PRIOR LAKE - SPRING LAKE
WATERSHED DISTRICT

2019

Integrated Pest Management Plan (IPM Plan)

FOR COMMON CARP

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wsb

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Integrated Pest Management Plan (IPM)
For Common Carp

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PART 1 - INTRODUCTION

Common carp (*Cyprinus carpio*), a non-native fish originating in the Caspian region of Eurasia, are the most widely distributed nuisance fish in the United States (Nico et al., 2012). Carp can have direct and indirect negative effects on water quality by uprooting submergent and emergent aquatic vegetation and by releasing phosphorous sequestered in lake sediments. The phosphorus is then available to free floating algae and can lead to an increase in total phosphorous and Chlorophyll-a concentrations in the lake and to a decrease in water clarity. By removing the carp from the system, both the phosphorus within the carp carcass and the amount that would typically be excreted will be completely removed, while also abating the release of phosphorus created by foraging behavior.

Spring Lake, as well as Pike Lake, Upper Prior Lake, and portions of County Ditch 13 are listed on the MPCA's impaired waters list due to excess nutrients. These impairments limit recreational opportunities as well as waterfowl habitat, native aquatic vegetation abundance, and native game fish populations (MPCA Impaired Waters Viewer, 2018). As most of the waterbodies within the PLSLWD are connected, improvements to the impaired waters will also have benefits downstream.

This plan uses integrated pest management (IPM) principles to effectively manage the common carp populations. IPM involves the use of targeted carp removals and barriers, as well as monitoring environmental parameters that can inhibit or promote carp population growth within the waterbodies. Adaptive management will use data that is collected on the carp population including population and biomass estimates as well as migration routes and winter aggregation locations.

This IPM plan is intended to be a living document; using adaptive management may includedeveloping new management strategies and plan goals through data collection and analysis. As new data is collected and analyzed, current approaches, data collection efforts, and prioritization may change. This IPM aims to mitigate the effect that common carp are having on the load of excess nutrients to these lakes, and protect those that are currently meeting water quality standards.

PART 2 - WATERSHED OVERVIEW

Located within Scott County, the 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.

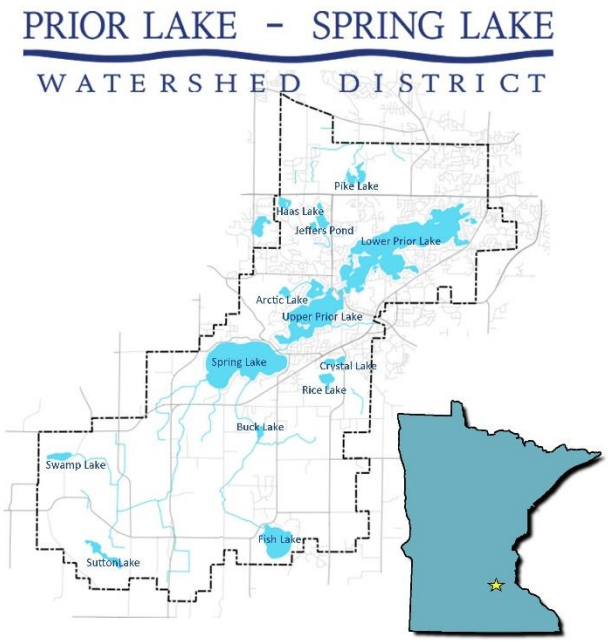


***Figure 1**. PLSLWD Location Map*

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** shows some of the land uses and highlights the waterbodies and wetland areas that carp may be present and/or use as spawning areas. **Figure 3** shows the topography throughout the watershed and some of the hydrological connections that carp might use to travel between waterbodies.

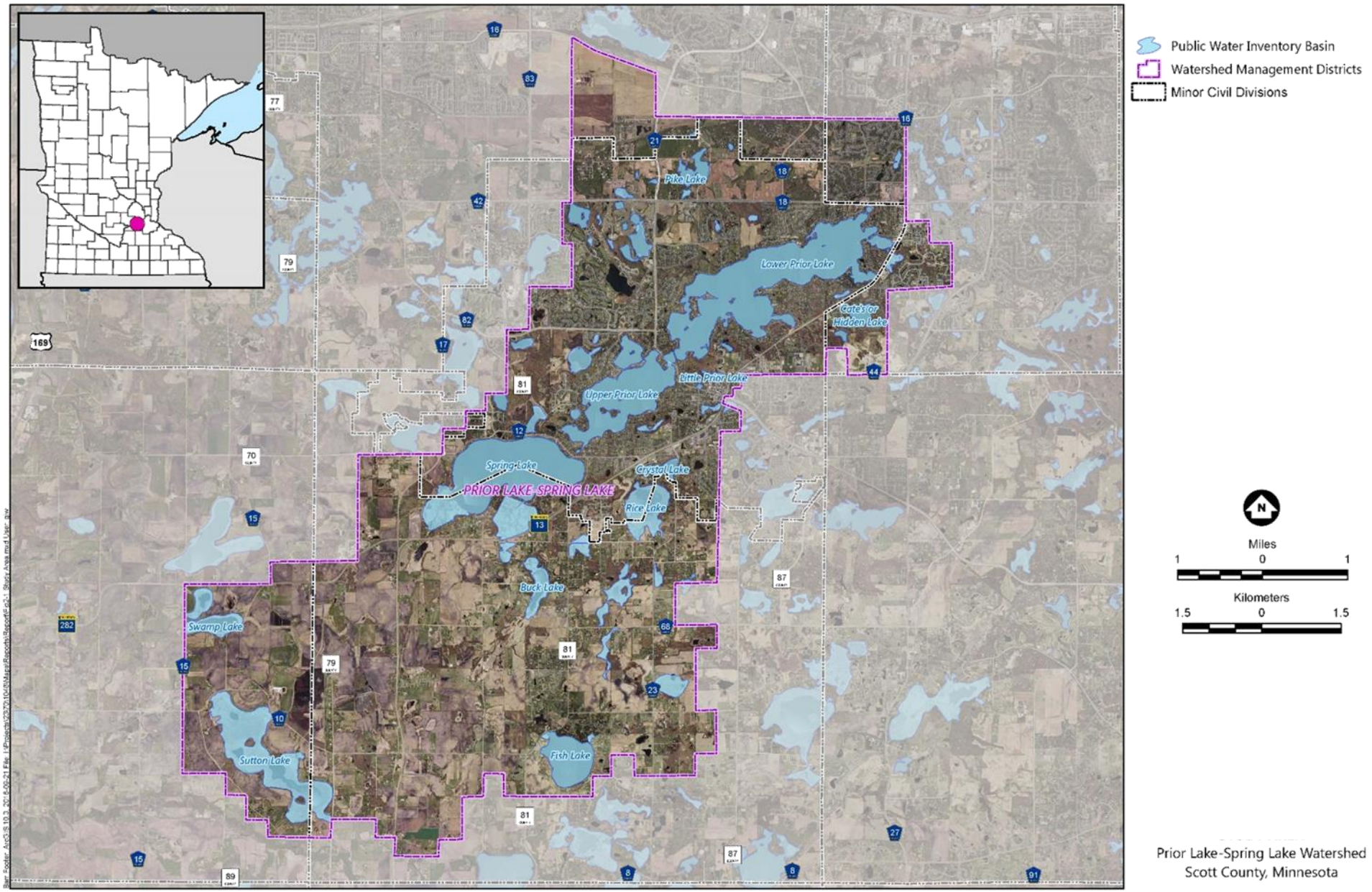


Figure 2. *Watershed Overview Map*

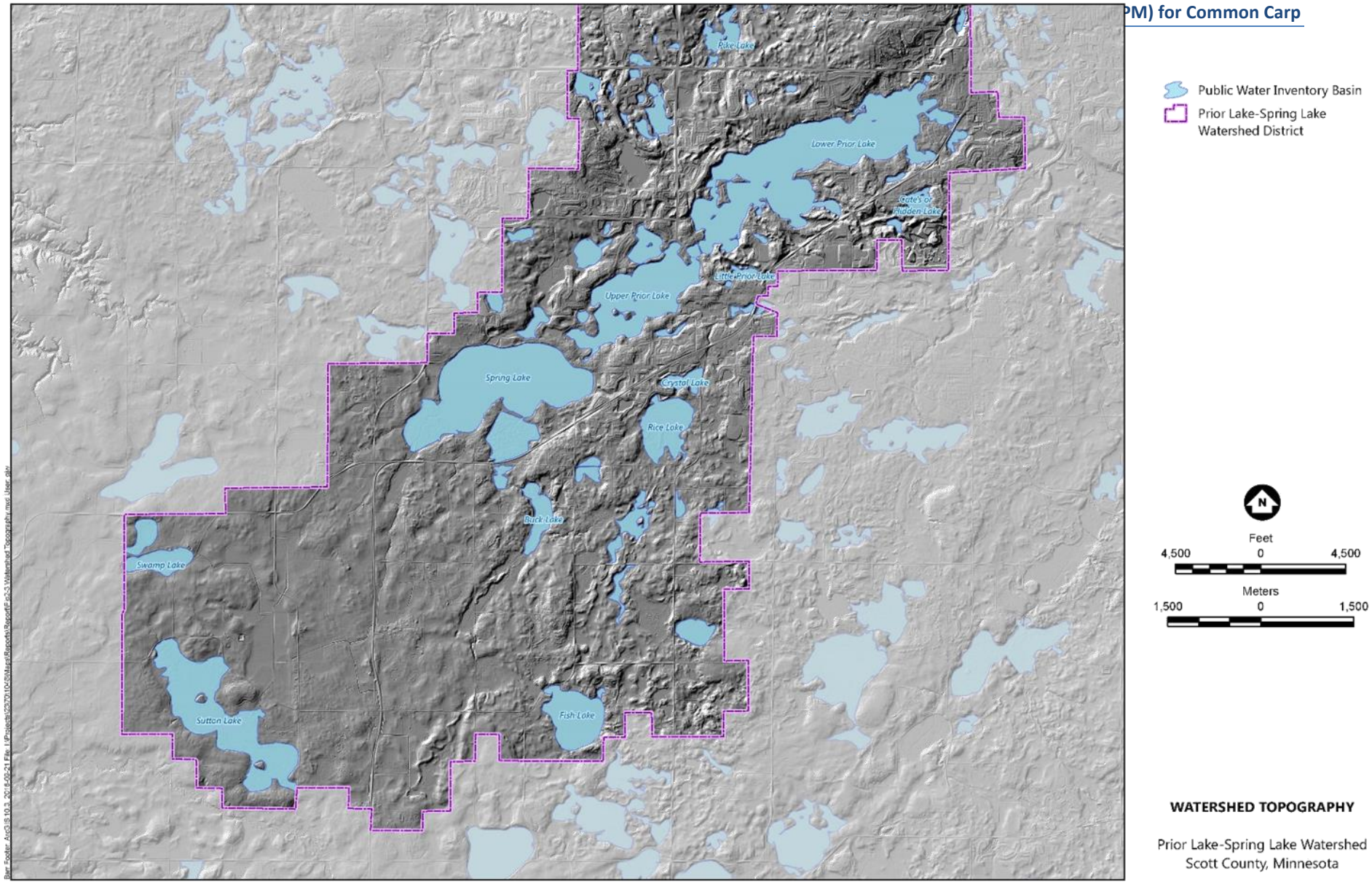


Figure 3. *Topographic Map*

PART 3 - CARP MANAGEMENT WATERBODIES

3.1 CARP MANAGEMENT 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 4 below (Fish, Buck, Spring, Arctic, Upper Prior, Lower Prior, Jeffers Pond & Pike Lakes). An overview of each carp management lake is listed below.

