Memorandum

To: **Jessica Vanderwerff Wilson**

From: **Jordan Wein, WSB**

Date: **August 28, 2022**

Re: **Indianhead Fishery Survey and Dissolved Oxygen Profiles**
Edina, MN
WSB Project No. 018642-000

BACKGROUND

Indianhead Lake (MN DNR DOW #27004400) located in Edina, MN, is a 14-acre lake with an average depth of 4.5 feet with a maximum of 6 feet. Hypoxia (lack of enough oxygen to support living tissues) can occur in winter when ice and snow have prevented reintroduction of dissolved oxygen to the lake. This can result in the observation of fish kills in springtime when ice melts off the lake. In addition, in shallow lakes, hot and dry months in summer can deplete oxygen to the point of summer fish kills. To prevent this, a common management option is to install aeration systems to artificially add dissolved oxygen to the water column. An aeration system consisting of 4 aerators spread throughout the lake was installed in 1979 as part of a Clean-Flo system to control algae and submerged plants. Furthermore, the aeration system served to prevent conditions that usually result in hypoxia in the lake and fish winterkill. However, a lack of knowledge of this fishery existed and thus the effect of the aerators was not well known. This system was paid for by the lake association and maintenance is coordinated by the service contractor through the City of Edina.

To this point, there had not been a standard MN DNR fishery assessment using standard trap nets or electrofishing. Therefore, it is believed this is the first standardized survey efforts on the lake. In the last 10 years, MN DNR permitted stocking has occurred in 2013 and 2016, stocking native species like bluegill sunfish (200 and 5000 respectively) black crappie, (50 and 2000 respectively) and largemouth bass (200 and 1900 respectively). This stocking was paid for by lake residents. The desire was to promote a healthy, native fisheries balanced for sustainable fish populations.

The results of these surveys will give a baseline index for catch per unit effort (CPUE) for comparison of subsequent surveys in order to understand population and diversity dynamics as well as presence/absence of invasive species.

INDIANHEAD TRAP NET SURVEYS: SEPTEMBER 2021 AND JUNE 2022

Methods

We used three (3) MN DNR standard double frame fyke trap nets with ¾” mesh and a 60’ lead line. In addition, we used three (3) mini fyke trap nets with 3/8” mesh and a 30’ lead line (seen in Figure 1). This style of traps targets the natural movement patterns of fish along the shorelines during a 24-hour period. Once the lead line is anchored to shore, the trap is stretched perpendicular to the shoreline and held up with an anchor. Fish swimming along the shore are guided toward funneled throats that allow the fish in but are not able to escape. The contents of each trap were emptied, all fish were identified, and a representative sample were measured for length for comparative purposes.

Figure 1: Example of mini fyke trap net set in a lake.

Results

Both standard trap nets and mini fyke trap nets resulted in the same diversity of species: black crappie, bluegill sunfish, golden shiner, hybrid sunfish, and largemouth bass as shown in Figure 2. The most abundant by far were bluegill sunfish with an average size of 6.7 inches, followed by hybrid sunfish at an average length of 8.2 inches, then black crappie at 7.3 inches, golden shiners at 6.9 inches and finally largemouth bass at 10.6 inches (see Figures 3 and 4 below).

Figure 2: On the left, snapping turtles were regularly caught in out traps as well as bluegills, black crappie and golden shiners shown on the right.

Table 1: Fall total catch of each species using mini and standard trap nets compared to normal ranges.

September 2021 sampling				
Species	**Gear**	**Total catch**	**CPUE**	**Normal CPUE range**
Bluegill sunfish	Mini trap net	470	78.3	-
Bluegill sunfish	Standard trap net	530	88.3	2.8-43.3
Black crappie	Mini trap net	18	3.0	-
Black crappie	Standard trap net	83	13.8	1.2-20.5
Golden shiner	Mini trap net	2	0.3	-
Golden shiner	Standard trap net	13	2.2	.4-3.9
Hybrid sunfish	Mini trap net	50	8.3	-
Hybrid sunfish	Standard trap net	42	7.0	NA
Largemouth bass	Mini trap net	3	0.5	-
Largemouth bass	Standard trap net	3	0.5	.1-.8

Table 2: Breakdown of size classes of each species in fall of 2021.

