxygen concentrations are low during the winter months.

Geis Wetland did support bluegill, carp, and white sucker prior to 2022 sampling. Bluegill were stocked as a biocontrol effort as recorded dissolved oxygen concentrations were sufficient to support this fishery. However, 2022 sampling showed no fish present which may be the result of very low water levels persisting into 2022.

The Buck Lake assessment showed that northern pike, yellow bullhead, pumpkinseed, hybrid bluegill, bluegill, yellow perch, and bluegill all in low abundance (except for bullhead) with a size structure skewed towards smaller fish. No carp were present during the one (1) survey completed in 2019.

Task BDC35. Complete baseline fishery assessment for Jeffers Pond (east and West).

7.6 Habitat Evaluation

Habitat is the critical component to support a resilient and robust fishery. In this document, habitat is defined as the water quality, aquatic vegetation, substrates, bathymetry, and in-lake structure within the waterbodies identified and discussed throughout this plan.

Water quality and vegetation is described generally for each of the lakes in Section 1, but additional information on submergent aquatic vegetation is included as it ties overall lake health and can be a direct benefit from carp management.

Submergent aquatic vegetation (SAV) abundance and plant area coverage (PAC) can also be utilized to gauge the change and subsequent improvements in lake ecology. The district collects data on SAV using both a point-intercept sampling method and BioBase (automated vegetation mapping system utilizing sonar) in both Spring Lake and Upper Prior Lake. Point-intercept data for Spring Lake shows an increase in distribution, density, and species richness for SAV. Between 2015 and 2021, a low of six individual species were documented in 2016 and a high of 15 individual species were documented in 2021. Species richness has been on an increasing trend since 2019.

Biobase software is used to collect baseline aquatic vegetation data and to detect and compare changes in plant distribution and density over time. Plant growth in lakes is expected to change seasonally due to changes in water temperature, sunlight, and nutrient availability. However, the location and density of plant growth can also be affected by rough fish abundance. Detecting and comparing changes in plant growth may provide insight on the effectiveness of water quality improvement projects, such as carp biomass reduction. PAC levels have been steadily increasing since 2014, with record high numbers of 51% and 29% in Upper Prior Lake and Spring Lake respectively (2021).

Task BDC36. Complete PI and BioBase Survey for Upper Prior Lake.

Task BDC37. Complete PI and BioBase Survey for Spring Lake.

Task BDC38. Complete PI and BioBase Survey for Fish Lake.

Task BDC39. Complete PI and BioBase Survey for Arctic Lake.

Task BDC40. Complete PI and BioBase Survey for Lower Prior Lake.

Task BDC41. Complete PI and BioBase Survey for Pike Lake.

Task BDC42. Complete PI and BioBase Survey for Jeffers Pond.

Task BDC43. Develop baseline water quality assessments for all Tier 1, 2, and 3 lakes.

7.7 Carp Size Structure

Documenting size structure (length and weight) allows managers to observe trends in reproduction and recruitment when using size as a surrogate for age as well as determine how the size structure changes in response to management activities.

Carp length and weight data has been collected almost every year on Upper Prior and Spring Lakes and is available on all other lakes where carp are present. Weight data is a required metric for determining total and per hectare biomass.

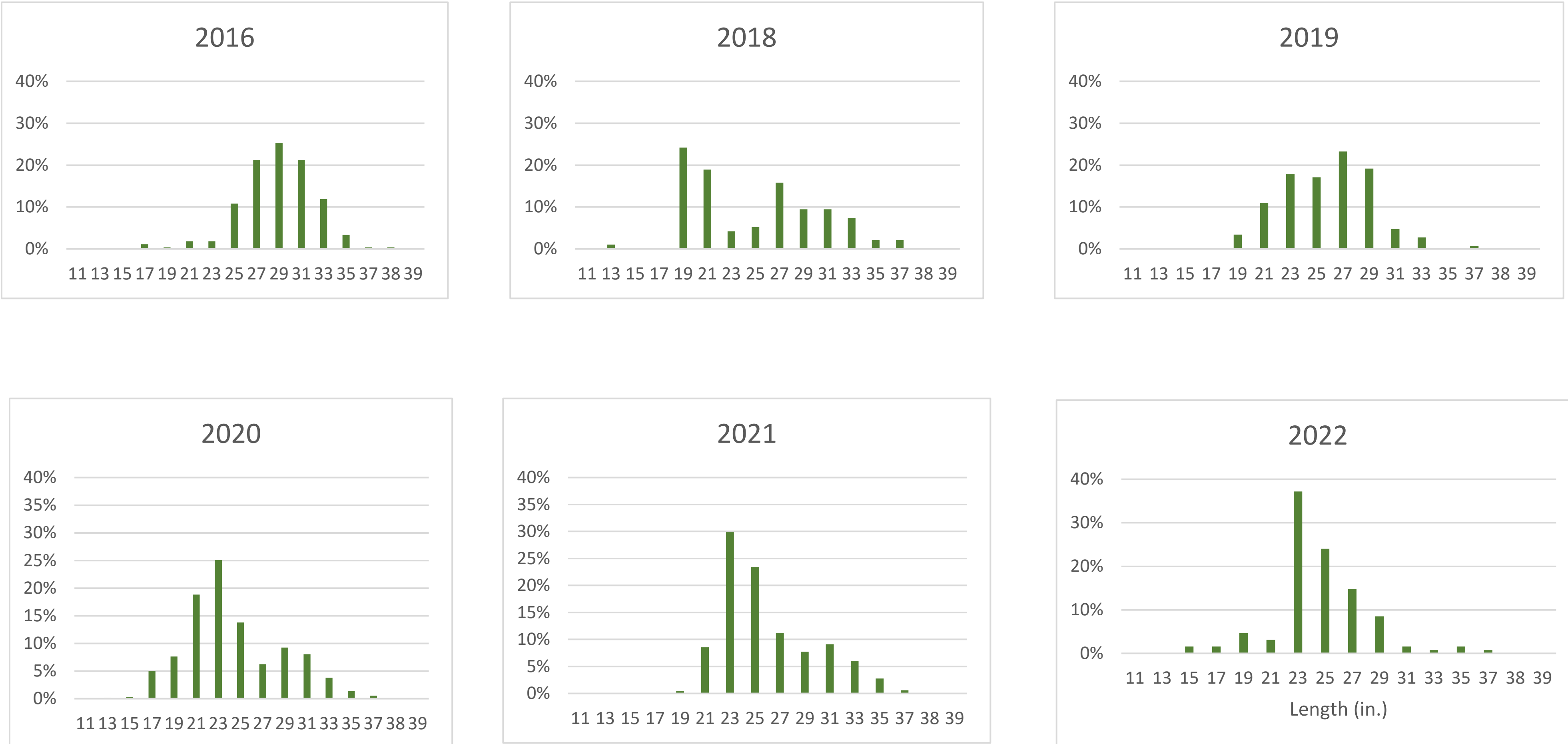
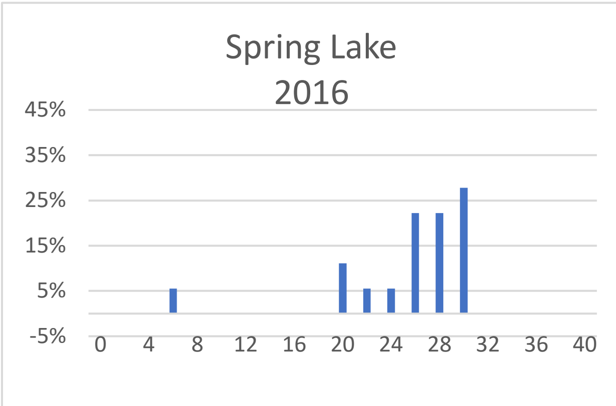
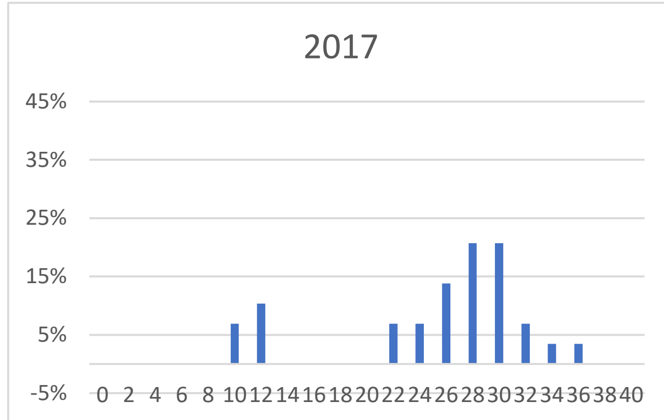
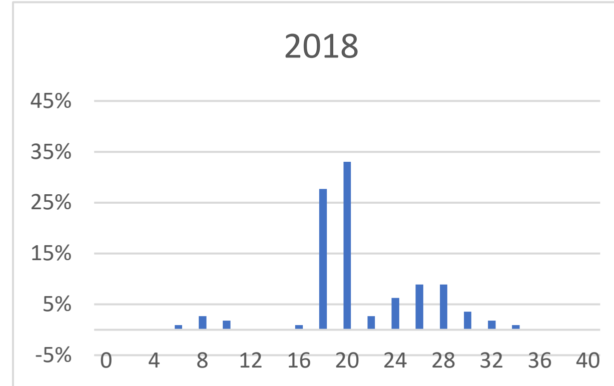
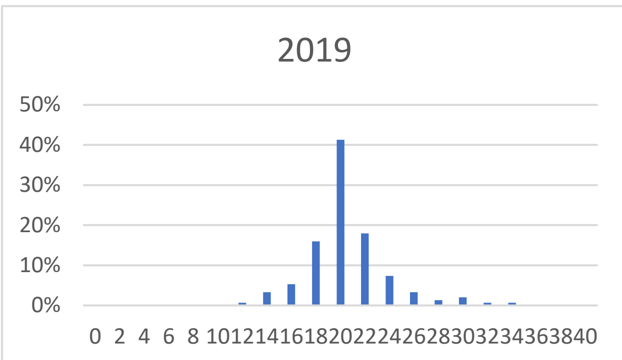


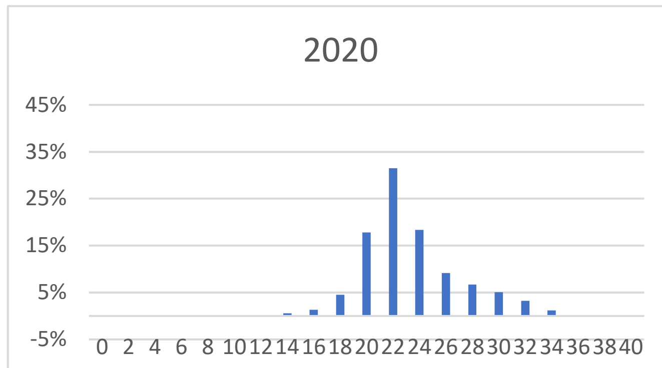
Figure 26. These graphs show the changes in carp length (in inches) structure in Upper Prior Lake between 2016 and 2022. The average length of carp in Upper Prior Lake has shown a decreasing trend since 2016 when the average length of captured carp was 28" to an average length of 23.7" in 2022. However, the percentage of carp captured less than the average length decreased from 37% to ~12% during the same time period potentially indicating the recruitment has been dramatically reduced. The Freemont barrier was installed in 2015 but was not kept closed on a continual basis (and not secured with a locking mechanism) until 2020. The Northwoods Barrier was also installed in 2020.

