Lake Charles

The Lake County Health Department - Ecological Services (LCHD-ES) conducts studies of multiple lakes within the County and has been a great resource for the Village of Vernon Hills. The Health Department has performed studies of Lake Charles in 2000, 2012 and again in 2019. A copy of their 2019 Lake Charles Summary Report is attached for reference.

Lake Charles parameters and ownership

Lake Charles is in the Des Plaines River Watershed and the Indian Creek Sub-Watershed. It has a surface area of 39.41 acres with a 1.03 mile shoreline length. The lake has a large upstream watershed with its headwaters starting by the Mundelein Crossing Shopping Center. The watershed area is highly urbanized with many erosive streambanks encompassing a total of 3529.87 Acres. The lake has a volume of 144.33 acre-feet and is very shallow having a maximum depth of 7.50 feet and an average depth of 3.84 feet.

Lake Charles is a man-made lake that was created by adding sheet-piling to the southern end and re-routing the Seavey Ditch into an area that was excavated for sand and gravel. It was acquired by the Village as part of the development of the Gregg's Landing subdivision approvals. The original impoundment dam was replaced by the Zale Companies as part of the development agreement and brought to current standards. The leased White Deer Run golf course was developed along the western and southern edge of the lake and Lake Charles Park was deeded to the Vernon Hills Park District who made improvements to their land on the western side of the lake.

Lake Charles 2019 Summary Report by the Lake County Health Department

In 2019, the LCHD-ES monitored Lake Charles as part of routine water quality sampling. Water samples were collected once a month from May through September and these 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. The Village is a member of the Des Plaines River Watershed Workgroup and inlets were also monitored on Lake Charles.

A summary of the water quality sampling, shoreline survey and aquatic macrophyte survey from the 2019 monitoring season on Lake Charles is as follows:

 Overall water quality is good for Lake Charles and have improved slightly since previous years monitoring. Lake Charles water quality is above average compared to other lakes in Lake County based on water quality parameters.

 Average water clarity as measured by Secchi depth in 2019 was 2.95 feet. This is a 34% increase since 2012. The 2019 Secchi is below 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 Lake

Charles was 6.9 mg/L in 2019, which is below the Lake County median of 7.6 mg/L. TSS have decreased by 54.8% since 2012 from 15.1 mg/L to 6.9 mg/L.

 Nutrient availability indicated that Lake Charles is both nitrogen and phosphorus limited with an average TN:TP ratio of 14:1.

 In 2019, the average total epilimnion phosphorus concentration was 0.069 mg/L. This is above the Illinois Environmental Protection Agency (IEPA) water quality standard of 0.050 mg/L. While above the IEPA standard, TP concentrations have decreased by 25.8% since the 2012 sampling from 0.093 mg/L to 0.069 mg/L.

 Trophic State Index based on 2019 total phosphorus concentrations (TSIp) for Lake Charles is 65.2 meaning Lake Charles is considered eutrophic and nutrient enriched.

 The aquatic macrophyte survey showed that 97.9% of all sampling sites had plant coverage on Lake Charles. IDNR recommends 20-40% aquatic plant coverage for a healthy fish habitat.

 In 2019, a total of 16 plant species and 1 macro-algae (Chara) were present in Lake Charles. This is an increase in aquatic plant diversity since the 2012 sampling. The Floristic Quality Index (FQI) of Lake Charles went from 9.0 to 21.2

 The most dominant aquatic plants in Lake Charles was Coontail found at 85.1% of all sampling sites.

 Curlyleaf Pondweed, Eurasian Watermilfoil, and Brittle Naiad are all aquatic invasive plant species found in Lake Charles during the 2019 aquatic macrophyte survey.

 Based on the shoreline assessment, 34.2% of Lake Charles had some degree of erosion along the shoreline.

 Based on the shoreline assessment, 27.4% of Lake Charles shoreline had poor buffer.

Lake Recommendations from the 2019 Lake Charles Summary Report by LCHD-ES

Lake Charles water quality is good and a combination of managing aquatic plant diversity and watershed improvements can help improve and maintain its water quality. To improve overall quality of Lake Charles, the LCHD-ES has the following recommendations:

 Develop a Lake Management Plan for Lake Charles. A key component to this plan should focus on maintaining aquatic plant diversity while reducing aquatic invasive species. (Note: Lake Management Plan is being developed)

 It is recommended to not treat native plants. If native pondweeds become significant a pathway can be
created for recreational access.

