LAKE COUNTY, IL

2019 ROUND LAKE SUMMARY REPORT

LAKE COUNTY HEALTH DEPARTMENT

ECOLOGICAL SERVICES

Round Lake, 2019

Round Lake is a 230-acre glacial lake in west central Lake County. Round Lake receives water from Hook and Highland Lake and eventually empties into Long Lake and then the Fox River. The Round Lake Management Commission (RLMC) manages the lake and holds monthly meetings, lake clean-ups, fishing derbies, and education efforts. The lake is used for swimming (four licensed swimming beaches), fishing and boating. Round Lake is also listed as an ADID (advanced identification) wetland by the U.S. EPA and the Illinois Natural Areas Inventory (INAI) by the state of Illinois. This indicates that the lake and surrounding natural environments have potential to have high quality aquatic resources based on water quality and hydrology values.

In 2019, the Lake County Health Department - Ecological Services (LCHD-ES) monitored Round Lake as part of routine water quality sampling. Two water samples were collected once a month from May through September. Water chemistry can be significantly different between the epilimnion (warm upper layer) and hypolimnion (cool bottom layer) within the lake. Therefore, two water samples were collected at the deepest point in the lake; three feet below the surface and 3 feet above the bottom (Appendix A). Samples were analyzed for nutrients, solid concentrations and other chemical parameters. Additionally, LCHD-ES conducted an aquatic plant survey in August 2019 and a shoreline assessment in October 2019. A lake level gauge was also installed on Round Lake in 2019 as part of a larger NASA-funded project in collaboration with the Department of Geological Sciences at UNC-Chapel Hill titled "Lake Observations by Citizen Scientists and Satellites" .

ECOLOGICAL SERVICES WATER QUALITY SPECIALISTS

Alana Bartolai
abartolai2@lakecountyil.gov

Ecological Services
847-377-8020

Gerard Urbanozo
gurbanozo@lakecountyil.gov

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LAKE FACTS

MAJOR WATERSHED:
Fox River

SUB-WATERSHED:
Squaw Creek

SURFACE AREA:
230.0 Acres

SHORELINE LENGTH:
4.5 Miles

MAXIMUM DEPTH:
30.4 Feet

AVERAGE DEPTH:
8.6 Feet

LAKE VOLUME:
1986.6 Acre-Feet

WATERSHED AREA:
2427.6 Acres

LAKE TYPE:
Glacial

CURRENT USES:
Swimming, Fishing, and boating.

ACCESS:
Public Launch

ROUND LAKE SUMMARY

Following is a summary of the water quality sampling, shoreline survey and aquatic macrophyte survey from the 2019 monitoring season on Round Lake. Overall water quality is good for Round Lake and have improved slightly since previous years monitoring. Round Lake water quality is above average compared to other lakes in Lake County. The complete data sets can be found in Appendix A & B of this report, and discussed in further detail in the following sections. Included in the Appendix is an "Understanding Your Lake Data" guide that will help with additional questions about water chemistry results.

- Average water clarity as measured by Secchi depth in 2019 was 12.97 feet. This is an 85% increase since 2009 when the secchi was 7.01 ft. The 2019 Secchi is also well above the average Lake County median Secchi depth of 3.02 ft.
- Water clarity is influenced by the amount of particles in the water column; this is measured by total suspended solids (TSS) concentration. The average epilimnion TSS concentrations on Round Lake was 4.3 mg/L in 2019, which is below the Lake County median of 7.6 mg/L. TSS have increased by 43 % from 3.0 mg/L (2009) to 4.3 mg/L (2019).
- Nutrient availability indicated that Round Lake was phosphorus limited with an average TN:TP ratio of 38:1.
- In 2019, the average total epilimnion phosphorus concentration was 0.019 mg/L. This is below the Illinois Environmental Protection Agency (IEPA) water quality standard of 0.050 mg/L. TP concentrations have also decreased by 26% since the 2009 sampling from 0.023 mg/L to 0.019 mg/L.
- Trophic State Index based on 2019 total phosphorus concentrations (TSIp) for Round Lake is 46.6 meaning Round Lake is considered mesotrophic.
- The aquatic macrophyte survey showed that 69.4% of all sampling sites had plant coverage on Round Lake. IDNR recommends 20-40% aquatic plant coverage for a healthy fish habitat.
- In 2019, a total of 21 plant species and 1 macro-algae (Chara) were present in Round Lake. This is an increase in aquatic plant diversity since the 2009 sampling. The Floristic Quality Index (FQI) of Round Lake is 24.9 ranking it 10/173 lakes in the county for aquatic plant diversity.
- The most dominant aquatic plants on Round Lake was Eurasian Watermilfoil at 63% of the sampling sites followed by Coontail at 42% of the sampling sites.
- Curlyleaf Pondweed, Eurasian Watermilfoil, and Brittle Naiad are all aquatic invasive plant species found in Round Lake during the 2019 aquatic macrophyte survey.
- Based on the shoreline assessment, 61.1% of Round Lake had some degree of erosion along the shoreline.
- Based on the shoreline assessment, 88% of Round Lake shoreline had poor buffer. Round Lake could benefit from shoreline native plantings.
- In 2019, a lake gauge was installed on Round Lake as part of the Lake Observations by Citizen Scientists & Satellites Project (LOCSS).
- Round Lake has 4 licensed swimming beaches that are monitored every two weeks from Memorial Day to Labor Day for E.coli bacteria.