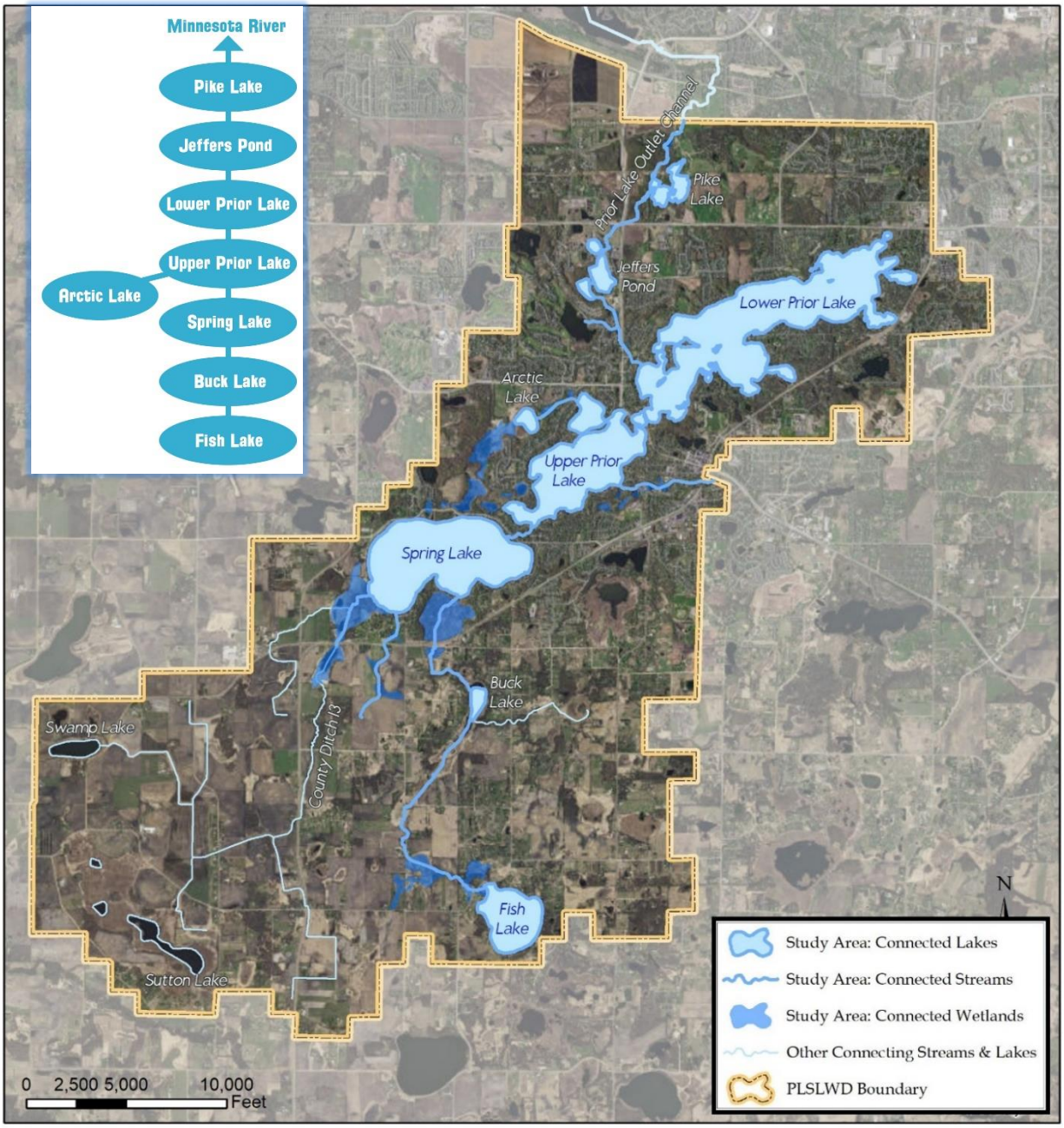
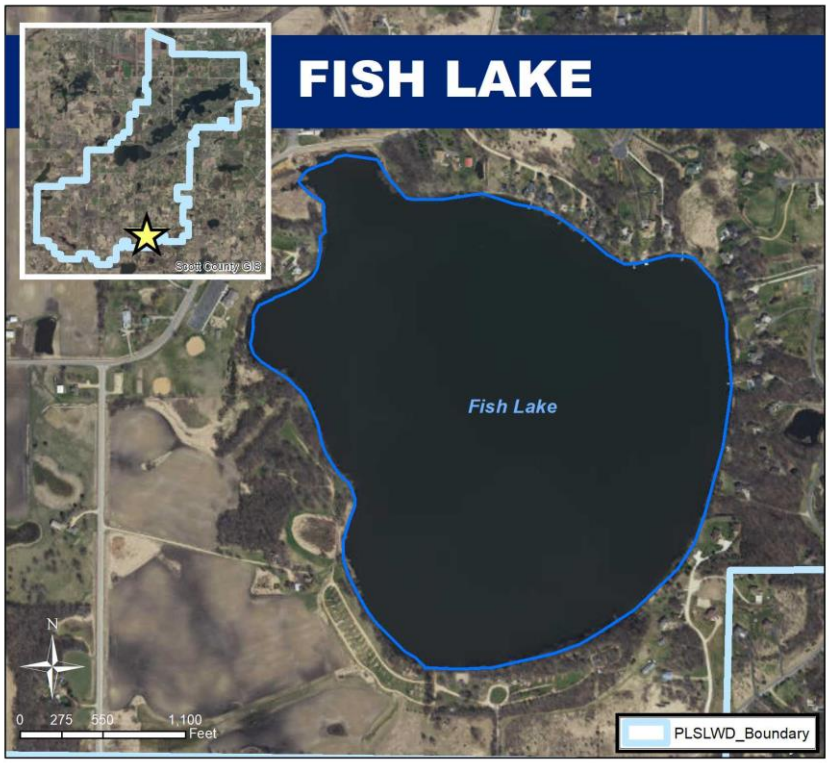


Figure 4. *Carp Management Lakes*

3.2 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-outflow, 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.



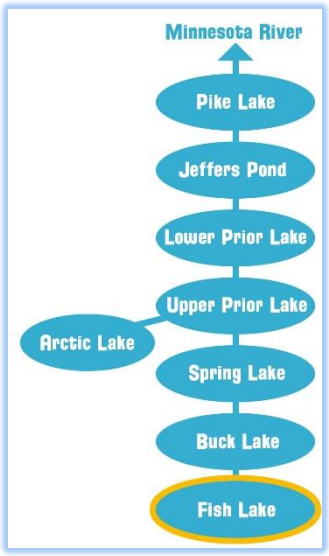


Figure 5. *Fish Lake Map*

INTERNAL LOADING

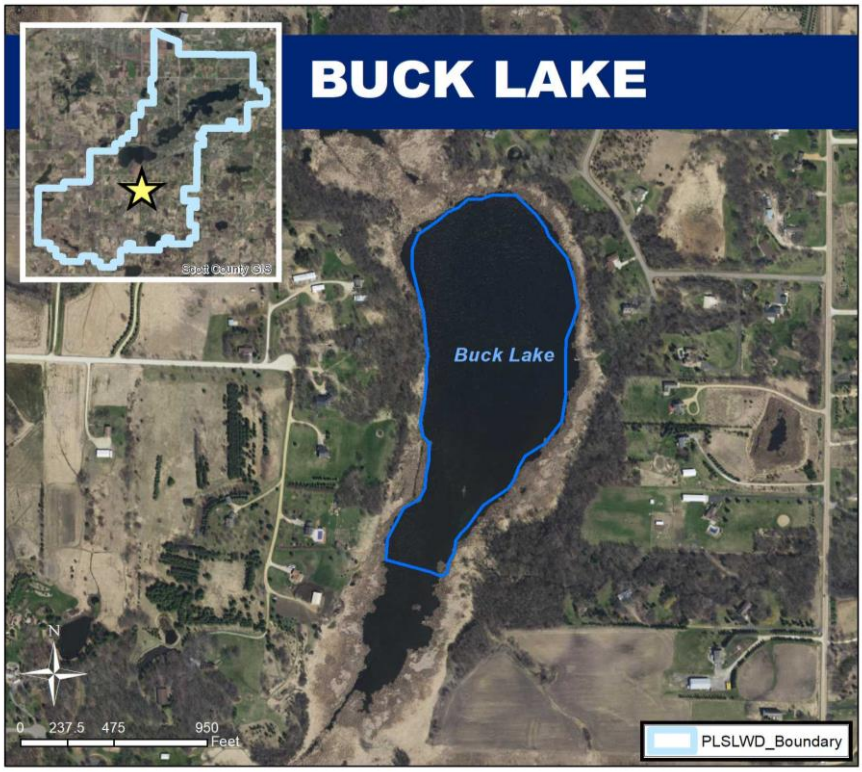
Fish Lake appears to be heavily impacted by internal loading. The 2006 Fish Lake Sustainable Lake Management Plan identifies an internal load ranging from 111 to 488 kg/yr (244 to 1,075 pounds/yr). The methodology used to derive this estimate is derived from a Canfield-Bachmann model. These models identify internal loading from anoxic release, hypolimnetic mass balance, and fall turnover; no analysis was done to determine the contribution from curly-leaf pondweed (CLP) senescence or from the foraging behavior of rough fish.

FISHERIES ASSESSMENT

A potential source of internal loading is from rough fish bioturbation. MN DNR fishery survey data from 2014 shows that carp and bullhead are present in Fish Lake. LaMarra (1975) identified an internal loading rate of 1.07 mp P/m²/day based on a carp density of 200 kg/ha. A very preliminary fish survey was conducted in fall of 2019 on Fish Lake and showed carp biomass at 85.7 +/- 69.2.

3.3 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.



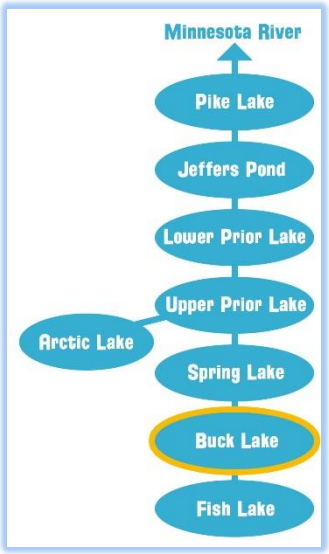


Figure 6. *Buck Lake Map*

INTERNAL LOADING

The watershed to lake ratio for Buck lake is quite high: ~837:1, which may result in a large amount of phosphorus loading to Buck Lake from the surrounding watershed. The average TP concentration for Buck Lake between 2014 and 2017 was 112.56 µg/l (almost twice the state standard).

While not specifically assessed, anoxic conditions within Buck Lake may be contributing to the phosphorus load through anoxic release within sediments. No assessment has been completed on the sediments in the Buck Lake basin to determine the sediment release rate of TP.