 Reinstall lake gauge near dam. (Note: Gauge has been reinstalled as of September 2020)

 Keep accurate records of management activities and lake observations.

 Update fisheries survey and fish stocking recommendations. (Note: Outreach to DNR made)

CBBEL Report January 30, 2019

The Village hired Christopher B. Burke Engineering, Ltd. to assist in studying potential measures that could be implemented to improve the water quality of Lake Charles including sedimentation concerns. They performed their evaluation at the site on December 18, 2018 and shared their findings on January 30, 2019.

CBBEL Report Summary of Issues

 Lake Charles is located in a well-developed suburban landscape. Suburban contaminants are draining to the lake including deicing salts, oils, asphalt sealants (heavy metals), leaf litter, pavement grit, and lawn fertilizer and pesticides.

 There is a large resident goose population contributing nutrients and organic matter to the lake.

 The Lake has a +/-3,600 acre tributary area which drains into the lake through Seavey Ditch, which is a deeply incised and highly eroded channel.

- The lake functions as a settling basin for all of Seavey Ditch upstream of the lake.

- Significant sediment loading of the lake is occurring due to the excessive erosion of the Seavey Ditch streambanks.

- Significant loading of organic sediments due to contribution from the buckthorn thickets.

 Residents are concerned about the extensive wetland and aquatic vegetation within the lake.

 The lake is becoming shallower due to the continual accumulation of sediments. This negatively impacts the lakes ability to assimilate the organic matter and nutrients draining into the lake.

Seavey Ditch BMP Alternatives

1. Work with all up-stream landowners and stakeholders (i.e. Mundelein, Lake County) to complete a comprehensive Seavey Ditch streambank stabilization program. Attack areas with most severe erosion first. This includes areas vegetated with dense woody vegetation (especially with buckthorn) which have the worst erosion.
    a. Initial project should be completed between Gregg's Parkway and Hazeltime Drive.

i. Clear all non-native brush and trees (preferably at least 50 feet wide to either side of the channel) to increase sunlight to ground surface to increase the herbaceous layer – seed with natives
ii. Repair streambank

b. Repair scour hole on the east side of the Butterfield Road Bridge
c. West of Butterfield Road Open Space streambank stabilization
    i. Clear all non-native brush and trees (preferably at least 50 feet wide to either side of the channel) to increase sunlight to ground surface to increase the herbaceous layer – seed with natives
    ii. Repair streambank
d. Hanrahan Park streambank stabilization
    i. Clear all non-native brush and trees to increase sunlight to ground surface to increase the herbaceous layer
e. Repair streambanks

2. Construct upstream sediment basins, possibly as part of future Village of Mundelein flood control projects

3. Restore adjacent woodland areas to native dominated communities:
    a. NW of Gregg's Parkway and Huntington Drive.
    b. East of Hazeltime Drive and north of Huntington Drive
    c. East of Butterfield Road Open Space – entire channel length
    d. Hanrahan Park
    e. East of Shaddle Avenue to Hawthorne Blvd.

Lake Charles BMP Alternatives

1. Continue lake vegetation management activities
2. Execute a goose harassment program
3. Install aerators and use optional supplemental bacteria (i.e. Bio-Boost) to hasten organic sediment digestion
4. Stabilize Seavey Ditch south of Gregg's Parkway as it discharges into Lake Charles
5. Dredge sediment from portions or all of Lake Charles
6. Restore two stormwater inlet channels adjacent to Lake Charles
7. Install sediment basin/forebay at the following potential locations:
    a. Within delta at mouth of Lake
    b. To the west side of the Seavey Ditch, south of Gregg's Parkway

Lake Charles is the most upstream online lake on Seavey Ditch. The channel erosion and degradation of Seavey Ditch upstream of lake, as well as other inputs, has resulted in impairments within Lake Charles that have been noted by residents and documented by the Lake County Health Department and the IEPA.