WATERSHED & LANDUSE

Round Lake is in the Fox River Watershed and the Squaw Creek subwatershed. It's watershed is 2428 acres. Round Lake receives water from Hook and Highland Lake and eventually empties into Long Lake and then into the Fox River. Watershed landuse is mainly residential.

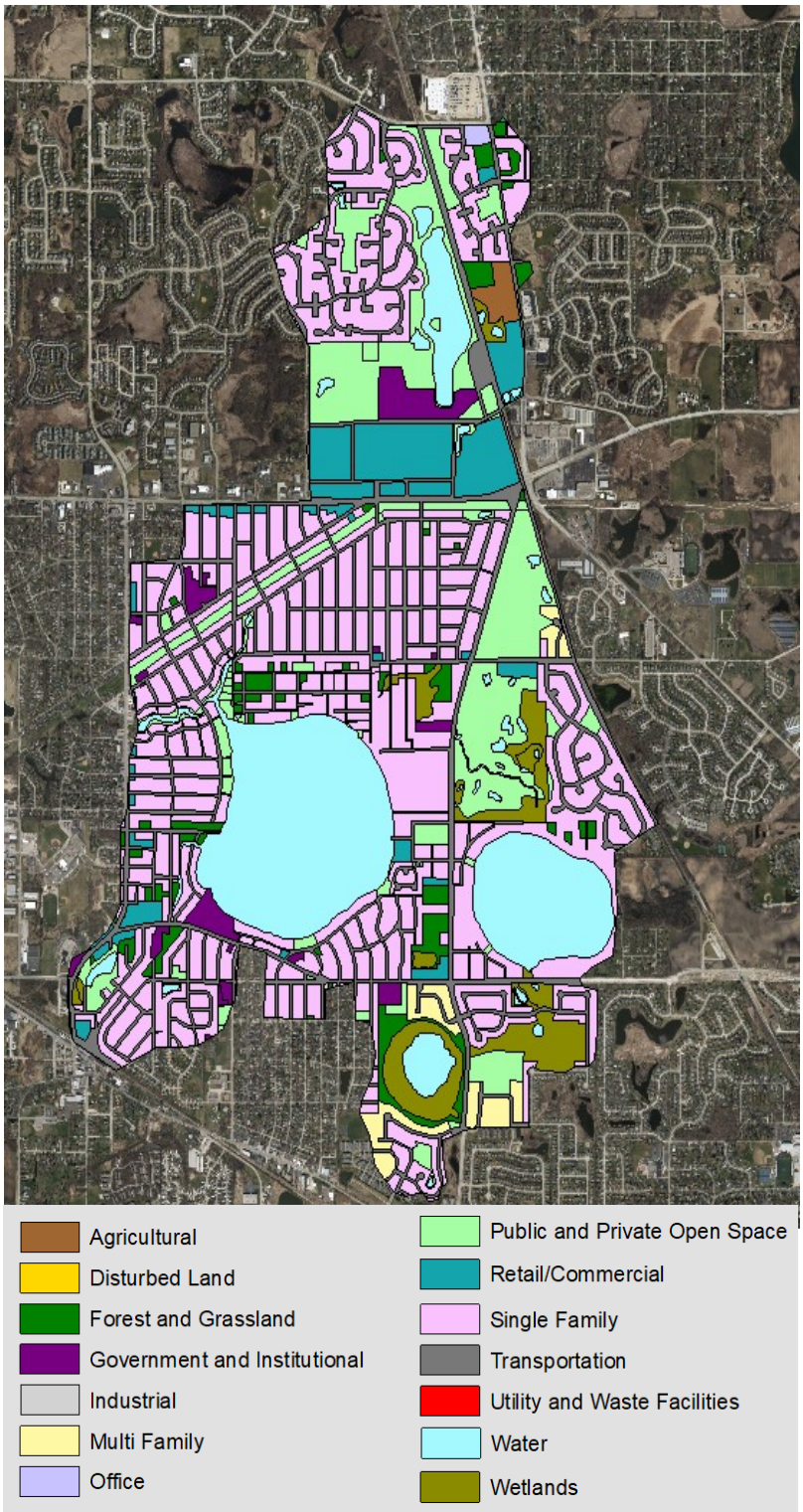
The primary land use within the watershed is single family (36.8%) followed by water (17.0%) and transportation (15.9%) (Figure 1). Based on the amount of impervious surfaces each land use contributes varied amounts of runoff. Because impervious surfaces (parking lots, roads, buildings, compacted soil) do not allow rain to infiltrate into the ground, more runoff is generated than in the undeveloped condition. The major sources of runoff for Round Lake are water (33.4%),transportation (26.6%) and single family (21.7%) landuses. For a full breakdown of landuse, see the landuse table in Appendix B.

Runoff is referring to the amount of water making its way to the lake, however, each land use contributes different amount of pollutant loads associated with it's runoff. For example, the land use "water" does not have high pollutants associated with it since it refers to the rainfall falling directly on the lake. Pollutants in rainfall are mostly related to atmospheric deposition and contribute pollutants at a lower quantity than other land uses in urbanized areas. The transportation land use, and other impervious surfaces, contain higher pollutants that are carried to the lake by runoff. In Round Lake, most pollutants are likely a result of the single family home and transportation land uses.