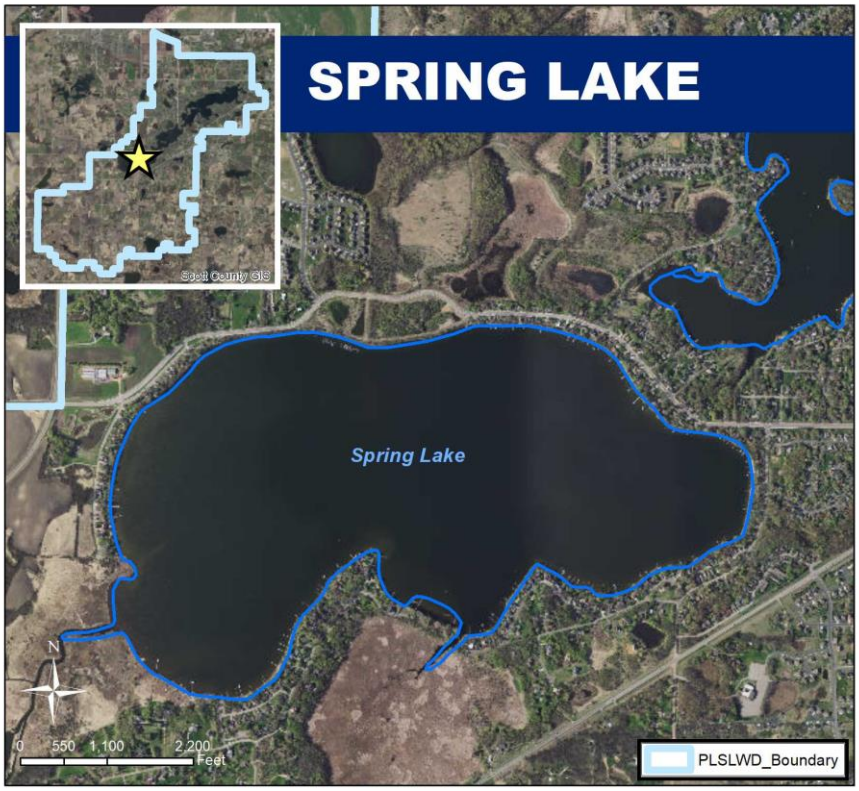
FISHERIES ASSESSMENT

Very preliminary survey data from fall 2019 indicates that carp have low populations on Buck Lake. The widespread presence of aquatic vegetation in Buck Lake also may hint at a low density of rough fish presence in the lake. Typically, lakes that support high rough fish density are incapable of supporting dense or widely-distributed aquatic vegetation.

3.4 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.

Spring Lake has three (3) 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 small channel which connects to Upper Prior Lake.



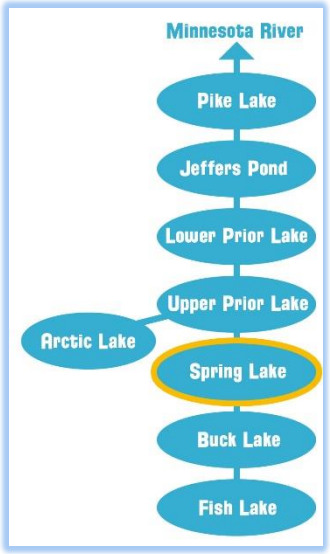


Figure 7. *Spring Lake Map*

INTERNAL LOADING

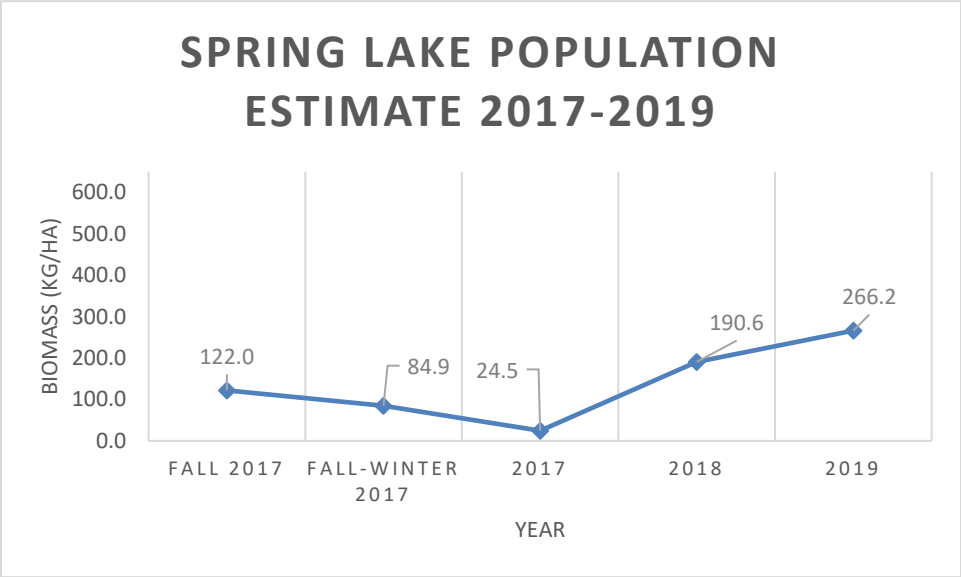
Internal loading constitutes the bulk of the total phosphorus load to Spring Lake at 5,161 lbs/year or 49%. Internal loading may be from anoxic sediment release of phosphorus, senescence of aquatic vegetation during the growing season, and overabundant rough fish. The 2012 TMDL attributed the entire 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.

FISHERIES ASSESSMENT

Past surveys show elevated carp biomass in Spring Lake, which is influencing internal loading. In winter 2012, the PLSLWD marked 1,752 adult carp by inserting floy tags in the dorsal area. The carp were initially captured using a commercial fishing crew that deployed a seine net around a winter

aggregation of common carp. The carp were captured, measured for length and weight, tagged, and released. An attempt was made to recapture the carp in 2013, but was unsuccessful.

Past surveys show elevated carp biomass in Spring Lake, which is influencing internal loading. A 2014 study completed by St. Mary's University using a catch per unit effort (CPUE) model showed that carp biomass in Spring Lake was 343.5 kg/ha. A subsequent survey completed in 2016 by WSB showed 122.5 kg/ha using the CPUE method and 84.7 kg/ha using a mark-recapture methodology. Using this abundance estimate and LaMarra's estimation of calculating loading due to an abundance of rough fish, nearly 2.37 pounds of phosphorus per day were being added to Spring Lake. This number equates to an estimated loading rate of over 866 pounds of phosphorus per year caused by the overabundance of common carp.

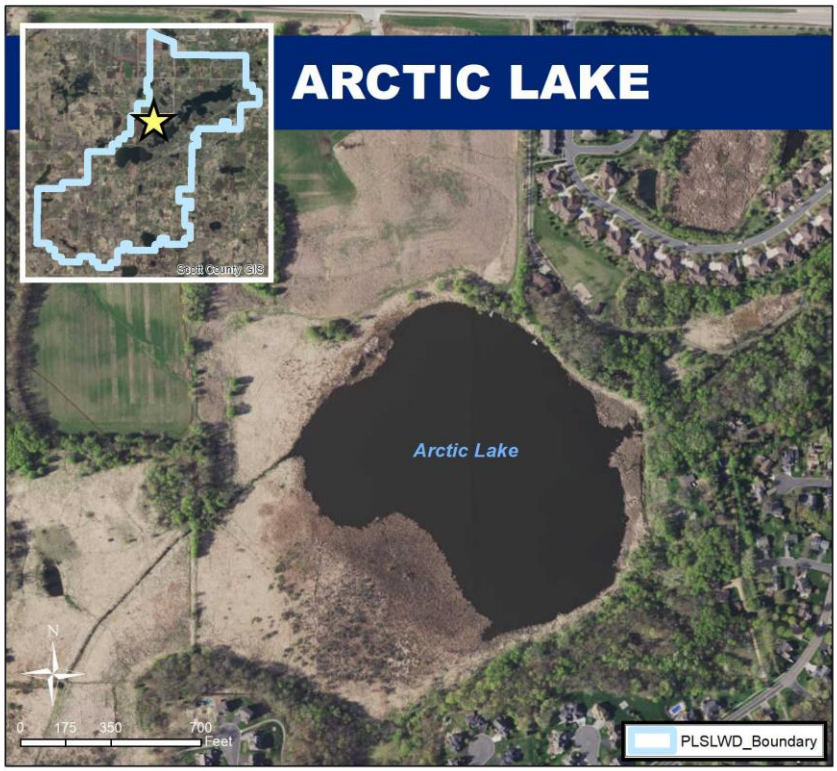


PAST CARP MANAGEMENT EFFORTS

Carp in Spring Lake were netted and inspected for marks on January 30, 2017 as part of a recapture and removal event capturing 2,577 individual carp, an estimated 59.9 kg/ha of carp biomass resulting in a reduction of 615.5 pounds of phosphorus per year. Using the ratio of marked to unmarked carp, WSB calculated a pre-removal population estimate of 3,623 ± 1,167 individual carp in Spring Lake. Using a 5.6 kg average weight, Spring Lake carp biomass was calculated at 84.9 ± 27.3 kg/ha, close to the ecological threshold value of 100 kg/ha and well above the value of 30 kg/ha that PLSLWD has identified as a biomass goal. Biomass calculated after removal is estimated to be 24.5 kg/ha ± 7.9.

3.5 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 an 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.



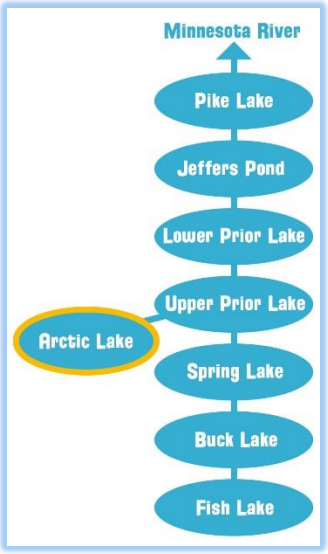


Figure 8. *Arctic Lake Map*

INTERNAL LOADING

Sediment release rates from sediment coring was not available at the time the 2013 diagnostic report was drafted. However, HDR attempted quantify the internal load from anoxic sediment release using a mass balance approach. Results of this analysis showed that annual loading ranged from 177-327 lbs TP/year.

FISHERIES ASSESSMENT

Carp have been documented in multiple fish surveys completed in 2012, 2014, 2017, and 2018. The 2012 survey utilized standard and mini trap nets to determine assemblage and size structure. Small carp (9.5-13") were captured in trap nets which indicates recruitment and suggests that Arctic Lake was functioning as a nursery. The 2014 electrofishing survey determined that the carp biomass density was 264.5 kg/ha and found numerous young of the year carp.

A carp mark-recapture population and biomass estimate were completed in 2017. Survey data shows that the carp biomass for Arctic Lake was 462.6 kg/ha, with juvenile carp dominating the biomass (336.9 kg/ha) and adults making up a smaller portion of the biomass (125.7 kg/ha). Note

that a carp barrier was installed in 2016 at the connection to Upper Prior from Arctic, which may have prevented migration out of Arctic to Upper Prior, resulting in higher biomass than in 2014.

PAST CARP MANAGEMENT EFFORTS

In 2017 to 2018, an estimated 398 kg/ha of carp biomass was removed from Arctic Lake resulting in a reduction of 230 pounds of phosphorus per year. The monitoring of the recruitment rates of young carp to the system is likely to continue through the partnership these groups formed in 2013 and the actual effects of this removal on the phosphorus concentrations will be monitored by regular sampling throughout the growing months (May-September) of each year.

	Carp Biomass Estimate (kg/ha)	Phosphorus Loading Rate (lbs/year)
Before Removal	460.0	265
After Removal	62.0	35
Reduction Amount	**-398.0**	**-230**

3.6 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.