2021 Length of select species sampled				
Length categories (inches)	***Bluegill sunfish***	***Black crappie***	***Golden shiner***	***Largemouth bass***
0-5	14	3	0	0
6-7	112	45	8	0
8-9	94	27	7	1
10-11	0	9	0	2
12-14	0	0	0	3
15-19	0	0	0	0

Table 3: Spring total catch of each species using mini and standard trap nets compared to normal ranges.

June 2022 sampling				
Species	**Gear**	**Total catch**	**CPUE**	**Normal CPUE range**
Bluegill sunfish	Mini trap net	843	140.5	-
Bluegill sunfish	Standard trap net	456	76.0	2.8-43.3
Black crappie	Mini trap net	8	1.3	-
Black crappie	Standard trap net	23	3.8	1.2-20.5
Golden shiner	Mini trap net	0	0.0	-
Golden shiner	Standard trap net	7	1.2	.4-3.9
Largemouth bass	Mini trap net	8	1.3	-
Largemouth bass	Standard trap net	1	0.2	.1-.8

Table 4: : Breakdown of size classes of each species in spring 2022.

2022 Length of select species sampled				
Length categories (inches)	***Bluegill sunfish***	***Black crappie***	***Golden shiner***	***Largemouth bass***
0-5	14	0	0	0
6-7	180	12	4	3
8-9	80	17	3	2
10-11	8	4	0	3
12-14	0	2	0	5
15-19	0	0	0	3

INDIANHEAD BOAT ELECTROFISHING SURVEYS: AUGUST 2022

Methods

Boom electrofishing consists of a boat with an onboard gasoline generator that supplies power to a dual boom cathode array that hangs off the front of the boat, as shown in ***Figure 3*** below. A control box run by the navigator adjusts the type of electrical output depending on lake depth, temperature, and conductivity. Generally, the output runs around 18-22 amps and 2,000-3,000 watts. This amount of electricity caused a phenomenon known as electrotaxis, movement toward an electric field, and as the fish entered the strongest area of electricity, it was immobilized and was able to be netted without long term harm to the fish. The fish generally returned to normal behavior between a few seconds to a few minutes after removal from the electric field. The zone which immobilized fish was generally about four feet around each boom array and about four feet deep.

Three transects around the lake of 15 minutes were completed. This allowed us to sample all shoreline one time as well as a short portion down the middle of the lake. This prevented us from double-counting fish that had already been captured in earlier transects.

Figure 3: Electrofishing survey on a lake

Results

A total of four species were sampled during the electrofishing survey. As seen with the trap nets, the most abundant species was bluegill sunfish. Relatively fewer black crappie were sampled compared to largemouth bass and golden shiners were not sampled. A breakdown of species and average lengths is shown below.

Table 5: Breakdown of species sampled during August 2022 electrofishing survey.

	Total caught	Average length (inches)
Black crappie	4	8.2
Bluegill sunfish	119	6.2
Bluegill young of year	70	1.2
Hybrid sunfish	2	7.4
Largemouth bass	7	10.6

DISSOLVED OXYGEN ASSESSMENT: MONTHLY SURVEYS FROM AUGUST 2021 THROUGH JULY 2022

Methods

Figure 4: YSI equipment sensing DO at a depth during a winter survey on Indianhead Lake.

Dissolved oxygen (DO) profiles were surveyed in Indianhead Lake once per month from August 2021 through May 2022. In June and July of 2022, profiles were collected twice per month approximately 2 weeks apart. December and January profiles were not collected due to unsafe ice conditions.

Using a YSI dissolved oxygen meter and thermometer, DO and temperature were collected at one-foot intervals until the lake bottom was contacted. DO was not collected on the bottom of the lake or at the water's surface due to confounding results because turbulence could significantly change the immediate reading of the device. Six locations were chosen based on proximity to aerator heads. The intention was to have two locations consistently surveyed near to aerators and four locations nearer to shore away from the aerators to detect the lateral mixing difference throughout the lake.

