Lake County, Illinois

2013 Buffalo Creek Reservoir

Prepared by the

LAKE COUNTY HEALTH DEPARTMENT

Population Health Environmental Services

Great Blue Heron and Great White Egret on Beaver Den, 2013

The 35.18 acre Buffalo Creek Reservoir is located within the Buffalo Creek Forest Preserve property in Long Grove, Illinois. The Lake County Forest Preserve District (the District) acquired the property between 1978 and 1987. The reservoir was constructed in 1984 as part of a joint effort between the District and the Metropolitan Water Reclamation District of Greater Chicago (MWRD) to store stormwater from the Buffalo Creek watershed. It was later expanded in 1989. The reservoir was "carefully designed to create a natural looking wetland area" (LCFPD). Flora and fauna are found using the area and it is common to see scenes such as the great blue heron and egret along the shorelines of the basins.

The Buffalo Creek watershed is expansive and encompasses area within both Lake and Cook counties. It is estimated to be 10,300 acres.

The reservoir contains two basins that are separated by a gabion weir. BCR1 receives waters from a small part of the Buffalo Creek watershed located in Lake County plus the area contained in Cook County. BCR2 receives water from BCR1 as well as the remaining area of the Buffalo Creek watershed that drains into the reservoir. The maximum depth of the basins differs slightly, BCR1 is 3.91 feet deep and BCR2 is 4.92 feet deep.

Environmental Services Water Quality Specialists

Kathy Paap
kpaap@lakecountyil.gov

Kelly Deem
kdeem@lakecountyil.gov

Gerard Urbanozo
gubanozo@lakecountyil.gov

Special points of interest:

- *Phosphorus Impairment*
- *Total Suspended Solids*
- *Submerged Vegetation*
- *Algal Blooms*
- *Carp Infestation*

Inside this issue:

Watershed/ Landuse	3
Water Clarity	4
Total Suspended Solids	5
Nutrients	6
Dissolved Oxygen	9
Chlorides/ Conductivity	9
Shoreline Erosion	11
Aquatic Plants	12
Algae	12
VLMP	14
Fish	14
Sediments	15
Recommendations	16

SUMMARY (CONTINUED)

Lake Facts:

Major Watershed: Des Plaines

Sub-Watershed: Buffalo Creek

Location: T46N, R10E, Section 34

Surface Area: Buffalo Creek Reservoir 35.18 acres

Shoreline Length: Buffalo Creek Reservoir 2.98 miles; BCR1, 0.95 miles, BCR2, 2.03 miles

Maximum Depth:

BCR1, 3.91 feet; BCR2, 4.92 feet

Average Depth:

BCR1, 3.00 feet; BCR2, 3.17 feet

Lake Volume: BCR1,125.84 acre-ft; BCR2, 186.03 acre-ft

Maximum storage capacity: Approx. 700 acre-feet

Watershed Area: 10,299.76 acres

Lake Type: Stormwater Impoundment

Management Entity: Metropolitan Water Reclamation District of Greater Chicago (MWRD)

Lake County Forest Preserve District

Current Uses: fishing, aesthetics , storm water retention

Access: Public

The overall water quality of the reservoir is poor. Like many of the lakes in our county, it is impaired for phosphorus based upon the Illinois Environmental Protection Agency's (IEPA) standard for total phosphorus (TP) of ≥ 0.05 mg/L. The average TP concentrations found in the reservoir were 0.068 mg/L and 0.096 mg/L, for BCR1 and BCR2, respectively. In 2013, the ratio of total nitrogen to total phosphorus (TN:TP) was 16:1 in BCR1 and 12:1 in BCR2. These ratios indicate that there are plenty of both nutrients in the basins to promote nuisance algae or plant growth.

The average chloride concentration was the same in both basins 210 mg/L; this is considered elevated and begins to approach the U.S. Environmental Protection Agency's (USEPA) critical concentration for chlorides of 230 mg/L. The average chloride concentration in BCR2 has decreased slightly based upon the estimated average chloride concentration of 217 mg/L from 2001.

The average Secchi depths measured at BCR1 (2.6 feet) and BCR2 (2.3 feet) were both below the County median (3.00 feet) for lakes sampled between 2000-2013. The average Secchi depth in BCR2 has improved since 2001when it was 1.1 feet. Secchi depth can be affected by differences in precipitation, carp population, or even the amount of construction activity taking place in the watershed during the periods monitored.

During 2013, total suspended solids (TSS) were 90% worse in BCR2 than they were in BCR1; this is likely due to differences in sediment load entering into each basin from the watershed.

LCHD-ES collected sediment samples for the Buffalo Creek Clean Water Partnership as part of their work plan for a grant they received from the watershed management board. The samples were analyzed by a private laboratory for 136 different parameters. Many of the pollutants measured were below detectable limits. This does not necessarily mean that they were not present, as they could have been present at concentrations below the sensitivity of the tests.

Aquatic vegetation was sampled throughout the reservoir during September, 2013. In total 34 sites were evaluated. Seventy-nine percent of the sites were vegetated. There were six species identified in the reservoir in 2013. Curlyleaf Pondweed (*Potamogeton crispus*), a non-native, invasive species was among those identified. The plant assemblage changed considerably within the reservoir since it was last sampled in 2001. The sampling method differed between monitoring years, so it is hard to evaluate if the changes in assemblage occurred due to sampling method difference or if species such as Leafy (*P. foliosus*) and Small Pondweed (*P. pusillus*) have disappeared from the reservoir. Floristic quality (FQI) of the reservoir dropped slightly from 13.1 in 2001 to 11.4 in 2013, due to the presence of less conservative (weedier) species.

In October of 2013, the shoreline of the reservoir was assessed for erosion. Sixty percent of the reservoir was exhibiting some degree of erosion. Forty-three percent of the erosion was either moderate (26%) or severe (17%). An additional 17% was assessed as having slight erosion. The amount of erosion in the basin decreased since its last assessment in 2001. At that time 84% of the shoreline was assessed as having some degree of erosion; however, the severity of the erosion found on the shoreline has increased.

There is no record of a fish survey being completed by the Illinois Department of Natural Resources for the reservoir. It is likely that there is at the very least a rough fish population present in the reservoir as there have been frequent observations of fishermen fishing from the shorelines.

WATERSHED

The portion of the Buffalo Creek watershed influencing the water quality of the Buffalo Creek Reservoir is estimated to be 10,352.97 acres and encompasses real estate in both Lake and Cook counties (Figure 6). The dominant land uses in the Buffalo Creek water shed were Public and Private Open Space (16%) and Single Family (43%). The total percent runoff from the land use has Single Family (45%), Transportation (17%) and Retail/Commercial (20%) as the largest contributors (Appendix 1, Table 1). It is noteworthy to mention that many areas designated as Single Family had transportation corridors not defined as transportation land use and therefore the total percent runoff coming from Transportation is likely under-represented.

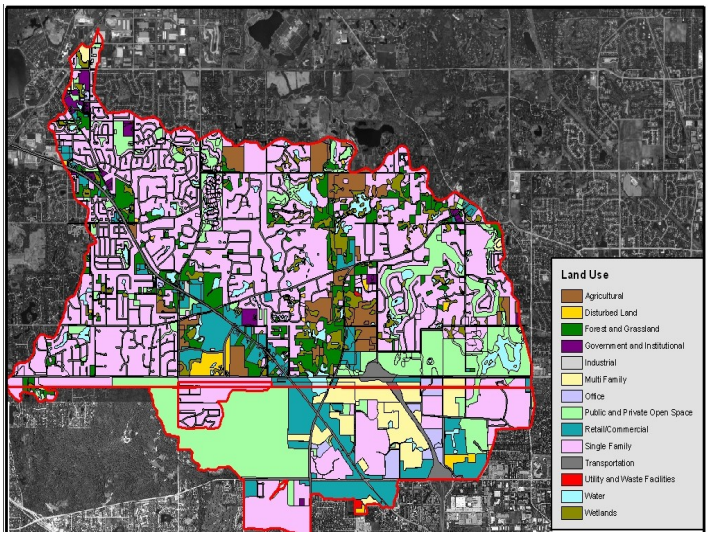
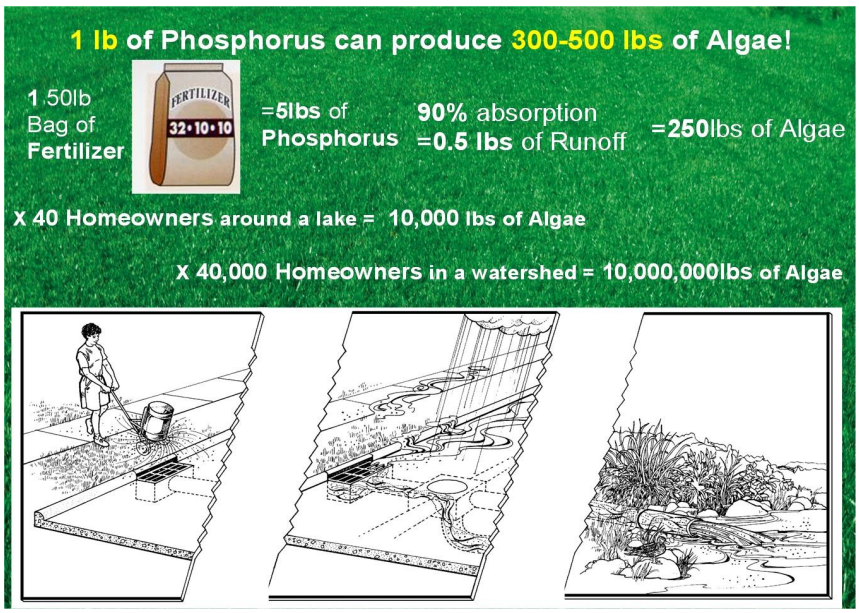


Figure 6. Estimated land use of Buffalo Creek Watershed (boundary information collected from MWRD, Lake and Cook Counties (2013).



WATER CLARITY

In 2013, two sample points were selected to collect water quality samples within the reservoir. BCR2 remained from the previous monitoring year (2001) and BCR1 was incorporated into the sampling protocol (Appendix A, Figure 1).

Average Secchi depths measured at BCR1 (2.2 feet) and BCR2 (2.3 feet) were below the County median of 3.0 feet for lakes sampled between 2000-2013 (Appendix A, Table 2). BCR1 ranked 95th of 158 lakes in the county measured for Secchi depth between 2000 and 2013, while BCR2 ranked 103rd out of the 158 lakes (Appendix A, Table 3).

Secchi depths in BCR1 ranged from 1.6 feet in May to 2.7 feet in September (Figure 1). There was an improvement in water clarity at BCR2 since it was last measured in 2001, the average Secchi depth at that time was 1.1 feet, and measurements ranged between 0.6 feet to 1.4 feet. In 2013, Secchi depths at BCR2 ranged from 1.2 feet to 3.6 feet (Figure 1). The improved water clarity could be due to differences in rainfall, a reduction in the carp population, or changes in nutrient or sediment loading from the watershed.

The reservoir is designed to capture and detain an estimated volume of storm water from the Buffalo Creek watershed. In May and June, BCR2 had exhibited better water clarity than what was measured in BCR1. This could be due to differences in basin volume, BCR1 is the smaller of the basins and therefore likely impacted by smaller rain events than the larger BCR2 basin. Two weeks before the July water sampling, 5 inches of rain fell in a 24 hour period as captured at the Lake County Stormwater gage stations located nearby (Figure 2). This storm event is likely responsible for the large decrease in water clarity in both basins during the July (Figure 1). By August,

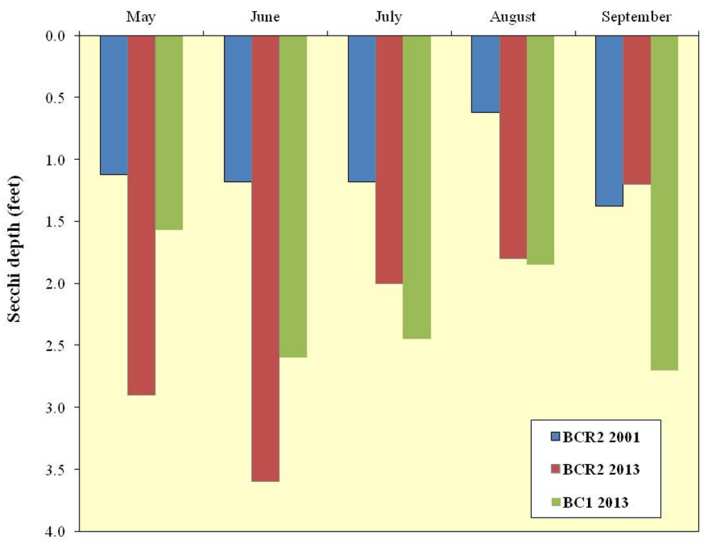


Figure 1. Secchi depths in Buffalo Creek Reservoir, measured at 2 points in 2013, BCR1 and BCR2. BCR2 has had an improvement in Secchi depth since 2001.

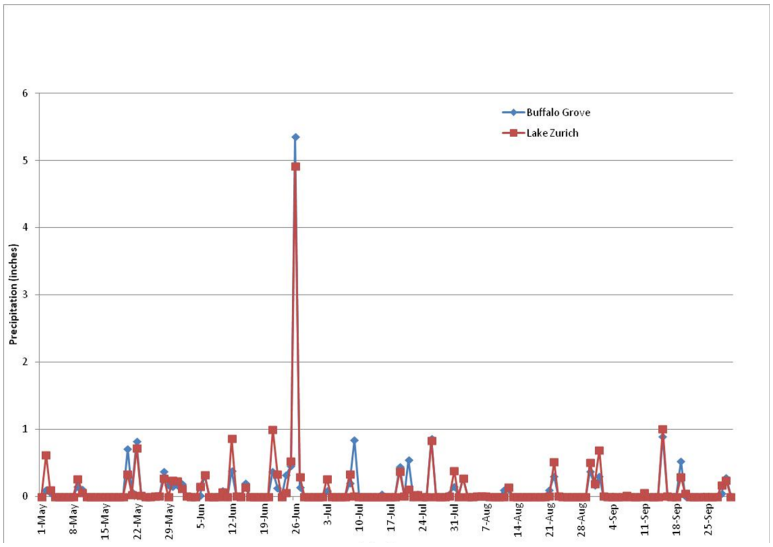


Figure 2. Rainfall data from two Lake County Stormwater Commission (LCSMC) rain gages installed near the Buffalo Creek watershed.

Water Clarity (Continued)

BCR1 became the less turbid of the basins, although both basins experienced decreased water clarity until September when water clarity in BCR1 improved while it continued to decline in BCR2. Decreases in water clarity during summer months can occur as a result of an increase in total suspended solids (algae or sediment) in the water column. Carp can decrease water clarity through their foraging activities; as can wind and wave action as they tend to keep materials suspended in the water column through mixing.

Aquatic plants play an important role in water clarity and can, in turn, be negatively impacted by low water clarity. Plants compete with algae for resources such as nutrients (phosphorus and nitrogen) and light; they also stabilize bottom sediments. Generally, lakes with a balanced plant population will have better water clarity than those with less plants. Both basins were well vegetated; with vegetation being detected at 89% and 76% of the sample sites in BCR1 and BCR2, respectively.

There is a planned expansion of the reservoir being coordinated between the MWRD and the District, and although it is understood that water clarity will always be affected by storm events coming from the expansive watershed of the reservoir, design factors that reduce sediments in the water such as reduced shoreline slopes and aquatic shelves vegetated with native emergent species, should be considered. The shelves would assist in trapping sediments as storm water moves through the reservoir.

Total Suspended Solids

Total Suspended Solids (TSS) are made up of volatile solids (flora, fauna) and non-volatile solids (sediments); both adversely affect water clarity.