The size of the watershed feeding the lake relative to the lake size is also important factor in determining the amount of pollutants in a lake. The watershed to lake ratio is, 11:1. Watershed best management practices will have impacts on Round Lake .The retention time, the amount of time it takes for water entering a lake to flow out of it again, was calculated to be approximately 0.58 years.

Round Lake is in the Squaw Creek sub-watershed of the Fox River Watershed

Figure 1: *Round Lake 2019 Land Use and Watershed Boundary*



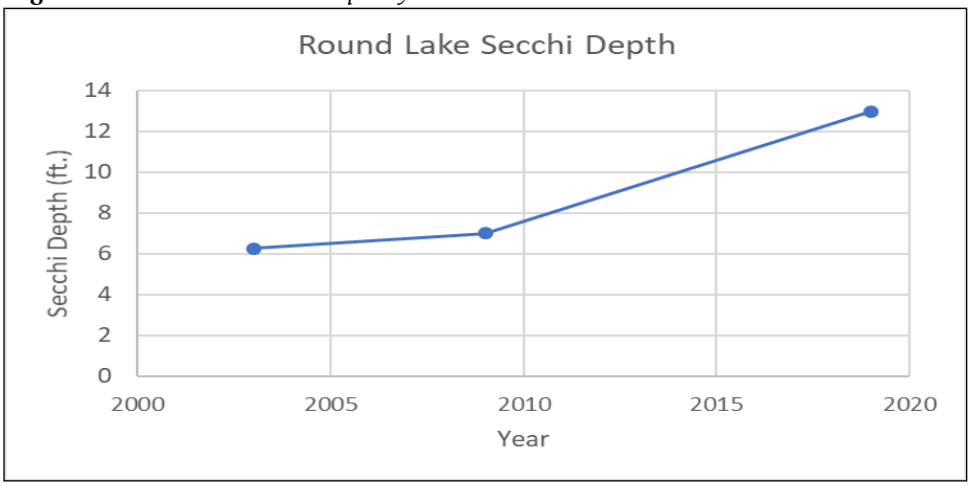
WATER CLARITY & VOLUNTEER LAKE MONITORING PROGRAM

Water Clarity is typically measured with a Secchi disk and is primarily used as an indicator of algal abundance and general lake productivity. Although it is only indicator, Secchi disk depth is the simplest and one of the most effective tools for estimating a lakes' productivity. It can also provide an indirect measurement of the amount of suspended materials in the water. A number of factors can interfere with light penetration and reduce water clarity. This includes: algae, water color, re-suspended bottom sediments, eroded soil, and invasive species.

The 2019 average water clarity for Round Lake based on Secchi depth was 12.97 feet. This is an 85% increase since the 2009 water quality sampling, which had a Secchi depth of 7.01 feet (Figure 2). Water clarity has continued to be above the Lake County average (3.02 ft). Zebra mussels were discovered in the lake in 2012 and have impacted water clarity as zebra mussels are filter feeders. In addition, the high aquatic plant density in Round Lake in 2019 contributed to increased secchi depth readings and overall water clarity.

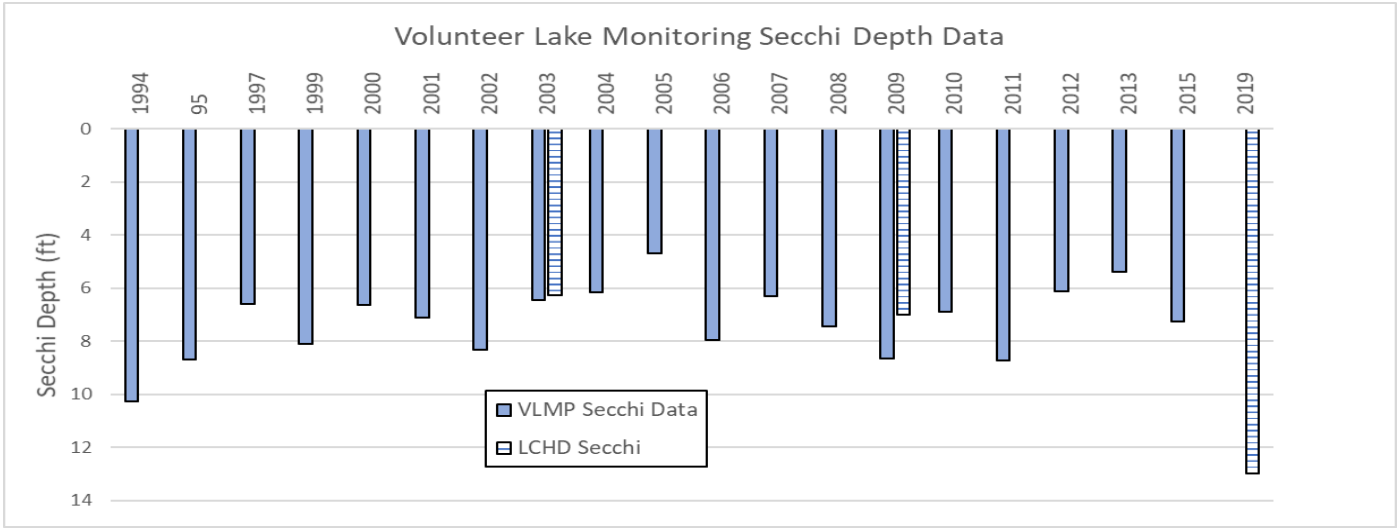
Round Lake has participated on and off in the Volunteer Lake Management Program (VLMP) (Fig 3). The VLMP was established in 1981 by the Illinois Environmental Protection Agency (IEPA) to be able to collect information on Illinois inland lakes, and to provide an educational program for citizens. The primary measurement by volunteers is Secchi depth (water clarity). This provides data to look at long-term trends on the lake. It is recommended that Round Lake continues to monitor secchi depth for overall water quality data, especially with the documentation of zebra mussels. Volunteers can still monitor even though the official program is currently suspended in 2019. For more information contact LCHD at 847-377-8009.