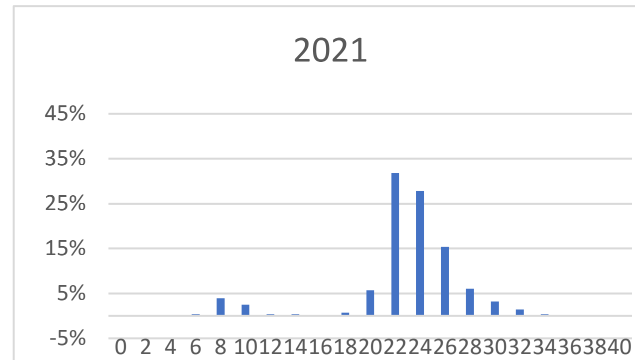












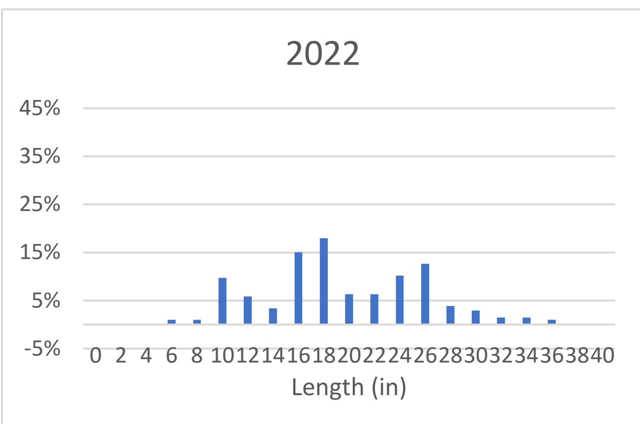


Figure 27. These graphs show the same data as presented for Upper Prior on the previous page. A large percentage of the Spring Lake population was removed in early 2017 (~78% of carp biomass). The 2018 graph shows the larger sized carp mostly gone from the sample and the smaller size classes shown as 10-12" carp in the 2017 graph making up the majority of the sample in 2018. This persists into 2019 and 2020 until we see what may be indications of in-lake spawning and recruitment in 2021 and 2022, as ~36% of the sample is less than the average length and 46% is greater than. Barriers were installed more recently on the Spring Lake Nurseries which may have allowed recruitment or we are seeing carp switch to in-lake spawning and recruitment.

Table 10. Average Length and sample sizes for Upper Prior and Spring Lake

Year		**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**
Sample size	Spring Lake	18	29	112	150	1648	280	206
	Upper Prior Lake	268	*na*	95	146	930	1007	129
Average Length (in.)	Spring Lake	24.4	24.2	20.1	19.6	22.3	21.9	18.6
	Upper Prior Lake	28.0	*na*	23.9	24.9	23.4	25.0	23.7

Table 10 above provides a summary of the sample size and average length of sampled carp in inches. Additional analysis may be required to determine if time of year, gear type, and/or sample size may be factors influencing changes in size structure.

Task BDC44. Aggregate all carp size data for Spring Lake and create length and weigh histograms.

Task BDC45. Aggregate all carp and size data for Upper Prior Lake and create length and weight histograms.

7.8 BDC Data Gaps

7.8.1 Carp Age Structure

No ageing data collected to date. We anticipate a remnant older age class on spring (pre-2017), and large dominant age class from 2017. Also looking to see if YoY observed the last 2 years on spring are recruiting to adulthood.

Size structure has been changing on Upper Prior and appeared to be increasing minimally through 2021 and changed dramatically in 2022 with smaller size being well represented. Ageing will help in determining if recruitment is occurring in Upper Prior. Additional analysis may be required to determine if smaller carp are migrating from Spring Lake.

Task BDC46. Collect a representative subsample of 50 to 100 carp from Spring Lake for ageing analysis.

Task BDC47. Collect a representative subsample of 50 to 100 carp from Upper Prior Lake for ageing analysis.

7.8.2 Lower Watershed Carp Movement Patterns

Critical carp movement data has been collected that has allowed the District to identify carp aggregation areas for removal and install barriers to prevent recruitment within the Upper and Central portions of the watershed, but little data is available for the Lower Watershed which, in this case, is the remaining area downstream of Lower Prior Lake connected by the Prior Lake Outlet Channel (PLOC).

The SMSC completed a brief radio tag study on Pike Lake, but radio tagged carp died during a winterkill event in 2020. The SMSC has also installed PIT stations at the inlet and the outlet to Pike Lake, but water levels in the PLOC have remained low or there has been no flow during the study period.

Specific data needs in regard to carp movement within the lower watershed include:

- Wintering areas in Jeffers (East and West).

- Level of movement between PLOC outlet to first daylight location and the watershed district boundary just downstream of Pike Lake.
- Identification of nursery sites (lakes, wetlands, and/or stormwater features).

Task BDC48. Implant up to 8 radio tags in Jeffers Pond basins (total) to identify wintering areas.

Task BDC49. Identify locations for PIT stations in Lower watershed between the PLOC daylight outlet and the Pike Lake outlet.

Task BDC50. Implant up to 30 carp with PIT tags in Jeffers Pond.

TaskBDC51. Install PIT stations at selected locations (3-4).

Task BDC52. Maintain PIT stations.

Task BDC53. Download and assess PIT data.

8.0 IPM Phase 2- Implementation

Plan implementation activities are determined through a data driven approach using the data collected and assessed in previous sections (**primarily Section 7**) of this planning document. To meet the two (2) goals of this plan, a sustained reduction in carp biomass will be required. The results of abundance estimates indicate that removal should be as a primary task; the radio telemetry and PIT station data, along with fisheries survey data, indicate that blocking carp migration will also be a critical component of this IPM.

Remote monitoring of water levels, dissolved oxygen, and fish movements can lead to sudden pivots (rapid response) to different implementation tasks for a specific year. Water level fluctuations during the year can alter migration/movement and precipitate changes to implementation plans and opportunities; extremely high-water levels can result in major issues that negatively affect carp management implementation.

8.1 Removal

Carp can be removed from waterbodies using a variety of methods as documented in the sections below. PLSLWD will consider the following when deciding which removal methods to employ:

1) **Feasibility:** How likely will this method result in success? What are the obstacles?

2) **Time-Oriented:** Is immediate removal necessary to meet goal deadlines? Will the timeliness affect success of other projects (e.g. alum treatment)?

3) **Cost-Effective:** Is this method worth the cost based on anticipated results?

4) **Effort for Results:** Is this the best method for the amount of effort required? Given limitations of staff, what methods produce the greatest results for the least amount of effort?

Given the wide range of possible removal techniques, it is important for the District to choose the most optimal technique for any given scenario. Factors including season, size of aggregation, location, availability of commercial netters, and general carp behaviors all influence the selection of removal techniques. For example, when large aggregations occur in pre-determined seining locations, it can be highly productive to conduct a seine in either open water or under the ice. However, carp populations will continue to diminish and adapt as they approach the 100 kg/ha threshold. In this scenario, the District may have more seasons similar to 2022, when in stream removal during spawning season was the most effective and consistent removal tool.

The key is to keep the four primary considerations in mind (feasibility, time-oriented, cost-effective, and effort for results) when making removal technique decisions. A diversified and flexible strategy will help the District to continue to make good progress even in changing conditions.

While the IPM plan addresses carp management strategies on a holistic, watershed-wide approach, the PLSLWD is dedicated to first reaching carp management goals on its top priority carp management lakes before it works to actively manage the other six lakes.

Table 11. Spring Lake Removal Events and year end Biomass Estimates.

Lake	**Date**	**Method**	**No. Carp Removed**	**Kilograms carp removed**	**Biomass estimate (kg/ha)**
Spring Lake	**2019**				
	December 2019	CPUE	n/a	n/a	266.2 +/- 53.7
	2020				
	April 2	REMOVAL: Open Water Seine	4	7	-0.03
	April 3	REMOVAL: Gill Netting	8	15	-0.06
	April 5	REMOVAL: Open Water Seine (district net) Netting	23	43	-0.2
	April 5	REMOVAL: Gill Netting	0	0	0
	April 24	REMOVAL: Open Water Seine Netting	345	1388	-5.8
	May 18	REMOVAL: Push Trap	22	69	-0.3
	May 19	REMOVAL: Push Trap	8	22	-0.1
	May 20	REMOVAL: Push Trap	9	24	-0.1
	May 21	REMOVAL: Push Trap	14	41	-0.2
	May 21	REMOVAL: Boat Electrofishing	64	153	-0.6
	May 22	REMOVAL: Push Trap	0	0	0
	May 22	REMOVAL: Boat Electrofishing	97	259	-1.1
	May 24	REMOVAL: Push Trap	3	8	-0.03
	May 24	REMOVAL: Boat Electrofishing	163	414	-1.7
	May 27	REMOVAL: Push Trap	32	97	-0.9
	May 27	REMOVAL: Boat Electrofishing	142	431	-4.0
	May 28	REMOVAL: Push Trap	1	1.97	0
	May 28	REMOVAL: Boat Electrofishing	29	76	-0.7
	June 1	REMOVAL: Push Trap	9	23	-0.1

June 1	REMOVAL: Boat Electrofishing	39	106	-0.4
June 2	REMOVAL: Push Trap	32	69	-0.3
June 2	REMOVAL: Boat Electrofishing	78	219	-0.9
June 3	REMOVAL: Push Trap	15	36	-0.2
June 4	REMOVAL: Boat Electrofishing	7	18	-0.1
June 8	REMOVAL: Push Trap	9	15	-0.1
June 16	REMOVAL: Boat Electrofishing	33	167	-0.7
July 16	REMOVAL: Box Netting (Trap 1)	137	279	-1.2
July 16	REMOVAL: Box Netting (Trap 2)	113	231	-1.0
July 23	REMOVAL: Box Netting (Trap 1)	83	169	-0.7
July 23	REMOVAL: Box Netting (Trap 2)	56	109	-0.5
August 12	REMOVAL: Box Netting (Trap 1)	8	14	-0.1
August 20	REMOVAL: Box Netting (Trap 1)	94	205	-0.9
August 20	REMOVAL: Box Netting (Trap 2)	89	245	-1.0
December 2020	2018 CPUE minus fish removed	n/a	n/a	242.5 +/- 48.9
2021				
February 18	REMOVAL: Under Ice Seine Netting	1238	3402	-14.2
June 4	REMOVAL: Boat Electrofishing	114	314	-1.3
June 7	REMOVAL: Boat Electrofishing	1	3	-1.3
June 10	REMOVAL: Boat Electrofishing	0	0	0
November 19	REMOVAL: Gill Net (District Gills)	5	14	-0.1
November 19	REMOVAL: Open Water Seine (District Net)	1	2.8	0
December 2021	2019 CPUE minus fish removed	n/a	n/a	227 +/- 45.7

Table 12. Upper Prior Lake Removal Events and year end Biomass Estimates.