TSS concentrations in the reservoir varied by basin. The average TSS concentration at BCR1 was 7.2 mg/L, and was below the county median of 8.0 mg/L for lakes in the county assessed between 2000 and 2013, while the average TSS concentration in BCR2 was 19.2 mg/L and is more than double the county median TSS concentration.

The average TSS concentration decreased in BCR2 by 80% from the 2001 average TSS concentration of 34.7 mg/L, and is likely due the slowing of construction projects taking place in the watershed in 2013 compared those that were active during 2001.

In 2013, the median non-volatile suspended solid (NVSS) concentrations differed greatly between the basins. The median NVSS in BCR1 was 3.6 mg/L while it was 9.2 mg/L in BCR2. Recall, NVSS are sediments, and the sediment load coming into BCR2 from the branch of Buffalo Creek watershed that drains from the north has many areas of severe bank erosion. Albert Lake discharges into Buffalo Creek. Albert Lake has very poor water quality and although it is located quite a distance upstream of the reservoir, these waters are ultimately deposited into the reservoir at BCR2. In 2013, Albert Lake had TSS concentrations ranging from 8.9 mg/L to 13.0 mg/L measured at its outlet.

Total volatile solids (TVS) in BCR2 were 112 mg/L , this is greater than the 106 mg/L TVS concentration measured in BCR1. TVS concentrations in both basins are below the county median TVS concentration of 119 mg/L for lakes in the county sampled for TVS between 2000 and 2013.

Shoreline erosion within the basins, is also a major contributor of TSS. In 2013, erosion was assessed in the reservoir and it is estimated that 60% of the shoreline exhibited some degree of erosion. The long fetch of the reservoir allows for wind and wave action to re-suspend sediments from the shallow basins and keeps the water column mixed.

TSS and TP are highly correlated and sediments entering into the basins are bound by phosphorus. Both basins in the reservoir are impaired for TP (this will be further discussed under the section

Total Suspended Solids (Continued)

on nutrients).

The LCHD-ES recommends remediation of eroded shorelines both within the reservoir and throughout the watershed in order to reduce TSS and improve water clarity throughout the reservoir. Storm events cause large water level fluctuations and heavy flows which impact shorelines. A mix of solutions will likely be required to remedy the eroded areas identified in the basins. These solutions can range from hardscaping to establishing vegetated shorelines and shelves using native vegetation with deep penetrating root systems to secure the soils within the basins.

Common carp although not noted during 2013, are likely present in the reservoir. Their feeding habits cause bottom sediments to be distributed into the water column which decreases water clarity and habitat for both aquatic plants and fish. The LCHD-ES recommends that reduction of the carp population occur when ever possible due to their impact on water clarity.

Nutrients

Phosphorus and nitrogen are essential, naturally occurring nutrients needed for plant growth, however when in excess they can impair water quality. High phosphorus levels can lead to excessive algae and aquatic plant growth which can harm aquatic life and impair recreational use. Additionally, it can cause toxic algae blooms, reduce water clarity, and be a precursor to depleted oxygen levels. Like many of the lakes in Lake County the basins of the Buffalo Creek Reservoir are impaired under IEPA's general use standard for TP of ≥ 0.05 mg/L, within the epilimnion (surface waters) at anytime during the monitoring season.

The average TP concentrations measured in the basins during 2013 were 0.068 mg/L and 0.096 mg/L, for BCR1 and BCR2 respectively. The average TP concentration in BCR1 was very close to the median TP concentration of 0.067 mg/L found in lakes in the county monitored between 2000 - 2013 and ranked 80th out of the 175 lakes monitored for phosphorus in the county during the same time period (Appendix A, Table 4). The average TP concentration measured in BCR2 was much higher than the median for county lakes, and ranked 113th of the 175 lakes monitored for phosphorus during 2000 - 2013.

TP concentrations measured in BCR1 during 2013 ranged from 0.034 mg/L (May) to 0.115 mg/L (July) while the concentration in BCR2 ranged from 0.045 mg/L to 0.161 mg/L . The average TP concentration found in BCR2 was 41% greater than what was measured in BCR1.

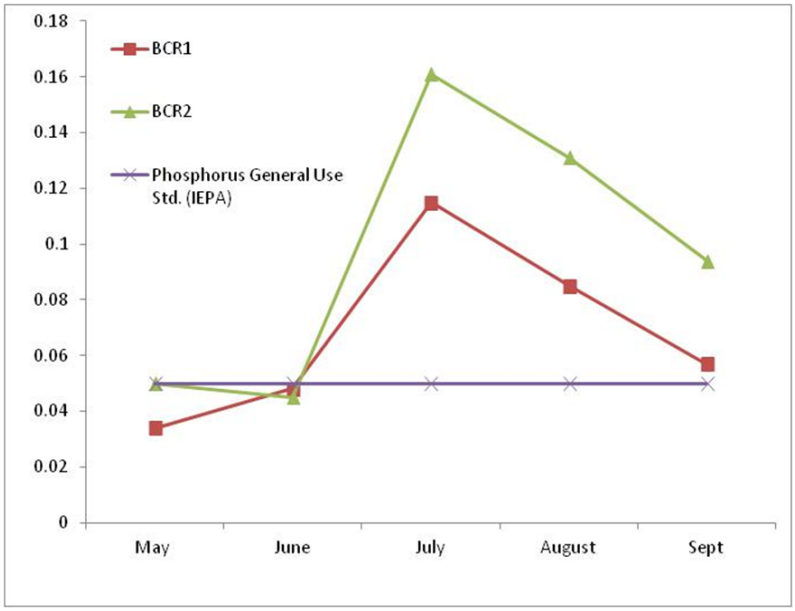


Figure 3. TP concentrations measured in Buffalo Creek Reservoir during the 2013 monitoring season.

NUTRIENTS (CONTINUED)

These points are not geographically very distant from each other; however, as pointed out in the section on TSS, the sediment load entering the basins is quite different, with large amounts of sediment entering BCR2 compared to that of BCR1. This is illustrated by the differences in TP concentrations between the basins as they spiked in July; as phosphorus bound sediments entered the reservoir in storm water from a 5" rain event that inundated the area (Figure 2).

The difference in TP concentrations in the basin can be explained by looking closely at what happened to the TN:TP ratio in the basins. TN:TP is an indicator of which, if either, nutrient (nitrogen or phosphorus), are limiting in a system. Ratios of less than 10:1 indicate a system limited by nitrogen, while lakes with ratios greater than 20:1 are limited by phosphorus. Ratios falling between those limits indicate a system where neither nutrient is limiting.

In July, the TN:TP ratio changed in BCR2 from a system limited by phosphorus (23:1) to one limited by nitrogen (9:1), indicating that there was just too much phosphorus in the basin and all the phosphorus could not be taken up by aquatic organisms. BCR2 remained limited by nitrogen until September, when neither of the nutrients were limiting in the basin.

BCR1, was also affected by the flush of phosphorus into the system, however, there was sufficient amounts of both nutrients present. TN:TP of BCR1 in May was 25:1, indicating a system limited by phosphorus. From June through September, neither of the nutrients were limiting (TN:TP ratios ranged from 12:1 to 20:1).

Excess phosphorus in the basins is evident due to the the presence of soluble reactive phosphorus (SRP) concentrations in the water. SRP is the biologically available form of phosphorus in water, it was nearly 100% more concentrated in BCR2 (0.019 mg/L) than it was in BCR1 (0.010 mg/L).

Carlson's Trophic State Index (TSIp) uses average TP to determine a lakes trophic state. The TSIp for BCR1 was 65 and 70 for BCR2. The higher the TSIp score the more nutrient rich is the lake system. As indicated in Table 1 below,

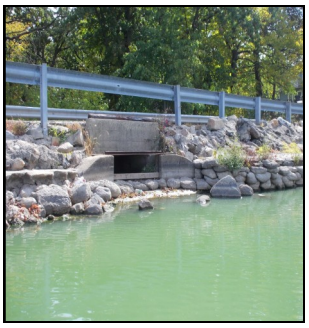
Figure 4. Trophic States found in lakes.

OLIGOTROPHIC:

Lakes are generally clear, deep and free of weeds or large algae blooms. Though beautiful, they are low in nutrients and do not support large fish populations.

MESOTROPHIC:

Lakes lie between the oligotrophic and eutrophic stages. Devoid of oxygen in late summer, their hypolimnion limit cold water fish and cause phosphorus cycling from sediments.



EUTROPHIC: Lakes are high in nutrients, they are usually either weedy or subject to frequent algae blooms, or both. Eutrophic lakes often support large fish populations, but are also susceptible to oxygen depletion.

NUTRIENTS (CONTINUED)

BC1 is eutrophic and BCR2 is hypereutrophic per the TSIp scores.

Phosphorus was excessive throughout both basins. Measures should be taken within the watershed, as well as in future basin design to minimize sources of phosphorus loading of the reservoir.

Although not all sources of phosphorus pollution have been identified in the Buffalo Creek watershed, Albert Lake, was monitored in 2013, and had an average TP concentration measured at its outlet of 0.495 mg/L. Practices should be implemented in Albert Lake, as well as other areas of the watershed to reduce the amount of phosphorus eventually entering into BCR2 via Buffalo Creek.

Internal phosphorus cycling can also occur through the release of phosphorus into the water from bottom sediments due to anoxic conditions occurring in the sediments. It has recently been determined (Nurnberg, 2013) that internal cycling of phosphorus can occur even as DO concentrations above the bottom sediments remain oxic ≥1 mg/L. This mode of introduction will be discussed further under the section on dissolved oxygen (DO).

Internal cycling has been known to occur in many lakes and can elevate phosphorus concentrations. Other sources of internal cycling come from carp, eroding shorelines and dispersal of sediments through wind and wave action.

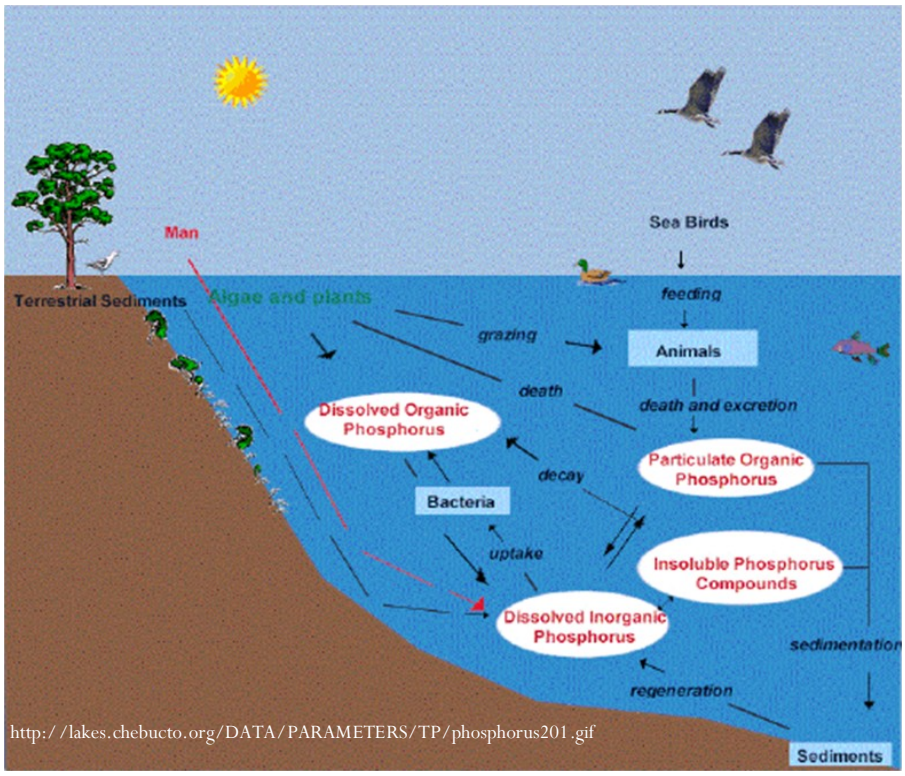


Figure 5. Phosphorus cycle.

DISSOLVED OXYGEN (DO)

Dissolved oxygen (DO) is essential for the survival of fish and invertebrates and influences many different biological and chemical processes.

DO is considered supersaturated as % DO concentrations of >100% occur and if they become greater than 110%, impacts to certain fish species are possible and in rare cases, excessive DO can lead to gas bubble disease in fish, where oxygen bubbles or emboli block the blood flow through blood vessels.

Percent DO concentrations of >110% were observed in the Buffalo Creek Reservoir. DO concentrations ranged from 138% to 142% in BCR1 within the first two feet of the surface during June (Appendix A, Table 5). And although they decreased the % DO remained elevated in BCR1 with % DO ranging from 118% to 132% within a foot from the surface through July.

In May, BCR2 had % DO ranging from 104% at the surface to 121% at the bottom. These elevated conditions persisted in the surface waters of BCR2 through June, with % DO ranging from 130% to 114% within a foot of the surface. By July this condition began to clear with elevated % DO occurring only at the surface of the basin. It completely disappeared by August.

Anoxic conditions can also cause problems ranging from fish kills to increased algae blooms. Very low oxygen conditions in the water near the bottom sediments have been enough to cause the release of phosphorus from anoxic bottom sediments. Although both basins stratified in 2013, BCR2 exhibited polymictic tendencies, as it mixed and stratified multiple times during the season. This could conceal the lowest hypoxia (oxygen deficient) occurring in BCR2, while anoxic bottom sediments continually were releasing phosphorus. The DO concentrations did become very low near the bottom of BCR2 during August and September with DO concentrations of 1.06 mg/L and 2.15 mg/L, respectively.

CHLORIDES/CONDUCTIVITY

Conductivity measures the amount of ions contained in water. The more ions or salts that water contains the higher it's conductivity. Conductivity has been used to estimate both total dissolved solids (TDS) and chloride concentrations. LCHD-ES collected conductivity data during all years that Buffalo Creek Reservoir was monitored. In 2001, conductivity and TDS concentrations were analyzed and in 2013 conductivity and chloride concentrations were analyzed. Chloride was chosen due to a strong relationship found between road salt usage (which contains 40% chloride) and increasing chloride concentrations in lakes. Even more recently water softeners have been found to play an important role in increases in chlorides. It only takes 1 teaspoon of salt (chloride) to pollute 5 gallons of water (230 mg/L). Once chlorides are in water they remain there indefinitely, unless they are diluted or treated using a reverse osmosis system which is a costly alternative.

It only takes1 teaspoon of salt to pollute 5 gallons of water .

In 2013, the average chloride concentration in both basins was 210 mg/L. This concentration is considered elevated and approaches the USEPA's critical concentration of 230 mg/L. The critical concentration was exceeded in both basins during May and June, with chloride concentrations of 270 mg/L and 265 mg/L occurring in BCR1 and 259 mg/L and 288 mg/L occurring in BCR2, respectively. It is likely that the concentrations were even higher earlier as snowmelt

CHLORIDES/CONDUCTIVITY (CONTINUED)

runoff made it's way into the reservoir. The average conductivity increased in BCR2 by 14% from the average conductivity measured in 2001, and could be because of differences in weather patterns or the development of the watershed which occurred between monitoring years. Conductivity and chloride are strongly correlated ($R^2 = 0.87$), therefore it is highly likely that chlorides have similarly increased.

The LCHD-ES and Lake County Stormwater Management Commission have been holding annual training sessions targeting deicing maintenance personnel for both public and private entities. This is an attempt to educate winter road maintenance crews on the recommended application rates for applying deicers and hopefully reduce the amount of chloride being introduced into our environment while maintaining safe passageways. Since the two of the largest contributors of runoff in the Buffalo Creek watershed comes from transportation and single family land usage, homeowners in the watershed should also be aware of proper application and choice of deicing materials. The "What can I do to help?" tip box gives recommended practices for snow removal around your homes. Almost all deicing products contain chloride so it is important to read the product label for proper material selection and application rates. For instance, at 10° Fahrenheit, rock salt is not at all effective in melting ice and will likely blow away before it melts anything. Additionally, homeowners should encourage the local government agency responsible for snow removal to implement practices into their maintenance plans that will minimize usage of deicing products.