Figure 2: *Round Lake Secchi depth by Year*



Round Lake average Secchi depth was 12.97 ft., which is above the Lake County median Secchi depth of 3.02 ft.

Figure 3: *Secchi Depth collected by lake volunteers through VLMP Program.*



TOTAL SUSPENDED SOLIDS

The Total Suspended Solids (TSS) parameter represents the concentration of all organic and inorganic materials suspended in the lakes water column, which includes both sediment and algal cells. Typical inorganic components of TSS are referred to as non-volatile suspended solids (NVSS) and originate from weathering and erosion of rocks and solids in the lakes watershed. The organic portion of TS are referred to as volatile suspended solids (TVS) and are mostly composed of algae and other organic matter such as decaying plants.

In 2019 TSS concentrations in the epilimnion of Round Lake averaged 4.3 mg/L, which is below the Lake County median of 7.6 mg/L. It is a 43% increase since the 2009 sampling (3.0 mg/L), see Figure 3. Secchi depth and TSS are inversely related. A lake can have a TSS impairment which is based on if the median surface NVSS is greater or equal to 12 mg/L for the monitoring season. In 2019, the median surface NVSS was less than 1 mg/L, therefore there is no TSS impairment on Round Lake.

The percentage of TSS that are NVSS gives insight into the source of the suspended solids. Lakes that have a higher percentage of NVSS to TSS represent more allochthonous (originating outside of the lake) input, or resuspended sediment indicative of more inorganic material. Lakes with lower percentage of NVSS to TSS may have more algae and organic material. The highest percentage of NVSS:TSS occurred in June (60%). For a list of TSS, TS, and TVS for the epilimnion and hypolimnion of Highland Lake, refer to Table 1.

TSS

Total Suspended Solids

TSS are particles of algae or sediment suspended in the water column.

TVS

Total Volatile Solids

TVS represents the fraction of total solids that are organic in nature, such as algae cells.

NVSS

Non-Volatile Suspended Solids

NVSS represents the non-organic clay and sediments that are suspended in the water column.

Figure 3: *Total Suspended Solid Concentrations by Year, Round Lake*

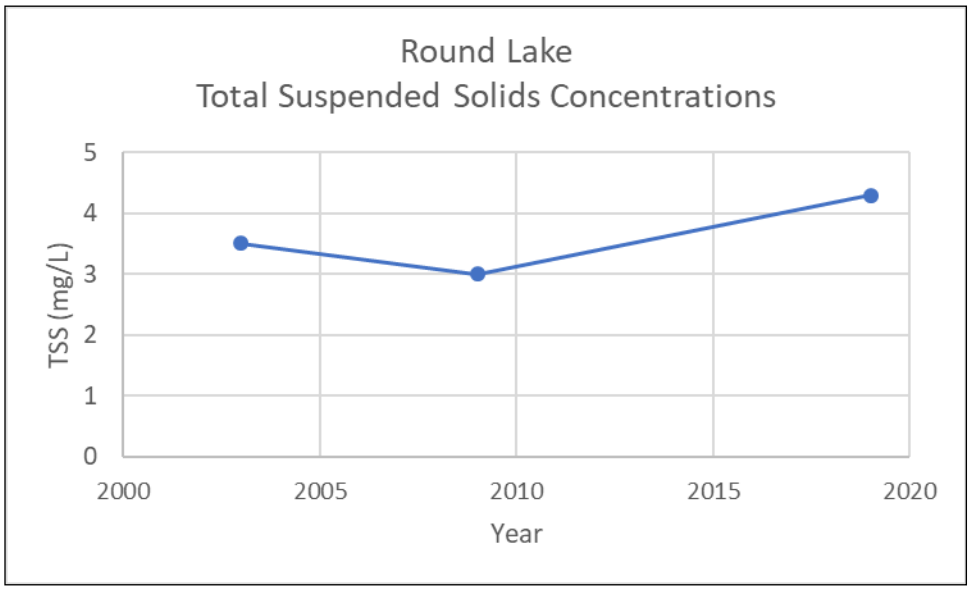


Table 1: *Solid concentrations on Round Lake, 2019*

2019 Epilimnion solid concentrations in mg/L on Round Lake

DATE	TSS	TS	TVS
15-May	10	588	94
12-Jun	1.6	568	92
17-Jul	<1.0	515	63
14-Aug	3.3	531	89
18-Sep	5.5	470	86
Average	4.3	534	85

2019 Hypolimnion solid concentrations in mg/L on Round Lake

DATE	TSS	TS	TVS
15-May	3.1	599	94
12-Jun	4	593	79
17-Jul	8	533	71
14-Aug	9.7	617	116
18-Sep	6.6	564	85
Average	5.4	581	89

NUTRIENTS: PHOSPHORUS

In a lake, the primary nutrients needed for aquatic plant growth are phosphorus (P) and nitrogen (N). Sources of phosphorus can be external, internal, or both. External sources include: human and animal waste, soil erosion, detergents, sewage treatment plants, septic systems, and runoff from lawns. Internal sources of phosphorus originate with the lake and are typically linked to the lake sediment. When phosphorus is bound to sediments it is generally not available for use by algae, however, various chemical and biological processes can allow phosphorus to be released from the sediment, making it available in the water column.