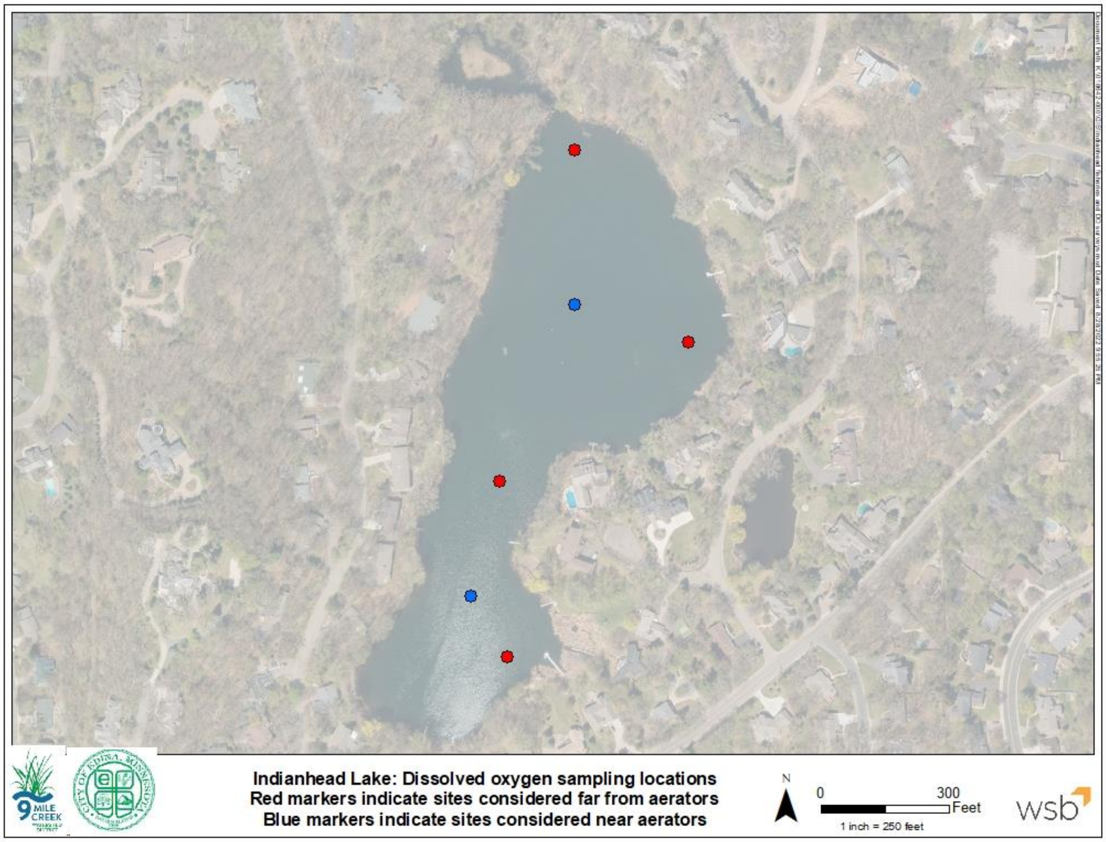

Figure 5: Locations of repeated DO sampling each month.

Results

Although DO readings were collected at each 1-foot interval, there generally was little difference between depths. At times, the readings at a depth of 1 foot from the surface were higher than the rest, but much of that difference was attributed to acute surface disturbance like slight splashing of waves on the canoe. We chose to display the average DO at a depth of 4 feet since all locations were at least this deep before contacting the bottom sediments and it would be farthest from surface disturbance to skew results. In addition, this would be the closest average depth most fish in this lake type would be occupying. Therefore we felt it most pertinent to display any problem areas for DO to cause distress to fish in the lake.

In general, it appeared there was a consistent average DO at this depth around 5.5 mg/l. Sensitive species like bluegill sunfish become significantly distressed when DO falls below 2 mg/l. These results show that DO in the water column appear to be maintained throughout the year well above that threshold and assuming normal operation of the aeration systems, fish species in Indianhead are at little risk of significant stress due to low DO.

Figure 5 is displayed comparing proximity to aeration heads (far and near) to determine lateral mixing of DO. Although it appears to show a drop in DO at locations far from aeration heads, the difference is minimal. For perspective, the far locations were between 250-400 feet away from the heads, which is still relatively quite close to them. Regardless, the aerators appear to be spreading DO evenly across the lake.