What can I do to help?

- Shovel (or use a snow blower) before you use any product; never put a deicing product on top of snow.
- Read the product label, before applying product.
- Sweep up un-dissolved product after a storm is over for reuse.
- Consider switching to a non-chloride deicer.
- Support changes in chloride application in your municipality.
- Inform a neighbor about the impacts chlorides have on our lakes rivers and streams.

Modified from (DuPage River Salt Creek Workgroup , 2008)

SHORELINE EROSION

Shoreline erosion contributes to poor water quality by increasing the amount of both total suspended solids and phosphorus concentrations in a lake, resulting in one of two outcomes, a very weedy lake due to an increase in a normally limiting nutrient (phosphorus) or a lake with few weeds due to decreased water clarity as either excessive amounts of sediment or algae are in the water column. In a system without plants, algae can become a problem due to the lack of competition for nutrients. Sedimentation can cause destruction of habitat for fish and other macroinvertebrates by reducing foraging and breeding sites or by direct suffocation of eggs.

In 2013, 60% of the shoreline in the reservoir was experiencing some degree of erosion (Figure 7). Gabions were in place at inlet areas in the reservoir, so attempts have been made to reduce erosion; however, the reservoir is not a static system, and when flood waters make there way through the reservoir, shorelines become scoured by flow and fluctuating water levels. The degree of scour varies per storm event.

There was a difference in the percent of shoreline eroding between the basins. BCR2 exhibited some degree of erosion on 66% of its shoreline; while BCR1 was found to have 44% of its shoreline with some degree of erosion (Table 1). There were differences in the degree of erosion between the basins, with the most notable difference being in the moderate classification, BCR1 had 9% of it's shoreline showing signs of moderate erosion, while 34% of BCR2 exhibited the same degree of erosion on its shorelines. This could be due to differences in elevation between the basins; as BCR1 is situated higher in the landscape than BCR2.

LCHD-ES recommends that shoreline slopes be minimized and the construction of vegetated shelves be considered during the redesigning of the basins. If there are slopes not impacted by the expansion, consideration should be given to reducing those slopes, as this would minimize erosion. A mix of solutions should be implemented to remedy eroded areas ranging from the use of hardscaping materials to vegetating areas with native plants so that their deep root systems can better anchor soils along shoreline areas.

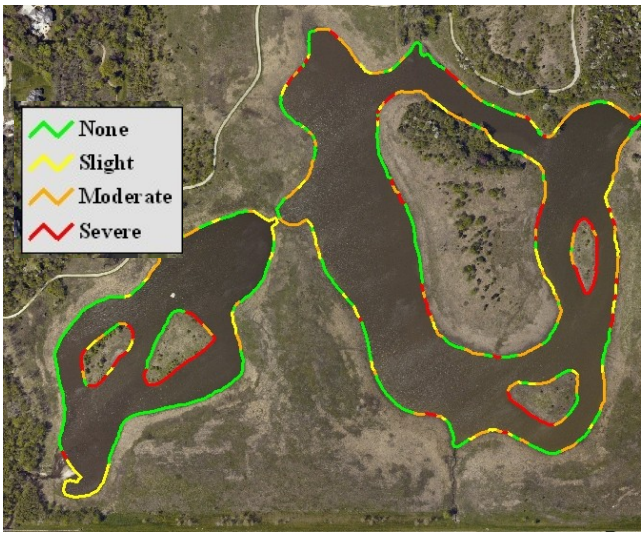


Figure 7. Degree of erosion assessed in the Buffalo Creek reservoir, 2013.

Table 2. Results of Shoreline Erosion Assessment, Buffalo Creek Reservoir, 2013

	Entire Reservoir		BCR#1		BCR#2	
Degree Erosion	Miles	%	Miles	%	Miles	%
No Erosion	1.19	40%	0.50	52%	0.69	34%
Slight	0.50	17%	0.20	21%	0.31	15%
Moderate	0.78	26%	0.09	9%	0.69	34%
Severe	0.51	17%	0.17	18%	0.34	17%
Total Shoreline	2.98	100%	0.95	100%	2.03	100%

Aquatic Plants

Aquatic plants are a critical feature in most water bodies as they compete against algae for nutrients, improve water quality and provide fish habitat.

An aquatic vegetation survey was conducted in September, 2013. A 60-meter grid was randomly overlaid on an aerial photo of Buffalo Creek Reservoir and a total of 34 points were assessed. Seventy-nine percent of the points sampled in the reservoir were vegetated (Figure 8). Six plant species were identified; Coontail, Curlyleaf Pondweed, Duckweed, Elodea, Flat-stemmed Pondweed and Sago Pondweed were found in the reservoir. Coontail was the dominant species. Curlyleaf Pondweed, a non-native invasive species, was found at one point in BCR1; however, in June, it was noted as topped out over the entire basin. It was also noted as present in BCR2. Eurasian Water Milfoil, another widespread invasive species was not detected in either basin during the 2013 vegetation survey.

The diversity of plants in the reservoir has not changed since 2001, however, species composition has changed and species such as Leafy and Small Pondweed have since been replaced by Duckweed and Elodea, which are less conservative species. This resulted in a decrease in floristic quality index (FQI) . The FQI in 2013 was calculated at 12.5 for the reservoir. This is a fair FQI score for a lake whose purpose is storm water retention. Floristic quality assessments are used to identify natural areas, allow for comparison among sites, long term monitoring of remnant natural areas, and for habitat restoration. A FQI of 35 indicates that a site is at least of marginal quality. However, a majority of the lands in the Chicago region exhibit FQI's of 20 or less and essentially have no significance from a natural area perspective (Swink and Wilhelm, 1994).

It is recommended that Curlyleaf Pondweed be managed in the reservoir, although it likely will not result in increased plant diversity, it will enable the spread of native species throughout the basins by allowing light to penetrate to the bottom in the absence of Curlyleaf Pondweed. CLP growth supersedes the growth of native species and therefore shades establishing native vegetation.

If there was interest in embellishing the plant community in the basins during the expansion project, LCHD-ES recommends that the focus of that activity be in BCR1, due to the very high TSS concentrations encountered in BCR2 during the 2013 monitoring season. The sediments in the waters of BCR2 would make it extremely difficult to establish plants in the basin. The District could however, use propagules from BCR2 to embellish the vegetative community in BCR1.

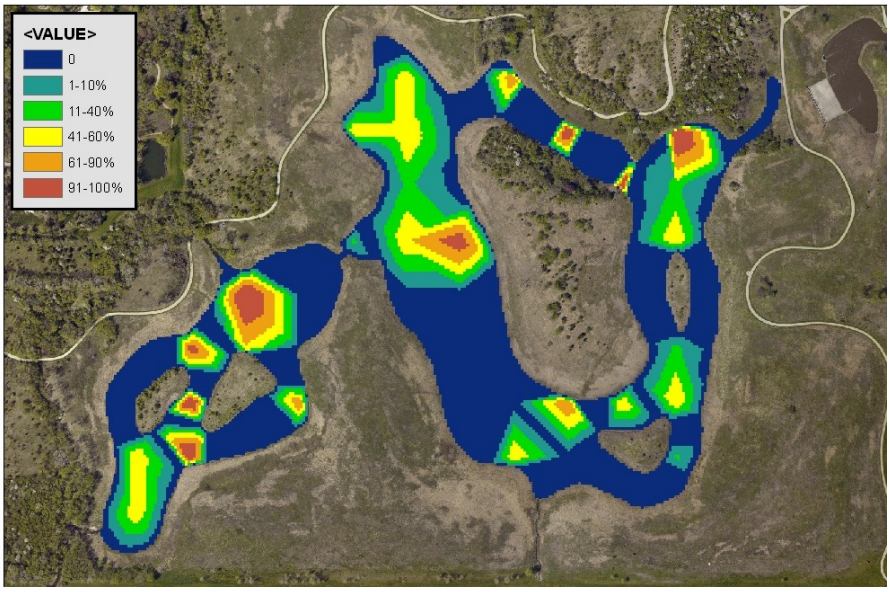
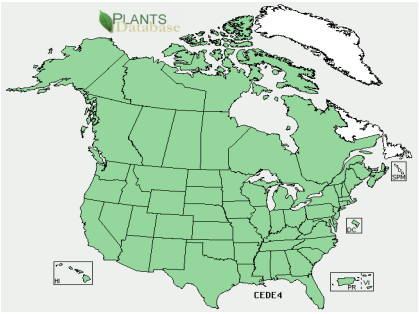


Figure 8. Rake Density and Location of plants in Buffalo Creek Reservoir, 2013.

Aquatic plants

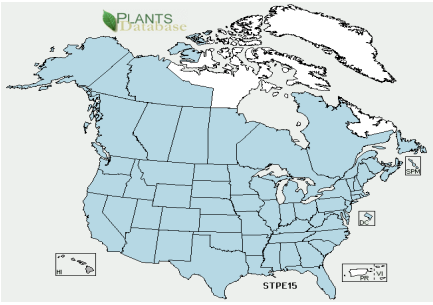
Coontail

Coontail (*Cerataphyllum demeserum*) is a widespread native in and around the United States and Canada. It is identified by its forked whorl of leaves which extends the length of the stem. Early in the season, plants can be confused with Chara, a macroalgae.

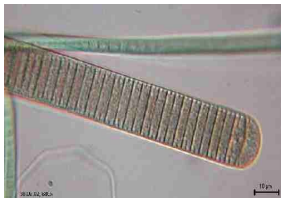


Sago Pondweed

Sago Pondweed (*Stuckenia pectiantus*) has narrow leaves that some say remind them of pine needles. It is an important food source for ducks. This species can be confused with flat stemmed pondweed especially early season plants, however upon close inspection Sago has rounded stem.



Algae

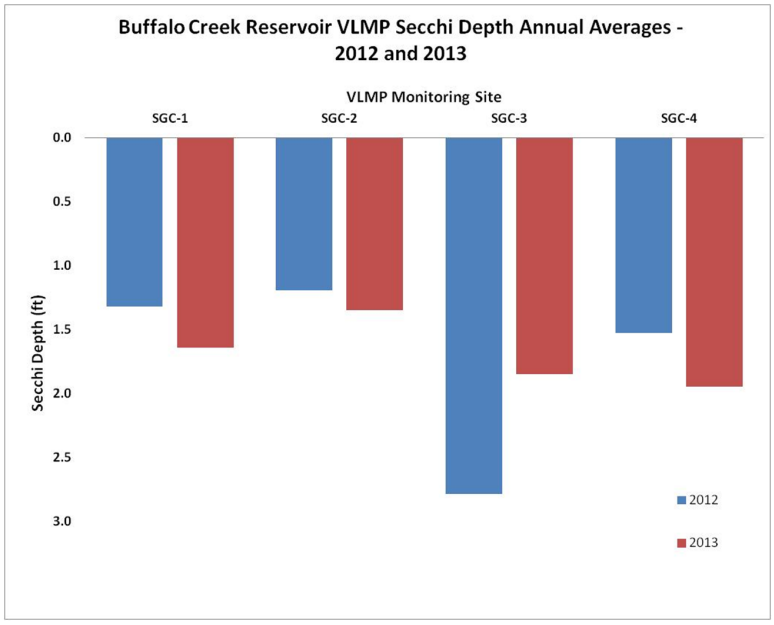


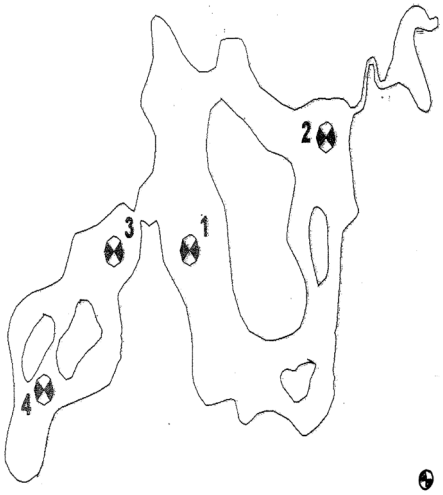
In June, an algal bloom which included a blue green algae, Oscillatoria (pictured to the left), was observed on the surface of the reservoir. Blue green algae are cyanobacteria and are considered an algae due to their ability to photosynthesize. Blue green algae, also termed HABs (harmful algal blooms) are capable of releasing toxins into water. The presence of a HABs does not mean that toxins are present , the cause of the release of toxins is currently being investigated by the experts. The IEPA and the LCHD have initiated a program to collect HAB's waters in the county to test for the presence of microcystin, a common toxin produced by HABs.

Although the reservoir is not used for swimming or boating, it is an area heavily used by the public. If a bloom did contain toxin it is potentially harmful to humans as well as pets. The World Health Organization recommends no contact when ELISA enzyme-linked immunosorbent assay are found to have a concentration of 20 or greater.

VLMP

In 2012 and 2013 Buffalo Creek Reservoir had two VLMP's participating in modified Tier II monitoring. They actively monitored the basins for water clarity (Secchi depth) and DO, additionally collecting water samples for chlorophyll a. The goal of the VLMP is to collect data every two weeks. Buffalo Creek Reservoir had four VLMP sites selected for monitoring, two in each of the basins that make up the entire reservoir. VLMP sites 1 and 3 are the same sites that LCHD-ES monitored in 2013. The results of the VLMP Secchi data for 2012 and 2013 are summarized below as annual average Secchi depths. The results of the 2013 VLMP monitoring indicate that the water clarity in BCR1 is better than BCR2. This agrees with the results from water clarity monitoring conducted in the basins in 2013 by the LCHD.





FISH

The IDNR has never conducted a fish survey on the reservoir. There is submerged aquatic vegetation in the reservoir for fish to use for habitat, and due to the connectiveness with Buffalo Creek it is likely that at the very least a rough fish population exists in the basins. There are frequently citizens fishing the shoreline of the basins. The main purpose of the reservoir is retention of stormwater. Therefore, LCHD-ES does not recommend stocking the lake, as fish make there way into the reservoir via inlets and are flushed out of the reservoir during large storm events. It is recommended that upon the restructuring and expansion of the basin that an effort be made to remove carp from the reservoir in order to promote the expansion of submerged vegetation in the basins. Additionally, if one of the goals of the District is to embellish the fish population in the reservoir, the LCHD-ES recommends that during the expansion the depths of the basins be increased.

SEDIMENTS

In 2013, LCHD-ES collected sediment samples for the Buffalo Creek Clean Watershed Partnership as part of a grant they received from the watershed management board. A composite sample was taken from three locations in each of the two basins in the reservoir. The samples were analyzed for 136 parameters. Of the parameters analyzed, 10 were elevated above listed sediment quality guidelines (SQG's). A table listing the full array of parameters tested and whether or not they exceeded limits is presented in Appendix A, Table 8.

McDonald, 2000 and Mitzelfelt, 1996 were the sediment quality standards used to determine if the pollutants were above normal limits. McDonald used two threshold values; TEC (threshold effect concentration), below the TEC one would not expect adverse effects to occur to soil dwelling organisms, and PEC (probable effect concentration), above the listed PEC, adverse effects to soil dwelling organisms are expected to frequently occur. Mitzelfelt SQG's are either elevated or highly elevated in the soils. Mitzelfelt's classifications were assigned by deviation from mean concentrations found from 273 samples of 63 Illinois lakes (Figure 9).