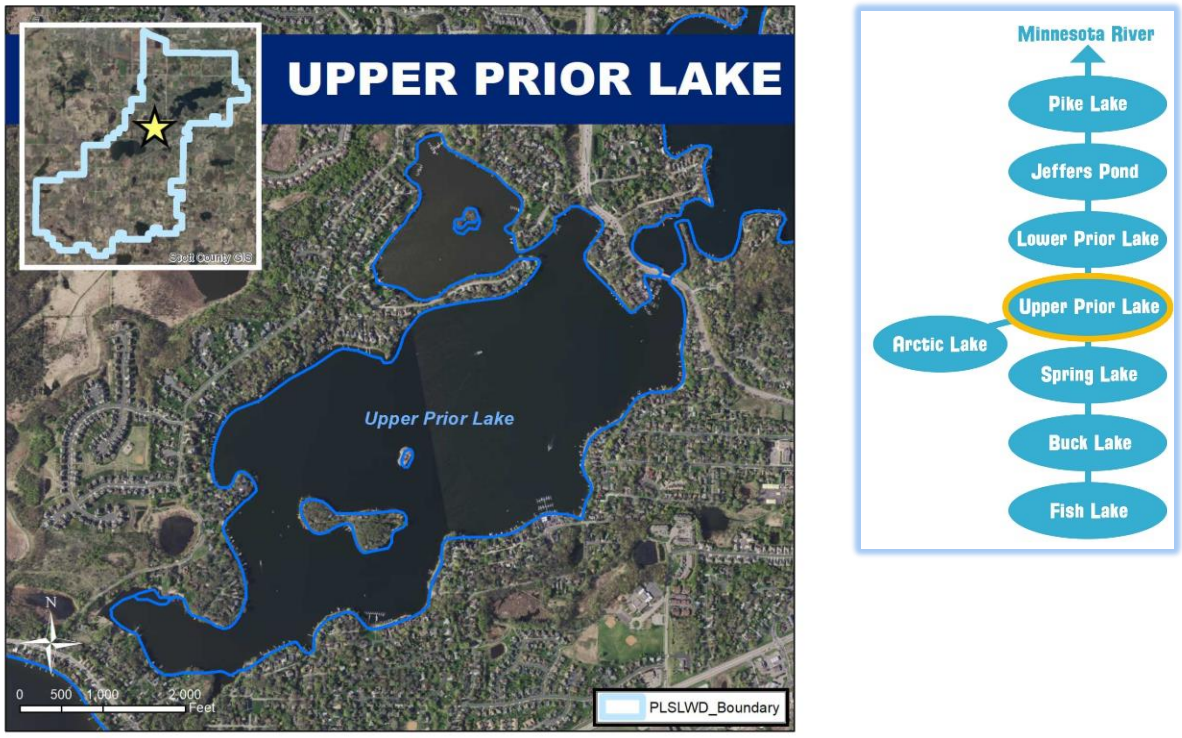


Figure 9. *Upper Prior Lake Map*

INTERNAL LOADING

The internal load of Upper Prior is a major cause of water quality impairment in Upper Prior 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 which may contribute and/or exacerbate internal loading.

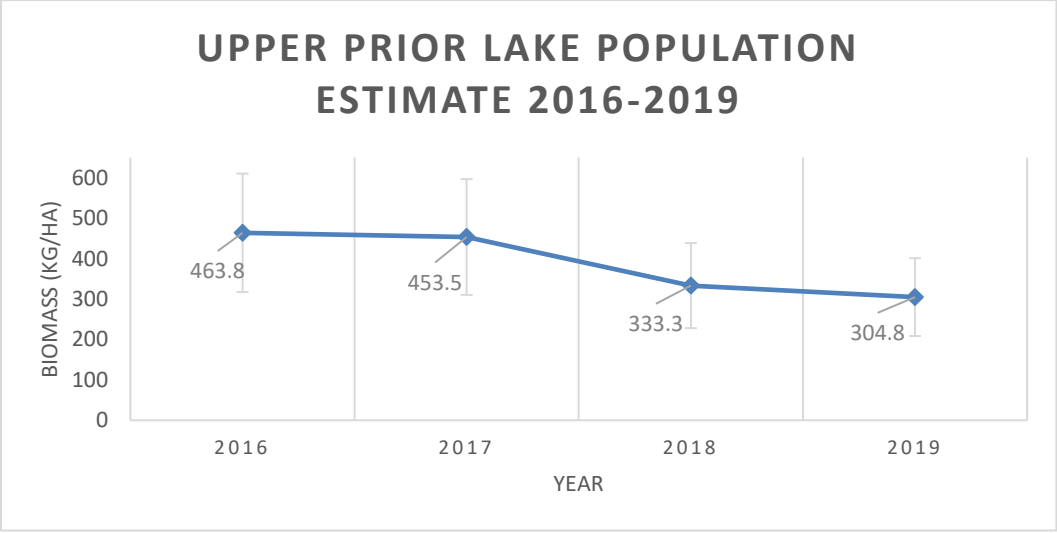
With the upstream alum treatment of Spring Lake to reduce internal nutrient loading, lower concentrations of phosphorus are reaching Upper Prior Lake. However, past studies have indicated that there is still an internal reservoir of phosphorus in Upper Prior Lake that continues to hinder the improvement of water quality in the lake.

FISHERIES ASSESSMENT

A number of carp were marked with a right pelvic and pectoral fin clip, radio tags, and passive integrated transponder (PIT) tags in Upper Prior Lake in 2015 and 2016. A mark-recapture estimate was calculated using the total number of fin clips and radiotags captured.

The biomass estimate as a result of this mark-recapture event was 13,840 ± 3,664 individuals in Upper Prior Lake before the removal. Using a 6 kg average weight, Upper Prior Lake biomass was calculated at 531.3 kg/ha ± 140.6, a biomass well above the 30kg/ha biomass goal identified by the PLSLWD.

Using LaMarra's estimation of loading due to an abundance of rough fish, nearly 10.54 pounds of phosphorus per day were being added to Upper Prior Lake as a result of this elevated population. This number equates to a loading rate of over 3,840 pounds of phosphorus per year caused by the overabundance of common carp.



PAST CARP MANAGEMENT EFFORTS

In the fall and winter of 2017-18, an estimated 113 kg/ha of carp biomass were removed from Upper Prior Lake resulting in a reduction of 845.8 pounds of phosphorus per year.

	Carp Biomass Estimate (kg/ha)	Phosphorus Loading Rate (lbs/year)
Before Removal	531.0 kg/ha ± 140.6	3,847.6
After Removal	418.0 ± 136.9	3,028.8
Reduction Amount	**-113.0**	**-845.8**

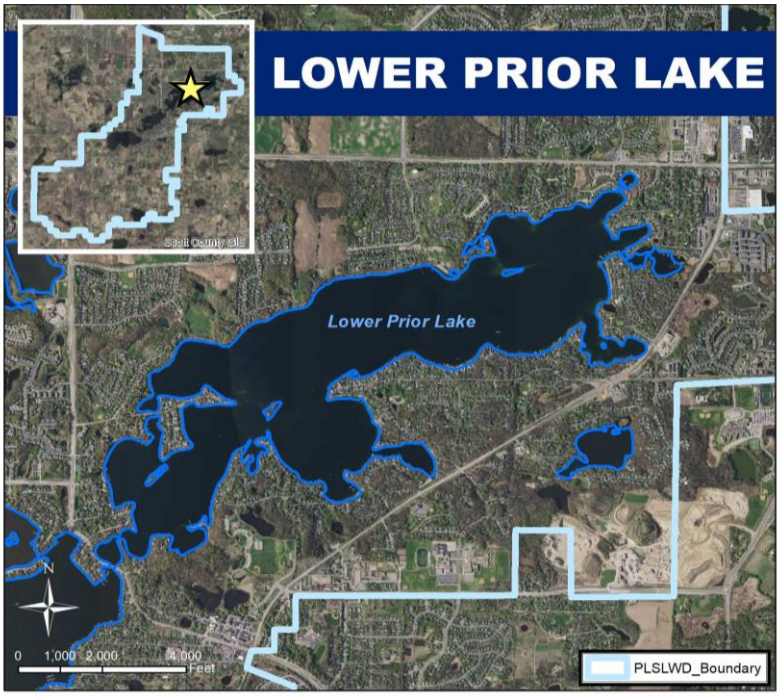
In the spring of 2019, two seine nettings and one electrofishing effort were completed in Crystal/Mud Bay, removing a total of 10,000 pounds of carp from Upper Prior Lake.

The monitoring of the recruitment rates of young carp to the system is continuing on a yearly basis and the actual effects of this removal on the phosphorus concentrations will be monitored by regular sampling throughout the growing months (May-September) of each year.

3.7 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.



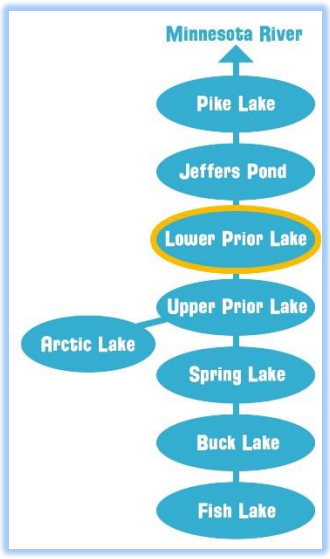


Figure 10. *Lower Prior Lake Map*

INTERNAL LOADING

The 2013 Diagnostic report discusses internal loading from sediment release as a possible source of loading but does not quantify the potential loading from this source.

FISHERIES ASSESSMENT

Carp are present in Lower Prior Lake and may travel freely between Lower Prior and Upper Prior Lakes through the existing connection under Eagle Creek Avenue (County Road 21). However, a biomass estimate completed in 2016 using a catch per unit effort (CPUE) model indicates that the annual load from carp is 158 lbs TP/year. Based on this, carp are not a significant source of phosphorus to Lower Prior Lake.

3.8 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 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, total acreage includes both basins).

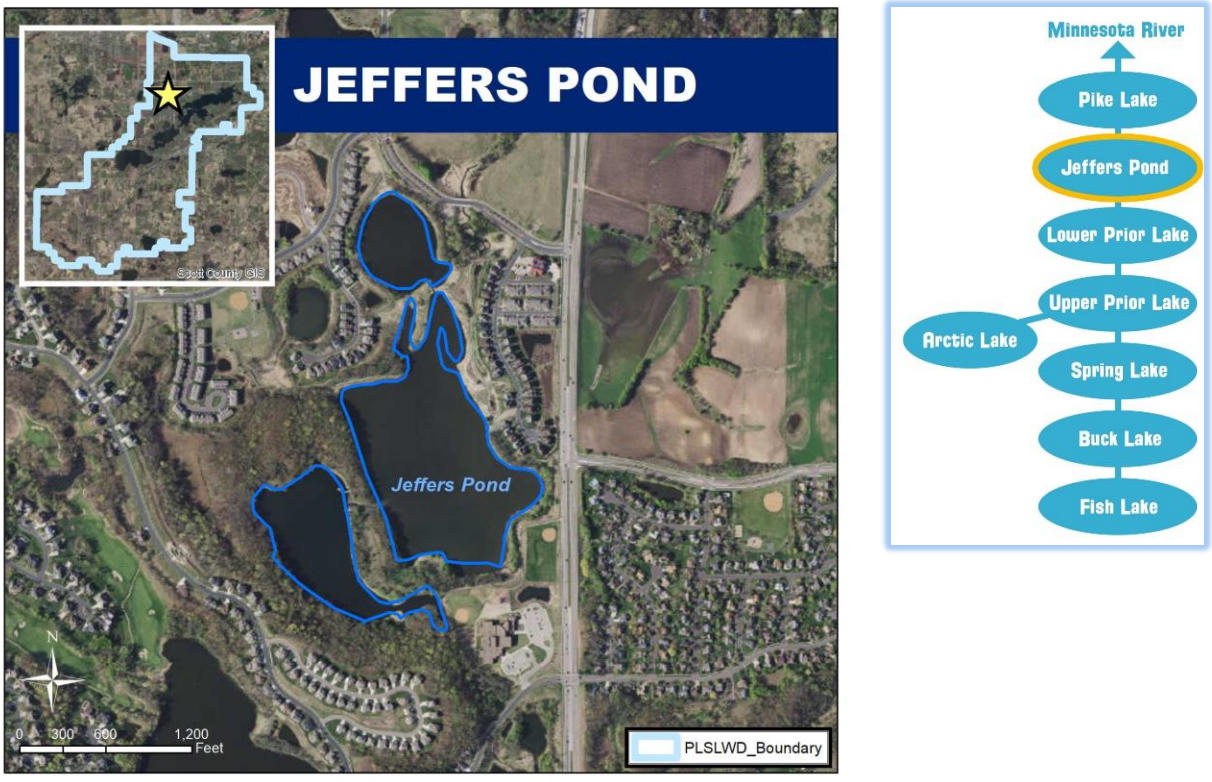


Figure 11. *Jeffers Pond Map*

INTERNAL LOADING

No diagnostic study has been completed to determine the phosphorus load (internal or external) to Jeffers Pond, nor is there any water quality data available to determine the impairment status of Jeffers Pond.