The DO appears to increase in the fall and into the winter as waters cool and the water is able to hold more DO. The drop back to the level of about 5.5 mg/l in February may have been due to fish respiration and ice cover reducing the introduction of DO from the surface. With the lack of submergent vegetation to photosynthesize under the ice, there was a lack of oxygen being released by plants. However, the lake still appeared to maintain DO above a significantly stressful level for sensitive fish species. As ice melted off in March, the DO is seen to jump significantly until water temperatures rose in May when the oxygen holding capabilities of the lake also dropped.

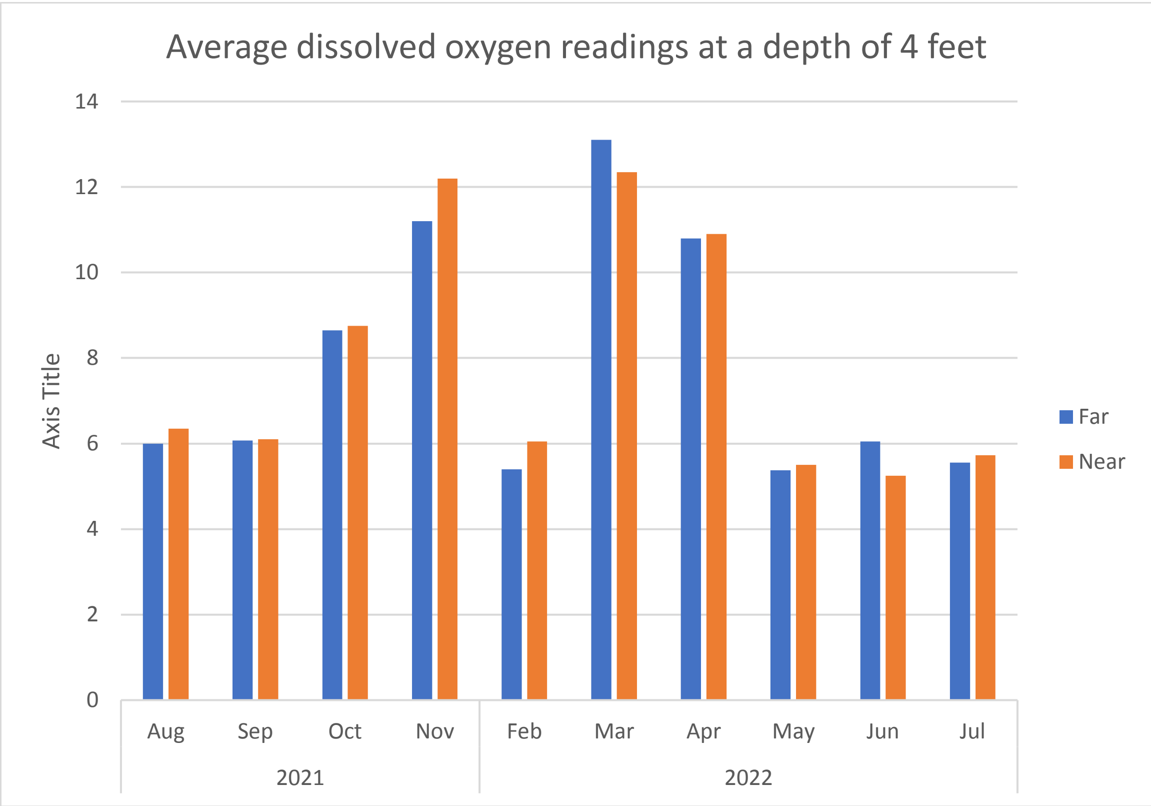

Figure 6: Average DO measurements from August 2021 through July 2022 at a depth of 4 feet.

CONCLUSIONS

Results support the assumption that the stocking efforts in 2013 and 2016 were successful and recruitment (survival of fish spawned within the lake) could be occurring. However, the lack of abundant small fish (<3 inches) during trap net surveys suggested low recruitment, but high survival of stocked fish. Electrofishing surveys did result in the sampling of a small number of young of year sunfish, likely bluegills. This is likely the main forage for the largemouth bass found in the lake. Regardless, the fishery seems to have benefitted from stocking efforts and the installation of aeration systems.