The average total phosphorus concentrations in the epilimnion of Round Lake was 0.019mg/L for 2019 which is a 17 % decrease since the 2009 sampling (0.023 mg/L). Total phosphorus concentrations have been on a decreasing trend in Round Lake which may be attributed to increased plant density, zebra mussels, and BMP practices around the lake (Figure 4).

WHAT HAS BEEN DONE TO REDUCE PHOSPHORUS LEVELS IN ILLINOIS?

July 2010—*The state of Illinois passed a law to reduce the amount of phosphorus content in dishwashing and laundry detergent*

July 2010: *The state of Illinois passed another law restricting the use of lawn fertilizers containing phosphorus by commercial applicators.*

Figure 4: *Phosphorus Concentrations in Round Lake monitored by LCHD*

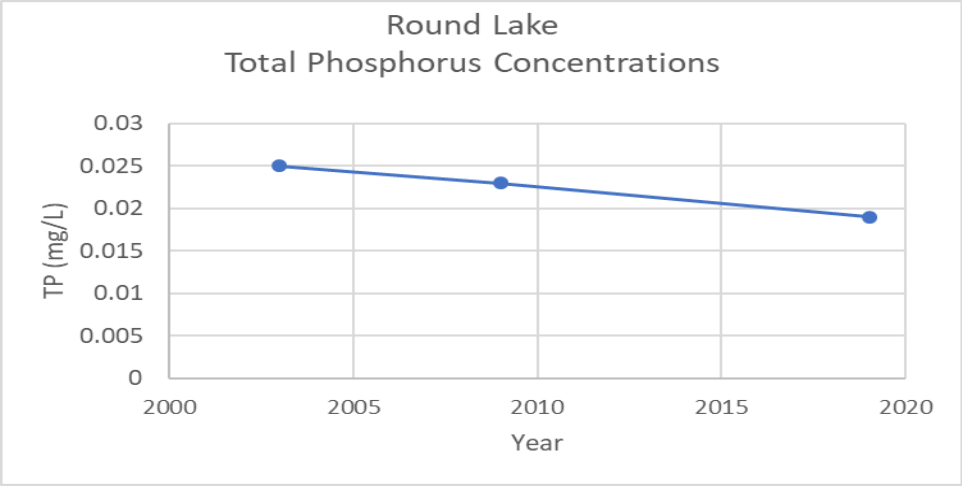


Table 2: *Total Phosphorus Concentrations on Round Lake, 2019*

2019 Epilimnion

DATE	TP	SRP
15-May	0.018	<0.005
12-Jun	0.012	<0.005
17-Jul	0.019	<0.005
14-Aug	0.017	<0.005
18-Sep	0.029	<0.005

2019 Hypolimnion

DATE	TP	SRP
12-May	0.033	<0.005
9-Jun	0.026	<0.005
14-Jul	0.018	<0.005
11-Aug	0.026	<0.005
15-Sep	0.014	<0.005

TROPHIC STATE INDEX

Total phosphorus is also used to calculate the Trophic State Index (TSI) value. Trophic states describe the overall productivity of a lake and refers to the amount of nutrient enrichment. This has implications for the biological, chemical and physical conditions of the lake. Lakes are classified into four main categories: oligotrophic, mesotrophic, eutrophic, and hyper-eutrophic. These range from nutrient poor and least productive (oligotrophic) to most nutrient rich and most productive (eutrophic).

In 2019, Round Lake had a TSIp value of 46.6 which categorizes it as mesotrophic. Based on the TSIp, Round Lake is ranked 13 out of 177 lakes studied by the LCHD-ES from 2000 – 2019 (Appendix B).

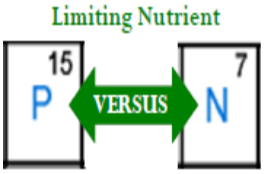
LAKE COUNTY AVERAGE TSIP = 65.1

ROUND LAKE TSIP = 46.6

TROPHIC STATE: MESOTROPHIC

RANK= 13/177

NUTRIENTS: NITROGEN



Nitrogen, in the forms of nitrate (NO_3^-), nitrite (NO_2^-), or ammonium (NH_4^+) is a nutrient needed for plant and algal growth. Nitrogen enters the ecosystem in a several chemical forms and a lake's nitrogen source can vary widely. Sources of nitrogen include septic systems, animal feed lots, agricultural fertilizers, manure, industrial waste waters, and sanitary landfills, and atmospheric deposition. All inorganic forms of nitrogen (NO3-, NO2-, and NH4+) can be used by aquatic plants and algae. If these inorganic forms exceed 0.3 mg/L, there is sufficient nitrogen to support summer algae blooms. If the surface median total nitrogen as N (TKN + NO2/NO3-N) exceeds 3.6 mg/L for the monitoring season, there is a nitrogen impairment for the water body.

Nitrogen concentrations (NO3-N and NH3-N) in the epilimnion of Round Lake were below detectable concentrations for the entire monitoring season. There are no nitrogen impairments for Round Lake. Total Kjeldahl nitrogen (TKN), an organically (algae) associated form of nitrogen, in Round Lake averaged 0.63 mg/L, which is lower than the Lake County median of 1.170 mg/L. Total Kjeldahl nitrogen is a measure of organic nitrogen, and is typically bound up in algal and plant cells.