FISHERIES ASSESSMENT

No water quality or fisheries information is available for Jeffers Pond; however anecdotal information suggests that carp are present in Jeffers Pond.

3.9 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

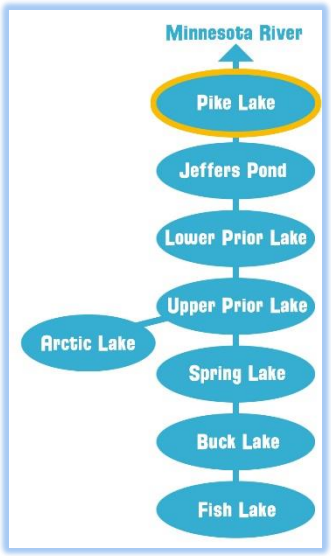


Figure 12. *Pike Lake Map*

INTERNAL LOADING

Based on available water quality data, Pike Lake is listed as impaired for nutrients. However, no TMDL or diagnostic study has been completed.

A sediment study to determine sediment release rates of phosphorus was completed by the Science Museum of MN in 2013. This study determined a lake-wide sediment release rate of 12.93 mg P/m^2/day but did not calculate a total load. Based on the release rate and lake size, the total load to Pike Lake from internal release of phosphorus from sediment under anoxic conditions is 1,825 pounds P/year.

FISHERIES ASSESSMENT

One fish survey was conducted in Pike Lake in 1978 by the MN DNR which only found black bullhead, yellow perch and no AIS. However, anecdotal evidence and observations made by District staff over the past decade conclude that common carp are present at potentially nuisance levels in this waterbody. No management actions have been taken to assess the status of the fishery or control of common carp at this time. A TMDL is in progress that is anticipated to help direct any potential management of carp for this lake.

PART 4 - CARP MANAGEMENT GOALS

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 30 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 three-year goals.

4.1 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.

The three 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

A review of Minnesota Pollution Control Agency's website on December 18, 2018 shows the list of impaired waters located within the PLSLWD as identified in the table below.f 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 are currently in-progress.

Table 1. List of Impaired Waters in PLSLWD:

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	Fishes 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	Fishes bioassessments
Upper Prior Lake	2002	Aquatic Consumption	Mercury in fish tissue
	2002	Aquatic Recreation	Nutrient/eutrophication biological indicators

As they receive some of the highest public use and are currently on the *state's impaired waters list,* the District has established the following two lakes as its **#1 carp management priority:**

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

4.2 GOALS

The District has four distinct goals for carp management. At the direction fo 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 help achieve successful long-term management without carp population rebound, it is important to also take steps to block recruitment and to understand how the connected system works as a whole to better management the carp population which is included in the three-year goals below.

BY THE END OF 2020:

As a short-term goal, the District will be aiming to have both Upper Prior Lake and Spring Lake to management levels by *the end of 2020:*

1) **Carp management goal of 30 kg/ha or less on Upper Prior Lake.**

2) **Carp management goal of 30 kg/ha or less on Spring Lake.**

In order to sufficiently manage these two waterbodies, all connected waterbodies that support carp recruitment to these lakes will also be managed.

THREE-YEAR GOALS:

It is anticipated in the next three year timeframe that the District will achieve the following:

3) **Spawning areas to Upper Prior and Spring Lakes effectively blocked with barriers to prevent recruitment.**

4) **Baseline information of fisheries, carp migration routes, aggregation areas, spawning locations sufficiently documented throughout the carp management lakes.**

PART 5 - IPM STRATEGIES

For years after the introduction of carp in the United States, various government agencies and other entities attempted to manage and mitigate carp populations simply through large-effort mass removals without quantifying the amount of carp before or after these efforts. Without baseline carp population information, this management method proved to be ineffective as mangers were not able to quantify the extent of the invasion and did not know when they were "done". Carp often recolonized waterbodies since a long-term approach was not implemented, and spawning areas remained open and available. This management approach was largely abandoned in the late 1900s due to its lack of success.

Ideas and strategies have since been adapted from management practices being used in Australia (Diggle et al., 2012) and by studying movement and behavior patterns of carp in the Upper Midwest. In the early-2000s the University of Minnesota Aquatic Invasive Species Research Center (MAISRC) instituted research to develop a sustainable approach to effectively mitigating and controlling common carp in the United States. This research showed that by addressing different life stages and developing an understanding of the entire system or watershed sustainable carp control could be possible.

Basic biological concepts can be applied to carp management parallel to controlling other invasive and terrestrial and aquatic invasive species. The diagram below illustrates considerations to be made in the development of a carp IPM (Figure 13). A carp IPM should be specific to the system in which it is to be applied. While some methods may not be applicable to all systems, the approach is adaptable.

Figure 13. *Integrated Pest Management (IPM) Strategies*

Existing qualitative and quantitative data show that applying data collection, physical removal, biological control, barrier technology, followed by regular monitoring and education to the PLSLWD may result in achieving successful management of carp to mitigate their deleterious effects on the system.

5.1 DATA GATHERING & ANALYSIS

Before implementation of management activities such as removal and barrier technology, the extent of the problem needs to be addressed. This can be defined as:

1) How many carp are in the system?

- Population estimates
- Removal amount calculations
- Setting goals

2) Where and when do carp travel and aggregate in the system?

- Document migration routes between waterbodies
- Aid in successful removals

3) What basins are the carp using to spawn?

- Identify potential locations for carp barriers
- Use to locate potential spawning trap locations (removals)

5.1.1 DATA COLLECTION TOOLS & TECHNIQUES

COLLECTING CARP:

Seines. Commerical fishermen use long mesh nets that hang vertically in the water with floats along the top and weights along the bottom. They are typically used to surround fish in an area and pulled through the water and along the lake bottom to crib up the carp in a shallow area for removal. Seine netting is very effective but limited to areas where carp aggregate and are snag free.

Electrofishing. An electric field is generated between anodes and cathodes placed in the water. The current causes muscle contraction and temporary paralysis in fish; most species will float to the surface where they can then be netted. Stunned fish usually recover quickly when the power is switched off. Unfortunately, fish in deep water are not often captured, so this technique is best used in shallower areas near the shore. Different electrofishing methods (e.g. backpack, bank-mounted and boat, including electroseining) are used depending on local site conditions.

Gill Netting. Mesh net panels are placed vertically in the water to entangle fish. The net has a rope along the top with floats attached and another rope along the bottom with weights attached. The mesh of a gill net is uniform in size and shape and the netting is large enough for a fish to fit its head through, but not its body, trapping them in place.

Fyke Nets. Collapsible, cone-shaped trap nets, held open by hoops. Leader net panels or wings guide fish towards the trap entrance. Due to their size and placement in shallow locations, fyke nets are effective for catching smaller carp.

Trap Nets. Mesh fish traps that have net guide walls leading fish into aggregation chambers. These are usually set in shallow water, and style and size can vary. The District is working on developing two specialized trap nets for netting during spawning season: the Push Trap Net that will include a one-way trap door panel on the opening, and the Newman Trap Net that will include multiple-staged guidance walls and openings for enhanced entrapment, both of which will be placed at carp spawning migratory routes.

Box Traps. The bait is located within a mesh trap that lays flat on the bottom of the lake, but quickly forms into a box when lifted to trap the carp inside. Carp are typically baited at the box trap location for several days until a large grouping forms. While a baited box trap catches fewer fish, it holds an advantage over a seine net because the carp are much less likely to escape.

TRACKING CARP:

Passive Integrated Transponder (PIT) Tags. PIT tags act as a lifetime barcode for an individual carp and when scanned are as reliable as a fingerprint (Gibbons & Andrews 2004). The tag is usually between 10 and 14 mm long and 2 mm in diameter. PIT tags are injected with a needle or inserted by surgical incision under the skin of the fish. PIT tags are dormant until activated; they therefore do not require any internal source of power throughout their lifespan. To activate the tag, a low-frequency radio signal is emitted by a scanning device that generates a close-range electromagnetic field. The tag then sends a unique alpha-numeric code back to the reader (Keck 1994). Scanners are available as handheld, portable, battery-powered models and as stationary, automated receiver devices that are used for automated scanning. PIT tag receivers are strategically placed in suspected carp migratory routes to determine movement behaviors in those channels.

Radio-Tags. A radio-tag consists of a 2.5 inch long cylinder which is surgically inserted inside the body of the carp with a foot long antenna extending outside of its body. Unlike PIT tags, radio-tagged fish can be located manually and tracked in real-time with an antennae from a boat or from on top of the ice in winter. Radio-tags implanted in the carp should last for about three years, providing the District with key information about where the carp gather to overwinter and where they go to spawn. Each radio tag has a unique frequency, which can be picked up from up to a mile away with the tracking antennae device.

Fin Clips / Plastic Tags. In order to determine population estimates, carp are sometimes marked with a unique fin clip for the waterbody (e.g. right dorsal fin, pectoral fin, etc.) which does not harm the fish but leaves an identifiable marker. In other studies, carp have been marked with plastic tags that are inserted into the body of the fish and are similar-looking to retail clothing tags.

Figure 14. *Plastic Tag*

POPULATION ESTIMATES:

Mark-Recapture Estimate. To complete a mark-recapture estimate of abundance, captured carp will be marked with a unique mark (e.g. a fin clip, a plastic tag, a PIT tag, or a radio-tag), measured for length and weight, and released back into the basin that they were captured. Subsequent surveys will note the ratio of marked to un-marked fish and a population estimate will begin to develop using this method of estimation. This method assumes that marked carp are redistributed with the unmarked population, meaning that sufficient time (upwards of one-week) must be given between the date of marking a carp to the recapture event (Chapman, 1951). It also assumes that no emigration or immigration of the species occurs in the lake during the survey period. This method of estimation will be evaluated throughout the project period in case one or more of these assumptions is being violated.

Figure 15. *Measuring carp*

Catch Per Unit Effort (CPUE) Survey. CPUE boat electrofishing surveys can be used to estimate carp abundance and to predict the density of adult common carp in some cases (Bajer, 2012). These surveys are completed in the late summer to early fall and over the span of one to two months. Ideally, up to three (3) separate electrofishing surveys in each lake are conducted to establish an average CPUE. Surveys will consist of at least three (3) 20-minute transects that cover shoreline and littoral zones that are suitable habitat for carp. Time spent, number of carp captured, and length and weight data are recorded. A population and biomass estimate of common carp are then calculated using this data in a CPUE model developed for using the protocol and gear described and reflects the population at the time of the survey (Bajer et al., 2012). An average of multiple surveys aims to develop a more robust estimate over a larger span of time.

Figure 16. *CPUE Survey*

5.1.2 CARP ABUNDANCE

OBJECTIVE 5.1.2A: Establish baseline abundance estimates for each of the carp management waterbodies in the PLSLWD.