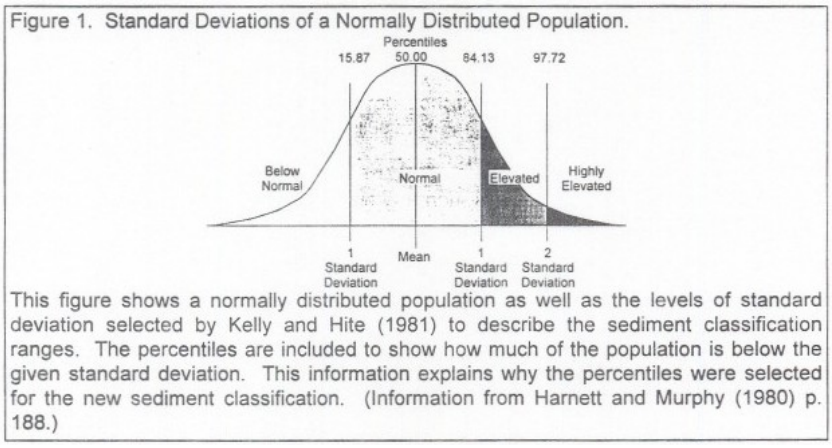


Figure 9. From Mitzelfelt,1996; classification defined.

The pollutants in the sediments of the reservoir whose values exceeded SQG's always were above the McDonald TEC.

The copper concentration in the sediment of BCR2 was above the TEC of 31.6 mg/Kg-dry, however it was not considered elevated under Mitzelfelt. The silver concentration from the sample collected in BCR1 was considered highly elevated by Metzelfelt, with a concentration of 3.48 mg/Kg-dry. The concentration of mercury in BCR1 was above the TEC and is considered elevated.

LakeCounty
Health Department and
Community Health Center

ENVIRONMENTAL SERVICES

Senior Biologist: Mike Adam

madam@lakecountyil.gov

Population Health Services
500 W. Winchester Road
Libertyville, Illinois 60048-1331

Phone: 847-377-8030
Fax: 847-984-5622

For more information visit us at:

http://www.lakecountyil.gov/Health/want/BeachLakeInfo.htm

Protecting the quality of our lakes is an increasing concern of Lake County residents. Each lake is a valuable resource that must be properly managed if it is to be enjoyed by future generations. To assist with this endeavor, Population Health Environmental Services provides technical expertise essential to the management and protection of Lake County surface waters.

Environmental Service's goal is to monitor the quality of the county's surface water in order to:

- Maintain or improve water quality and alleviate nuisance conditions
- Promote healthy and safe lake conditions
- Protect and improve ecological diversity

Services provided are either of a technical or educational nature and are provided by a professional staff of scientists to government agencies (county, township and municipal), lake property owners' associations and private individuals on all bodies of water within Lake County.

RECOMMENDATIONS

LCHD-ES recommends the following actions for improving the water quality and overall health of Buffalo Creek Reservoir:

- Reducing the Carp population in the basins.
- Promote the spread of native vegetation in basins. Management of Curlyleaf Pondweed early in Spring before natives emerge would allow for spread of native species.
- Work with groups in Buffalo Creek watershed to identify problems with eroding shorelines, and non-point sources of pollutants such as chlorides and phosphorus.
- Remediate eroded shorelines within the basin and throughout watershed to minimize sediments from entering into the lake. There are many options available to secure shorelines, naturalizing the shoreline with native plants provides a buffer for nutrient inputs as well as an attractive viewscape, in areas where this is not feasible a combination of hardscaping and shoreline naturalization should be considered.
- If the goal is to support fish in the reservoir, it is recommended that the depth of the basins be increased.
- Consider water quality as well as fish and wildlife habitat in any proposed expansion of the system.

STOP AQUATIC HITCHHIKERS!™

Prevent the transport of nuisance species.
Clean all recreational equipment.
www.ProtectYourWaters.net

When you leave a body of water:

- Remove any visible mud, plants, fish or animals before transporting equipment.
- Eliminate water from equipment before transporting.
- Clean and dry anything that comes into contact with water (boats, trailers, equipment, clothing, dogs, etc.).
- Never release plants, fish or animals into a body of water unless they came out of that body of water.

APPENDIX A

FIGURES AND TABLES
BUFFALO CREEK RESERVOIR
2013

Figure 1. Water quality sampling points, Buffalo Creek Reservoir, 2013.

Figure 2. Buffalo Creek Reservoir watershed, 2013.

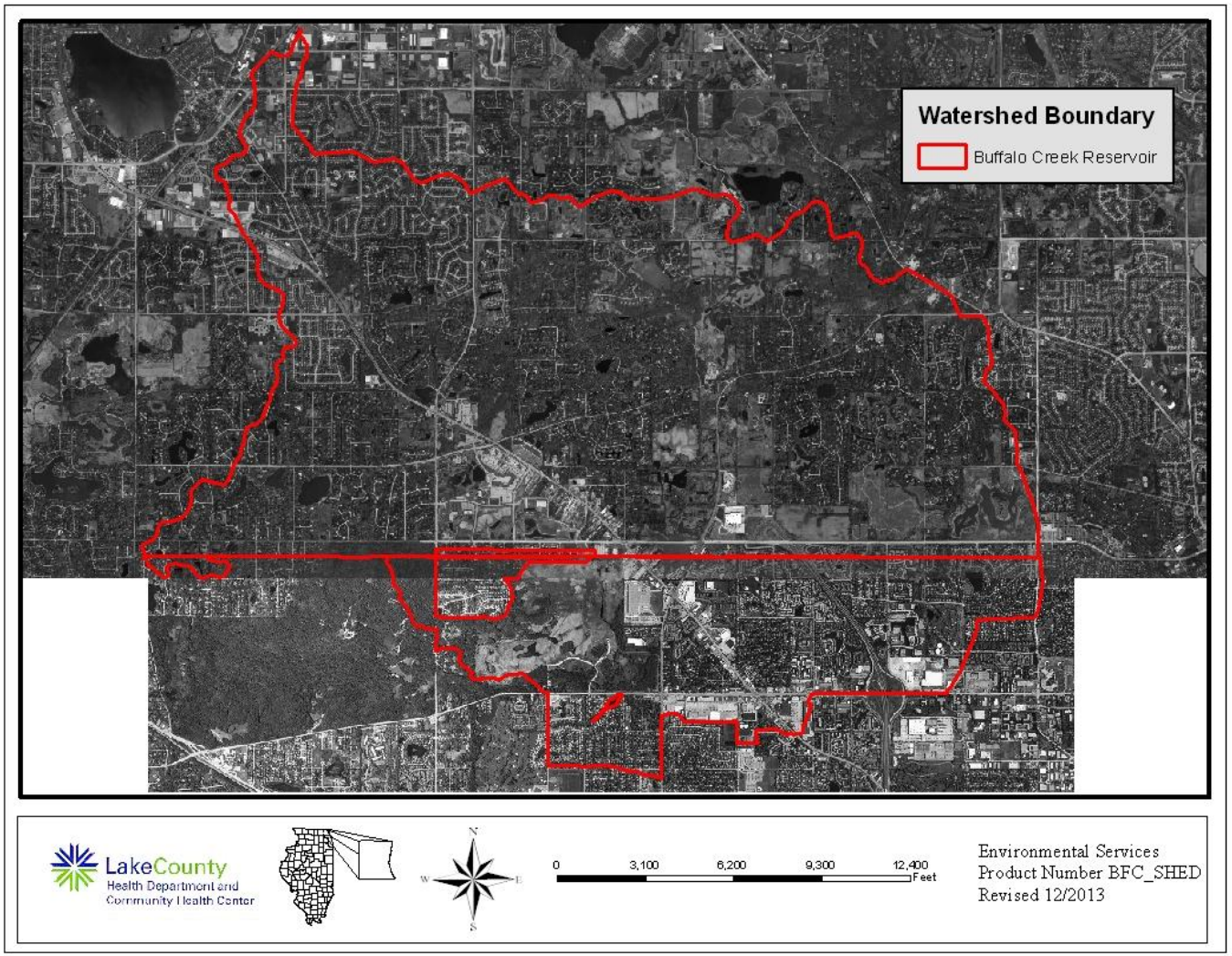


Figure 3. Land use of Buffalo Creek Reservoir watershed, 2013. Based upon 2010 imagery.

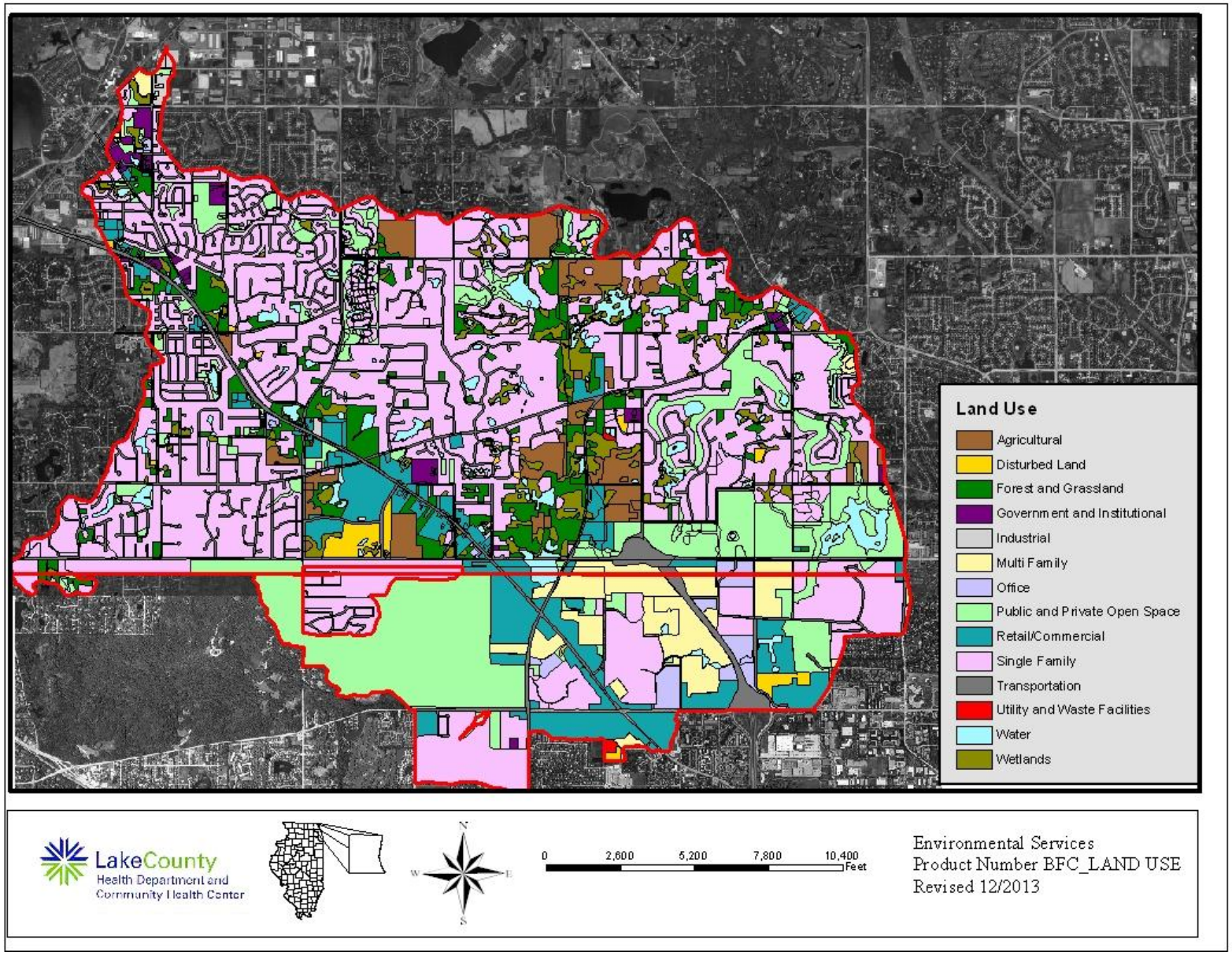


Table 1. Land Use and % total estimated runoff of Buffalo Creek Reservoir watershed.

Land Use	Acreage	% of Total
Disturbed Land	99.47	0.96%
Forest and Grassland	580.68	5.61%
Government and Institutional	87.18	0.84%
Industial	22.06	0.21%
Multi Family	408.97	3.95%
Office	119.96	1.16%
Utility and Waste Facilities	9.42	0.09%
Public and Private Open Space	1620.70	15.66%
Agriculture	384.91	3.72%
Retail/Commercial	797.40	7.70%
Single Family	4444.06	42.93%
Transportation	1024.12	9.89%
Water	356.42	3.44%
Wetlands	396.62	3.83%
TOTAL	**10351.97**	**100.00%**

Land Use	Acreage	Runoff Coeff.	Estimated Runoff, acft.	% total of Estimated Runoff
Disturbed Land	99.47	0.05	13.7	0.17%
Forest and Grassland	580.68	0.05	79.8	0.98%
Govt. & Institution	87.18	0.5	119.9	1.47%
Industial	22.06	0.8	48.5	0.59%
Multi Family	408.97	0.5	562.3	6.89%
Office	119.96	0.85	280.4	3.44%
Utility and Waste Facilities	9.42	0.3	7.8	0.10%
Public & Private Open Space	1620.70	0.05	222.8	2.73%
Agriculture	384.91	0.05	52.9	0.65%
Retail/Commercial	797.40	0.75	1644.6	20.15%
Single Family	4444.06	0.3	3666.4	44.92%
Transportation	1024.12	0.5	1408.2	17.25%
Water	356.42	0	0.0	0.00%
Wetlands	396.62	0.05	54.5	0.67%
TOTAL	**10351.97**		**8161.9**	**100.00%**

Lake volume	**105.5**	**acre-feet**
Retention Time (years)= lake volume/runoff	**0.01**	**years**
	4.72	**days**

Table 2. Water quality data for Buffalo Creek Reservoir, 2001 and 2013.

2013 BCR#1 Summary

DATE	DEPTH	ALK	TKN	NH_3-N	NO_3-N	TP	SRP	TDS*	Cl^-	TSS	TS	TVS	SECCHI	COND	pH	DO
5/14/2013	0	197	0.832	<0.100	<0.050	0.034	<0.010	1058	270	3.1	895	171	1.6	2.010	8.27	8.2
6/11/2013	0	173	0.910	<0.100	<0.050	0.048	0.012	674	265	7.7	777	97	2.6	1.247	8.47	11.8
7/9/2013	0	198	1.390	<0.100	<0.050	0.115	0.010	527	158	9.4	588	103	2.5	0.953	8.57	9.3
8/13/2013	0	154	1.250	<0.100	<0.050	0.085	0.009	541	192	9.6	590	96	1.9	0.982	8.13	6.9
9/10/2013	0	124	1.110	<0.100	<0.050	0.057	<0.010	468	163	6.1	491	64	2.7	0.837	8.47	7.5
	Average	169	1.098	<0.100	<0.050	0.068	0.010[k]	654	210	7.2	668	106	2.2	1.206	8.38	8.7

2013 BCR#2 Summary

DATE	DEPTH	ALK	TKN	NH_3-N	NO_3-N	TP	SRP	TDS*	Cl^-	TSS	TS	TVS	SECCHI	COND	pH	DO
5/14/2013	0	201	0.875	<0.100	<0.050	0.050	<0.010	1074	259	16.0	881	166	2.9	2.042	8.32	10.1
6/11/2013	0	139	1.040	<0.100	<0.050	0.045	0.006	685	288	29.8	789	123	3.6	1.268	8.43	10.9
7/9/2013	0	186	1.480	<0.100	<0.050	0.161	0.019	482	141	14.0	547	95	2.0	0.864	8.27	8.9
8/13/2013	0	166	1.170	<0.100	<0.050	0.131	0.320	533	182	23.4	599	93	1.8	0.966	8.04	7.2
9/10/2013	0	146	1.340	<0.100	<0.050	0.094	0.009	527	182	13.0	568	85	1.2	0.953	8.33	8.2
	Average	168	1.181	<0.100	<0.050	0.096	0.089	660	210	19.2	677	112	2.3	1.219	8.28	9.1

2001 BCR#2 Summary

DATE	DEPTH	ALK	TKN	NH_3-N	NO_3-N	TP	SRP	TDS	Cl^-*	TSS	TS	TVS	SECCHI	COND	pH	DO
5/14/2001	3	190	0.996	<0.100	0.300	0.145	0.016	654	242	36.6	713	145	1.12	1.146	7.69	8.0
6/18/2001	3	221	0.894	<0.100	0.052	0.152	0.031	641	223	29.6	734	190	1.18	1.086	7.88	5.9
7/23/2001	3	189	1.570	0.180	0.071	0.176	0.037	730	255	27.9	808	208	1.18	1.189	7.76	5.0
8/20/2001	3	155	1.550	0.362	0.077	0.160	0.038	594	174	58.6	665	151	0.62	0.929	7.43	4.8
9/17/2001	3	184	1.700	<0.100	<0.050	0.142	0.008	576	190	21.0	610	139	1.38	0.979	8.00	9.1
	Average	188	1.342	0.271[k]	0.125[k]	0.155	0.026	639	217	34.7	706	167	1.10	1.066	7.75	6.5

Glossary

ALK = Alkalinity, mg/L $CaCO_3$
TKN = Total Kjeldahl nitrogen, mg/L
NH_3-N = Ammonia nitrogen, mg/L
NO_3-N = Nitrate nitrogen, mg/L
TP = Total phosphorus, mg/L
SRP = Soluble reactive phosphorus, mg/L
TDS = Total dissolved solids, mg/L
TSS = Total suspended solids, mg/L
TS = Total solids, mg/L
TVS = Total volatile solids, mg/L
SECCHI = Secchi Disk Depth, Ft.
COND = Conductivity, milliSiemens/cm
DO = Dissolved oxygen, mg/L

k = Denotes that the actual value is known to be less than the value presented.
NA= Not applicable
* = Estimated from Conductivity

Figure 4. Water clarity (Secchi depth) for Buffalo Creek Reservoir (BCR1 and BCR2), monitoring years 2001 and 2013.