Body conditions of some black crappie captured suggested low forage or disease could be limiting their growth and recruitment. If small forage like fathead minnows or small golden shiners were more prevalent, there may be enough to support better growth and health of crappies in the lake. The lack of submergent aquatic vegetation could also be contributing to the lack of recruitment of species other than bluegill and largemouth bass.

APPENDIX

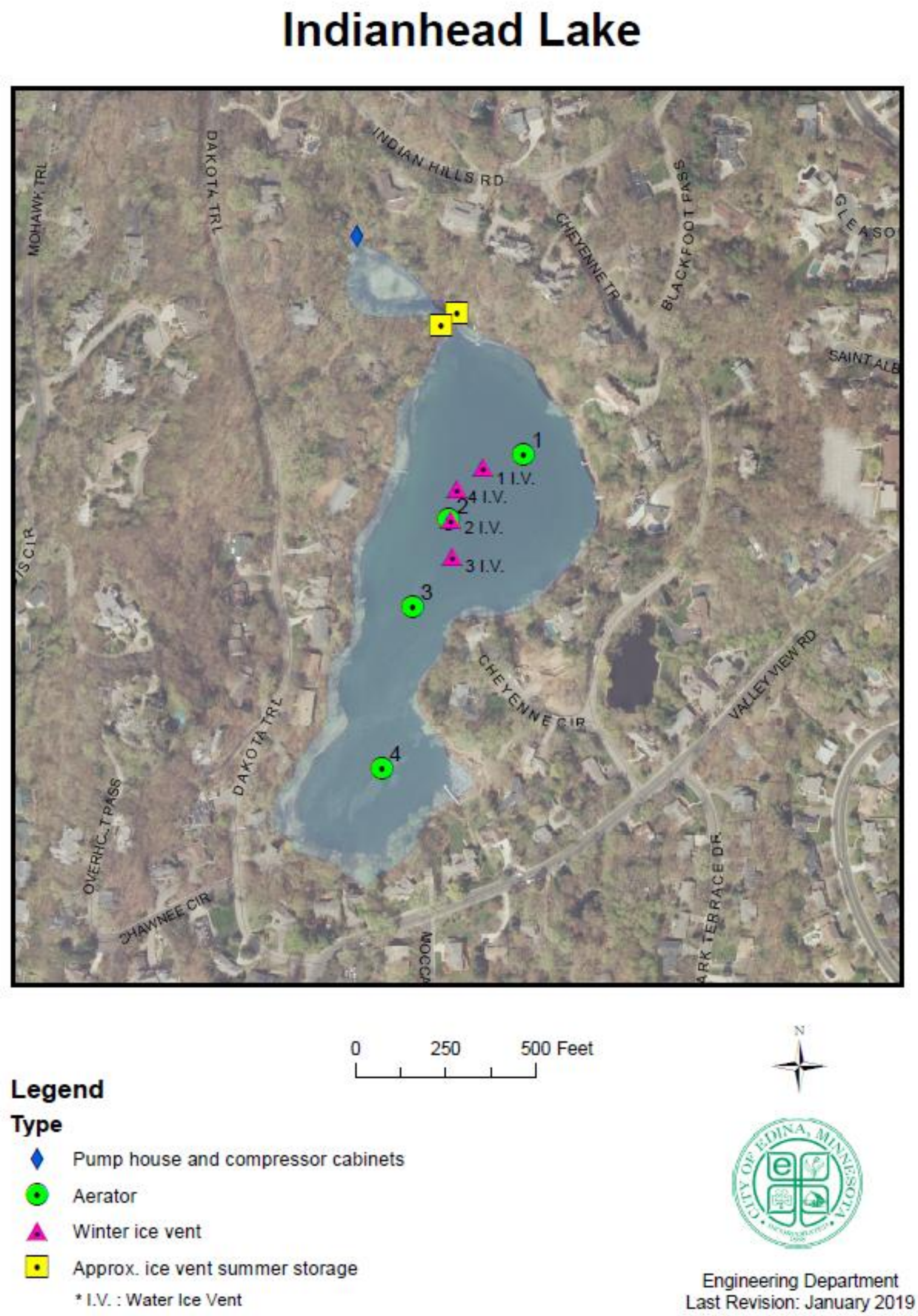

Figure 7: Map of aerator diffusers in Indianhead Lake