For this plan, the abundance of carp is defined as the number of individuals and the amount of biomass present within each waterbody, reported in kilograms per hectare. To determine the abundance of carp within the system, two methods have been deployed: a mark recapture population estimate and an electrofishing catch per unit effort (CPUE) model. The protocol used for these methods of estimation are described above. Current population estimates include:

Table 2. *Carp Biomass & Phosphorus Loading*

	CARP BIOMASS ESTIMATE (KG/HA)	PHOSPHORUS LOADING RATE (LBS/YEAR)
Spring Lake*	**24.5 kg/ha ± 7.9**	**250.5**
Upper Prior Lake*	**418.0 ± 136.9**	**3,028.8**
Arctic Lake	462.6 kg/ha ± 365.3	-
Buck Lake	*unknown*	*unknown*
Fish Lake	85.7 +/- 69.2	-
Jeffers Pond	*unknown*	*unknown*
Lower Prior Lake	9.4 kg/ha	-
Pike Lake	*unknown*	*unknown*

**** Carp Management Priority Lakes***

Action Item 5.1.2a *- Develop abundance estimates for the remaining carp management lakes (Buck, Fish, Jeffers Pond, and Pike) in Prior Lake - Spring Lake Watershed that could have a potential impact on the two priority lakes and/ or upcoming TMDL lakes.*

No data for carp abundance exists for the lakes identified above. This prevents PLSLWD staff from understanding the potential impact of carp on the water quality and ecological integrity of these waterbodies.

Action Item 5.1.2b *– Develop a baseline understanding of recruitment patterns in waterbodies that connect to the PLSLWD main basins (Geis wetland, Northwood Pond, 12/17 Wetland, and others where adult movement is detected).*

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 and basins can guide sampling decisions.

OBJECTIVE 5.1.2B: Track changes in carp abundance on managed lakes

As the PLSLWD implements carp management activities (removal, barriers, etc.), it will be important to monitor changes in carp abundance on these lakes to determine if these efforts are successful in suppression of carp population post-management or if adjustments to existing strategies or new strategies are necessary. See Part 3 for specific information on current populations of individual lakes.

Action Item 5.1.2c - *Continue to collect & track abundance data on Spring and Upper Prior Lakes.*

The PLSLWD began a focused effort on carp biomass removal as part of this long-term plan in 2017. An effort to track changes in the Spring Lake and Upper Prior Lake carp populations should continue throughout the lifetime of the project as additional biomass removal activities are completed for each lake identified in the plan. This activity can be practically achieved by conducting a series of boat electrofishing CPUE surveys in the fall and continued tracking of mark-recapture.

5.1.3 CARP SPATIAL USAGE

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 blockage to movement to limit recruitment (Bajer, 2011).

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 three (3) PIT tag monitoring stations. 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 (once/week) and during the winter aggregation period when ice conditions were safe enough for foot travel (once/week). The remainder of the year, radio telemetry surveys were completed on an infrequent and irregular basis.

The District has also acquired 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.

OBJECTIVE 5.1.3A: Identify carp aggregations on Spring Lake and Upper Prior Lake

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 carp aggregation areas that could be targeted for carp biomass removal. Two (2) distinct sites were identified, both of which commercial fishermen have been able to pull a seine net through.

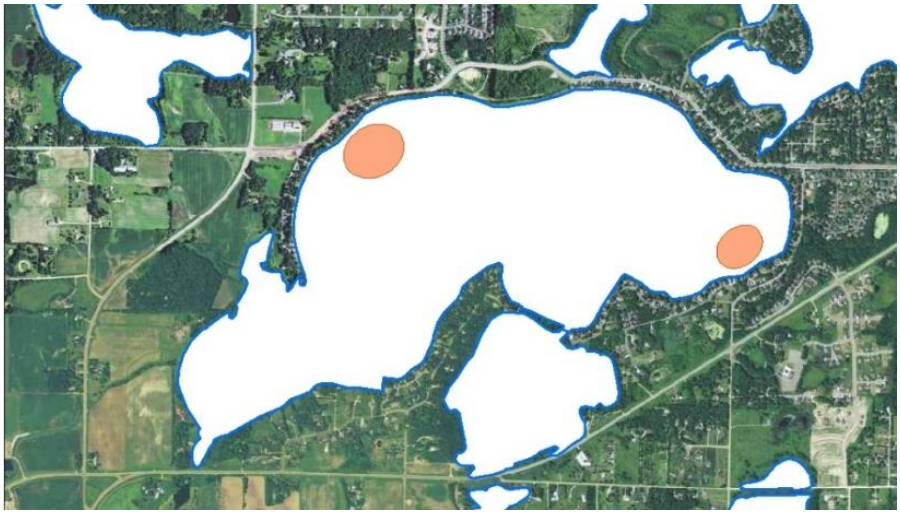


Figure 17. *Identified Spring Lake Carp Aggregation Areas*

Three full winters of telemetry data are available to identify winter aggregation areas on Upper Prior Lake and four (4) distinct sites have been identified where carp tend to aggregate, mainly in the winter. Locations 1-3 depicted on Figure 6 have been successfully seined, but location 4 has a significant presence of rocks on the lake bottom and is not suitable for netting.

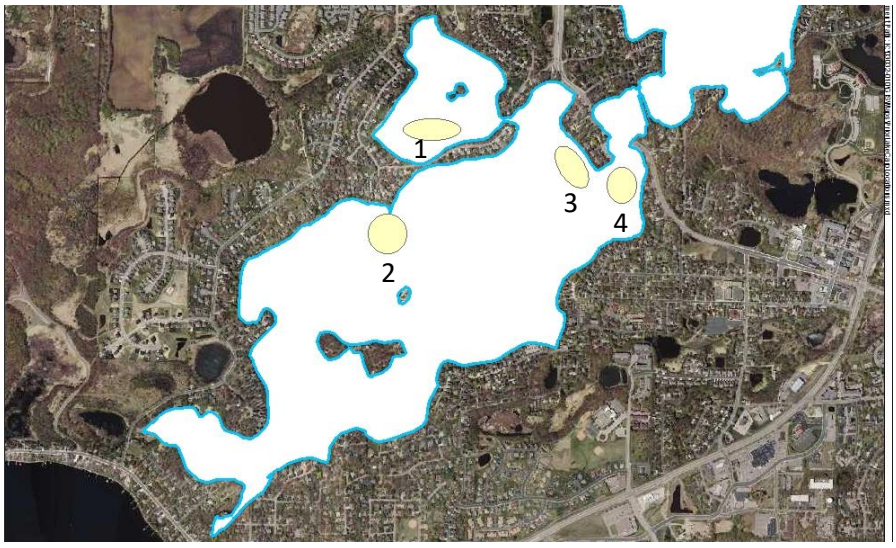


Figure 18. *2016-2019 Upper Prior Lake Carp Aggregation Areas*.

Radio-tags will continued to be tracked, mapped and documented to identify new and continued areas that carp are congregating on Upper Prior and Spring Lakes.

Action Item 5.1.3 – *Visually monitor carp at spawning areas to identify aggregations at connections to Spring and Prior Lakes.*

Using staff, volunteers, and stationary cameras, monitor the locations at or near Upper Prior or Spring Lakes that are suitable for small-scale carp removals when fish begin aggregating in the spring. This information will be used to coordinate electrofishing, gill-netting, or seine netting carp removals with consultants and/or commercial fishermen.

OBJECTIVE 5.1.3B: Map migration routes throughout the carp management lakes system and identify connected nursery sites for Upper Prior and Spring Lakes.

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 winter-kill 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 C).

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 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 and three (3) unmanned receivers/loggers placed in streams to detect movement and quantify the extent of movement in locations of highest priority. Two additional PIT tag receivers will be installed in 2020.

Table 3. Current and future PIT tags

	Current Active PIT Tags	2020 PIT Tags	2021 PIT Tags
Spring Lake	**156**	**50**	
Upper Prior Lake	**230**		
Arctic Lake	26	25	
Geis Wetland	114		
Fish Lake	0	50	
Pike Lake	0	50	

Table 4. Current and future radio-tags

	Current Active Radio-Tags	2020 Radio-Tags	2021 Radio-Tags
Spring Lake	**9**	**5**	**5**
Upper Prior Lake	**12**	**5**	**5**
Fish Lake		5	
Arctic Lake	**6**		

In 2020, more fish will be tagged in Spring Lake, Arctic Lake, Fish Lake and Pike Lake with PIT tags to detect movement into or out of them. Small PIT tags (12 mm) should be purchased to implant into carp young of the year in case they are captured. PIT tag stations will be strategically placed in 2020 to better understand the migration between the systems (see map below), and adjusted in 2021.

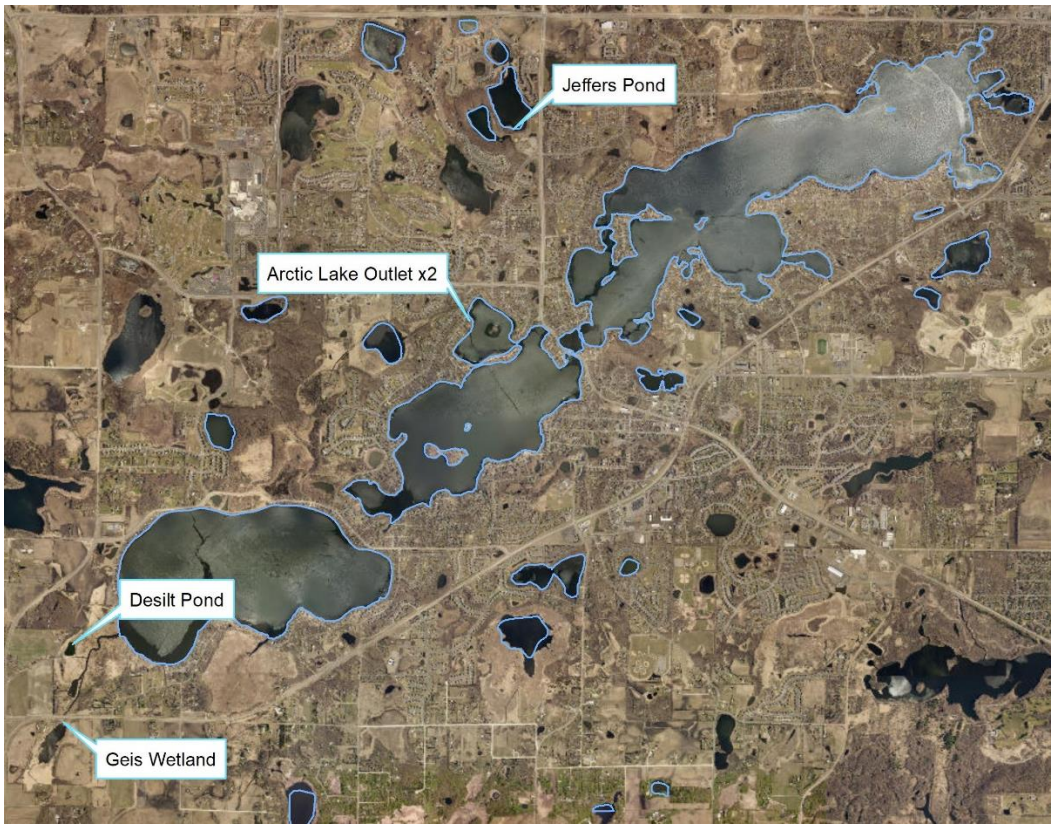


Figure 19. *PIT tag receiver locations planned for 2020.*

Tagged carp are suspected to have traveled between Upper Prior Lake and Arctic Lake after the barrier was installed in 2016. Additional PIT tags in Arctic will help confirm or deny whether or not carp are finding another way to travel between the two waterbodies.

PIT tag stations at the desilt pond and the Geis wetland will help the District verify if these barriers are sufficiently working to prevent carp migration during spawning.

5.2 PHYSICAL REMOVAL

Quantifying the carp population in terms of biomass density and number of individual carp, provides a basis for determining the level of removal necessary to achieve water quality and ecological restoration goals. As described in section 3.1, previous studies demonstrate that carp biomass densities of 100 kg/ha are ecologically damaging. To effectively manage carp below this threshold, an initial reduction to a density of 30 kg/ha has been recommended. By managing at a lower level, early detection of potential recruitment events may provide managers an opportunity to address the increase in carp population and biomass before it returns to a damaging level.