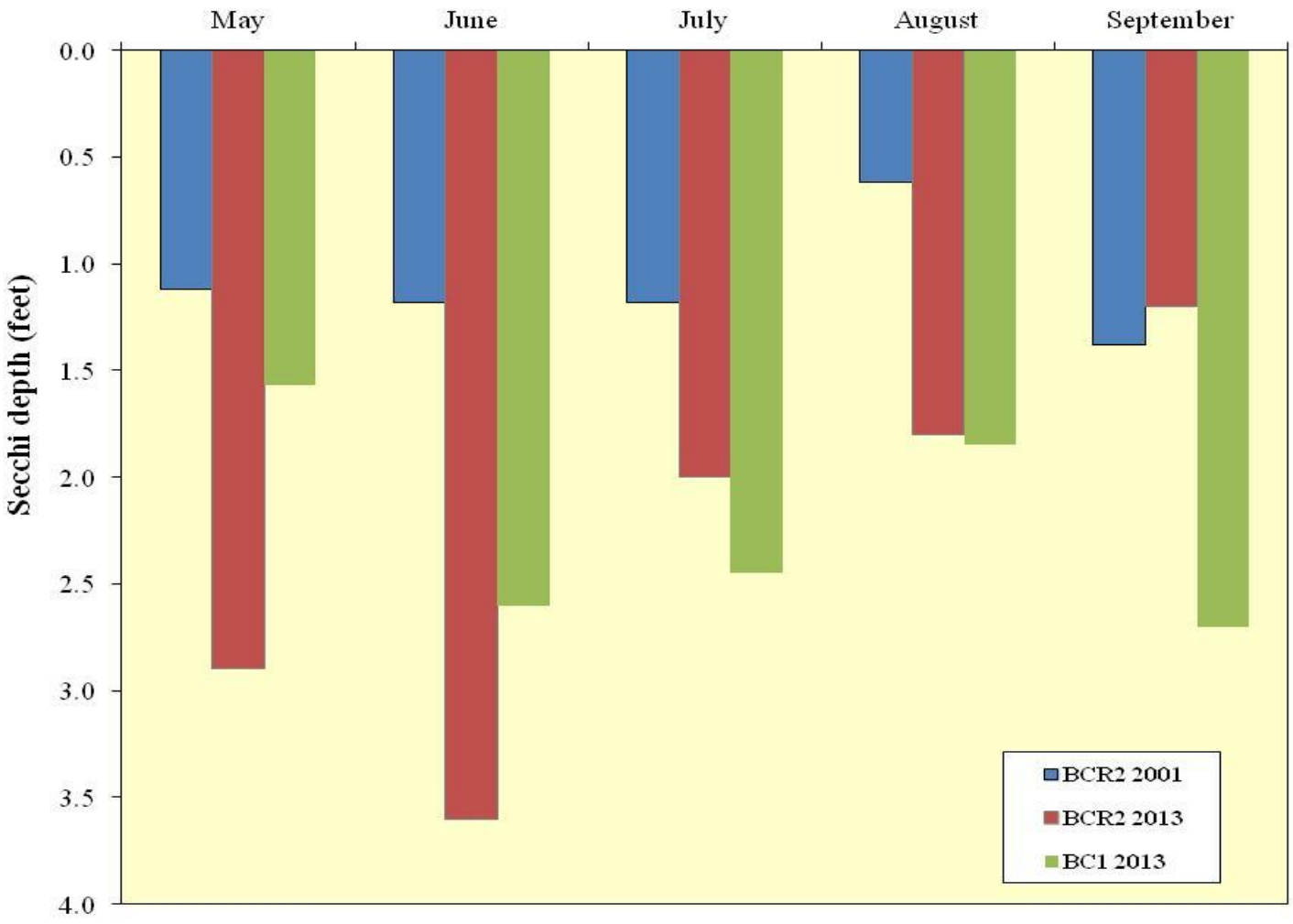


Table 3. Average Secchi depths measured from lakes in Lake County, 2000-2013.

RANK	LAKE NAME	SECCHI AVE	TSIsd
1	Windward Lake	14.28	38.8
2	Lake Carina	13.21	39.9
3	Druce Lake	12.25	41.0
4	Pulaski Pond	11.69	41.7
5	West Loon Lake	11.55	41.9
6	Independence Grove	11.50	41.9
7	Sterling Lake	11.35	42.1
8	Lake Zurich	10.40	43.4
9	Davis Lake	9.65	44.4
10	Harvey Lake	9.47	44.7
11	Little Silver Lake	9.42	44.8
12	Old School Lake	9.40	44.8
13	Lake Kathryn	9.39	44.8
14	Dugdale Lake	9.22	45.1
15	Dog Training Pond	9.04	45.4
16	Bangs Lake	8.90	45.0
17	Banana Pond	8.85	45.7
18	Deep Lake	8.83	45.7
19	Stone Quarry Lake	8.81	45.8
20	Lake of the Hollow	8.74	45.9
21	Cedar Lake	8.25	47.0
22	Cross Lake	8.18	46.8
23	Ames Pit	8.14	46.9
24	Briarcrest Pond	8.00	47.1
25	Cranberry Lake	7.88	46.0
26	Sand Lake	7.48	48.1
27	Sand Pond (IDNR)	7.42	48.2
28	Timber Lake (North)	7.37	48.3
29	Lake Miltmore	7.35	48.4
30	Lake Leo	7.31	48.4
31	Schreiber Lake	7.25	48.6
32	Nielsen Pond	7.23	48.6
33	Honey Lake	7.17	48.7
34	Lake Minear	7.13	48.8
35	Round Lake	7.01	49.1
36	Highland Lake	6.97	49.1
37	Channel Lake	6.65	49.8
38	Third Lake	6.60	50.0
39	Lake Catherine	6.58	50.0
40	Lake Helen	6.43	50.3
41	Sun Lake	6.33	50.5
42	Wooster Lake	6.21	51.0
43	Lake Barrington	6.12	51.0
44	Lake Fairfield	5.89	51.6
45	Countryside Lake	5.56	52.0
46	Gages Lake	5.45	52.7
47	Owens Lake	5.30	53.1
48	Valley Lake	5.05	53.8

Table 3. Average Secchi depths measured from lakes in Lake County, 2000-2013.

RANK	LAKE NAME	SECCHI AVE	TSIsd
49	McGreal Lake	5.04	53.8
50	Old Oak Lake	4.85	54.4
51	Waterford Lake	4.70	54.8
52	Lake Linden	4.60	55.1
53	Peterson Pond	4.51	55.4
54	Timber Lake (South)	4.46	56.0
55	Crooked Lake	4.39	55.8
56	Mary Lee Lake	4.35	55.9
57	Butler Lake	4.35	55.9
58	Crooked Lake	4.28	56.2
59	Deer Lake	4.20	56.4
60	Seven Acre Lake	4.18	56.5
61	Lambs Farm Lake	4.17	56.5
62	Grays Lake	4.08	56.9
63	Lake Naomi	4.05	57.0
64	White Lake	3.96	57.3
65	Hook Lake	3.95	57.3
66	Turner Lake	3.92	57.4
67	North Tower Lake	3.89	60.0
68	Leisure Lake	3.85	57.7
69	Salem Lake	3.77	58.0
70	Lake Fairview	3.75	58.0
71	Countryside Glen Lake	3.64	58.5
72	Taylor Lake	3.52	59.0
73	Hastings Lake	3.52	59.0
74	Duck Lake	3.49	59.1
75	Fish Lake	3.47	59.2
76	Bishop Lake	3.47	59.2
77	Lake Lakeland Estates	3.41	59.0
78	Lake Holloway	3.40	59.5
79	Stockholm Lake	3.38	59.6
80	East Loon Lake	3.30	59.9
81	Bresen Lake	3.28	60.0
82	Summerhill Estates Lake	3.27	60.0
83	Lucky Lake	3.22	60.3
84	Diamond Lake	3.17	60.5
85	Liberty Lake	3.16	60.5
86	International Mining and Chemical Lake	3.08	60.9
87	Lake Christa	3.01	61.2
88	Lucy Lake	2.99	61.3
89	Long Lake	2.87	62.0
90	Bluff Lake	2.85	62.0
91	St. Mary's Lake	2.79	62.3
92	Werhane Lake	2.71	62.8
93	Petite Lake	2.66	63.0
94	East Meadow Lake	2.61	63.3
95	Buffalo Creek Reservoir 1	2.60	64.0
96	Kemper Lake 1	2.56	63.6

Table 3. Average Secchi depths measured from lakes in Lake County, 2000-2013.

RANK	LAKE NAME	SECCHI AVE	TSIsd
97	Broberg Marsh	2.50	63.9
98	Antioch Lake	2.48	64.0
99	Spring Lake	2.46	64.2
100	Little Bear Lake	2.38	64.6
101	Island Lake	2.32	65.0
102	Tower Lake	2.31	56.0
103	Buffalo Creek Reservoir 2	2.30	67.0
104	Woodland Lake	2.28	65.0
105	Lake Marie	2.25	65.4
106	Rivershire Pond 2	2.23	65.6
107	Lake Charles	2.20	65.8
108	College Trail Lake	2.18	65.9
109	Loch Lomond	2.17	66.0
110	Echo Lake	2.11	66.4
111	Eagle Lake (S1)	2.10	66.4
112	West Meadow Lake	2.07	66.6
113	Forest Lake	2.04	66.9
114	Grand Ave Marsh	2.03	66.9
115	Columbus Park Lake	2.03	66.9
116	Grassy Lake	2.00	67.1
117	Sylvan Lake	1.98	67.3
118	Bittersweet Golf Course #13	1.98	67.3
119	Fischer Lake	1.96	67.4
120	Pistakee Lake	1.88	68.0
121	Kemper Lake 2	1.77	68.9
122	Fourth Lake	1.77	68.9
123	Nippersink Lake	1.73	69.2
124	Deer Lake Meadow Lake	1.73	69.2
125	Lake Louise	1.68	69.7
126	Willow Lake	1.63	70.1
127	Slough Lake	1.63	70.1
128	Rasmussen Lake	1.62	70.2
129	Lake Farmington	1.62	70.2
130	Half Day Pit	1.60	70.4
131	Dunn's Lake	1.54	70.9
132	Longview Meadow Lake	1.51	71.2
133	Lake Matthews	1.41	72.2
134	Fox Lake	1.37	72.6
135	Grass Lake	1.33	73.0
136	Big Bear Lake	1.32	73.1
137	Lake Nippersink	1.28	73.6
138	Redhead Lake	1.27	73.7
139	Lake Eleanor	1.16	75.0
140	McDonald Lake 1	1.13	75.4
141	Lake Napa Suwe	1.06	105.0
142	Rollins Savannah 1	1.05	76.4
143	Osprey Lake	1.03	76.7
144	Manning's Slough	1.00	77.1

Table 3. Average Secchi depths measured from lakes in Lake County, 2000-2013.

RANK	LAKE NAME	SECCHI AVE	TSIsd
145	Rollins Savannah 2	0.95	77.9
146	Dog Bone Lake	0.94	78.0
147	Redwing Marsh	0.88	79.0
148	Flint Lake Outlet	0.83	79.8
149	Slocum Lake	0.81	80.0
150	Fairfield Marsh	0.81	80.2
151	Oak Hills Lake	0.79	80.5
152	South Churchill Lake	0.73	81.7
153	Lake Forest Pond	0.71	82.1
54	ADID 127	0.66	83.1
155	North Churchill Lake	0.61	84.3
156	Hidden Lake	0.56	85.5
157	Ozaukee Lake	0.51	86.8
158	McDonald Lake 2	0.50	87.1

Table 4. Lake County average TSI phosphorus (TSIp) ranking 2000-2013.

RANK	LAKE NAME	TP AVE	TSIp
1	Lake Carina	0.0100	37.35
2	Sterling Lake	0.0100	37.35
3	Independence Grove	0.0130	41.14
4	Lake Zurich	0.0135	41.68
5	Druce Lake	0.0140	42.00
6	Windward Lake	0.0160	44.13
7	Sand Pond (IDNR)	0.0165	44.57
8	West Loon	0.0170	45.00
9	Pulaski Pond	0.0180	45.83
10	Banana Pond	0.0200	47.35
11	Cedar Lake	0.0200	47.35
12	Gages Lake	0.0200	47.35
13	Lake Kathryn	0.0200	47.35
14	Lake Minear	0.0200	47.35
15	Highland Lake	0.0202	47.49
16	Lake Miltmore	0.0210	48.00
17	Timber Lake (North)	0.0210	48.05
18	Cross Lake	0.0220	48.72
19	Dog Training Pond	0.0220	48.72
20	Sun Lake	0.0220	48.72
21	Deep Lake	0.0230	49.36
22	Lake of the Hollow	0.0230	49.36
23	Round Lake	0.0230	49.36
24	Stone Quarry Lake	0.0230	49.36
25	Bangs Lake	0.0240	50.00
26	Little Silver Lake	0.0250	50.57
27	Lake Leo	0.0260	51.13
28	Cranberry Lake	0.0270	51.68
29	Dugdale Lake	0.0270	51.68
30	Peterson Pond	0.0270	51.68
31	Fourth Lake	0.0360	53.00
32	Lake Fairfield	0.0300	53.20
33	Third Lake	0.0300	53.20
34	Lake Catherine	0.0310	53.67
35	Lambs Farm Lake	0.0310	53.67
36	Old School Lake	0.0310	53.67
37	Grays Lake	0.0310	54.00
38	Harvey Lake	0.0320	54.50
39	Hendrick Lake	0.0340	55.00
40	Honey Lake	0.0340	55.00
41	Sand Lake	0.0380	56.00
42	Sullivan Lake	0.0370	56.22
43	Channel Lake	0.0380	56.60
44	Ames Pit	0.0390	56.98
45	Diamond Lake	0.0390	56.98
46	East Loon	0.0400	57.34
47	Schreiber Lake	0.0400	57.34
48	Waterford Lake	0.0400	57.34
49	Hook Lake	0.0410	57.70
50	Duck Lake	0.0430	58.39
51	Nielsen Pond	0.0450	59.04
52	Seven Acre Lake	0.0460	59.36

Table 4. Lake County average TSI phosphorus (TSIp) ranking 2000-2013.