Lake	**Date**	**Method**	**No. Carp Removed**	**Kilograms carp removed**	**Biomass estimate (kg/ha)**
Upper Prior Lake	Nov 2018	CPUE	n/a	n/a	333.3 +/- 105.3
	2019				
	April 2019	REMOVAL: Open Water Seine	530	2471	-15.8
	May 2019	REMOVAL: Freemont Stream	348	1984	-12.7

June 2019	REMOVAL: Freemont Stream	33	109	-0.7
Dec 2019	2018 CPUE minus fish removed	n/a	n/a	304.1 +/- 96.1
2020				
March 2	REMOVAL: Under Ice Seine	815	4694	-30.0
March 5	REMOVAL: Under Ice Seine	12	45	-0.3
April 7	REMOVAL: Gill Netting	50	365	-2.3
April 21	REMOVAL: Gill Netting	72	447	-2.9
April 22	REMOVAL: Gill Netting	5	32	-0.2
April 30	REMOVAL: Gill Netting	30	195	-1.2
April 30	REMOVAL: Boat Electrofishing	45	119	-0.7
May 6	REMOVAL: Boat Electrofishing	35	105	-0.7
May 7	REMOVAL: Northwoods Barrier	50	140	-0.9
May 18	REMOVAL: Northwoods Barrier	21	59	-0.4
May 19	REMOVAL: Boat Electrofishing	209	613	-3.9
May 20	REMOVAL: Boat Electrofishing	53	140	-0.9
May 21	REMOVAL: Boat Electrofishing (night)	4	14	-0.1
May 27	REMOVAL: Boat Electrofishing	65	168	-1.1
May 28	REMOVAL: Newman Trap	25	67	-0.4
May 28	REMOVAL: Boat Electrofishing	29	74	-0.5
June 1	REMOVAL: Newman Trap	8	23	-0.1
June 1	REMOVAL: Boat Electrofishing	71	225	-1.3
June 2	REMOVAL: Boat Electrofishing	90	348	-2.0
June 3	REMOVAL: Newman Trap	125	354	-2.0
June 3	REMOVAL: Boat Electrofishing	18	44	-0.2
June 4	REMOVAL: Newman Trap	26	62	-0.3
June 4	REMOVAL: Boat Electrofishing	18	41	-0.2

June 11	REMOVAL: Boat Electrofishing	5	15	-0.1
June 15	REMOVAL: Boat Electrofishing	16	43	-0.2
December 2020	ESTIMATE: 2018 CPUE minus fish removed	n/a	n/a	250.4 +/- 79.1
		2021		
January 29	REMOVAL: Under Ice Seine + Gill Net + MUM (speakers)	160	1042	-6.6
February 23	REMOVAL: Gill Netting	212	1043	-6.6
March 5	REMOVAL: Gill Netting	19	139	-0.9
March 30	REMOVAL: Freemont Stream		719	-4.5
May 13	REMOVAL: Boat Electrofishing		242	-1.5
May 18	REMOVAL: Boat Electrofishing		836	-5.3
May 19	REMOVAL: Boat Electrofishing		803	-5.1
May 21	REMOVAL: Boat Electrofishing		380	-2.4
May 24	REMOVAL: Boat Electrofishing		503	-3.2
May 25	REMOVAL: Boat Electrofishing		217	-1.4
May 26	REMOVAL: Boat Electrofishing		206	-1.3
June 9	REMOVAL: Boat Electrofishing		79	-0.5
June 10	REMOVAL: Boat Electrofishing		32	-0.2
December 2021	ESTIMATE: 2018 CPUE minus fish removed			211.0 +/- 66.7

As carp biomass approaches the 100 kg/ha goal, the district will focus efforts that yield the best returns. As of 2022, in-stream removals and targeted electrofishing have been the most consistent method for reducing biomass. The goals of conducting multiple seining events between fall and end of winter may shift toward methods that have greater reliability because likelihood of removing 15,000-30,000 pounds annually seining is diminishing.

8.1.1 Seine netting permits

Most activities identified in this plan are covered under an annual fisheries research permit issued by the MN DNR. However, large scale removal other than gill netting requires that someone hold an

Inland Commercial Fish Removal Permit- Class “B” or “C”.

A Class B permit allows the holder to remove rough fish (carp) and sell them commercially in the area for which the permit holder is licensed in MN. The Prior Lake Spring Lake Watershed is located within MN Inland Commercial Fishing Permit Area 21 which is licensed to Don Geyer for the 2022/2023 Commercial Fishing Year (expires on May 12, 2023). Don has worked with the District to remove carp under the ice since 2017 and continues to do so.

However, Don has not always been available for removal operations and has not been interested in or does not have the equipment to complete open water seine netting. To allow for commercial fishing (large-scale removal), the district has acquired a Class C commercial permit in cooperation with other commercial fishing crews; Jeff Riedemann has been the primary signatory since 2018.

This has allowed the district to move forward with large-scale removal operations throughout the time period when commercial fishing may be permitted; generally, Labor Day through the first weekend in May of the following year (~8 month window).

Task I1. Acquire MN DNR issued "Class C" Commercial Fishing Permit.

8.1.2 Commercial Seine Netting

Commercial seine netting employs local commercial fishing crews to target large aggregations of carp. Since 2016, these crews have been guided to these aggregations by the use of the judas technique, which uses radio-tag locations to identify timing and relative extent of aggregations. In Spring Lake, a total of 41,630 pounds of carp have been removed using this method equating to a reduction in overall biomass of 80.2 kg/ha (Table 13). One haul area on Spring Lake has been well established by the commercial crew long before the district contracted with them. In recent years, the removal of obstructions in this area has helped to ensure the successful pull of a seine net through this area.

Table 13: Commercial seine netting on Spring Lake since 2017.

Lake	**Year**	**Date Reported**	**Method**	**Biomass Removed (kg/ha)**	**# Ind. Carp Removed**	**Pounds Carp Removed**
Spring Lake	2017	1/30/2017	Commercial Under Ice Seine	-60.1	2,577	31,800
		2017 Total		**-60.1**	**2,577**	**31,800**
	2020	4/2/2020	Commercial Open Water Seine	0.0	4	16
		4/24/2020	Commercial Open Water Seine	-5.8	345	3,062
		2020 Total		**-5.8**	**349.0**	**3078**
	2021	2/18/2021	Commercial Under Ice Seine	-14.3	1,238	7,552
		2021 Total		**-14.3**	**1,238**	**7,552**

Historically, seine netting on Upper Prior Lake did not occur. It was not until test seine netting was contracted by the PLSLWD in 2016 was pursued that commercial crews felt confident to target aggregations here.

Table 14: Commercial seine netting on Upper Prior Lake since 2016.

Lake	Year	Date Reported	Method	Biomass Removed (kg/ha)	# Ind. Carp Removed	Pounds Carp Removed
Upper Prior Lake	2016	11/30/2016	Commercial Open Water Seine	-10.3	267	3,552
	2016 Total			**-10.3**	**267**	**3,552**
	2018	1/18/2018	Commercial Under Ice Seine	-120.2	2,938	41,426
	2018 Total			**-120.2**	**2,938**	**41,426**
	2019	4/19/2019	Commercial Open Water Seine	-15.8	530	5,448
	2019 Total			**-15.8**	**530**	**5,448**
	2020	3/2/2020	Commercial Under Ice Seine	-30.0	815	10,350
		3/5/2020	Commercial Under Ice Seine	-0.3	12	100
	2020 Total			**-0.3**	**12**	**100**

Task I2. Complete initial seine netting at haul location #1 on Spring Lake.

Task I3. Complete initial Seine netting at haul location #1 on Upper Prior Lake.

Task I4. Identify other locations for seine netting based on radio tag aggregations in both Spring Lake and Upper Prior Lake.

Task I5. Open Water Seine Feasibility Test on Spring Lake and Upper Prior Lake - Mud Bay.

Task I6. Complete reconnaissance in secondary and tertiary seine netting locations for obstruction and impediments to netting with the use of "practice seines".

Task I7. Complete at least 1 commercial seine netting attempt in both Spring and Upper Prior Lakes if aggregations persist and conditions allow once/year until biomass goals are met.

8.1.3 District Led Micro Hauls

Targeting of small aggregations of carp using district net. Deployed 4 times on Spring Lake with 1,210 pounds equating to a biomass reduction of 1.24 kg/ha.

Table 15. District-led seine events on Spring Lake from 2020 to 2022

Lake	Year	Date Reported	Method	Biomass Removed (kg/ha)	# Ind. Carp Removed	Pounds Carp Removed
Spring Lake	2020	4/5/2020	District Led Open Water Seine	-0.2	23	94
	2020 Total			**-0.2**	**23**	**94**
	2021	11/19/2021	District Led Open Water Seine	0.0	1	6
	2021 Total			**0.0**	**1**	**6**
	2022	6/28/2022	District Led Seine Netting - Desilt Pond	-0.8	80	560
		8/16/2022	District Led Seine Netting - Desilt Pond	-1.04	78	550

2022 Total	**-1.9**	**158**	**1,110**

Task I8. Implement micro hauls in open water targeting radio tagged or sonar indicated aggregations in areas where a small seine can be deployed and retrieved easily by hand if necessary.

8.1.4 Gill Netting

Beginning in 2019, the District was allowed the opportunity through DNR permitting to conduct the Gill Netting Pilot Project for carp removal. Through this special permitting and under the watchful eye of the DNR, the District worked with commercial netters to deploy gill nets for large scale removal. Specific sizing of the gill nets was assigned to reduce the chance of catching non target species. The pilot program now part of our normal permit with special restrictions.