5.2.1 CARP REMOVAL GOALS

OBJECTIVE 5.2.1: ***Reduce carp biomass to and sustainably manage carp biomass at 30 kg/ha in lakes within the PLSLWD.***

Multiple methods may be employed to physically remove carp biomass (see Section 3.1 Data Collection). These may include seines, electrofishing, gill netting, trap netting, box nets, fish traps, in-stream removal techniques. Seine netting may be the most effective and efficient method for removal if carp effectively aggregate and the lake is free of obstructions on the bottom, the lake contours are not too steep, and substrates are not too flocculent.

Action Item 5.2.1: *Continue carp biomass removal on Upper Prior Lake and Spring Lake and their connected waterbodies that are recruiting to the lakes to reduce and maintain carp populations to at or below 30 kg/ha.*

5.2.2 ACCELERATED CARP MANAGEMENT STRATEGIES

OBJECTIVE 5.2.2: ***Develop alternative or innovative methodologies/techniques to improve or facilitate removal of carp biomass on waterbodies where carp may not aggregate, where obstructions prevent traditional removal operations, or where telemetry/PIT tag data suggest carp may be vulnerable.***

In many instances carp may become aggregated, but cannot be removed in the aggregation area due to obstructions on the bottom or along the shoreline. By developing alternative removal methodology, the PLSLWD will be able to expedite carp biomass removal and in some instances, make removal possible. By developing these techniques, the PLSLWD may be able to assist other water resource management entities in addressing carp management; especially in areas where traditional methods are difficult to employ.

The unified method may provide opportunity to enhance carp removal efforts by concentrating carp using underwater speakers; essentially using sound to herd carp to a specific location or drive them from undesirable removal locations.

Action item 5.2.2a: *Build, deploy, and test the unified method using radio telemetry and underwater sonar to observe response of carp to underwater sound.*

Herding Carp. Staff from WSB have been in contact with Illinois DNR and United States Geological Survey staff to gain a better understanding of the components and costs of such a system. The system consists of an MP3 player wired to underwater speakers and an amplifier to "pump" sound near an aggregation to drive them into nets or herd them to an area of the waterbody that is conducive to netting. This could be especially effective in an area like the northeast corner of Upper Prior Lake where rock obstructions exist near the Knotty Oar Marina.

Training Carp. The District will also test the effectiveness of training carp using sound and bait. Multiple studies have shown that carp can be trained within two weeks of consistent noise and rewards and will remember this training for as long as 4-5 months afterwards. If the District can train carp to come to a location when they hear a specific noise, this could be used to create or enhance opportunities for carp removal efforts (seines, box traps, etc.).

Action item 5.2.2b: *Purchase seine net for the District specifically for Upper Prior Lake.*

There has been some hesitancy by commercial fishing crews to commit resources to netting Upper Prior Lake due to the presence of aquatic invasive species (Eurasian watermilfoil, curly leaf pondweed, and zebra mussels) and the DNR's requirement to decontaminate nets and associated equipment. Depending on the weather, the decontamination period may be up to 21 days, meaning that commercial crews may not have gear to net other high priority lakes/projects. The purchase of a seine net by the Disrict for use by commercial fishermen should mitigate this obstacle by providing a net that could be properly decontaminated or used repeatedly in the same waterbody while not restricting the fishing crews' ability to continuously net in other waters.

Action item 5.2.2c: *Develop and deploy innovative carp trap nets that take advantage of spawning behaviors and migratory routes.*

Many locations on connections to Upper Prior and Spring Lakes have been identified as spawning migration routes. The District can exploit carp's spawning migrations by setting up traps at these connections.

Newman Cage. This design is similar to a baited box net, but rather than having to "trigger" 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. Below is an approximate version:

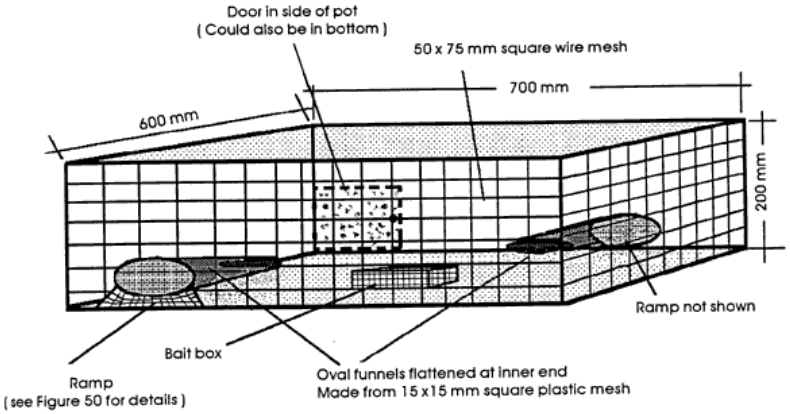


Figure 20. *Newman cage reference example.*

Push Trap. This trap takes advantage of the migratory behavior of carp as well as their propensity to "push" through barriers and is modeled conceptually on a design described in detail by Thwaites (2015). Initial laboratory results indicate that the push trap was successful in capturing 91% of adult carp in the experiment.

The design incorporates a row of stainless steel fingers mounted on a crossbar and set at angles that allow carp to push through and swim upstream into a collection basin. The rotating fingers are similar to those mounted at the ferric chloride weir, which rotate on a fixed cylinder. The fingers are set at a height that allow for the forward or upstream movement of the fingers that "open" the trap, but the fingers cannot swing back to allow carp to exit the trap.

Baited Box Trap. With assistance from volunteers, the District will use corn to bait carp in desired removal areas where a box trap has been set. Once a sufficient aggregation has been consistently feeding on the corn, staff will deploy the trap while carp feed, raising the net walls of the box trap. Carp would then be "corralled" and pulled into a boat. Multiple traps can be set and raised simultaneously in several sites around the lake system.

5.3 BIOLOGICAL CONTROL

Research completed by the 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 compliments 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.

Larger gamefish may also prey upon carp young of the year, but that relationship is not as well documented. Also, carp growth rates are quite accelerated compared to other fish species. By the second growing season (age 1) carp may be > 12 inches, reducing the likelihood that piscivorous fish species will be able to prey upon them.

In 2017, the PLSLWD partnered with the University of Minnesota as part of a graduate reseach 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 wasstocked 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.

OBJECTIVE 5.3.1: Manage lakes within the PLSLWD to support a robust gamefish and/or panfish population to effectively control carp as part of the IPM.

MN DNR fisheries data is available for both Upper Prior, Lower Prior, Spring, and Fish Lakes and two (2) studies have been completed on Arctic Lake. The remaining lakes in the watershed have not been assessed. Existing data for these lakes show a variety of fish assemblages and abundances.

Action Item 5.3.1a - *Analyze existing fisheries data to identify trends and determine typical fishery conditions.*

An analysis of all existing fisheries data will provide insights into each of the fisheries where such data is available, identify data gaps, and determine if the fishery is functioning to biologically control carp where necessary. Habitat improvements and other restorative efforts may be identified through this effort as well as waterbodies that may need additional survey work where minimal data is available.

Action Item 5.3.1b - *Complete baseline fisheries assessment for waterbodies that do not have existing fishery data within the PLSLWD to determine the status of the fishery.*

Several lakes listed in section 3.1.1 do not have fishery data available. These lakes may be functioning as carp nurseries, gamefish nurseries, or providing some other benefit to the system. To fully develop the biological control component and reduce or eliminate carp recruitment, a thorough understanding of how all the waterbodies within the watershed act as a system will be necessary.

Baseline fishery assessment may be completed using a variety of methodologies including electrofishing and netting. Data collected during these assessments can be compared to existing fisheries data from Action Item 3.3.1 to prioritize where potential improvements could be made or what areas should be protected.

Action Item 5.3.1c – *Stock bluegills as needed in carp nursery locations connected to Upper Prior and Spring Lakes to prevent recruitment.*

Stock existing carp spawning site at the Geis wetland with 4-6" bluegill in spring before carp migration and spawning. Winter dissolved oxygen measurements show elevated oxygen levels (7 ppm), which is high enough to support winter survival. It is unknown if the habitat is sufficient to support bluegill recruitment, but stocked bluegill should survive based on measured dissolved oxygen levels. Based on recommended stocking rates, the Geis wetland will be stocked with 2,500 bluegills to reach the rate of 500 bluegill/surface acre. Other nursery locations will also be analyzed for potential bluegill stocking.

5.4 BARRIERS

Barriers can be an incredibly effective component of a carp IPM. Barriers may be employed to protect sensitive areas from the destructive foraging behavior of carp or prevent carp from exploiting migration routes to disrupt recruitment. Barrier placement should be balanced with the potential need for fish passage with respect to native gamefish. Placement of barriers is supported by the implementation of movement monitoring as described in section 3.1.2.

Existing carp barriers were placed throughout the Upper Prior and Spring Lake connections based on documented carp migratory information and include the following locations:

- Arctic Lake Outlet
- 12/17 Wetland (west side of Spring Lake)
- FeCl Weir (south of Spring Lake on Ditch 13)
- Desilt Pond (south of Spring Lake at Ditch 13 outlet)

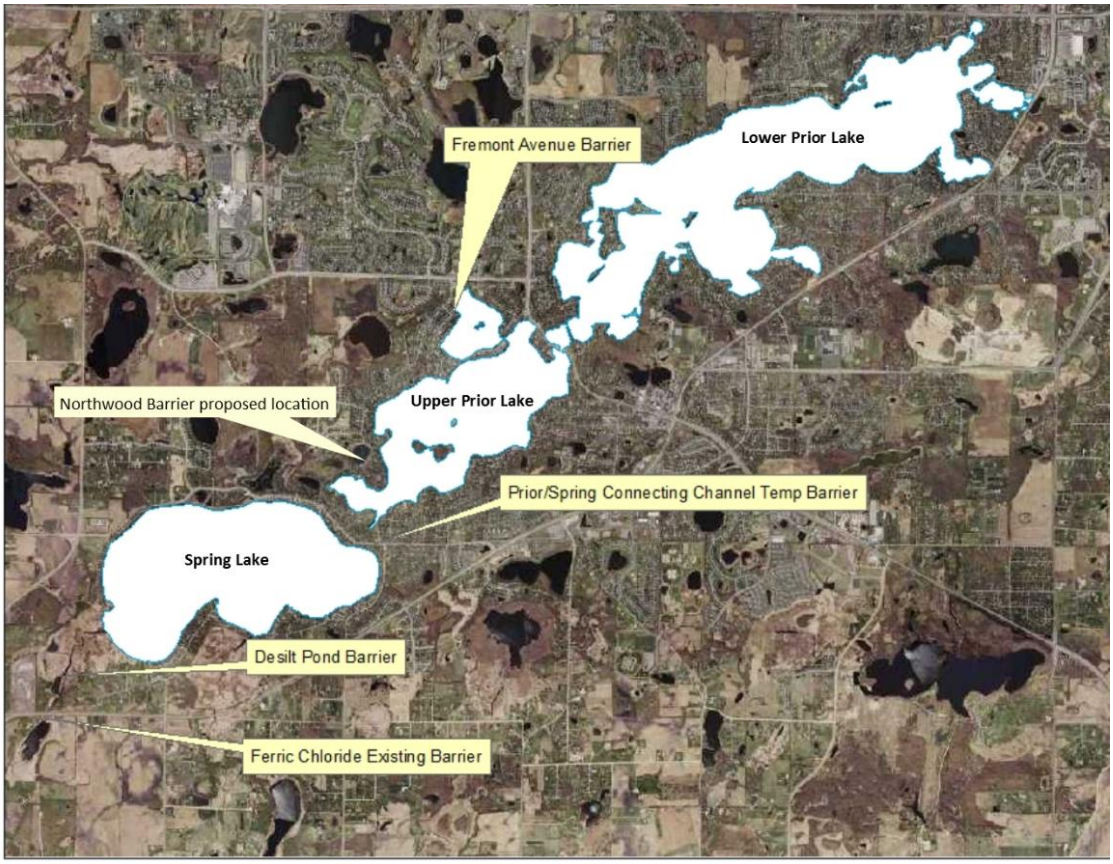


***Figure 21**. Barrier locations within the PLSLWD, including installed and proposed barrier sites.*

OBJECTIVE 5.4.1: Install new barriers within carp migration routes documented using PIT or radio tag technology or identified through fishery assessments.