Typically lakes are either phosphorus or nitrogen limited. This means that one of the nutrients is in short supply and any addition of that nutrient to the lake will result in an increase of plant and/or algal growth. Most lakes in Lake County are phosphorus limited. To compare the availability of nitrogen and phosphorus, a ratio of total nitrogen to total phosphorus (TN:TP) is used. Ratios less than 10:1 suggest the lake is limited by nitrogen, while ratios greater than 20:1 are limited by phosphorus. Round Lake has a TN:TP ratio of 38:1, meaning the lake is phosphorus limited and additions of phosphorus into the lake system can contribute to algae issues. In 2009, the TN:TP ratio was 31:1.

TN:TP Ratio

<10:1 = nitrogen limited

>20:1= phosphorus limited

TN:TP Ratio on Round Lake: 38:1

Round Lake is Phosphorus Limited

WAYS TO REDUCE NUTRIENTS IN YOUR LAKE

Waterfowl management (ducks and geese)

- Do not feed or encourage others to feed waterfowl
- Use good landscaping practices to discourage waterfowl. Landscapes with taller plants and shrubbery can discourage geese.

Fertilizer use:

- If you apply fertilizers to lawns and gardens, have your soil tested to determine how much fertilizer to apply.
- Check the weather before applying fertilizer—avoid applying before heavy rainfalls.
- Sweep up any fertilizer which is spilled on impervious surfaces such as walks and driveways.
- Do not spread fertilizer within 75 feet of surface waters or wetlands

Pet Waste Disposal

- Regularly scoop up and dispose of pest waste.

Landscaping Practices

- Consider native vegetation as a quality alternative to lawns. Native vegetation provides a more diverse plant community, and can filter out nutrients and also provides habitat for important pollinators.
- Plant a buffer strip of native plants (at least 20 feet) between the lake's edge and your property.

Keep fall leaves out of the storm drains

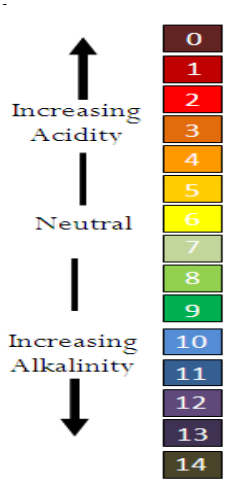
- Never rake leaves into or near storm drains, ditches, creeks, or on lakeshore.

ALKALINITY AND PH

Alkalinity is the buffering capacity of a water body. It measures the ability of water bodies to neutralize acids and bases to maintain a stable pH. In a lake, alkalinity acts to buffer lakes from the effects of acid rain. Alkalinity comes from rocks, soils, salts, and certain plant activities. If a lakes watershed contains large quantities of calcium carbonate (CaCO3, limestone), the surface waters tend to be more alkaline; while granite bedrock does not have high amounts of CaCO3 and therefore lacks alkaline materials to buffer acidic inputs. In 2019, the average alkalinity (CaCO3) concentration in Round Lake was 122 mg/L which is below the Lake County median alkalinity concentration of 163 mg/L. The USEPA considers lakes with CaCO3 concentrations greater than 20 mg/L to not be sensitive to acidification.

pH is a measure of the hydrogen ion concentration of water. As the hydrogen ions are removed, pH increases. A well buffered lake also means that daily fluctuations of CO2 concentrations result in only minor changes in pH throughout the day. Aquatic organisms benefit from stable pH. Each organism has an ideal pH threshold, but most aquatic organisms prefer pH of 6.5—8.0. pH values <6.5 or >9.0 cause a water quality impairment.

Round Lake average pH in 2019 was 8.61. There were no pH impairments for Round Lake for the 2019 season.



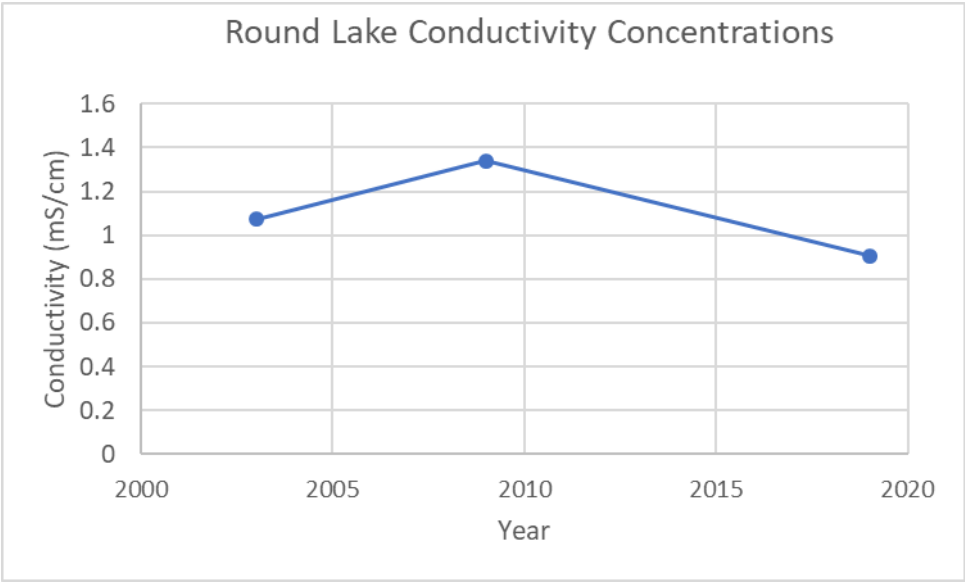
The pH scale ranges from 0 to 14. A pH of 7 is considered neutral. Substances with a pH of less than 7 are acidic, and greater than 7 are basic.