RANK	LAKE NAME	TP AVE	TSIp
53	Turner Lake	0.0460	59.36
54	Willow Lake	0.0460	59.36
55	East Meadow Lake	0.0480	59.97
56	Lucky Lake	0.0480	59.97
57	Old Oak Lake	0.0490	60.27
58	College Trail Lake	0.0500	60.56
59	Hastings Lake	0.0520	61.13
60	Butler Lake	0.0530	61.40
61	West Meadow Lake	0.0530	61.40
62	Lucy Lake	0.0550	61.94
63	Lake Linden	0.0570	62.45
64	Lake Christa	0.0580	62.70
65	Owens Lake	0.0580	62.70
66	Briarcrest Pond	0.0580	63.00
67	Lake Barrington	0.0600	63.10
68	Lake Lakeland Estates	0.0620	63.66
69	Lake Naomi	0.0620	63.66
70	Lake Tranquility (S1)	0.0620	63.66
71	Liberty Lake	0.0630	63.89
72	North Tower Lake	0.0630	63.89
73	Werhane Lake	0.0630	63.89
74	Countryside Glen Lake	0.0640	64.12
75	Countryside Lake	0.0660	65.00
76	Davis Lake	0.0650	64.34
77	Leisure Lake	0.0650	64.34
78	St. Mary's Lake	0.0670	64.78
79	Little Bear Lake	0.0680	65.00
80	Buffalo Creek Reservoir 1	0.0680	65.00
81	Mary Lee Lake	0.0680	65.00
82	Wooster Lake	0.0700	65.41
83	Crooked Lake	0.0710	66.00
84	Timber Lake (South)	0.0720	65.82
85	Lake Helen	0.0720	65.82
86	Grandwood Park Lake	0.0720	65.82
87	ADID 203	0.0730	66.02
88	Bluff Lake	0.0730	66.02
89	Long Lake	0.0730	66.02
90	Spring Lake	0.0730	66.02
91	Broberg Marsh	0.0780	66.97
92	Woodland Lake	0.0800	68.00
93	Redwing Slough	0.0822	67.73
94	Tower Lake	0.0830	67.87
95	Petite Lake	0.0830	67.87
96	Lake Marie	0.0850	68.21
97	Potomac Lake	0.0850	68.21
98	White Lake	0.0862	68.42
99	Grand Ave Marsh	0.0870	68.55
100	North Churchill Lake	0.0870	68.55
101	McDonald Lake 1	0.0880	68.71
102	Lake Fairview	0.0890	68.00
103	Rivershire Pond 2	0.0900	69.04
104	South Churchill Lake	0.0900	69.04

Table 4. Lake County average TSI phosphorus (TSIp) ranking 2000-2013.

RANK	LAKE NAME	TP AVE	TSIp
105	McGreal Lake	0.0910	69.20
106	Lake Charles	0.0930	69.40
107	Deer Lake	0.0940	69.66
108	Dunn's Lake	0.0950	69.82
109	Eagle Lake (S1)	0.0950	69.82
110	International Mine and Chemical Lake	0.0950	69.82
111	Valley Lake	0.0950	69.82
112	Big Bear Lake	0.0960	69.97
113	Buffalo Creek Reservoir 2	0.0960	69.97
114	Fish Lake	0.0960	69.97
115	Lochanora Lake	0.0960	69.97
116	Nippersink Lake	0.1000	70.56
117	Sylvan Lake	0.1000	70.56
118	Longview Meadow Lake	0.1020	70.84
119	Lake Forest Pond	0.1070	71.53
120	Bittersweet Golf Course #13	0.1100	71.93
121	Fox Lake	0.1100	71.93
122	Kemper 2	0.1100	71.93
123	Middlefork Savannah Outlet 1	0.1120	72.00
124	Osprey Lake	0.1110	72.06
125	Bresen Lake	0.1130	72.32
126	Round Lake Marsh North	0.1130	72.32
127	Deer Lake Meadow Lake	0.1160	72.70
128	Taylor Lake	0.1180	72.94
129	Island Lake	0.1210	73.00
130	Columbus Park Lake	0.1230	73.54
131	Lake Nippersink	0.1240	73.66
132	Echo Lake	0.1250	73.77
133	Grass Lake	0.1290	74.23
134	Lake Holloway	0.1320	74.56
135	Redhead Lake	0.1410	75.51
136	Antioch Lake	0.1450	75.91
137	Slocum Lake	0.1500	77.00
138	Lakewood Marsh	0.1510	76.50
139	Pond-A-Rudy	0.1510	76.50
140	Lake Matthews	0.1520	76.59
141	Forest Lake	0.1540	76.78
142	Middlefork Savannah Outlet 2	0.1590	77.00
143	Pistakee Lake	0.1590	77.24
144	Grassy Lake	0.1610	77.42
145	Salem Lake	0.1650	77.78
146	Half Day Pit	0.1690	78.12
147	Lake Eleanor	0.1810	79.11
148	Lake Farmington	0.1850	79.43
149	Lake Louise	0.1850	79.43
150	ADID 127	0.1890	79.74
151	Lake Napa Suwe	0.1940	80.00
152	Patski Pond	0.1970	80.33
153	Dog Bone Lake	0.1990	80.48
154	Summerhill Estates Lake	0.1990	80.48
155	Redwing Marsh	0.2070	81.05
156	Stockholm Lake	0.2082	81.13

Table 4. Lake County average TSI phosphorus (TSIp) ranking 2000-2013.

RANK	LAKE NAME	TP AVE	TSIp
157	Bishop Lake	0.2160	81.66
158	Ozaukee Lake	0.2200	81.93
159	Kemper 1	0.2220	82.08
160	Hidden Lake	0.2240	82.19
161	McDonald Lake 2	0.2250	82.28
162	Fischer Lake	0.2280	82.44
163	Oak Hills Lake	0.2790	85.35
164	Loch Lomond	0.2950	86.16
165	Heron Pond	0.2990	86.35
166	Rollins Savannah 1	0.3070	87.00
167	Fairfield Marsh	0.3260	87.60
168	ADID 182	0.3280	87.69
169	Manning's Slough	0.3820	90.22
170	Slough Lake	0.3860	90.03
171	Rasmussen Lake	0.4860	93.36
172	Albert Lake, Site II, outflow	0.4950	93.67
173	Flint Lake Outlet	0.5000	93.76
174	Rollins Savannah 2	0.5870	96.00
175	Almond Marsh	1.9510	113.00

Figure 5. TP concentrations in Buffalo Creek Reservoir, 2013.

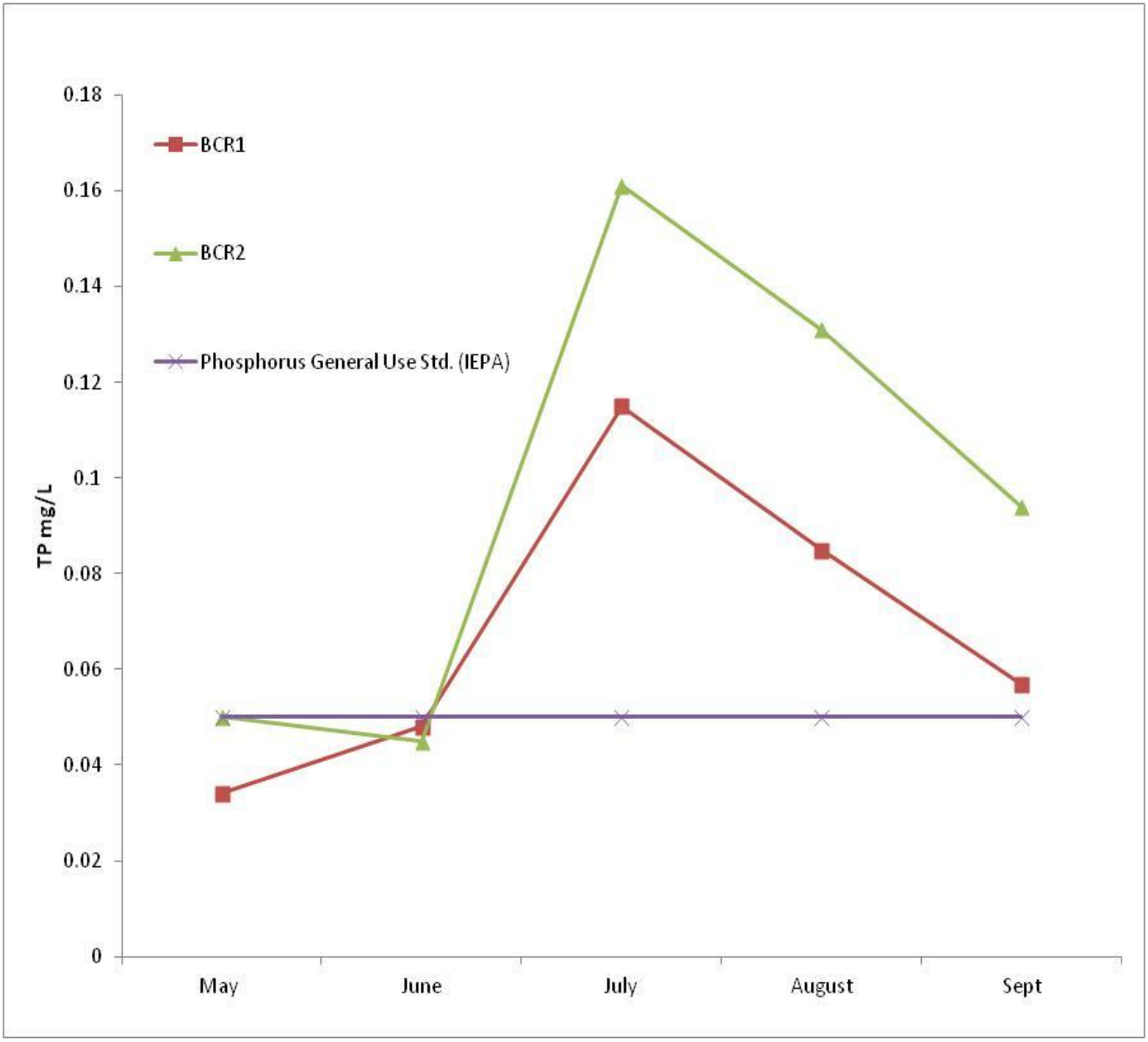


Table 5. Multiparameter data - Buffalo Creek Reservoir, 2013.

Buffalo Creek Reservoir #1 2013

Date MMDDYY	Text Depth feet	Dep25 feet	Temp øC	DO mg/l	DO% Sat	SpCond mS/cm	pH Units	BG cell	PAR æE/s/mý
5/14/2013	0.25	0.00	17.38	8.27	90.5	0.5985	8.27	NA	NR
5/14/2013	1	1.00	17.05	8.24	91.0	0.5986	8.24	NA	NR
5/14/2013	2	2.00	16.84	8.22	91.2	0.5984	8.22	NA	NR
5/14/2013	3	3.00	16.55	8.22	91.2	0.5984	8.22	NA	NR
									NR

Date MMDDYY	Text Depth feet	Dep25 feet	Temp øC	DO mg/l	DO% Sat	SpCond mS/cm	pH Units	BG cell	PAR æE/s/mý
6/11/2013	0	0.00	24.12	11.81	141.0	1.247	8.47	NA	NR
6/11/2013	1	1.00	23.41	12.00	142.0	1.239	8.48	NA	NR
6/11/2013	2	2.00	22.03	12.00	137.8	1.265	3.38	NA	NR
6/11/2013	3	3.00	19.62	7.44	88.9	1.346	7.92	NA	NR
6/11/2013	4	4.00	19.62	7.16	78.5	1.357	7.88	NA	NR

Date MMDDYY	Text Depth feet	Dep25 feet	Temp øC	DO mg/l	DO% Sat	SpCond mS/cm	pH Units	BG cell	PAR æE/s/mý
7/9/2013	0	0.511	27.61	9.27	117.9	0.953	8.57	3202	2594.1
7/9/2013	1	0.984	26.46	10.63	132.4	0.952	8.22	4780	3219.3
7/9/2013	2	1.977	25.47	8.10	99.1	0.963	7.96	7803	466.4
7/9/2013	3	2.957	23.61	6.39	75.6	0.998	7.86	7180	33.9
7/9/2013	4	3.907	23.57	4.19	49.5	0.998	7.61	13532	7.9

Date MMDDYY	Text Depth feet	Dep25 feet	Temp øC	DO mg/l	DO% Sat	SpCond mS/cm	pH Units	BG cell	PAR æE/s/mý
8/13/2013	0	0.00	23.47	6.91	81.1	0.982	8.13	NR	3004
8/13/2013	1	1.00	23.45	6.51	76.7	0.982	8.01	NR	2936
8/13/2013	2	2.00	23.34	6.38	75.0	0.981	7.98	NR	832
8/13/2013	3	3.00	23.21	5.71	67.0	0.984	7.90	NR	36
8/13/2013	4	4.00	23.21	5.55	64.9	0.984	7.84	NR	70

Date MMDDYY	Text Depth feet	Dep25 feet	Temp øC	DO mg/l	DO% Sat	SpCond mS/cm	pH Units	BG cell	PAR æE/s/mý
9/10/2013	0	0.49	24.96	7.48	90.7	0.837	8.47	1446	NR
9/10/2013	1	0.99	24.96	7.21	87.3	0.836	8.29	3347	NR
9/10/2013	2	2.01	24.94	7.37	89.3	0.836	8.28	4337	NR
9/10/2013	3	3.09	24.47	4.78	57.4	0.84	8.00	6467	NR
9/10/2013	4	3.88	24.21	4.69	56.1	0.835	7.75	6488	NR

Table 5. Multiparameter data - Buffalo Creek Reservoir, 2013.

Buffalo Creek Reservoir #2 2013

Date MMDDYY	Text Depth feet	Dep25 feet	Temp øC	DO mg/l	DO% Sat	SpCond mS/cm	pH Units	BG cell	PAR æE/s/mý
5/14/2013	0	0.00	17.78	10.10	104.3	2.042	8.32	NA	NR
5/14/2013	1	1.00	17.22	10.59	110.6	2.073	8.27	NA	NR
5/14/2013	2	2.00	16.96	10.85	112.8	2.091	8.24	NA	NR
5/14/2013	3	3.00	16.30	11.79	120.9	2.092	8.31	NA	NR

Date MMDDYY	Text Depth feet	Dep25 feet	Temp øC	DO mg/l	DO% Sat	SpCond mS/cm	pH Units	BG cell	PAR æE/s/mý
6/11/2013	0	0.00	23.82	10.91	129.8	1.268	8.43	NA	NR
6/11/2013	1	1.00	21.64	10.31	113.8	1.279	8.23	NA	NR
6/11/2013	2	2.00	20.14	6.85	72.5	1.283	8.09	NA	NR
6/11/2013	3	3.00	17.07	3.00	31.0	1.255	7.72	NA	NR

Date MMDDYY	Text Depth feet	Dep25 feet	Temp øC	DO mg/l	DO% Sat	SpCond mS/cm	pH Units	BG cell	PAR æE/s/mý
7/9/2013	0	0.49	26.70	8.90	111.3	0.864	8.27	4409	2283.8
7/9/2013	1	1.04	26.44	8.93	111.2	0.862	8.27	6997	2196.5
7/9/2013	2	1.93	25.83	8.76	107.9	0.873	8.19	5670	788.6
7/9/2013	3	2.97	25.13	7.61	92.5	0.877	8.02	5445	231.9
7/9/2013	4	3.96	24.87	6.07	73.4	0.873	7.94	7972	20.3

Date MMDDYY	Text Depth feet	Dep25 feet	Temp øC	DO mg/l	DO% Sat	SpCond mS/cm	pH Units	BG cell	PAR æE/s/mý
8/14/2013	0	0.78	23.32	7.06	83.1	0.966	8.04	3061	513.6
8/14/2013	1	1.02	23.32	7.04	82.8	0.966	8.05	2947	468.0
8/14/2013	2	2.24	23.31	7.00	82.3	0.967	8.07	3578	117.5
8/14/2013	3	3.00	23.31	6.94	81.6	0.967	8.07	4537	110.6
8/14/2013	4	4.27	23.38	1.06	12.5	0.887	7.44	2161	4.1

Date MMDDYY	Text Depth feet	Dep25 feet	Temp øC	DO mg/l	DO% Sat	SpCond mS/cm	pH Units	BG cell	PAR æE/s/mý
9/10/2013	0	0.48	25.15	8.24	100.2	0.953	8.33	5930	NR
9/10/2013	1	1.05	25.15	8.23	100.1	0.954	8.33	3565	NR
9/10/2013	2	2.00	25.07	8.23	100.0	0.961	8.33	3497	NR
9/10/2013	3	3.02	24.00	7.44	88.6	0.989	8.26	8788	NR
9/10/2013	4	4.24	22.82	2.15	25.1	1.005	7.81	6382	NR
9/10/2013	5	4.92	22.57	2.17	25.2	0.997	7.76	6382	NR

Figure 6. Volunteer lake monitor Secchi data, 2012 - 2013.