There is currently one new barrier (Northwood barrier) in plans for construction and an update to the existing FeCl Weir barrier. The District is investing in other potential barrier locations including two wetland connections on the west side of Spring Lake and one wetland connection on Upper Prior Lake.

Action Item 5.4.1 - *Upgrade FeCl barrier.*

Modification plans have been finalized to repair and improve the design of the existing weir in consultation with PLSLWD staff. The new design is similar to the existing structure, but includes longer fingers that form a ramp and require carp to swim longer distances upstream outside of the water column. The new design also makes cleaning and removal of rebar fingers easier. Updated design plans are included in Appendix D.

Figure 22. *Ferric Chloride outflow.*

Action Item 5.4.1 – *Install Northwood wetland barrier.*

In the spring of 2017, one radio-tagged carp, originally tagged in Upper Prior Lake, was found to have migrated into the Northwood wetland. Upon inspection, splashing and movement of common carp was observed (spawning behavior). A simple barrier has been designed and will be constructed and installed in the fall of 2019 in an existing water control structure (Figure 23).

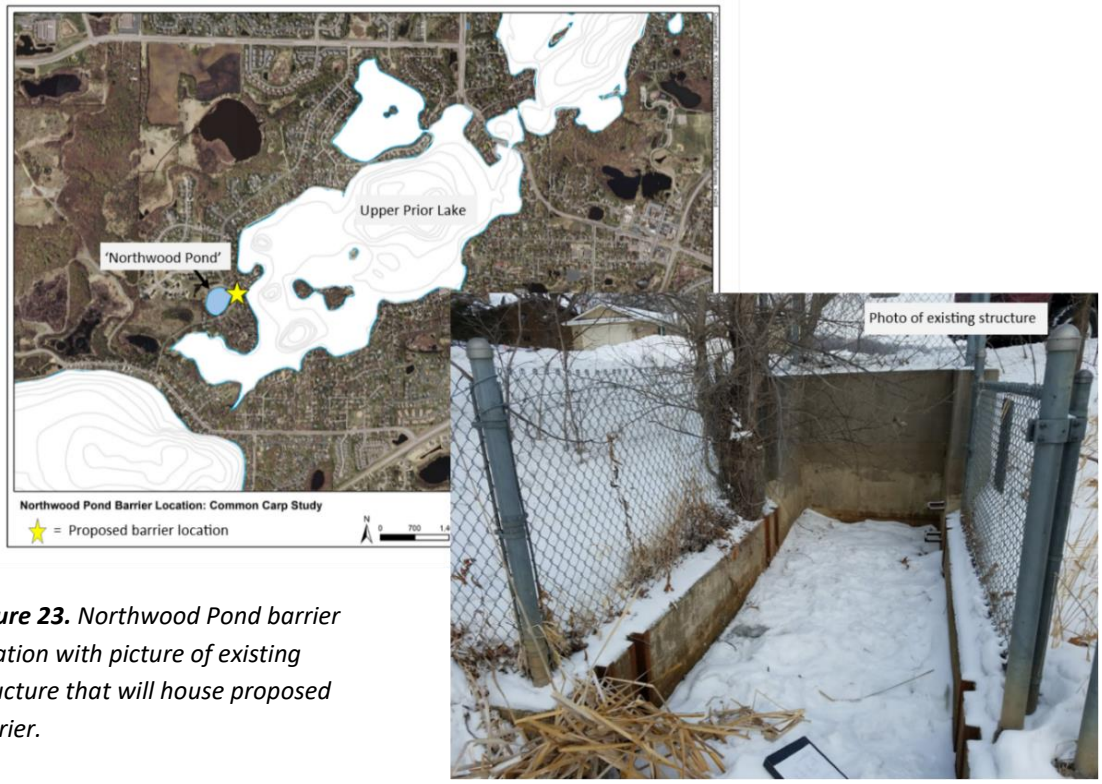


Figure 23. *Northwood Pond barrier location with picture of existing structure that will house proposed barrier.*

Action Item 5.4.2 - *Continue to track carp movement with PIT and radio tags to identify other potential barrier sites along migration routes.*

Annual surveys will be necessary to continue in order to capture the potential for additional migration routes as long term hydrologic cycles and other environmental influence and trigger carp movement. To document these movements, PLSLWD will continue monitoring radio-tags and PIT tags to site additional barrier sites.

5.5 EDUCATION

As with other long term restoration efforts, building public support through education and information sharing is critical in continuing the project from year to year and seeing it through until completion. In addition, creating stewards that work to further and foster restoration efforts rather than counteract those efforts promotes lasting efforts beyond initial project implementation.

OBJECTIVE 5.5.1: Provide educational opportunities on aquatic invasive species (carp) to citizens within the watershed.

The PLSLWD can create environmental stewards by educating youth and adults about what aquatic invasive species (AIS) are, the impacts those species have on our natural environment, and what they can do to prevent or mitigate those effects.

Action Item 5.5.1 - *Continue to engage local youth through classroom interactions and hands on field exercises.*

PLSLWD staff and WSB scientists have visited four local classrooms as part of its carp management efforts in 2015-2017. Each visit involved a presentation on AIS with a focus on carp, hands on telemetry exercise, and an invasive species conceptual game. As part of its current grant programs, the District will continue these education efforts through 2021.

Action Item 5.5.2 – *Provide information to the public regarding carp management and grant programs through interactive website updates and through presentations to local groups, such as the lake associations.*

PLSLWD staff will continue to update its website with current information on the carp project. The District will also present information on the project to the Prior Lake Association, the Spring Lake Assocation, the District's CAC and to other groups as requested.

OBJECTIVE 5.5.2: Develop citizen scientists to aid in collecting additional data on carp populations within the watershed and assisting with removals.

As part of a long-term effort, the PLSLWD can engage its citizenry to assist with data collection through a program similar to the Citizen Assisting Monitoring Program (CAMP). Interested citizens can provide important observations and data that can inform this plan and management activities.

Action Item 5.5.4 - *Train citizen scientists to assist with baited box traps and training carp.*

Train citizen scientists to assist District efforts with carp removals. This could include regularly baiting carp with corn at desired locations or assisting with training carp with noise. There also may be opportunities where citizen scientists can assist in the carp removals on the lakes.

PART 6 - CARP MANAGEMENT SCHEDULE

The following table includes the carp activities anticipated for 2019-2021 in order to achieve the goals identified in Part 4.

CARP MANAGEMENT SCHEDULE

2019-2021

PRIOR LAKE – SPRING LAKE WATERSHED DISTRICT

TASK	START	END	Spring 2019			Summer 2019			Fall 2019			Winter 2020			Spring 2020			Summer 2020			Fall 2020			Winter 2021			Spring 2021			Summer 2021			Fall 2021		
			A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D
Carp Tracking & Project Development																																			
Implant carp with PIT tags & Radiotags	*Mar 2010*	*May 2021*																																	
Install/monitor PIT tag reader stations	*Apr 2019*	*Sep 2021*																																	
Track PIT tags across waterbodies	*Apr 2019*	*Dec 2021*																																	
Update GIS location information & online maps	*Apr 2019*	*Dec 2021*																																	
Install stationary cameras at strategic locations	*Sep 2019*	*Dec 2021*																																	
Use underwater camera for tracking carp	*Sep 2019*	*Dec 2021*																																	
Purchase boat for tracking and removing carp	*Oct 2020*	*Oct 2020*																																	
Analysis: *identify aggregation areas, migration routes and population status*	*Jun 2019*	*Dec 2021*																																	
Carp Barriers																																			
Identify strategic locations for carp barriers	*Oct 2019*	*Oct 2021*																																	
Site analysis & design of barriers	*Dec 2019*	*Mar 2021*																																	
Install Northwood Barrier	*Sep 2019*	*Nov 2019*																																	
Install FeCl Barrier Redesign	*Sep 2019*	*Nov 2019*																																	
Install Barriers #2 & 3 (Location TBD)	*Apr 2020*	*May 2021*																																	
Install temporary barrier at Spring Lake Outlet	*Apr 2020*	*Jul 2020*																																	
Carp Removals																																			
Spring Lake carp removals	*Nov 2019*	*Apr 2021*																																	
Upper Prior Lake carp removals	*Mar 2019*	*Apr 2021*																																	
Geis wetland carp removals	*Apr 2019*	*Oct 2021*																																	
Pike Lake carp removals	*Apr 2020*	*Oct 2021*																																	
Purchase seine net for Upper Prior Lake	*Oct 2020*	*Nov 2020*																																	
Deploy Newman Cage in Geis wetland	*Apr 2020*	*Jun 2021*																																	
Deploy Push Trap in desilt pond	*Apr 2020*	*Jun 2021*																																	
Stock bluegills in Geis wetland	*Apr 2020*	*May 2021*																																	
Box Trap removals with volunteers	*Apr 2020*	*Sep 2021*																																	
Purchase additional speaker for herding/training carp	*Jan 2020*	*Jan 2020*																																	
Carp removals in other waterbodies (TBD)	*Nov 2020*	*Dec 2021*																																	
Education & Outreach																																			
Outreach mailings	*Apr 2019*	*May 2020*																																	
Lake Association meetings/presentations	*Apr 2020*	*Jun 2021*																																	
Update website with current information	*Jan 2019*	*Dec 2021*																																	
Educational activities with local schools	*Sep 2019*	*May 2021*																																	
Update IPM Plan																																			
Annually update plan to include new information	*Sep 2019*	*Oct 2021*																																	

Note: The above Carp Management Schedule includes work funded by a 319 Grant, a BWSR Watershed Based Funding Grant, and the PLSLWD District Levy.

PART 7 - SUMMARY

With the understanding that common carp play a role in the decline of water quality within the PLSLWD and with the knowledge that they are present, the goals and action items established in this plan will aid the PLSLWD in accomplishing its primary goal of managing and preserving the water resources across the watershed.

This plan is intended to be a living document; using adaptive management that may develop new management strategies and plan goals through data collection and analysis. As new data is collected and analyzed, current approaches, data collection efforts, and prioritization may change. The PLSLWD Carp IPM should be reviewed annually to provide updates to identified goals and action items and potentially add or modify goals as data collection may dictates. This plan incorporates an adaptive management approach. As data is collected and analyzed it will be used to inform the plan and possibly develop new objectives or approaches.

The PLSLWD Carp IPM has been developed as a guidance document for the management of common carp populations within the Prior Lake - Spring Lake Watershed District. The PLSLWD Carp IPM supports the goals of the 2011 Upper Prior and Spring lake TMDL and goals established for individual waterbodies throughout the watershed.

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APPENDIX A

2018 CLEAN WATER PARTNERSHIP GRANT FINAL REPORT

APPENDIX B

ARCTIC LAKE FISHERIES ASSESSMENT 2017

APPENDIX C

FERRIC CHLORIDE WEIR IMRPOVEMENTS SITE PLANS

APPENDIX D

NORTHWOODS CARP BARRIER SITE PLANS