Table 16. Gill netting on Spring Lake from 2020 to 2022

Lake	**Year**	**Date Reported**	**Method**	**Biomass Removed (kg/ha)**	**# Ind. Carp Removed**	**Pounds Carp Removed**
Spring Lake	2020	4/3/2020	Commercial Gill Netting	-0.1	8	33
		4/5/2020	District Led Gill Netting	0.0	0	0
	2020 Total			**-0.1**	**8**	**33**
	2021	11/19/2021	District Led Gill Netting	-0.1	5	30
	2021 Total			**-0.1**	**5**	**30**
	2022	6/28/2022	District Led Gill Netting - Desilt Pond	-0.3	30	150
	2022 Total			**-0.3**	**30**	**150**

Table 17. Gill netting on Upper Prior Lake from 2020 to 2022

Lake	**Year**	**Date Reported**	**Method**	**Biomass Removed (kg/ha)**	**# Ind. Carp Removed**	**Pounds Carp Removed**
Upper Prior Lake	2020	4/7/2020	Commercial Gill Netting	-2.3	50	805
		4/21/2020	Commercial Gill Netting	-2.9	72	986
		4/22/2020	Commercial Gill Netting	-0.2	5	70
		4/30/2020	Commercial Gill Netting	-1.2	30	432
	2020 Total			**-6.6**	**157.0**	**2292.7**
	2021	2/23/2021	Commercial Gill Netting	-6.6	212.0	2300
		3/5/2021	Commercial Gill Netting	-0.9	19	305
	2021 Total			**-7.5**	**231.0**	**2605.1**

Task I9. Request gill netting authorization from MN DNR.

Task I10. Complete gill netting feasibility on both Upper Prior and Spring Lakes to determine feasibility and mortality to bycatch.

Task I11. Based on feasibility results implement the use of gill nets as a removal technique as needed.

8.1.5 Baited Box netting

Box netting has had varied success since 2020 as shown in Tables 18 and 19 below. Difficulties in establishing locations limits the use of the method. Box netting is low on the list of cost-effective removal methods but is kept in the toolbox should winter seining yield low results or water levels have negative impacts on in-stream removals. New trap setting technologies and use of PIT stations during baiting are ways the District is looking to improve method effectiveness in the future.

Table 18. Box netting on Spring Lake from 2020 to 2021

Lake	**Year**	**Date Reported**	**Method**	**Biomass Removed (kg/ha)**	**# Ind. Carp Removed**	**Pounds Carp Removed**
Spring Lake	2020	7/23/2020	Box Netting	-0.7	83	373
		7/23/2020	Box Netting	-0.5	56	241
		8/12/2020	Box Netting	-0.1	8	32
		8/20/2020	Box Netting	-0.9	94	452
		8/20/2020	Box Netting	-1.0	89	540
		7/16/2020	Box Netting	-1.2	137	616
		7/16/2020	Box Netting	-1.0	113	508
		8/27/2020	Box Netting	-0.1	8	49
		9/15/2020	Box Netting	-1.1	94	570
		9/25/2020	Box Netting	-0.4	36	218
	2020 Total			**-6.8**	**718.0**	**3598.8**
	2021	7/20/2021	Box Netting	-0.9	78	473
		7/27/2021	Box Netting	-0.1	5	30
		7/30/2021	Box Netting	-0.2	18	109
	2021 Total			**-1.2**	**101.0**	**612.4**

Table 19. Box netting on Upper Prior Lake in 2020

Lake	**Year**	**Date Reported**	**Method**	**Biomass Removed (kg/ha)**	**# Ind. Carp Removed**	**Pounds Carp Removed**
Upper Prior Lake	2020	8/27/2020	Box Netting	-0.3	15	89
	2020 Total			**-0.3**	**15**	**89**

Task I12. Survey Spring Lake and Upper Prior Lake for Box net locations.

Task I13. Poll Spring Lake residents to gain shoreline access for additional box netting locations.

Task I14. Test Baiting at Spring Lake and Upper Prior Lake potential box net locations.

Task I15. Install, operate, and remove box nets.

8.1.6 Push Trap

The push trap as described in section 5.5.3 works besting when spring flows are in their medium range and consistent during the runup to ideal spawning temperatures. Table 20 shows that in 2020 the trap was effective at removing biomass during a small window of operation. Water levels were low in 2021 and 2022 which led to the trap being ineffective at capturing carp.

Table 20. Push trap removals on Spring Lake 2020 to 2022

Lake	**Year**	**Date Reported**	**Method**	**Biomass Removed (kg/ha)**	**# Ind. Carp Removed**	**Pounds Carp Removed**
Spring Lake	2020	5/18/2020	Push Trap	-0.3	22	153
		5/19/2020	Push Trap	-0.1	8	
		5/20/2020	Push Trap	-0.1	9	52
		5/21/2020	Push Trap	-0.2	14	89
		5/22/2020	Push Trap	0.0	0	
		5/24/2020	Push Trap	0.0	3	
		5/27/2020	Push Trap	-0.9	32	214
		5/28/2020	Push Trap	0.0	1	4
		6/1/2020	Push Trap	-0.1	9	
		6/2/2020	Push Trap	-0.3	32	
		6/3/2020	Push Trap	-0.2	15	
		6/8/2020	Push Trap	-0.1	9	
	2020 Total			**-2.2**	**154**	
	2022	5/18/2022	Push Trap	-0.2	20	112
	2022 Total			**-0.2**	**20**	**112**

Task I16. Construct push trap and install at desilt pond outlet.

8.1.7 Newman Trap

The Newman Trap design is similar to a baited box net. Rather than having to set the net by pulling up the sides to capture the carp, this net provides constant capture of carp when set. Carp swim into the trap and cannot escape. Like the Push Trap, this removal method is heavily dependent on normal to high water levels to allow carp access to specific migration routes for the trap to be effective. During the first year of deployment, the Newman Trap generated four removal capture events shown in Table 21.

Table 21. Newman Trap removals on Upper Prior Lake in 2020

Lake	**Year**	**Date Reported**	**Method**	**Biomass Removed (kg/ha)**	**# Ind. Carp Removed**	**Pounds Carp Removed**
	2020	5/28/2020	Newman Trap	-0.4	25	148
		6/1/2020	Newman Trap	-0.1	8	51

Upper Prior Lake		6/3/2020	Newman Trap	-2.2	125	780
		6/4/2020	Newman Trap	-0.4	26	137
	2020 Total			**-3.2**	**184.0**	**1115.5**

Task I17. Design and build Newman Trap.

Task I18. Install and monitor Newman Trap making modifications as necessary.

Task I19. Install Newman trap as needed.

8.1.8 Targeted Electrofishing

As discussed in section 5.5.2, targeted electrofishing has proven to be a consistent and reliable removal method. Tables 22 and 23 show efforts in Spring and Upper Prior Lakes have led to significant percentages of annual removals over the past three years.

Table 22. Electrofishing on Spring Lake from 2020 to 2022

Lake	**Year**	**Date Reported**	**Method**	**Biomass Removed (kg/ha)**	**# Ind. Carp Removed**	**Pounds Carp Removed**
Spring Lake	2020	5/21/2020	Boat Electrofishing (night)	-0.6	64	337
		5/22/2020	Boat Electrofishing	-1.1	97	571
		5/24/2020	Boat Electrofishing	-1.7	163	913
		5/27/2020	Boat Electrofishing - Tadpole & CD 13	-4.0	142	950
		5/28/2020	Boat Electrofishing - Tadpole & CD 14	-0.7	29	168
		6/1/2020	Boat Electrofishing	-0.4	39	
		6/2/2020	Boat Electrofishing	-0.9	78	
		6/4/2020	Boat Electrofishing	-0.1	7	
		6/16/2020	Boat Electrofishing	-0.7	33	
		Total	2020 Total	**-10.2**	**652**	
	2021	6/4/2021	Boat Electrofishing	-1.3	114	691
		6/7/2021	Boat Electrofishing	0.0	1	6
		6/10/2021	Boat Electrofishing	0.0	0	
		Total	2021 Total	**-1.3**	**115**	
	2022	5/18/2022	Boat Electrofishing	-0.5	45	253
		5/19/2022	Boat Electrofishing	-1.0	86	516
		5/24/2022	Boat Electrofishing	0.0	7	5
		6/7/2022	Boat Electrofishing	-0.1	21	42
		6/28/2022	Boat Electrofishing - Desilt Pond	0.0	4	
		8/30/2022	Boat Electrofishing	-0.5	53	239
		9/23/2022	Boat Electrofishing	-0.2	33	109

	Total	2022 Total	**-2.2**	**249**	

Table 23. Electrofishing on Upper Prior Lake from 2020 to 2022

Lake	**Year**	**Date Reported**	**Method**	**Biomass Removed (kg/ha)**	**# Ind. Carp Removed**	**Pounds Carp Removed**
Upper Prior	2020	4/30/2020	Boat Electrofishing	-0.7	45	264
		5/6/2020	Boat Electrofishing	-0.7	35	232
		5/19/2020	Boat Electrofishing	-3.9	209	1352
		5/20/2020	Boat Electrofishing	-0.9	53	308
		5/21/2020	Boat Electrofishing (night)	-0.1	4	30
		5/27/2020	Boat Electrofishing	-1.1	65	370
		5/28/2020	Boat Electrofishing	-0.5	29	163
		6/1/2020	Boat Electrofishing	-1.4	71	496
		6/2/2020	Boat Electrofishing	-2.2	90	767
		6/3/2020	Boat Electrofishing	-0.3	18	97
		6/4/2020	Boat Electrofishing	-0.3	18	91
		6/11/2020	Boat Electrofishing	-0.1	5	32
		6/15/2020	Boat Electrofishing	-0.3	16	94
	2020 Total			**-12.3**	**658**	
	2021	5/13/2021	Boat Electrofishing	-1.5	44	532
		5/18/2021	Boat Electrofishing	-5.3	152	1839
		5/19/2021	Boat Electrofishing	-5.1	146	1767
		5/21/2021	Boat Electrofishing	-2.4	105	836
		5/24/2021	Boat Electrofishing	-3.2	139	1107
		5/25/2021	Boat Electrofishing	-1.4	60	478
		5/26/2021	Boat Electrofishing	-1.3	57	454
		6/9/2021	Boat Electrofishing	-0.5	22	174
		6/10/2021	Boat Electrofishing	-0.2	9	71
	2021 Total			**-20.8**	**734**	**7258.7**
	2022	5/2/2022	Boat Electrofishing	-2.2	112	784
		5/10/2022	Boat Electrofishing	-1.0	50	350
		5/19/2022	Boat Electrofishing	-1.5	74	518
		5/20/2022	Boat Electrofishing	-0.2	8	56
		5/26/2022	Boat Electrofishing	-0.2	8	56
		5/31/2022	Boat Electrofishing	-0.1	4	28
		6/7/2022	Boat Electrofishing	-0.8	38	266
		8/25/2022	Boat Electrofishing	-0.2	6	53
		8/30/2022	Boat Electrofishing	-0.1	3	27

	9/28/2022	Boat Electrofishing	-0.1	3	27
2022 Total			**-6.2**	**306**	**2164.8**

Task I20. Complete reconnaissance (ocular or radio telemetry) to determine if there are and where spawning aggregations of carp are located.