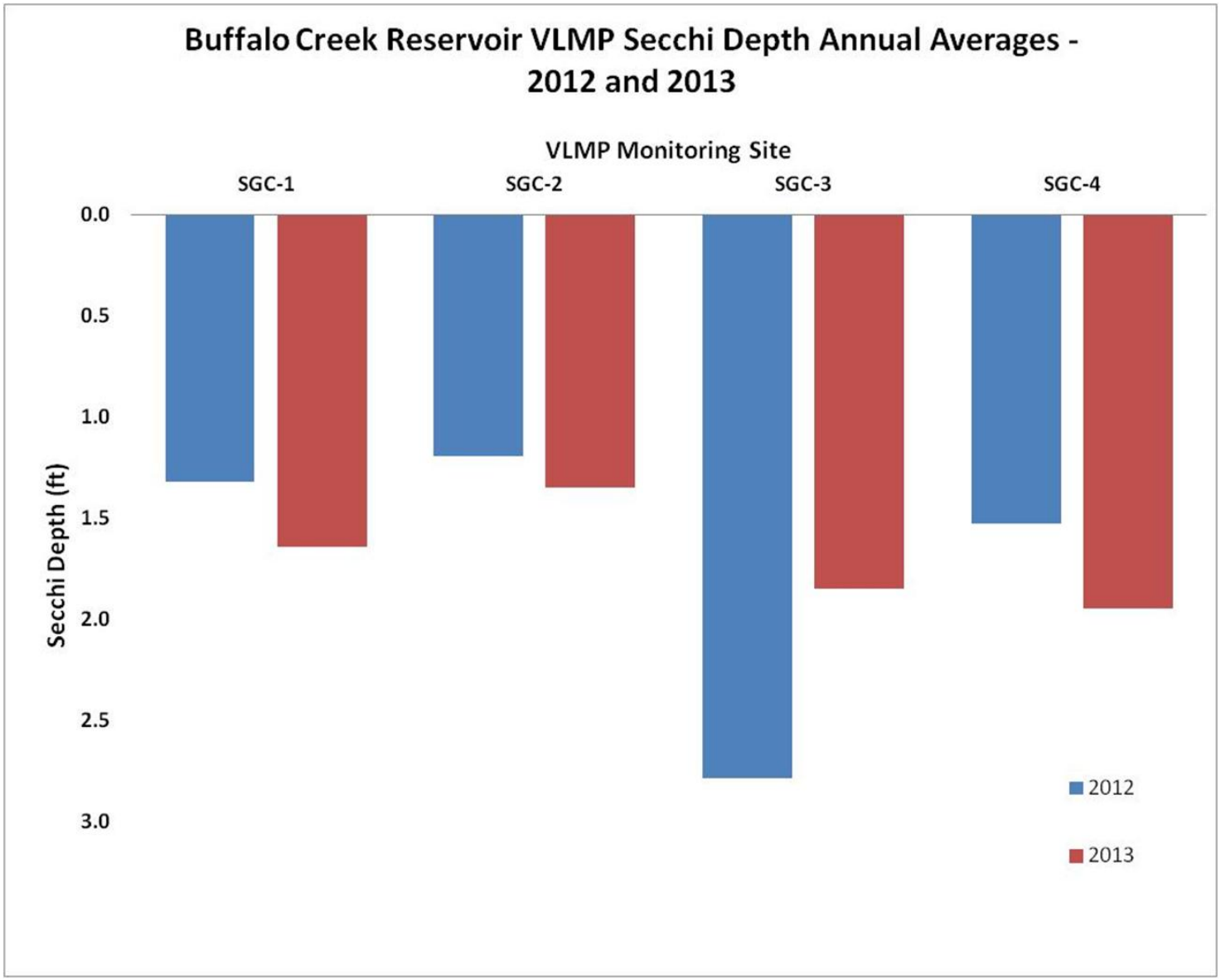


Table 6a. Aquatic vegetation species found at the 34 sampling sites on Buffalo Creek Reservoir, September, 2013. Maximum depth that plants were found was 5.0 feet.

Plant Density	Coontail	Curlyleaf Pondweed	Duckweed	Elodea canadensis	Flatstem Pondweed	Sago Pondweed	Unknown
Absent	7	33	30	29	31	32	31
Present	7	1	3	1	2	2	1
Common	10	0	1	1	1	0	1
Abundant	4	0	0	2	0	0	1
Dominant	6	0	0	1	0	0	0
% Plant Occurrence	79.4	2.9	11.8	14.7	8.8	5.9	8.8

Table 6b. Distribution of rake density across all 34 sampling sites, Buffalo Creek Reservoir, September 2013.

Rake Density (coverage)	# of Sites	% of Sites
No Plants	7	21
>0-10%	5	15
10-40%	11	32
40-60%	3	9
60-90%	2	6
>90%	6	18
Total Sites with Plants	27	79
Total # of Sites	34	100

Figure 7. Estimated rake density of vegetation occurring in Buffalo Creek Reservoir, 2013.

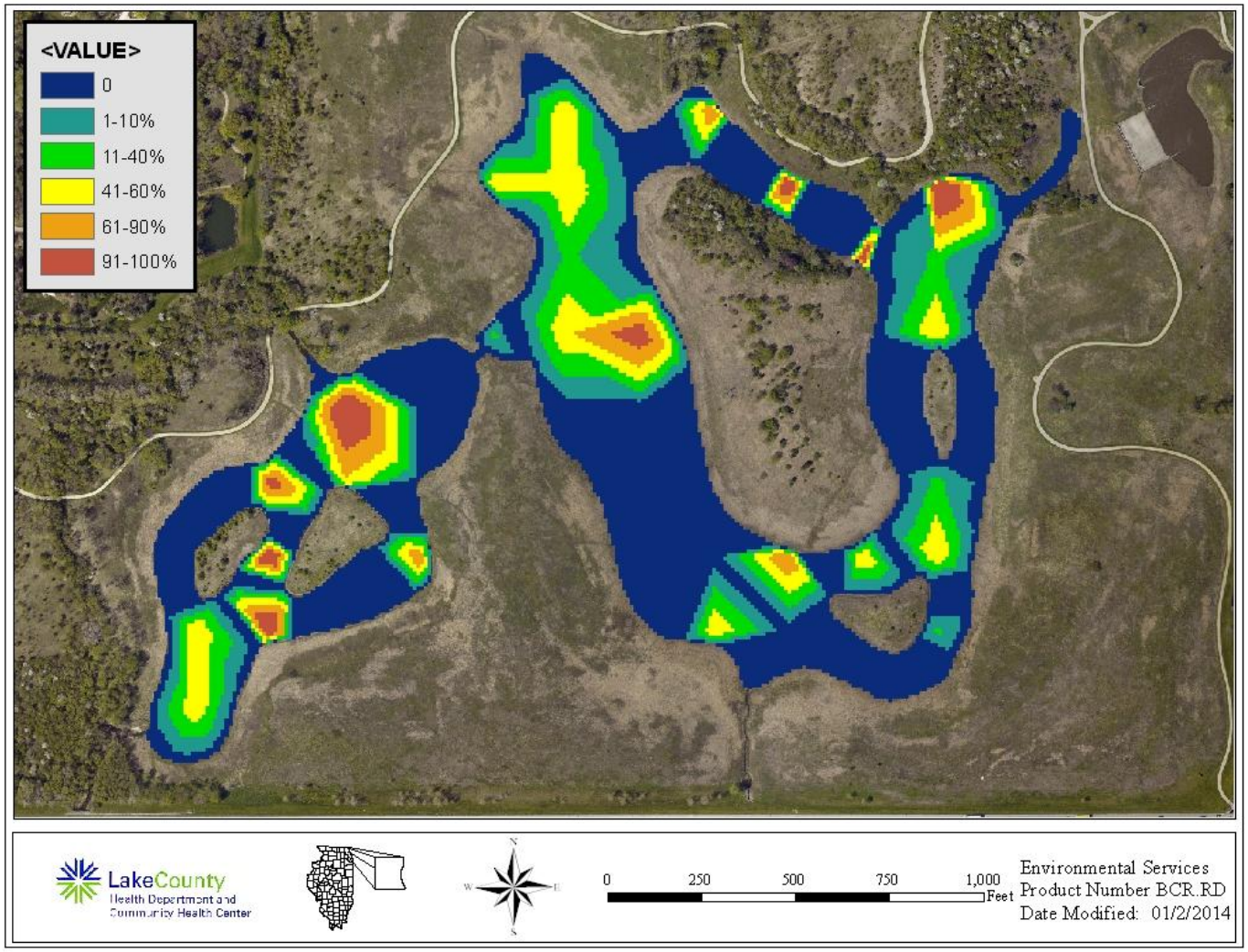


Table 7. Lake County average Floristic Quality Index ranking 2000 – 2013.

RANK	LAKE NAME	FQI (w/A)	FQI (native)
1	Cedar Lake	38.0	36.6
2	East Loon Lake	34.7	36.1
3	Cranberry Lake	29.7	29.7
4	Deep Lake	29.7	31.2
5	Bangs Lake	29.6	26.0
6	Little Silver Lake	29.6	31.6
7	Round Lake Marsh North	29.1	29.9
8	West Loon Lake	27.1	29.5
9	Sullivan Lake	26.9	28.5
10	Third Lake	25.1	22.5
11	Fourth Lake	24.7	27.1
12	Independence Grove	24.6	27.5
13	Sterling Lake	24.5	26.9
14	Sun Lake	24.3	26.1
15	Lake Zurich	24.3	27.1
16	Redwing Slough	24.0	25.8
17	Schreiber Lake	23.9	24.8
18	Lakewood Marsh	23.8	24.7
19	Deer Lake	23.5	24.4
20	Round Lake	23.5	25.9
21	Honey Lake	23.3	25.1
22	Lake of the Hollow	23.0	24.8
23	Wooster Lake	22.8	21.1
24	Cross Lake	22.4	24.2
25	Countryside Glen Lake	21.9	22.8
26	Davis Lake	21.4	21.4
27	Butler Lake	21.4	23.1
28	Lake Barrington	21.2	21.2
29	Duck Lake	21.1	22.9
30	Timber Lake (North)	20.9	23.4
31	ADID 203	20.5	20.5
32	Broberg Marsh	20.5	21.4
33	McGreal Lake	20.2	22.1
34	Lake Kathryn	19.6	20.7
35	Fish Lake	19.3	21.2
36	Redhead Lake	19.3	21.2
37	Druce Lake	19.1	21.8
38	Turner Lake	18.6	21.2
39	Salem Lake	18.5	20.2
40	Lake Helen	18.0	18.0
41	Old Oak Lake	18.0	19.1
42	Potomac Lake	17.8	17.8
43	Long Lake	17.7	15.8
44	Hendrick Lake	17.7	17.7
45	Rollins Savannah 2	17.7	17.7
46	Grandwood Park Lake	17.2	19.0
47	Seven Acre Lake	17.0	15.5
48	Lake Miltmore	16.8	18.7
49	McDonald Lake 1	16.7	17.7
50	Highland Lake	16.7	18.9
51	Bresen Lake	16.6	17.8
52	Almond Marsh	16.3	17.3
53	Owens Lake	16.3	17.3
54	Windward Lake	16.3	17.6
55	Grays Lake	16.1	16.1
56	White Lake	16.0	17.0
57	Dog Bone Lake	15.7	15.7
58	Osprey Lake	15.5	17.3

Table 7. Lake County average Floristic Quality Index ranking 2000 – 2013.

RANK	LAKE NAME	FQI (w/A)	FQI (native)
59	Heron Pond	15.1	15.1
60	North Churchill Lake	15.0	15.0
61	Hastings Lake	15.0	17.0
62	Lake Tranquility (S1)	15.0	17.0
63	Forest Lake	14.8	15.9
64	Dog Training Pond	14.7	15.9
65	Island Lake	14.7	16.6
66	Grand Ave Marsh	14.3	16.3
67	Nippersink Lake	14.3	16.3
68	Taylor Lake	14.3	16.3
69	Manning's Slough	14.1	16.3
70	Tower Lake	14.0	14.0
71	Dugdale Lake	14.0	15.1
72	Eagle Lake (S1)	14.0	15.1
73	Crooked Lake	14.0	16.0
74	Longview Meadow Lake	13.9	13.9
75	Bishop Lake	13.4	15.0
76	Ames Pit	13.4	15.5
77	Mary Lee Lake	13.1	15.1
78	Old School Lake	13.1	15.1
79	Dunn's Lake	12.7	13.9
80	Summerhill Estates Lake	12.7	13.9
81	Buffalo Creek Reservoir 1	12.5	11.4
82	Buffalo Creek Reservoir 2	12.5	11.4
83	McDonald Lake 2	12.5	12.5
84	Rollins Savannah 1	12.5	12.5
85	Stone Quarry Lake	12.5	12.5
86	Kemper Lake 1	12.2	13.4
87	Pond-A-Rudy	12.1	12.1
88	Stockholm Lake	12.1	13.5
89	Lake Carina	12.1	14.3
90	Lake Leo	12.1	14.3
91	Lambs Farm Lake	12.1	14.3
92	Grassy Lake	12.0	12.0
93	Lake Matthews	12.0	12.0
94	Flint Lake Outlet	11.8	13.0
95	Albert Lake	11.5	10.3
96	Rivershire Pond 2	11.5	13.3
97	Antioch Lake	11.3	13.4
98	Hook Lake	11.3	13.4
99	Briarcrest Pond	11.2	12.5
100	Lake Naomi	11.2	12.5
101	Pulaski Pond	11.2	12.5
102	Lake Napa Suwe	11.0	11.0
103	Redwing Marsh	11.0	11.0
104	West Meadow Lake	11.0	11.0
105	Lake Minear	11.0	13.9
106	Nielsen Pond	10.7	12.0
107	Lake Holloway	10.6	10.6
108	Sylvan Lake	10.6	10.6
109	Crooked Lake	10.2	12.5
110	Gages Lake	10.2	12.5
111	College Trail Lake	10.0	10.0
112	Valley Lake	9.9	9.9
113	Werhane Lake	9.8	12.0
114	Loch Lomond	9.4	12.1
115	Columbus Park Lake	9.2	9.2
116	Lake Lakeland Estates	9.2	9.2
117	Waterford Lake	9.2	9.2

Table 7. Lake County average Floristic Quality Index ranking 2000 – 2013.