CONDUCTIVITY

Conductivity is the measure of different chemical ions in solution. As the concentration of these ions increases, conductivity increases. The conductivity of a lake is dependent on the lake and watershed geology, size of the watershed flowing into the lake, land use, evaporation, and bacterial activity. Conductivity in urban areas has been shown to be highly correlated with chloride ions found in road salt mixes.

In 2019, Round Lake average conductivity was 0.9059 mS/cm. This is above the Lake County median conductivity of 0.7773 mS/cm and a 26.3% decrease since the 2009 monitoring (Figure 5).

Figure 5: *Conductivity Concentrations in Round Lake*

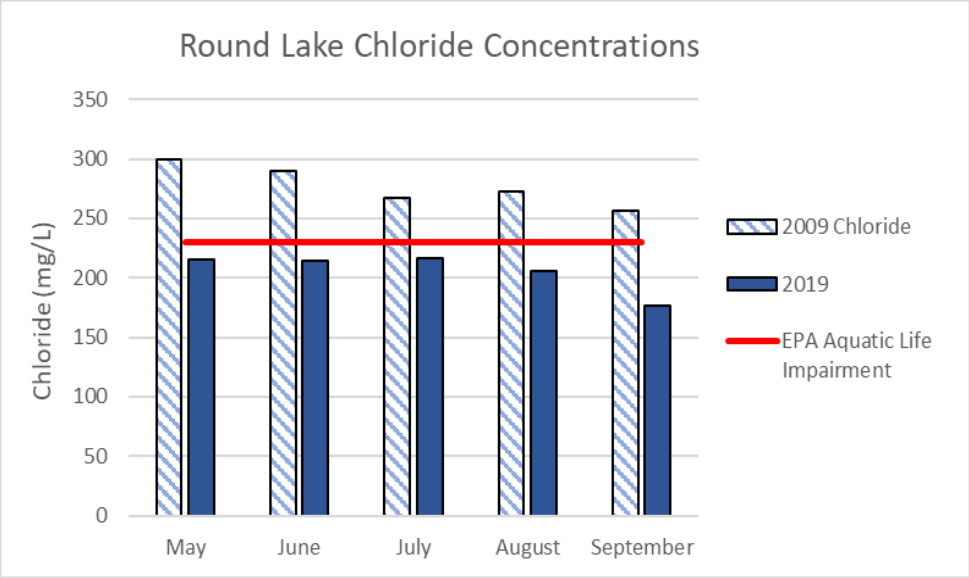


CHLORIDES

One of the most common dissolved solids is road salt used in winter road deicing. Most road salt is sodium chloride, calcium chloride, potassium chloride, magnesium chloride or ferrocyanide salts. Round Lake chloride concentration averaged 206 mg/L which is above the Lake County median of 170 mg/L (Figure 6). The United States Environmental Protection agency has determined that chloride concentrations higher than 230 mg/L can disrupt aquatic systems. While Round Lake chloride concentration is below the aquatic life criteria, recent research has indicated organisms can get stressed at values much lower than 230 mg/L. Chloride ions do not break down and accumulate within a watershed. High chloride concentrations may make it difficult for many of our native plant species to survive while many of our invasive species such as Eurasian Watermilfoil, Cattail, and Common Reed are tolerant to high chloride levels. Chloride concentrations decreased since 2009, likely a result of larger flooding events that can move chlorides downstream.

The LCHD-ES and Lake County Stormwater Management Commission (LCSMC) have been holding annual trainings targeting deicing maintenance personnel for both public and private entities to hopefully reduce the amount of chloride being introduced into our environment while maintaining safe passageways. Almost all deicing products contain chloride so it is important to read an follow product labels for proper application. For instance, at 10°F Fahrenheit, rock salt is not at all effective in melting ice and will blow away before it melts anything. Additionally calling your local township office to ask them if they are taking actions to minimize deicers on their properties or supporting changes in their deicing policy to minimize salt usage is encouraged. Since a majority of pollutant-carrying runoff in Round Lake watershed is single family homes and transportation, efforts should be made in the watershed for efficient de-icing practices, both for homeowners and streets.

Figure 6: *Round Lake Chloride Concentrations*



THE CRITICAL VALUE FOR CHLORIDES IN AQUATIC SYSTEMS IS 230 MG/L.

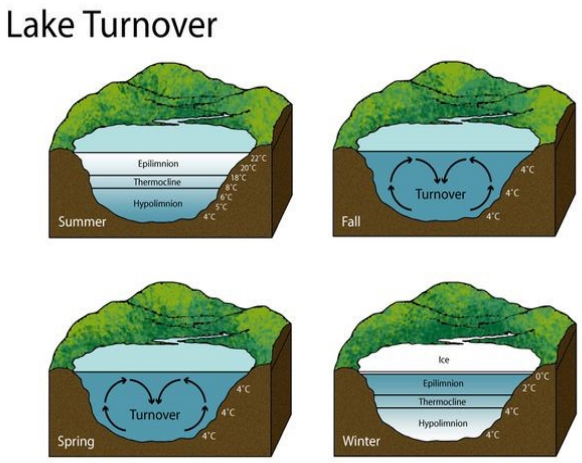
230 mg/L = 1 teaspoon of salt added to 5 gallons of water.