Task I21. Complete nightly or daytime targeted electrofishing runs until carp are no longer present in numbers/densities large enough to warrant removal.

8.1.9 Application of Modified Unified Method- MUM

Table 24. Summary of biomass removed using MUM Method

Lake	**Year**	**Date Reported**	**Method**	**Biomass Removed (kg/ha)**	**# Ind. Carp Removed**	**Pounds Carp Removed**
Upper Prior Lake	2021	1/29/2021	Commercial Seine + Gill Net + MUM	-6.6	160	2297
	2021 Total			**-6.6**	**160**	**2297**

Task I22. Purchase and construct 1 MUM array.

Task I23. Deploy MUM arrays as needed to move carp aggregations or keep aggregations away from a particular location.

8.1.10 In-Stream Removals

Stream removals for Spring Lake County Ditch 13 are included with the targeted electrofishing summary in section 8.1.6 (Table 20).

Stream removals in Upper Prior Lake includes two sites (Table 25). The first and most frequently visited site is the connection to the Arctic Lake channel located in Mud Bay and is known as the Mud Bay Cutout. A total of 1,407 individual carp have been removed from this location since 2019. That number equates to nearly 33 kg/ha of carp biomass removed from Upper Prior Lake. Another 1.3 kg/ha was removed from the Northwoods Barrier in 2020. Both of the locations have barriers that prevent movement further upstream, thus stalling carp during their yearly attempt at springtime spawning migration.

The Mud Bay Cutout location has been a prolific removal location where tens to hundreds of carp can be removed during one event.

Table 25: Summary of Carp removal efforts at stream locations connected to Upper Prior Lake including the Mud Bay Cutout and Northwoods Barrier.

Lake	**Year**	**Date Reported**	**Method**	**Biomass Removed (kg/ha)**	**# Ind. Carp Removed**	**Pounds Carp Removed**

Upper Prior Lake	2019	5/22/2019	Stream Removal - Mud Bay Cutout	-12.7	348	4374
		6/5/2019	Stream Removal - Mud Bay Cutout	-0.7	33	240
	2019 Total			**-13.4**	**381.0**	**4614.0**
	2020	5/7/2020	Stream Removal - Northwoods Barrier	-0.9	50	309
		5/18/2020	Stream Removal - Northwoods Barrier	-0.4	21	130
	2020 Total			**-1.3**	**71.0**	**438.4**
	2021	3/30/2021	Stream Removal - Mud Bay Cutout	-4.5	222	1582
	2021 Total			**-4.5**	**222.0**	**1582.4**
	2022	4/22/2022	Stream Removal - Mud Bay Cutout	-4.7	256	1637
		5/12/2022	Stream Removal - Mud Bay Cutout	-3.6	214	1256
		5/20/2022	Stream Removal - Mud Bay Cutout	-6.3	314	2198
		5/31/2022	Stream Removal - Mud Bay Cutout	-0.4	20	140
	2022 Total			**-14.9**	**804.0**	**5230.7**

Carp are still present in Arctic Lake, located upstream from Upper Prior Lake and the Mud Bay Cutout. A PIT tag station has monitored this stream section 2018 - 2022, however, little to no movement has been detected in recent years. This decrease in movement is attributed to the barrier and water control structure that has been in place near the confluence to Upper Prior Lake and in the Mud Bay Cutout. A small removal event took place in 2022 along the Arctic Lake channel with results shown in table 26.

Table 26. Stream removal in the Arctic Lake – Prior Lake connecting channel in 2022

Lake	**Year**	**Date Reported**	**Method**	**Biomass Removed (kg/ha)**	**# Ind. Carp Removed**	**Pounds Carp Removed**
Arctic	2022	5/18/2022	Stream Removal	-33.0	118	884
	2022 Total			**-33.0**	**118**	**884**

The opportunity for in-stream removal events occurs only in the springtime and can be somewhat un-predictable as these pulses of movement often coincide with rain events or a change in water level. In recent years, a camera placed at the site as well as reports received from the Carp Espionage Program, have enhanced district and consultant response time to aggregations that present themselves at these locations. Beyond detecting aggregations in these locations, physical removal can be laborious as carp are captured using hand dip nets with the aid of a backpack electro-fisher. The district will continue to modify the techniques used to remove these carp from the system and be innovative in the approach to trapping carp that are attempting to move so that response time is not as demanding.

Task I24. Field survey potential in-stream trapping locations.

Task I25. Install trap and cameras at Spring Lake Desilt Pond and Upper Prior Lake Mud Bay cutout.

8.2 Obstruction Removal

One of the most critical factors to a successful seine is have an area that is clear of obstructions on the lake bottom. The PLSLWD can help prepare known aggregation areas prior to seine season (November – April) by engaging a commercial netter to run a test seine through areas with their nets, or by running a chain on the bottom of the lake. These obstruction removals may occur on Spring Lake and Upper Prior Lake each October/early November to prep the sites if a seine event is anticipated. In the Fall of 2020, district staff and consultants located obstructions on the lake bottoms that had caused issues during prior seining attempts. The obstructions were mapped using side scanning sonar and verified using an underwater drone. Coordinating with commercial netters and a diver, debris ranging from tires to blocks were found and either moved outside of the seining perimeter or disposed of.

The PLSLWD will also use its underwater drone to check the removal area conditions prior to a seine to avoid any new or unforeseen obstructions in an area. If there are new obstructions under the ice, they can potentially be avoided or removed prior to the seine.

In 2022, the two winter seine haul areas were traversed while using side-scan survey to look for any possible obstructions to seine netting. Near-shore areas were too shallow to access but the areas that were traversed had no obvious obstructions to pursue for removal.

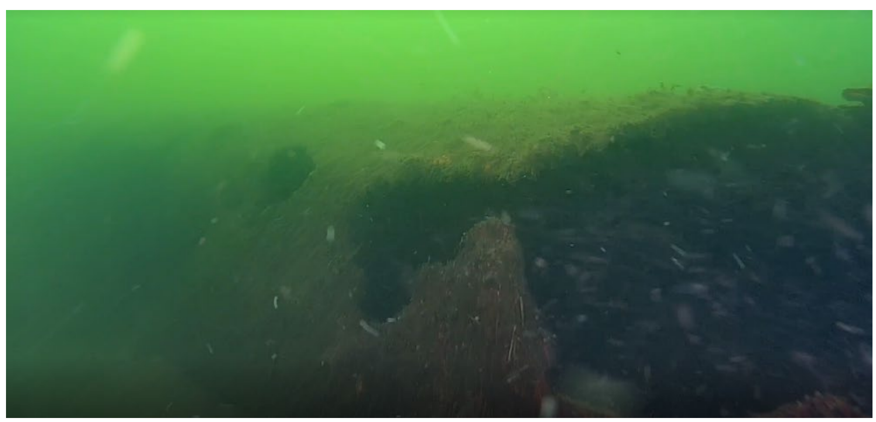


Figure 28. Obstructions removed from Spring and Upper Prior Lake.

Task I26. Remove obstructions identified by sonar and/or underwater drone.

Task I27. Use sonar to scan established haul locations for the presence of obstructions each fall prior to ice on.

8.3 Barriers

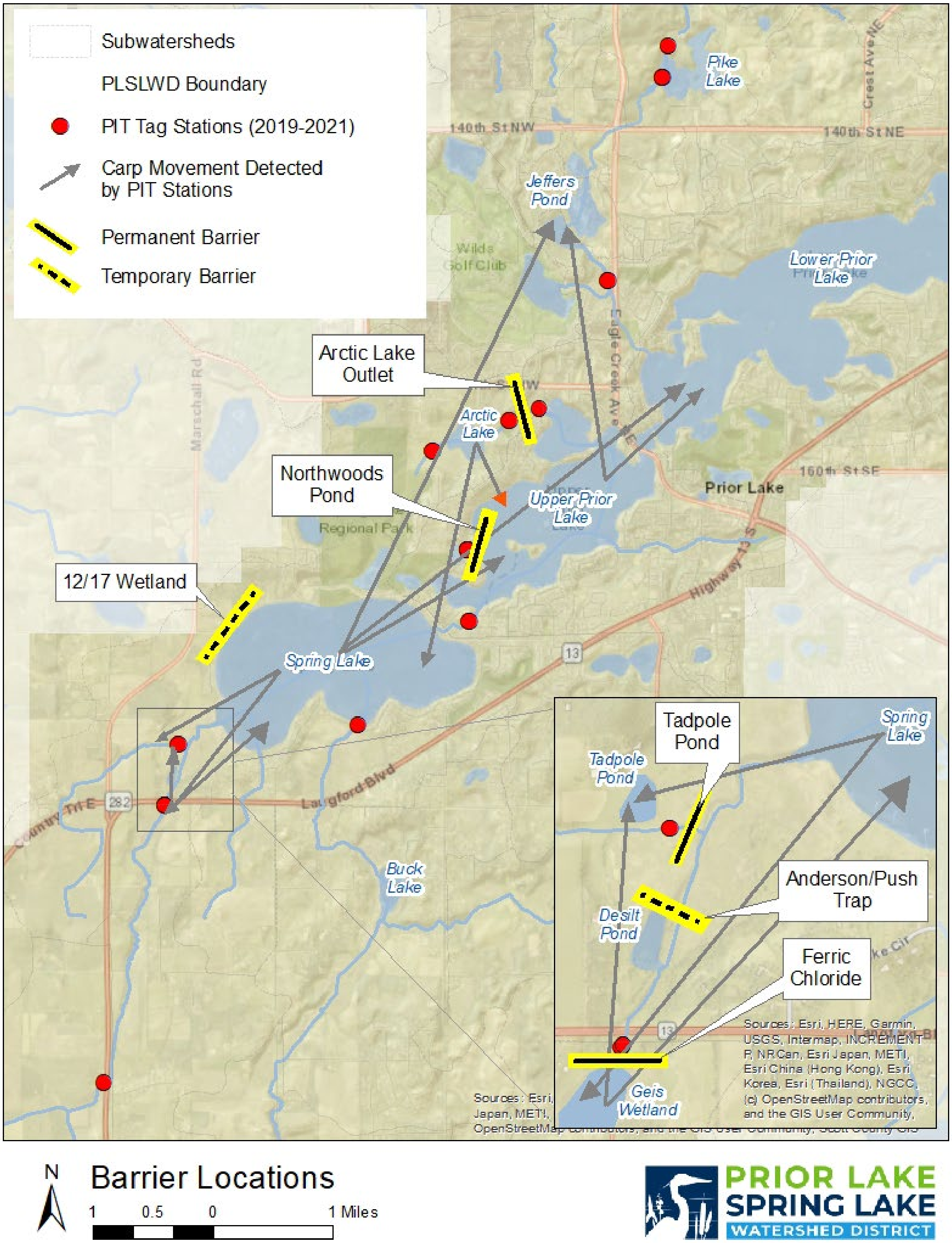


Figure 29. PIT stations, barriers, and carp movements mapped within the watershed

Barriers may be a critical component of any carp IPM plan. Based on radio and PIT tag data, carp were clearly exploiting connected waterbodies/wetlands for spawning and recruitment purposes through a network of migration routes connected to both Spring and Upper Prior Lakes.