Note: the Village of Vernon Hills coordinated with other watershed stakeholders on the Lake Charles report. The Village Engineer met with the Village of Mundelein and Libertyville on their upstream

improvements on potential impacts to flood protection and water quality in Lake Charles. Additionally, the Village Manager's Offices also met on the report findings.

Summary and Estimates of Cost of the Seavey Ditch and Lake Charles BMP Alternatives

Dredge Scenario 1: Full Dredge $11,300,000

- Establishes lake bathymetry to support full restoration
- Lake will continue to fill in with sediment until upstream watershed is stabilized
- Cost assumes onsite disposal of sediment

Dredge Scenario 2: Shoreline Dredge $6,400,000

- Dredges shoreline areas to reduce shoreline aquatic vegetation
- Lake will continue to fill in with sediment until upstream watershed is stabilized
- Cost assumes onsite disposal of sediment
- Insufficient depth will limit overall health of lake

Dredge Scenario 3: Targeted Shoreline Dredge variable cost

- Depends on Amount of Dredging
- Targets shoreline dredging to reduce shoreline aquatic vegetation at specific areas
- Lake will continue to fill in with sediment until upstream watershed is stabilized
- Cost assumes onsite disposal of sediment
- Insufficient depth will limit overall health of lake

Dredge Scenario 4: Sediment Delta Removal and Create $1,200,000

- Dredges sediment at delta where Seavey Ditch enters lake to create sediment trap
- Does not reduce sediment depth in lake
- Will require frequent maintenance of sediment basin

Aeration System $30,000

- Establishes circulation and oxygenation of lake to improve health
- Provides numerous water quality benefits to the lake
- Will require yearly O&M costs and should be continually operated
- Does not significantly reduce sediment depth in lake below organics

Bacterial Organic Sludge Digestion $26,000/year

- May increase biologic digestion of organic matter in lake
- Little case study evidence of success in Northeastern Illinois
- Can only be applied in warmer months
- Could be coordinated as a pilot project with Lake County Health Department or College of Lake County

Lake Charles Channel Inflow Restoration $330,000

- Will improve water quality entering lake from Gregg's Landing
- The amount of sediment entering the lake from these channels is very small in comparison to Seavey Ditch, so these improvements
  will not fully address the source of impairment for the lake

Seavey Ditch Sediment Basins $390,000/basin

- Trap sediment from Seavey Ditch prior to entering Lake
- The sediment basin(s) will only be marginally effective given the limited residence time and will require frequent maintenance

Stream Corridor Restoration $5,200,000

- Reduce Seavey Ditch channel erosion that is primary source of Lake Charles impairment
- Expensive due to channel length and severity of erosion
- Could be phased over the course of multiple years
- Critical component of lake restoration as channel degradation will continue to impact lake without it

Riparian Corridor Restoration $375,000

- Reduces erosion in Seavey Ditch riparian corridor
- Limited benefit without stream corridor restoration
- Could be phased with stream corridor restoration

Stream Maintenance $60,000

- Corrects spot erosion in channel
- Repair scour hole at downstream side of Butterfield Road, could be joint funded with LCDOT

Summary & Conclusions

Lake Charles has improved in many parameters, but requires additional actions. The lake has a large upstream watershed which requires a full watershed approach. It is important to continue to review opportunities and communication with our upstream neighbors. Village staff have discussed the report with them and look for opportunities to pursue grant funding opportunities. The Lake County SMC and Des Plaines River Workgroup are also knowledgeable of Lake Charles and would be great advocates for obtaining grant funds.

The larger challenges for Lake Charles is the shallow depth of this waterbody and the sediment accumulation at its inlet. Village staff has met with both Libertyville and Mundelein relative to their upstream flood control projects. Both projects have components that would benefit downstream areas including Lake Charles. The upstream riparian corridor has erosive banks with buckthorn thickets that require stabilization to reduce the sediment loading into the lake. The study includes cost estimates for dredging of all or portions of the lake, but without resolving the upstream sediment concerns it would be unwise to expend these funds.