ICE FACTS

- Deicers melt snow and ice. They provide no traction on top of snow and ice.
- Anti-icing prevents the bond from forming between pavement and ice.
- De-icing works best if you plow/shovel before applying material.
- Pick the right material for the pavement temperatures.
- Sand only works on top of snow as traction. It provides no melting.
- Anti-icing chemicals must be applied prior to snow fall.
- NaCl (Road Salt) does not work on cold days, less than 15° F.
- NaCl is more effective at warmer temperatures—when it is warmer out, you do not need to put as much road salt down to melt ice efficiently.

STRATIFICATION

Figure 7: Lake Turnover/Stratification diagram

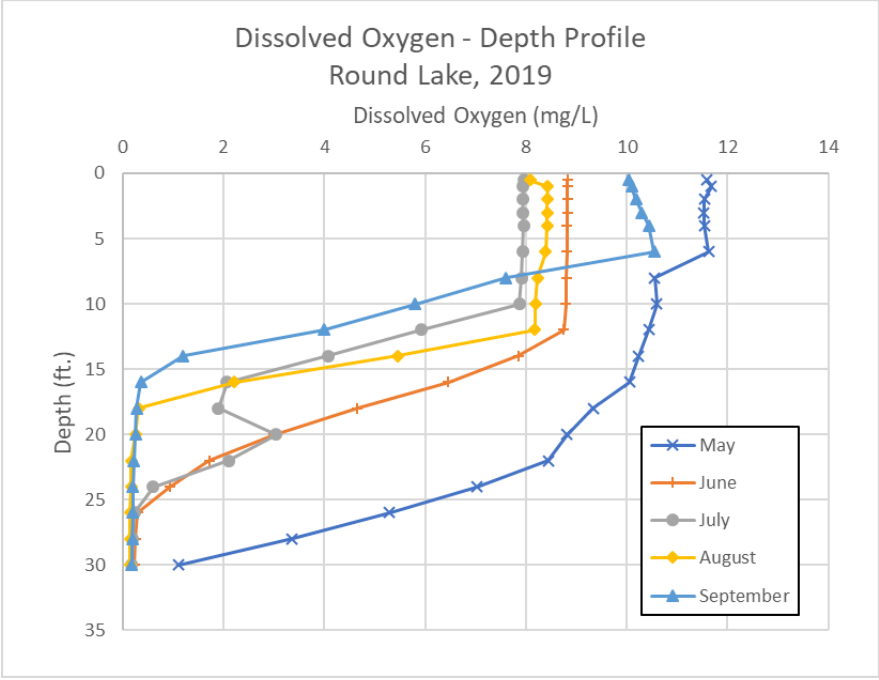


Lake stratification is a result of variations in density caused by temperature (or salinity) and can prevent warm and cold water from mixing. A lake's water quality and ability to support fish are affected by the extent to which the water mixes. Lakes that experience stratification have the water column divided in three zones: epilimnion (warm surface layer), thermocline (transition zone between warm and cold water) and hypolimnion (cold bottom water) (Figure 7). Stratification traps nutrients released from bottom sediments in the hypolimnion and prevents mixing. Lakes in Lake County are either dimictic or polymictic. Dimictic means there are only two lake turnovers (spring and fall), whereas polymictic means that the thermocline is never that strong so the lake can go mix multiple times throughout the season.

Monthly depth profiles of water temperature, dissolved oxygen, conductivity, and pH were taken every two feet from the lake surface to the lake bottom on Round Lake. The relative thermal resistance to mixing (RTRM) value can be calculated from this data and indicates if a lake stratifies, how strong the stratification is, and at what depth the thermocline occurs. Round Lake remained stratified throughout the monitoring season (May –September) with the thermocline occurring between 14-18 ft.

DISSOLVED OXYGEN

Figure 8: Round Lake 2019 DO Profile



A dissolved oxygen (DO) concentration of 5.0 mg/L is considered adequate to support a fishery as fish can suffer oxygen stress below 5 mg/L. DO concentrations dropped below 5 mg/L towards the bottom the lake, which is common for deep stratified lakes like Round. September had the month where DO dropped below 5 mg/L at it's shallowest depth. , DO drops below 5 mg/L at depths greater than 10 ft. This amounts to 28.5% of the lake volume below 5 mg/L in September. Figure 8 shows the DO depth profiles.

Anoxic conditions, where DO concentrations are <1 mg/L, occurred June - September. Typically, oxygen production is greatest in the epilimnion, where sunlight drives photosynthesis, and oxygen consumption is greatest near the bottom of a lake, where organic matter accumulates and decomposes. The oxygen difference between the top and bottom water layers can be dramatic, with plenty of oxygen near the surface, but practically none near the bottom. This is important because the absence of oxygen (anoxia) near the lake bottom can have adverse effects in eutrophic lakes resulting in the chemical release of phosphorus from lake sediment and the production of hydrogen sulfide (rotten egg smell) and other gases in the bottom waters. Round Lake experienced it's greatest volume of anoxic conditions in September where oxygen levels dropped below 1 mg/L at depths greater than 14 ft (16.4% anoxic). September had heavy rainfalls bringing in significant organic material that use up oxygen while it decomposes.