Based on this a series of barriers were necessary to limit recruitment so as to maintain lowered carp biomass due to removal efforts in Tier 1 lakes.

A wide variety of barrier types exist using velocity, electricity, etc. The PLSL WD uses fixed physical barriers at all locations. These barriers consist of a series of evenly spaced vertical bars to prevent the movement of adult carp through the barrier while allowing for water flow and the movement of panfish, forage fish, and smaller gamefish. Spacing is typically 1 7/8" between bars based on head measurements of ~2-year old carp that were found to be sexually mature.

Task I30. Use data from radio telemetry, PIT stations, and observations such as carp espionage to identify potential barrier locations.

Task I31. Field survey barrier locations along migration routes.

8.3.1 Ferric Chloride (Geis Wetland)

The existing FeCl Weir barrier from 2003 was re-designed and updated in 2020. This barrier system needed repair for nearly a decade. The new system requires less maintenance and is designed to be more effective in high water flood conditions. This barrier was placed in response to PIT tag data collected at the Ferric Chloride PIT station that showed movement out of Geis Wetland towards Spring Lake and movement from Spring Lake towards Geis Wetland in the springtime during spawning migration period.

Task I32. Design barrier for installation at FeCl site.

Task I33. Install barrier at FeCl site.

8.3.2 Desilt

The desilt pond just downstream of the FeCl site and upstream of Spring Lake along CD 13, was identified as a potential nursery site based on radio tagged carp located there in late spring. To mitigate this, a rotating drum barrier was designed and installed at the outlet of the pond. However, low water levels persisted, and carp were found in the pond post installation. These carp were assumed to be using the secondary channel over the CD weir or were coming from the Geis wetland (prior to the installation of the FeCl barrier in 2021). The rotating drum barrier was removed in 2019 and the push trap was installed to effectively trap carp and prevent them from testing the drum barrier and moving upstream using the secondary channel.

Task I34. Design drum barrier.

Task I35. Install drum barrier.

Task I36. Uninstall drum barrier.

8.3.3 CD 13 Alternate Flow Weir

As indicated in the section above, carp appear to be accessing the desilt pond using the secondary CD 13 channel over the weir located along this stretch. This is an issue as carp stir up the desilt floc which the desilt pond is designed for, and carp may be able to spawn successfully in the desilt (undetermined) potentially contributing to additional carp biomass in Spring Lake.

A design and feasibility is needed to understand if and how a barrier could be installed at the CD 13 weir structure. The feasibility would need to focus on the ability of water to pass over the weir and through the barrier without being held back causing flow related issues. This feasibility would also aid in determining if a no rise certificate is needed.

One design consideration would be the use of removable tines.

Task I37. Complete draft design of carp barrier at CD 13 weir.

Task I38. Complete feasibility study for barrier at CD 13.

Task I39. Based on feasibility study, install barrier at CD 13 weir.

8.3.4 Tadpole

Since 2020, radio-tagged carp have been accurately documented visiting a small, connected waterbody to the southwest of Spring Lake during spawning season named Tadpole Pond. A PIT station installed in 2021 confirmed seasonal movement. PLSLWD and WSB consultants began working together to design a barrier that could meet multiple challenges. The first challenge was to design a barrier knowing it was to be installed in a channel surrounded by wetland. The design idea formed by turning what our hypothetical temporary barrier would look like and using long lasting materials like the Northwood barrier. The second challenge in the design was making sure season fish passage and boat passage when necessary. Building the barriers in four panels allowed for the middle two to swing open. The third challenge was that installation was to be completed by the end of the year and to be done without the use of heavy equipment. Boat access was also limited from low was level in 2021. Building the barrier panels out of aluminum, using dock anchoring technologies, transporting the fabricated materials to the site with Jon boats, and hard work made the undertaking possible. The installation of this barrier was completed on October 15, 2021. Future PIT monitoring at this site will help to confirm the efficiency of this barrier. More information regarding the Tadpole barrier and its role in the carp management program can be found in Appendix C.

Task I40. Design tadpole barrier.

Task I41. Install tadpole barrier.

Task I42. Install, download data from, and uninstall PIT station at Tadpole barrier.

8.3.5 Agri-Drain Fish Screen at County Road 12/17 Wetland Restoration Outlet

In 2016, the wetland enhancement project site located at the southeast corner of County Road 12 and County Road 17 was outfitted carp control grates to prevent carp from entering the wetland from Spring Lake. The wetland site flows into the northwest corner of Spring Lake and was quickly identified as a migration route for spawning carp when high water levels in the wetlands and on the lakeside created sufficient flow for passage of migrating carp. Carp have visually been seen traveling up the small channel from Spring Lake into the culvert under Sunset Ave and attempting to enter the wetlands through the Agri-drain water control structure. Grates were installed on the top the structures to prevent carp passage.

Task I43. Install fish screen at Agri Drain outlet at 12/17 wetland restoration site.

8.3.6 Temp barrier on Spring to Upper Prior Channel

Anecdotal observations suggested that carp and other fish species use the Spring-Upper Prior connecting channel as a migration route. To address this, a temporary barrier was installed to determine if carp movement could be blocked and if the proposed design would work.

The design was a series of horizontal PVC pipes inserted into a series of wooden posts.

Elevated water levels during the spring summer of 2018 caused the channel to increase in width resulting in an "open channel" on the sides of the barrier that carp could exploit. Scouring along the bottom of the barrier required a series of sandbags to be installed throughout the growing season to prevent carp from swimming under the barrier as well.

These issues will need to be addressed if a new barrier is needed in the future.

Task I44. Design temp Spring-Upper Prior connecting channel temporary barrier.

Task I45. Install and monitor Spring-Upper Prior Temporary barrier.

Task I46. Update temporary barrier design.

8.3.7 Northwoods Barrier

In 2019, the District identified a carp nursery site when radio-tagged carp were documented within Northwood Pond during spring spawning. The potential location for a carp barrier was determined where carp been observed entering wetland on the west side of Upper Prior Lake along Northwood Ave. The Northwood Pond PIT station confirmed movement into this basin from Upper Prior Lake. The District worked with the City of Prior Lake and WSB Consultants on final design for the Northwood carp barrier. As construction had to wait until after fish spawning period, a temporary carp barrier was installed at the Northwood carp barrier location that was made from PVC pipe and 2x4s to prevent carp reaching these spawning grounds. In April of 2020, the temporary PVC carp barrier was removed immediately prior to the permanent barrier installation. The District worked with WSB Consultants to ensure the Northwood carp barrier was properly stabilized with vegetation after completion of the project. In 2021, after the barrier had been installed for one year, zero (0) PIT tags were detected. PIT station data indicates that the Northwood Pond barrier is effective at preventing migration into the basin. More information regarding the Tadpole barrier and its role in the carp management in Appendix C.

Task I47. Design Northwoods Barrier.

Task I48. Dewater and Install Northwoods Barrier.

8.3.8 Fremont Barrier

The connecting channel between Arctic Lake and Mud Bay in Upper Prior Lake has historically been a carp migration route. To mitigate this, the district installed a barrier at the culvert pipe outlet on the Mud Bay side of the culvert under Freemont Avenue. The barrier was unlocked and there was some indication (citizen observation) that the barrier was being opened from time to time which allowed carp to move through the barrier an upstream into Arctic Lake.

The barrier was locked in 2021 which prevented movement. The City of Prior Lake also modified the drop structure on the Arctic Lake side of Freemont further reducing the ability of carp to move through this location.

Task I49. Install Freemont Barrier.

Task I50. Lock and ensure Freemont Barrier remains locked.

8.3.9 PLOC

Upper Prior Lake flows into Lower Prior Lake both of which share the same Ordinary High-Water level. The lakes were naturally landlocked until the Prior Lake outlet structure was first build in 1983. The water when above the weir height of 902.5’ travels nearly ¼ mile underground and enters into the Prior Lake Outlet Channel, beginning its seven-mile journey to the Minnesota River. The outlet structure was replaced in 2010 and has a trash rack and accordion weir within the structure. The velocity of the water leaving the outlet structure combined with the design make carp travel a one-way option. Carp have been documented traveling downstream at the outlet structure where they end up in the daylight pond near Jeffers Pond Elementary School. The outlet structure is considered a one-way barrier where carp are unable to move upstream back into Lower Prior Lake.

8.4 Bluegill Stocking

Research completed by the Minnesota Aquatic Invasive Species Research Center (MAISRC) showed that bluegill sunfish are the main predator of carp, preying on the eggs and larvae of carp young of year. Carp actively seek out nursery sites that are devoid of these predator fish and proliferate in lakes where bluegill abundance is low. A robust panfish and gamefish population may act as biological control and complements the other IPM strategies (Weber et al., 2012). These predator fish are necessary to prevent carp recruitment after a significant portion of the carp biomass has been removed or to keep carp from establishing in lakes.

In 2017, the PLSLWD partnered with the University of Minnesota as part of a graduate research project to assess the effectiveness of using bluegill sunfish as biocontrol for common carp (Poole, 2018). The eastern basin at the 12/17 wetland restoration site was one of four study basins in the Twin Cities metro area used; it was stocked with both spawning carp and adult bluegill to measure the effective rate of bluegill predation on carp eggs. The results from the study indicate that bluegill predation had a major effect on the abundance of post-larval carp. In the 12/17 wetland study basin, there 0% recruitment of carp during the study period.

As part of the workplan for this project, this District and WSB used trap netting and electrofishing methods to collect data where carp are migrating to and spawning (Figure 29). These methods are ideal for sampling young of year carp and bluegills. While bluegills typically have self-sustaining populations, winterkill is common in smaller shallow basins where carp can exploit the lack of predator fish. Project managers analyzed sample data (Table 27) and worked with the DNR to determine where bluegill stocking could be an effective control method.