During the 2020 construction season, the Vernon Hills Public Works staff has removed a substantial amount of buckthorn between Gregg's Parkway and the Shadow Creek subdivision. These areas were replanted with native grasses to assist in stabilizing the streambanks. Staff has also shared our findings with the adjacent property owners to the west who are also receptive to

addressing buckthorn concerns. The Vernon Hills Park District is planning on removing buckthorn and reseeding their Seavey Ditch parcel. The area between Hazeltime and Butterfield Road was re-meandered and restored a decade ago and substantially addressed the sediment loading of this stream segment.

The Village also has banned the use of phosphorus fertilizer except for new lawns which has had a positive effect on Lake Charles. Staff also reviewed options on installing an aeration system, but this was deferred until additional research was performed. Staff met with ILM who agreed to test their nanobubbler aeration system, but unfortunately the existing electrical park lighting system could not serve this system. The aeration system would have some benefits, but would only serve to slow the eutrophication of the lake.

The Village is creating a lake management plan for Lake Charles. Staff will continue to manage the lake vegetation and has been successful in increasing the native plant diversity, but needs to continue to address the invasive plants. Lake Charles is largely influenced by upstream watershed impacts and its wetland pond characteristics. Its shallow nature presents challenges and obtaining a blue, Lake Michigan appearance is not obtainable without substantial funding ($11.3 million if the spoils are placed onto the golf course property). Dredging of Lake Charles would soon thereafter be filled in should the initial steps of upstream impacts not be performed.

The property owner impacts to the lake also need to be addressed. The White Deer Run operators need to improve the current buffer to reduce geese impacts and erosion impacts. Private property owners at the northwesterly side of the lake have also encroached more dozens of feet off of their property and some owners have disposed of leaves, branches and logs onto the shoreline and buffer of the lake. Village staff have made requests to stop these practices that adversely impact Lake Charles.

The Village will continue to make improvements that will improve Lake Charles. The educational component is important and we are considering having a Lake Management plan in 2021 which will assist in identifying opportunities and managing the expectations of this shallow waterbody. Grant opportunities will also be pursued as feasible.

11.11.2020

Illinois EPA conducts routine monitoring on inland lakes as part of the legal requirements for the Clean Water Act, Section 305(b). There are chemical water quality standards for Illinois general use waters that we use to diagnose causes and potential sources of pollutants in lakes. These findings are reported in the biannual Integrated Water Quality Report and Section 303(d) List (https://www2.illinois.gov/epa/topics/water-quality/watershed-management/resource-assessments/Pages/default.aspx).

Little Bear and Big Bear lakes are in an area where the surrounding land use is mainly park land, mowed grass, and pavement including roads, parking lots, and bike paths. The surrounding watershed has hard impervious surfaces, roads, buildings and stores. There is a high amount of human impacts in the area directly surrounding the lake and the watershed. This leads to a decline in natural habitat sources for fish and macroinvertebrates in a lake. There is less canopy cover around the edges of the water, less leaf litter falling into the water, and less woody debris in the lake. The lakes do have some good cover and habitat for the fish and aquatic insects in the form of submerged aquatic plants. Some of the cover is invasive Eurasian Watermilfoil and Curley leaf Pondweed. The water quality of Little and Big Bear reflects their surroundings. There were some dissolved oxygen violations in the late summer samples, high phosphorus levels throughout the monitoring season, chloride violations in Spring, and elevated chlorophyll *a* levels. Both lakes are relatively shallow, Little Bear is a little deeper, and shows some summer stratification. There is a small anoxic zone during stratification in the deeper area of the lake.

The shoreline habitat is assessed by navigating to 10 evenly spaced places around the shoreline of the lake and observing habitat characteristics in the water and adjacent shoreline. The form notes human impacts around the lake, substrate types, canopy cover, and other features that would measure habitat quality. In the rating of human disturbances nationally, Little Bear and Big Bear both have a medium level of human disturbances. Most of them are buildings, mowed grass, and parkland. Both lakes also scored below average for habitat quality in the littoral and riparian areas of the lake. This is due to the lack of woody debris and hard substrates such as cobble. Muck, sand, seawall and rip rap provide lower quality habitat for aquatic organisms. Habitat is needed to support feeding, hunting, and spawning areas for fish and aquatic invertebrates.

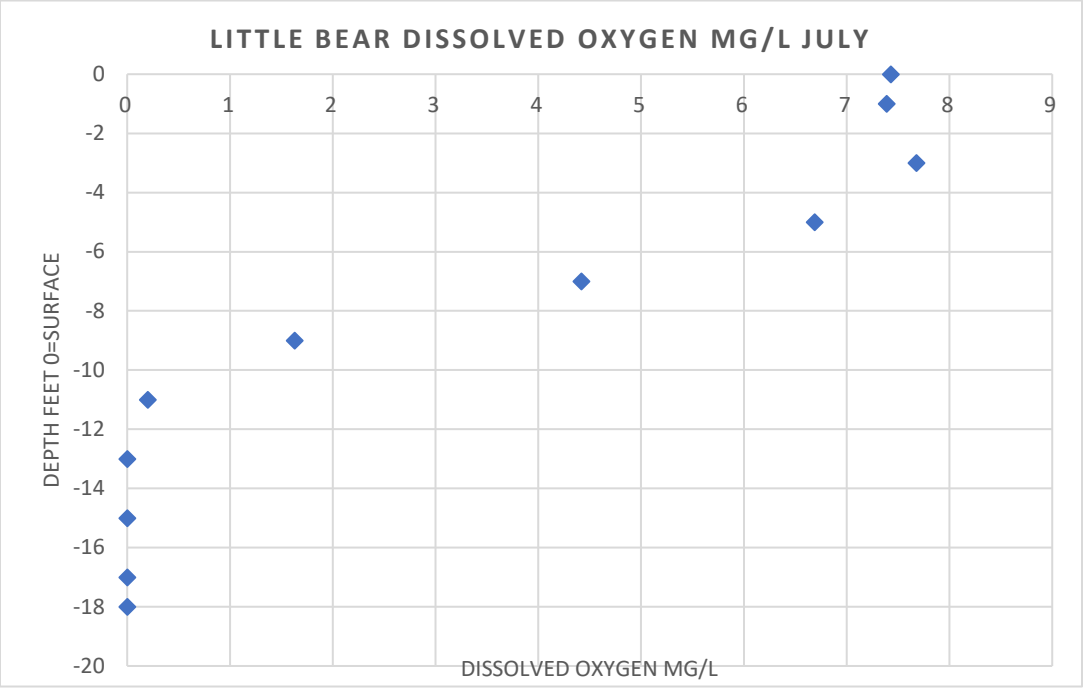
Little Bear and Big Bear have similar plant communities. The IL EPA plant survey method is a random selection of points sampled with a rake. The number of sampling points depends on the size of the lake. Little Bear and Big Bear are similar in size, so they were both sampled at 30 different points. Little Bear has 14 different plant taxa, 2 are invasive species. The maximum depth of plant growth was found at 12 feet, meaning the lake had good clarity to allow plants to grow at that depth. Coontail was the dominant plant in Little Bear with Eurasian Watermilfoil close behind. Both plants can grow very dense limiting water flow and fish hunting. Stands of these plants will provide very good substrate and shelter for aquatic insects. When these plants die off large amounts of nutrients are rereleased into the water column which can cause algal blooms and oxygen depletion in late Summer and early Autumn. Ten percent of the survey locations had a maximum plant density rating. Over 75% of the sites had an invasive plant present. There were only 3 taxa in the lake that are intolerant to water pollution. Big Bear had a similar plant community with a diversity of 15 different taxa. Coontail and Eurasian Watermilfoil were dominant plants in this lake too. A greater number (23%) of sites had the maximum density of plants present. The maximum depth of plant growth was 10 feet and 83% of the sites had invasive species present. There were 3 pollution intolerant plant species. Compared with other lakes in Illinois, Little Bear and Big Bear have a low diversity in the plant community. With fewer than 20 taxa, they are being impacted by the dominant taxa out-competing for the available nutrients and habitat. The positives about the plant communities are that they have greater than 10 taxa, and many of the stations have some plant growth. This means that there is a good spread of available plant habitat and that light is penetrating deep enough to support plants in greater depths than just a few feet. This increases the hide, spawning, and feeding areas for fish and other aquatic organisms. Lakes with dense plant populations also benefit from the plant's nutrient requirements. Available phosphorus and nitrogen are utilized by the plants during their growing season which helps control algae populations. Monitoring and control of the plants in these lakes is important to try to maintain or help increase the current plant diversity.