Table 27. YOY Carp and Bluegill Trap Netting and Electrofishing Presence Absence Summary

Key - Presence (P), Absence (A), Trap Netting (TN), Electrofishing (E) Bluegill Stocking (B)					
Waterbody	**Year**	**Common Carp**	**Bluegill**	**Sample Method**	**Stocking**
Geis Wetland	2019	P	P	E, TN	
	2020	P	P	E, TN	B
	2021	P	P	TN	B
Tadpole Pond	2019	P	P	TN	
	2020	P	P	TN	
Pike Lake	2019	A	P	TN	
	2020	A	P	TN	
Lower Jeffers Pond	2021	P	P	TN	
Upper Jeffers Pond	2021	A	P	TN	
Arctic Lake	2019	A	P	TN	
Northwoods Pond	2020	A	A	TN	B
	2021	A	A	TN	B
*Spring Lake**	2019	A	P	E	
	2020	P	P	E	
	2021	P	P	E	
*Upper Prior Lake**	2019	A	P	E	
	2020	A	P	E	
	2021	A	P	E	
12/17 Wetland	2020	P	P	TN	
	2021	A	P	TN	
Desilt Pond	2020	A	P	TN	
	2021	A	P	TN	B
Buck Lake	2019	A	P	TN	
** Spring and Upper Prior Lakes Survey Data include DNR Fisheries data*					
*** Additional Waterbodies with absence of YOY carp and blue without stocking are not shown in the table*					

Prior to any barrier installations, Geis Wetland, Desilt Pond, and Tadpole Pond were all interconnected form a carp spawning standpoint. All three water bodies are along County Ditch 13, which inlets into Spring Lake. Geis Wetland is furthest upstream, just south of the Ferric Chloride treatment facility; Desilt Pond is right after the Ferric Chloride treatment; and Tadpole Pond is just downstream of Desilt Pond. Northwoods Pond lies to the west of Upper Prior Lake and is not directly connected to County Ditch 13 or the other three water bodies.

Acting upon this information and the bluegill and carp young of year (YoY) sampling discussed previously, the district has stocked three (3) locations with bluegill. The table below displays stocking completed to date.

Table 28. District-wide bluegill stocking totals.

Waterbody	2020 Stocking	2021 Stocking	2022 Stocking
Geis Wetland	2,000	2,000	2,400
Northwoods Pond	900	700	0
Tadpole Pond	100	0	0
Desilt Pond	0	700	1,200

All of these wetlands and ponds have been used for carp spawning; however, as permanent barriers have been installed on Geis Wetland, Tadpole Pond, and Northwoods Pond, carp spawning locations and behaviors have been altered. In order to utilize bluegill stocking efficiently and effectively, changes in bluegill stocking have been made accordingly. As can be seen in Table 28 above, neither Northwoods Pond nor Tadpole Pond were stocked with bluegill in 2022. That decision was based on barrier locations, PIT tag data, YOY trap net data, and carp spawning activities.

As the District moves forward with potential future bluegill stocking, those factors will continue to be used in order to determine optimal stocking basins.

8.4.1 Geis Wetland

Carp do not appear to be accessing Geis wetland based on radio and PIT data due to the installation of the barrier. Low water levels and anoxic conditions during 2021 and 2022 winter has resulted in winterkills. Carp carcasses have appeared at the outflow of the wetland suggesting carp are still present. Bluegill stocking efforts should continue until carp presence is absent.

Task I51. Stock Geis with Bluegill based on a 300/acre stocking rate if water levels are at normal pool.

8.4.2 Northwoods Pond

Stocking had been completed as this was a nursery prior to the barrier installation. Stocking has been discontinued as carp are no longer able to access this site. Low water levels have also led to draw-down like conditions further solidifying evidence carp are not present.

Task I52. Stock Northwoods Pond with Bluegill at a rate of 300/acre.

8.4.3 Desilt Pond

The desilt pond is still “on-line” as there is not a barrier on the CD 13 secondary channel and radio tagged carp are still accessing this location. Bluegill and largemouth bass were documented in desilt in 2022 so may be acting to limit spawning and recruitment of carp from larvae to age-0 fingerling.

Task I53. Stock desilt pond with bluegill at a rate of 300/acre.

8.4.4 Tadpole Pond

Carp do not appear to be accessing Tadpole Pond based on radio and PIT data due to the installation of the barrier.

Task I54. Stock Tadpole Pond with bluegill at a rate of 300/acre.

8.5 Protect and Improve Fish and riparian Habitat

Habitat forms the basis for a quality and therefore resilient fishery which may then provide biocontrol to prevent carp from spawning, recruiting, and dominating waterbodies.

Data collection efforts and summaries are provided in section 7.0 of this plan. Unfortunately, there are not many implementation opportunities within the district to implement riparian habitat improvements as much of the riparian zone around many of the lakes is privately owned.

The district however will remain vigilant and opportunistic for opportunities to improve fish habitat within the riparian zone and in lake areas above and beyond existing programs to manage aquatic invasive species and improve water quality.

Task I55. Manage invasive aquatic plants to promote growth of native submergent aquatic vegetation.

Task I56. Investigate opportunities for in-lake fish habitat.

8.6 Carp Disposition Options

A secondary requirement of carp management is determining proper disposition after they are removed from the water. When working with commercial netters, carp are primarily taken to live market. Conditions leading to live market are large removals during late fall and throughout the winter. Factors such as market economics and live haul transportation availability can impact commercial netting schedules. PLSLWD works with local farmers, residents, and organizations to find suitable locations for carp when removals are small and/ or occur during the spring and warmer months. Carp disposition has posed challenging at times and has led to lack of removal action due to uncertainties in where the carp will end up. Continued efforts are needed to identify non-commercial or innovative commercial options for carp disposition in consultation with DNR and other stakeholders.

Options for the disposition of removed carp include, but are not limited to:

- Live market
- Dead market
- Rendering/Fertilizer
- Organic Recycling
- Animal Feeding Operations
- Burial
- Incineration

Task I57. Investigate options for carp reuse and/or disposal.

9.0 IPM Phase 3- Maintenance

As the baseline data collection and implementation phase tasks are completed and carp biomass is reduced sustainably, this PLSL WD carp management program will enter the maintenance phase.

Perhaps one of the most data driven metrics that triggers a pivot from implementation to maintenance is achieving the two (2) goals outline in this IPM- Meeting carp biomass densities in Upper Prior and Spring Lakes (100 kg/ha).

Once this has been accomplished the PLSL WD can reassess these goals and establish a new sset of goals for the watershed or simply restate these goals as "maintain" carp biomass density at 100 kg/ha which will be supported by the maintenance tasks listed below and by additional implementation as needed.

9.1 Update PEs and Removals

To determine if carp biomass levels remain at or below the stated goal of 100 kg/ha, the district will complete a population estimate (boat electrofishing CPUE) on Tier 1 lakes annually and may include Tier 2 or 3 lakes as budget and data dictate. Proactively identifying increases in carp biomass will allow the district to remain "on top of" carp recruitment and prevent losses to water quality and ecological integrity.

Under this phase a strategic and purposeful approach to integrate automated and remote sampling/data collection will be made to reduce staff time and provide needed data.

Task M1. Complete CPUE abundance estimates annually on Spring Lake and Upper Prior Lake after the biomass density goal is met.

Task M2. Based on findings on Upstream waterbodies, Update PEs for these lakes on a similar schedule (can alternate and batch CPUEs to save funds).

Task M3. If a spike in PE is detected, implement removal as a rapid response action.

9.2 Sampling for YoY and Juvenile

Similar to updating PEs to monitor the "pulse" of carp abundance throughout the watershed, sampling for YoY and juvenile carp will aid in proactively managing carp reproduction and recruitment before it is a large-scale problem.

Task M4. Complete sampling for young of year/juvenile carp and bluegill on tier 1 lakes once every 2 to 3 years.

Task M5. Sample documented nursery sites to ensure no spawning or recruitment success once every 2 to 3 years.

Task M6. Stratified random sampling for YoY in hydrologically connected waterbodies every 2 to 3 years.

9.3 Fishery Surveys and Bluegill stocking

Task M7. Update baseline (MN DNR Standard) survey using the same methodology for comparative analysis every 4 years.

Task M8. Complete Targeted bluegill survey to augment or fill data gaps from standard survey concurrently with standard survey (every 4 years).

9.4 Bluegill Stocking

PLSLWD will continue assessing carp nursery locations for bluegill populations. More bluegills will be stocked in identified nursery locations if deemed necessary to prevent carp recruitment. Additional nursery locations based on spring 2022 spawning observations will be analyzed for potential bluegill stocking 2023.

Task M9. Stock bluegills if water quality is sufficient and carp reproduction is detected.

9.5 Ageing

Task M10. Collect and assess carp otoliths from a subsample of 50-100 individuals once every 5 years to monitor changes and identify recruitment events or increases in abundance in Spring Lake and Upper Prior Lake

9.6 PIT Monitoring

The district has invested finances, time, and staff knowledge building into developing a network of PIT monitoring stations. The network will require minimal financial investment to maintain and may be used for other data collection purposes for other fish species if required. Maintaining the network can also make is available for rapid response in the event it is needed for carp monitoring.

Task M11. Seasonal installation and monitoring of PIT station network.

Task M12. Data download and analysis of PIT data.

Task M13. Implant additional PIT Tags to increase the number of at-large PIT tags to 500 at any one time.

9.7 Barriers

As a structural BMP, the carp barriers should be inspected annually for signs of wear and other issues that carp may exploit (undermining of sediment below barrier) to remain effective. Maintenance should be scheduled as needed.

Task M14. Develop an annual carp barrier inspection SOP and associated form.

Task M15. Complete annual carp barrier inspections for all barriers.

9.8 Radio Telemetry

A goal of 10 active radio tags in each Spring and Upper Prior Lakes are found to be a high enough quantity to determine aggregations while low enough to make tracking time effective. Radio tag battery life is good for around 24 months. Implanting 5 radio tags in both lakes every year has been the general procedure.

Task M16. Implant radio tags if necessary.

9.9 Permits

Activities completed in the IPM are permitted through the MN DNR.

Task M17. Acquire annual MN DNR scientific and/or Class C commercial fishing permits as needed.

9.10 Innovation Process

The District will continue to explore options for removals using non-commercial fishing crews. Researching and deploying novel methods has allowed the District to utilize year-round management practices and have success while does so.