Little Bear and Big Bear both had some water chemistry violations throughout the Summer. The General Use water quality standards are available on the Illinois Pollution Control Board website. Title 35 is where the environmental regulations for Illinois are outlined.
https://pcb.illinois.gov/SLR/IPCBandIEPAEnvironmentalRegulationsTitle35

Phosphorus, a nutrient responsible for plant and algal growth, levels were elevated. The total phosphorus standard in Illinois for lakes is 0.05 mg/L. Out of 13 samples, 9 samples were in violation in Big Bear, and Little Bear had 8 violations out of 12 samples. Much of the Summer, the levels of phosphorus in the lakes are high. This can lead to increased algal blooms, increased water turbidity, and nuisance plant growth. The secchi transparency of the lake was moderate, ranging from just under 1

meter to about 1.5 meters in both lakes. Both lakes had Secchi Trophic State Index values greater than 50, so the lakes are categorized as eutrophic. This is confirmed by the high levels of phosphorus. This means it's a productive lake, where Bass may dominate the fish population, it will have anoxic areas during stratification, and may have nuisance plant growth. The levels of anoxia were exhibited in the dissolved oxygen profile data.

The dissolved oxygen levels in a lake are dependent on many variables including presence of cyanobacteria and plants, water temperature, and wind and wave action. Cyanobacteria and plants in the water produce oxygen through photosynthesis. Fish and other aquatic organisms require this oxygen for respiration. Dissolved oxygen can and is expected to fluctuate throughout the day, and within the water column. There are different dissolved oxygen standards throughout the year based on when organisms are more sensitive to low levels of oxygen, for example the standard is higher during times when fish are spawning. Both lakes had small areas in the water column that dropped below the dissolved oxygen standard in July. Big Bear had another decrease in oxygen at the bottom layer of the lake in October. These were small occurrences, not impacting large parts of the lake. Any sensitive organisms would likely find refuge in different areas of the lake if they became stressed. When dissolved oxygen drops too low, it can cause widespread fish kills and reduce the diversity of aquatic insects that live in the waterbody. It is natural for lakes to stratify and have a wide range of dissolved oxygen throughout the water column as shown in the chart below. Increased nutrients, algal and decomposition productivity can cause oxygen levels to drop. Little Bear and Big Bear are showing some signs of impacts from this productivity but are still supporting the organisms in the lake.



Related to the levels of nutrients and dissolved oxygen in a lake is the algal biomass. Algae blooms are naturally occurring in lakes and are part of a balanced ecosystem. However, increased nutrients can lead to blooms that are thick, reducing water clarity and even producing toxins that cause harm to both

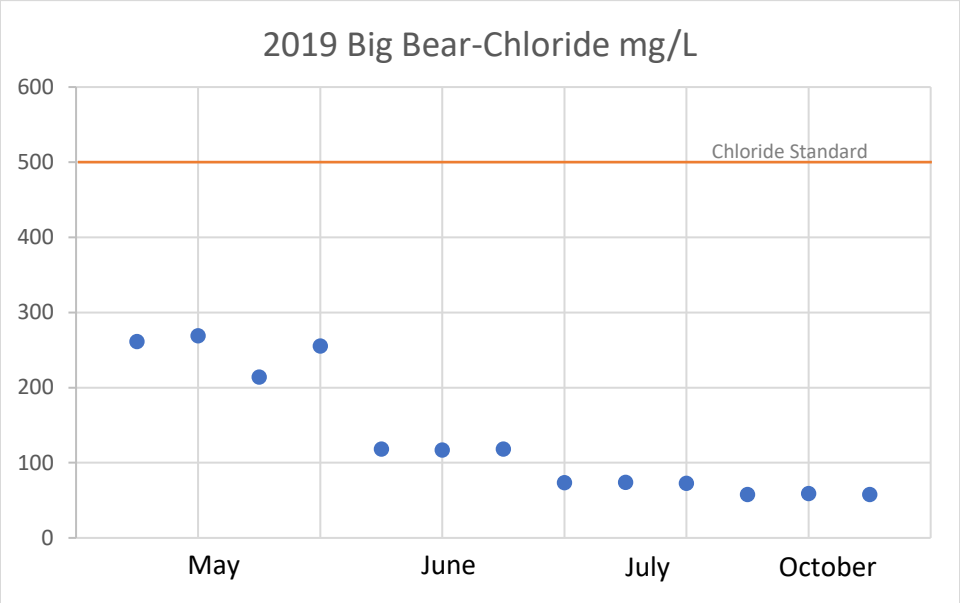
humans and aquatic organisms. To gage the amount of algae growing in a lake, IL EPA collects chlorophyll samples. The measure of different pigments is related to how much algae is growing in the water. When chlorophyll *a* concentrations are high, this indicates that a large amount of cyanobacteria are growing in the lake. Eutrophic lakes will usually have chlorophyll *a* levels greater than 20 µg/L. There were wide fluctuations in chlorophyll *a* levels throughout the summer in both lakes, but both have average levels of 20µg/L. The lakes are showing an elevated amount of algal biomass due, in part to the elevated nutrient levels in the water.