10.0 Phase Task Tables and Schedules

Table 29. Baseline Data Collection Planning Table

Sub-Phase	Phase- Baseline Data Collection	Status	2015	2016	2017	2018	2019	2020	2021	2022	2023				2024			
											Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Abundance	Complete initial boat electrofishing CPUE Estimate for Fish Lake	Complete																
	Complete Initial boat electrofishing CPUE Estimate for Spring Lake	Complete																
	Complete Initial boat electrofishing CPUE Estimate for Arctic Lake	Complete																
	Complete Initial boat electrofishing CPUE Estimate for Upper Prior Lake	Complete																
	Complete Initial boat electrofishing CPUE Estimate for Lower Prior Lake	Complete																
	Complete Initial boat electrofishing CPUE Estimate for Jeffers Pond	Planned																
	Complete Initial boat electrofishing CPUE Estimate for Pike Lake	Complete																
	Generate a mark and recapture estimate for Upper Prior Lake	Complete																
	Generate a mark and recapture estimate for Spring Lake	Complete																
	Calculate internal P load from carp based on data collected in Task BDC1 and 2	Complete																
Movement	Implant 10 adult carp with high frequency radio transmitters in Spring Lake in 2015-2016	Complete																
	Implant 10 adult carp with high frequency radio transmitters in Upper Prior Lake in 2015-2016	Complete																
	Complete a weekly surveys in winter to identify carp aggregation areas in Spring Lake and Upper Prior Lake	Complete																
	Complete weekly surveys during carp spawning period to identify migration routes and nursery sites	Complete																
	Complete monthly surveys during summer and fall to document last known locations and identify potential open water seining areas	Complete																
	Transfer field data from each telemetry survey to GIS (create shapefile).	Complete																
	Install PIT station in waterways connecting lakes and wetlands to Upper Prior Lake and Spring Lake to provide additional specificity on carp migration (date and time) and determine if other tributaries are being utilized.	Complete																
	Download PIT data	Complete																
	Assess and Report on PIT data	Complete																
Biocontrol	Complete baseline fisheries (MN DNR Standard) survey to document assemblage and relative abundance (MN DNR)	Complete																
	Complete targeted YoY and Juvenile carp and bluegill survey in Desilt pond	Complete																
	Complete targeted YoY and Juvenile carp and bluegill survey in tadpole pond	Complete																
	Complete targeted YoY and Juvenile carp and bluegill survey in Spring Lake	Planned																
	Complete targeted YoY and Juvenile carp and bluegill survey in Arctic Lake	Complete																
	Complete targeted YoY and juvenile carp and bluegill surveys in Geis Wetland	Complete																
	Complete targeted YoY and juvenile carp and bluegill surveys in Northwood Pond	Complete																
	Complete targeted YoY and juvenile carp and bluegill surveys in Unnamed Potential Nursery Sites Connected to Spring Lake	Complete																
	Complete targeted YoY and juvenile carp and bluegill surveys in Unnamed Potential Nursery Sites Connected to Upper Prior Lake	Complete																
Ageing	Collect a subsample of 50 to 100 individual carp for otolith removal and aging analysis from Spring Lake	Planned																
	Collect a subsample of 50 to 100 individual carp for otolith removal and aging analysis from Upper Prior Lake	Planned																
Habitat	Complete a baseline “score your shore” or other ecological assessment to evaluate riparian and/or in lake habitat	Planned																

Table 30. Implementation Planning Table

				2022		2023				2024				2025			
				Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Task ID	**Sub-Phase**	**Phase-Implementation**	**Status**														
I1		Acquire "Class C" issued MN DNR Commercial Fishing Permit	Ongoing														
I2		Complete initial seine netting at haul location #1 on Spring Lake	Complete														
I3		Complete initial Seine netting at haul location #1 on Upper Prior Lake	Complete														
I4		Identify other locations for seine netting based on radio tag aggregations in both Spring Lake and Upper Prior Lake	Complete														
I5		Open Water Seine Feasibility Test on Spring Lake and Upper Prior Lake - Mud Ba	Complete														
I6		Complete reconnaissance in secondary and tertiary seine netting locations for obstruction and impediments to netting with the use of "practice seines".	Complete, as needed														
I7		Complete at least 1 commercial seine netting attempt in both Spring and Upper Prior Lakes if aggregations persist and conditions allow once/year until biomass goals are met.	Ongoing														
I8		Implement micro hauls in open water targeting radio tagged or sonar indicated aggregations in areas where a small seine can be deployed and retrieved easily by hand if necessary.	Ongoing														
I9		Request gill netting authorization from MN DNR	Complete														
I10		Complete gill netting feasibility on both Upper Prior and Spring Lakes to determine feasibility and mortality to bycatch	Complete														
I11		Based on feasibility results implement the use of gill nets as a removal technique as needed	Complete; on-going														
I12		Survey Spring Lake and Upper Prior Lake for Box net location	Complete														
I13		Poll Spring Lake residents to gain shoreline access for additional box netting location	Complete														
I14		Test Baiting at Spring Lake and Upper Prior Lake potential box net location	Complete														
I15		Install, operate, and remove box nets	Complete; on-going														
I16	Physical Removal	Construct Push trap and install at desilt pond outlet	Complete														
I17		Design and build Newman Trap	Complete														
I18		Install and monitor Newman Trap making modifications as necessary	Complete														
I19		Install Newman trap as needed	On-going														
I20		Complete reconnaissance (ocular or radio telemetry) to determine if there are and where spawning aggregations of carp are located	Complete														
I21		Complete nightly or daytime targeted electrofishing runs until carp are no longer present in numbers/densities large enough to warrant removal	Complete; on-going														
I22		Purchase and construct 1 MUM array	Complete														
I23		Deploy MUM arrays as needed to move carp aggregations or keep aggregations away from a particular location	Complete; as-needed														
I24		Field survey potential in-stream trapping locations	Complete														
I25		Install trap and cameras at Spring Lake Desilt Pond and Upper Prior Lake Mud Bay cutout	Complete; on-going														
I26		Remove obstructions identified by sonar and/or underwater drone	Complete														
I27		Use sonar to scan established haul locations for the presence of obstructions each fall prior to ice on	Complete; on-going														
I57		Investigate Options for carp reuse and/or disposal options	On-going														
I28	Administrative and	Update PLSLWD Carp IPM in August 2023	Planned														
I29	Planning or Outreach	Maintain carp biomass removal records	On-going														
I30		Use data from radio telemetry, PIT stations, and observations such as carp espionage to identify potential barrier location	Complete														
I31		Field survey candidate barrier locations	Complete														
I32		Design barrier for installation at FeCl site	Complete														
I33		Install barrier at FeCl site	Complete														
I34		Design drum barrier	Complete														
I35		Install drum barrier	Complete														
I36		Uninstall drum barrier	Complete														
I37		Complete draft design of carp barrier at CD 13 weir	Planned														
I38		Complete feasibility study for barrier at CD 13	Planned														
I39		Based on feasibility study, install barrier at CD 13 weir	Planned														
I40	Barriers	Design tadpole barrier	Complete														
I41		Install tadpole barrier	Complete														
I42		Install, download data from, and uninstall PIT station at Tadpole Barrier	Complete														
I43		Install fish screen at Agri Drain outlet at 12/17 wetland restoration sit	Complete														
I44		Design temp Spring-Upper Prior connecting channel temporary barrier	Complete														
I45		Install and monitor Spring-Upper Prior Temporary barrier	Complete														
I46		Update Spring-temporary barrier design	Complete														
I47		Design Northwoods Barrier	Complete														
I48		Dewater and Install Northwoods Barrier	Complete														
I49		Install Freemont Barrier	Complete														
I50		Lock and ensure Freemont Barrier remains locked	Complete														
I51		Stock Geis with Bluegill based on a 300/acre stocking rate if water levels are at normal poo	Complete														
I52	Biocontrol	Stock Northwoods Pond with Bluegill at a rate of 300/acre	Complete														
I53		Stock desilt pond with bluegill at a rate of 300/acre	Complete														
I54		Stock Tadpole Pond with bluegill at a rate of 300/acre	Complete														
I55		Manage invasive aquatic plants to promote growth of native submergent aquatic vegetation	Complete; on-going														
I56	Habitat	Investigate opportunities for in-lake fish habitat	Planned														

Table 31. Maintenance Planning Table

				2023	2024	2025	2026	2027
				Q4	Q2			
Task ID	**Sub-Phase**	**Phase-Maintenance**	Status					
M1	Abundance	Complete CPUE abundance estimates annually on Spring Lake and Upper Prior Lake after the biomass density goal is met	Planned					
M2		Based on findings on Upstream waterbodies, Update PEs for these lakes on a similar schedule (can alternate and batch CPUEs to save funds)	Planned					
M3		If a spike in PE is detected, implement removal as a rapid response action	Planned					
M4	Recruitment	Complete sampling for young of year/juvenile carp and bluegill on tier 1 lakes once every 2 to 3 years	Planned					
M5		Sample documented nursery sites to ensure no spawning or recruitment success once every 2 to 3 years	Planned					
M6		Stratified random sampling for YoY in hydrologically connected waterbodies every 2 to 3 years.	Planned					
M7	Biocontrol	Update baseline (MN DNR Standard) survey using the same methodology for comparative analysis every 4 years	Planned					
M8		Complete Targeted bluegill survey to augment or fill data gaps from standard survey concurrently with standard survey (every 4 years)						
M9		Stock bluegills if water quality is sufficient and carp reproduction is detected.	Planned					
M10	Ageing	Collect and assess carp otoliths from a subsample of 50-100 individuals once every 5 years to monitor changes and identify recruitment events or increases in abundance in Spring Lake and Upper Prior Lake	Planned					
M11	Movement	Seasonal installation and monitoring of PIT station network	Planned					
M12		Data download and analysis of PIT data	Planned					
M13		Implant additional PIT Tags to increase the number of at-large PIT tags to 500 at any one time	Planned					
M14		Develop an annual carp barrier inspection SOP and associated form	Planned					
M15		Complete annual carp barrier inspections for all barriers						
M16		Implant radio tags if necessary.	Planned					
M17	Administrative	Acquire annual MN DNR scientific and/or Class C commercial fishing permits as needed.						

11.0 Partners and Funding

Successful implementation of the IPM has achieved through the support of state and federal grant funds as well as partnering with local organizations and volunteers.

BG Stocking – Prior Lake Rotary, Spring Lake Association, Prior Lake Association

Grants – Minnesota Board of Water and Soil Resources (BWSR), Minnesota Pollution Control Agency (MPCA), Minnesota Department of Natural Resources

Project partners – Shakopee Mdewakanton Sioux Community (SMSC), City of Prior Lake, Volunteers

Appendices

Visit the following sites online to download the appendices documents:

APPENDIX A – CARP MANAGEMENT COST-BENEFIT SUMMARY 2020
https://www.plslwd.org/wp-content/uploads/2020/09/Carp-Cost-Benefit-Summary.pdf

APPENDIX B – 2018 CLEAN WATER PARTNERSHIP GRANT FINAL REPORT
https://www.plslwd.org/wp-content/uploads/2020/09/CWP-Carp-Management-Grant-FINAL-Report_Jun-2018.pdf

APPENDIX C – PLSLWD 319 FINAL REPORT 2022
https://www.plslwd.org/wp-content/uploads/2022/04/319-Final-Report_Public.pdf