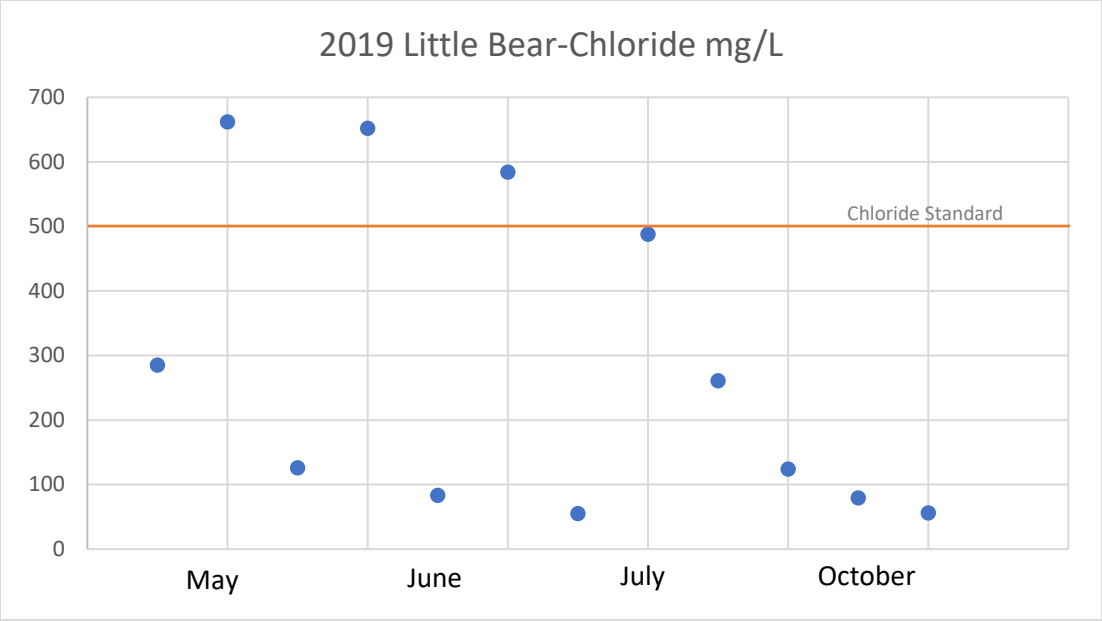
Station	LakeName	CollectionDate	Chlorophyll *a*	Unit
WGZU-1	BIG BEAR	05-01-2019	18.7	ug/l
WGZU-1	BIG BEAR	05-14-2019	25.6	ug/l
WGZU-1	BIG BEAR	06-04-2019	10.7	ug/l
WGZU-1	BIG BEAR	06-11-2019	31	ug/l
WGZU-1	BIG BEAR	07-16-2019	13.9	ug/l
WGZU-1	BIG BEAR	07-30-2019	16.9	ug/l
WGZU-1	BIG BEAR	08-13-2019	47	ug/l
WGZU-1	BIG BEAR	09-17-2019	28.8	ug/l
WGZU-1	BIG BEAR	10-02-2019	22.4	ug/l
WGZU-2	BIG BEAR	05-01-2019	17.8	ug/l
WGZU-2	BIG BEAR	06-04-2019	9.79	ug/l
WGZU-2	BIG BEAR	07-30-2019	8.9	ug/l
WGZU-2	BIG BEAR	10-02-2019	23	ug/l
WGZU-3	BIG BEAR	05-01-2019	21.4	ug/l
WGZU-3	BIG BEAR	06-04-2019	16	ug/l
WGZU-3	BIG BEAR	07-30-2019	16	ug/l
WGZU-3	BIG BEAR	10-02-2019	23.5	ug/l
WGZV-1	LITTLE BEAR	05-01-2019	17.4	ug/l
WGZV-1	LITTLE BEAR	05-14-2019	21.4	ug/l
WGZV-1	LITTLE BEAR	06-04-2019	13.8	ug/l
WGZV-1	LITTLE BEAR	06-11-2019	0	ug/l
WGZV-1	LITTLE BEAR	07-16-2019	6.41	ug/l
WGZV-1	LITTLE BEAR	07-30-2019	17.8	ug/l
WGZV-1	LITTLE BEAR	08-13-2019	28.8	ug/l
WGZV-1	LITTLE BEAR	09-17-2019	39	ug/l
WGZV-1	LITTLE BEAR	10-02-2019	29.9	ug/l
WGZV-2	LITTLE BEAR	05-01-2019	16.7	ug/l
WGZV-2	LITTLE BEAR	06-04-2019	11.1	ug/l
WGZV-2	LITTLE BEAR	07-30-2019	16.9	ug/l
WGZV-2	LITTLE BEAR	10-02-2019	28.8	ug/l

Nitrogen is monitored in lakes because it's an important nutrient for plant and algal growth. In Illinois there are standards for ammonia nitrogen. Ammonia nitrogen levels were below the single exceedance threshold for ammonia of 15 mg/L. Ammonia can also have negative impacts on fish development at lower concentrations overtime. These acute ammonia standards are calculated dependent on the pH levels of the water. There were no exceedances of the acute ammonia nitrogen standards in either lake.

Levels of pH in surface water will be impacted by the lake substrate, amount of algal and bacterial productivity, and the concentrations of oxygen. Normal pH in lakes in this region are above the neutral 7. PH levels should be in the range of 6.5 to 9.0 to be considered within the water quality standard. Naturally occurring numbers outside this range are considered acceptable. For example, in the anoxic lower layers of a stratified lake, the pH may be below 6.5, but this is considered natural, however a lake impacted by mining, that has a pH less than 6.5 throughout the water column, would not be considered natural. Little Bear and Big Bear had normal levels of pH throughout the monitoring season.

The surface water standard for chlorides in Illinois waters is 500 mg/L. Chloride concentrations become elevated in urban and suburban areas where road salt is applied. Chloride levels are usually highest after snow melt in the springtime. The levels usually decline throughout the summer as the water is cycled through the lake. Chloride levels in Big Bear were below the standard, but they were elevated in the beginning of the season. Little Bear had some violations of the standard early on, but the levels dropped over time. Little Bear receives the bulk of the impact of the incoming stormwater that is contaminated with salts. The samples in violation of the standard were collected from the deep zone of the lake. This layer of lake water will take longer to cycle out of the system and will reflect negative impacts for longer than the water in the surface layers of a lake. Increased density of water containing salts will keep it in place, rather than letting it mix with the rest of the lake. High concentrations of salt in the water can become a problem in lakes where the salt levels get so high, that the lake no longer mixes at all. This isn't the case with Little Bear, it is still turning over, and the salts are still moving out of the system. Impacts from salt will vary from year to year based on weather conditions. Concentrations of salt will impact sensitive fish and other organisms in the lake.





Overall Little Bear and Big Bear lakes are good quality lakes. They are at the center of a high traffic park with a bike path and fitness equipment. The park serves as a great location for people in the town to gather for picnics, fishing, and other recreational activities. We noted many fishermen, runners, walkers, and some kayakers while on our sampling visits. With proper management of the plants, keeping the shoreline stable, and curbing nutrient inputs where possible Little Bear and Big Bear will serve the public for many years.