RANK	LAKE NAME	FQI (w/A)	FQI (native)
118	Lake Fairfield	9.0	10.4
119	Lake Louise	9.0	10.4
120	Fischer Lake	9.0	11.0
121	Lake Fairview	8.5	6.9
122	Timber Lake (South)	8.5	6.9
123	East Meadow Lake	8.5	8.5
124	South Churchill Lake	8.5	8.5
125	Kemper Lake 2	8.5	9.8
126	Lake Christa	8.5	9.8
127	Lake Farmington	8.5	9.8
128	Lucy Lake	8.5	9.8
129	Bittersweet Golf Course #13	8.1	8.1
130	Lake Linden	8.0	8.0
131	Sand Lake	8.0	10.4
132	Countryside Lake	7.7	11.5
133	Fairfield Marsh	7.5	8.7
134	Lake Eleanor	7.5	8.7
135	Banana Pond	7.5	9.2
136	Slocum Lake	7.1	5.8
137	Lucky Lake	7.0	7.0
138	North Tower Lake	7.0	7.0
139	Lake Forest Pond	6.9	8.5
140	Ozaukee Lake	6.7	8.7
141	Leisure Lake	6.4	9.0
142	Peterson Pond	6.0	8.5
143	Little Bear Lake	5.8	7.5
144	Deer Lake Meadow Lake	5.2	6.4
145	ADID 127	5.0	5.0
146	Island Lake	5.0	5.0
147	Liberty Lake	5.0	5.0
148	Oak Hills Lake	5.0	5.0
149	Slough Lake	5.0	5.0
150	International Mining and Chemical Lake	5.0	7.1
151	Diamond Lake	3.7	5.5
152	Lake Charles	3.7	5.5
153	Big Bear Lake	3.5	5.0
154	Sand Pond (IDNR)	3.5	5.0
155	Harvey Lake	3.3	5.0
156	Half Day Pit	2.9	5.0
157	Lochanora Lake	2.5	5.0
158	Echo Lake	0.0	0.0
159	Hidden Lake	0.0	0.0
160	St. Mary's Lake	0.0	0.0
161	Willow Lake	0.0	0.0
162	Woodland Lake	0.0	0.0

Figure 5. Shoreline erosion assessed on Buffalo Creek Reservoir, 2013.

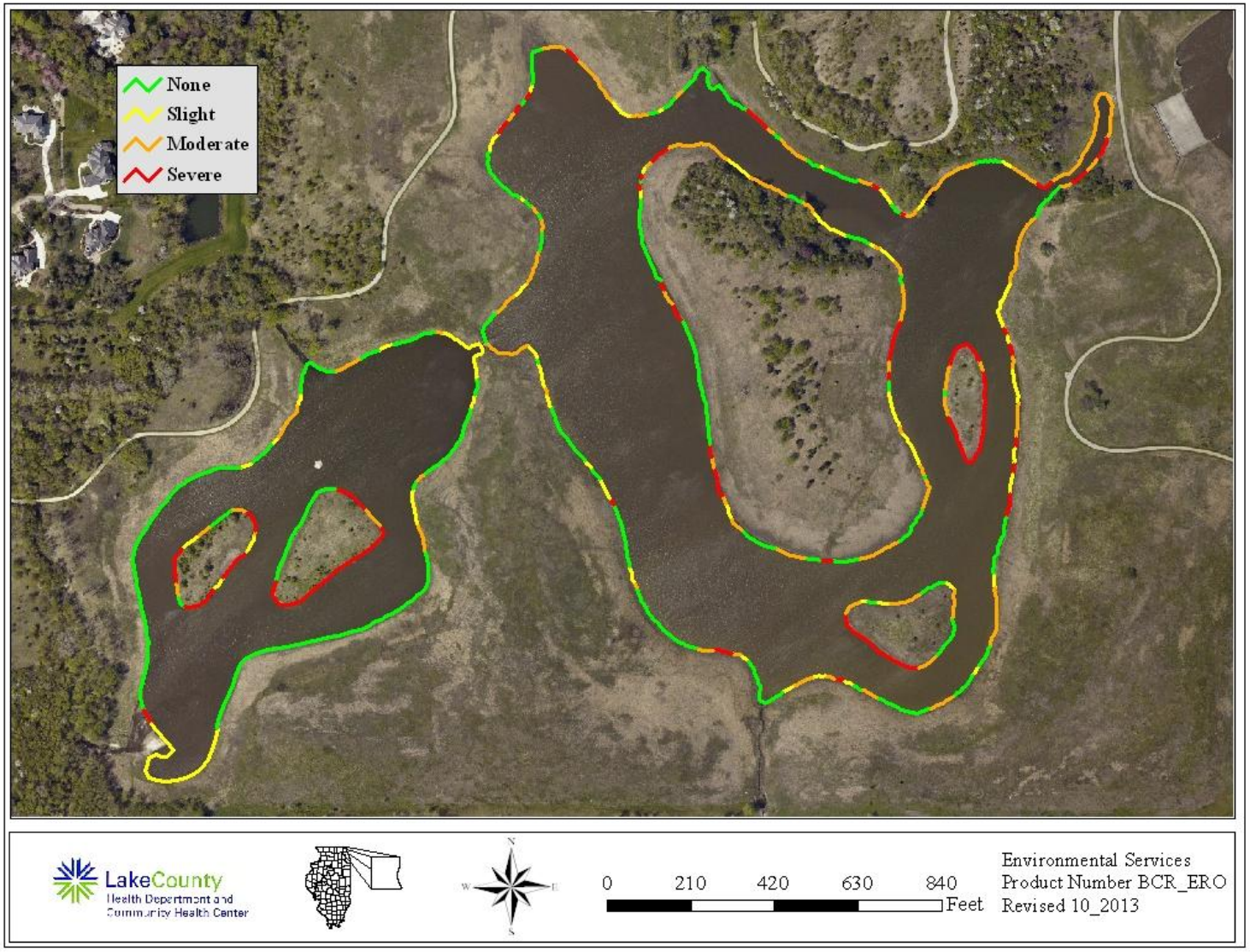


Table 8. Results of sediment analysis from Buffalo Creek Reservoir, 2013 (Provided by Cardno JF New, November 2013).

		Sample ID		MacDonald, 2000		Mitzelfelt, 1996	
Analyte	Units	BUF1 9/16/13 12:25 PM	BUF2 9/16/13 2:10 PM	TEC	PEC	Elevated	Highly Elevated
Nitrogen, Kjeldahl, Total	mg/Kg-dry	484	2120			5357-<11700	1170 or greater
Arsenic	mg/Kg-dry	<7.25	<5.28	9.79	33	14 to <95.5	95.5 or greater
Cadmium	mg/Kg-dry	0.87	0.951	0.99	4.98	5 to <14	14 or greater
Chromium	mg/Kg-dry	8.22	13.2	43.4	111	24 to <49	49 or greater
Copper	mg/Kg-dry	**25.2**	**34.8**	31.6	149	100 to <590	590 or greater
Lead	mg/Kg-dry	18.2	20.2	35.8	128	59 to<339	339 or greater
Nickel	mg/Kg-dry	17.6	21.3	22.7	48.6	31 to <43	43 or greater
Phosphorus	mg/Kg-dry	488	630			1115 to<2179	2179 or greater
Silver	mg/Kg-dry	**3.48**	**< 3.8**			0.1 to <1.0	1.0 or greater
Zinc	mg/Kg-dry	93.6	105	121	459	145 to <1100	1100 or greater
Mercury	mg/Kg-dry	**0.46**	**0.0969**	0.18	1.06	0.15 to <7.01	7.01 or greater
4,4´-DDD	µg/Kg-dry	< 15	< 10.7				
4,4´-DDE	µg/Kg-dry	< 15	< 10.7				
4,4´-DDT	µg/Kg-dry	< 15	< 10.7			5 to <12	12 or greater
Aldrin	µg/Kg-dry	< 15	< 10.7			1 to <1.2	1.2 or greater
alpha-BHC	µg/Kg-dry	< 15	< 10.7			na	1 or greater
beta-BHC	µg/Kg-dry	< 15	< 10.7				
Chlordane	µg/Kg-dry	< 15	< 10.7	3.24	17.6	5 to 12	12 or greater
delta-BHC	µg/Kg-dry	< 15	< 10.7				
Dieldrin	µg/Kg-dry	< 15	< 10.7	1.9	61.8	3.4 to <15	15 or greater
Endosulfan I	µg/Kg-dry	< 15	< 10.7				
Endosulfan II	µg/Kg-dry	< 15	< 10.7				
Endosulfan sulfate	µg/Kg-dry	< 15	< 10.7				
Endrin	µg/Kg-dry	< 15	< 10.7	2.22	207	n/a	1 or greater
Endrin aldehyde	µg/Kg-dry	< 15	< 10.7				
gamma-BHC	µg/Kg-dry	< 15	< 10.7	2.37	4.99	n/a	1 or greater
Heptachlor	µg/Kg-dry	< 15	< 10.7			n/a	1 or greater
Heptachlor epoxide	µg/Kg-dry	< 15	< 10.7	2.47	16	1 to <1.6	1.6 or greater

Table 8. Results of sediment analysis from Buffalo Creek Reservoir, 2013 (Provided by Cardno JF New, November 2013).

		Sample ID		MacDonald, 2000		Mitzelfelt, 1996	
Analyte	Units	BUF1 9/16/13 12:25 PM	BUF2 9/16/13 2:10 PM	TEC	PEC	Elevated	Highly Elevated
Methoxychlor	µg/Kg-dry	< 15	< 10.7			n/a	5 or greater
Toxaphene	µg/Kg-dry	< 300	< 214				
Aroclor 1016	mg/Kg-dry	< 0.075	< 0.0535				
Aroclor 1221	mg/Kg-dry	< 0.15	< 0.107				
Aroclor 1232	mg/Kg-dry	< 0.075	< 0.0535				
Aroclor 1242	mg/Kg-dry	< 0.075	< 0.0535				
Aroclor 1248	mg/Kg-dry	< 0.075	< 0.0535				
Aroclor 1254	mg/Kg-dry	< 0.075	< 0.0535				
Aroclor 1260	mg/Kg-dry	< 0.075	< 0.0535				
1,1,1-Trichloroethane	µg/Kg-dry	< 6.33	< 4.2				
1,1,2-Trichloroethane	µg/Kg-dry	< 6.33	< 4.2				
1,1-Dichloroethane	µg/Kg-dry	< 6.33	< 4.2				
1,1-Dichloroethene	µg/Kg-dry	< 6.33	< 4.2				
1,2-Dibromo-3-chloropropane	µg/Kg-dry	< 6.33	< 4.2				
1,2-Dibromoethane	µg/Kg-dry	< 6.33	< 4.2				
1,2-Dichloroethane	µg/Kg-dry	< 6.33	< 4.2				
1,2-Dichloropropane	µg/Kg-dry	< 6.33	< 4.2				
1-Butanol	µg/Kg-dry	< 627	< 417				
Acetone	µg/Kg-dry	< 185	< 123				
Benzene	µg/Kg-dry	< 6.33	< 4.2				
Bromodichloromethane	µg/Kg-dry	< 6.33	< 4.2				
Bromoform	µg/Kg-dry	< 6.33	< 4.2				
Bromomethane	µg/Kg-dry	< 21.4	< 14.2				
Carbon disulfide	µg/Kg-dry	< 6.33	< 4.2				
Carbon tetrachloride	µg/Kg-dry	< 6.33	< 4.2				
Chlorobenzene	µg/Kg-dry	< 6.33	< 4.2				
Chloroform	µg/Kg-dry	< 6.33	< 4.2				
cis-1,2-Dichloroethene	µg/Kg-dry	< 6.33	< 4.2				
cis-1,3-Dichloropropene	µg/Kg-dry	< 6.33	< 4.2				
Dibromochloromethane	µg/Kg-dry	< 6.33	< 4.2				

Table 8. Results of sediment analysis from Buffalo Creek Reservoir, 2013 (Provided by Cardno JF New, November 2013).

		Sample ID		MacDonald, 2000		Mitzelfelt, 1996	
Analyte	Units	BUF1 9/16/13 12:25 PM	BUF2 9/16/13 2:10 PM	TEC	PEC	Elevated	Highly Elevated
Ethylbenzene	µg/Kg-dry	< 6.33	< 4.2				
m,p-Xylene	µg/Kg-dry	< 7.37	< 4.89				
Methylene chloride	µg/Kg-dry	< 8.39	< 5.58				
o-Xylene	µg/Kg-dry	< 6.33	< 4.2				
Styrene	µg/Kg-dry	< 6.33	< 4.2				
Tetrachloroethene	µg/Kg-dry	< 6.33	< 4.2				
Toluene	µg/Kg-dry	< 6.33	< 4.2				
trans-1,2-Dichloroethene	µg/Kg-dry	< 6.91	< 4.59				
trans-1,3-Dichloropropene	µg/Kg-dry	< 6.33	< 4.2				
Trichloroethene	µg/Kg-dry	< 6.33	< 4.2				
Vinyl acetate	µg/Kg-dry	< 88	< 58.5				
Vinyl chloride	µg/Kg-dry	< 6.33	< 4.2				
1,2,4-Trichlorobenzene	µg/Kg-dry	< 13.6	< 9.97				
1,2-Dichlorobenzene	µg/Kg-dry	< 14.7	< 10.8				
1,3-Dichlorobenzene	µg/Kg-dry	< 13.6	< 9.97				
1,4-Dichlorobenzene	µg/Kg-dry	< 13.6	< 9.97				
2,4,5-Trichlorophenol	µg/Kg-dry	< 341	< 249				
2,4,6-Trichlorophenol	µg/Kg-dry	< 341	< 249				
2,4-Dichlorophenol	µg/Kg-dry	< 80	< 58.4				
2,4-Dimethylphenol	µg/Kg-dry	< 69.6	< 50.8				
2,4-Dinitrophenol	µg/Kg-dry	< 2250	< 1640				
2,4-Dinitrotoluene	µg/Kg-dry	< 341	< 249				
2,6-Dinitrotoluene	µg/Kg-dry	< 341	< 249				
2-Chloronaphthalene	µg/Kg-dry	< 13.6	< 9.97				
2-Chlorophenol	µg/Kg-dry	< 82.7	< 60.4				
2-Nitrophenol	µg/Kg-dry	< 341	< 249				
3,3´-Dichlorobenzidine	µg/Kg-dry	< 341	< 249				
4,6-Dinitro-2-methylphenol	µg/Kg-dry	< 4130	< 3010				
4-Bromophenyl phenyl ether	µg/Kg-dry	< 123	< 89.5				
4-Chloro-3-methylphenol	µg/Kg-dry	< 341	< 249				

Table 8. Results of sediment analysis from Buffalo Creek Reservoir, 2013 (Provided by Cardno JF New, November 2013).

		Sample ID		MacDonald, 2000		Mitzelfelt, 1996	
Analyte	Units	BUF1 9/16/13 12:25 PM	BUF2 9/16/13 2:10 PM	TEC	PEC	Elevated	Highly Elevated
4-Chloroaniline	µg/Kg-dry	< 341	< 249				
4-Chlorophenyl phenyl ether	µg/Kg-dry	< 117	< 85.7				
4-Nitrophenol	µg/Kg-dry	< 3130	< 2290				
Acenaphthene	µg/Kg-dry	14	17				
Acenaphthylene	µg/Kg-dry	< 104	< 76.2				
Anthracene	µg/Kg-dry	< 68.2	69	57.2	845		
Azobenzene as 1,2-Diphenylhydrazine	µg/Kg-dry	< 104	< 76.1				
Benz(a)anthracene	µg/Kg-dry	**420**	**500**	108	1050		
Benzidine	µg/Kg-dry	< 3250	< 2370				
Benzo(a)pyrene	µg/Kg-dry	**630**	**610**	150	1450		
Benzo(b)fluoranthene	µg/Kg-dry	1300	1170				
Benzo(g,h,i)perylene	µg/Kg-dry	676	674				
Benzo(k)fluoranthene	µg/Kg-dry	372	413				
Bis(2-chloroethoxy)methane	µg/Kg-dry	< 13.6	< 9.97				
Bis(2-chloroethyl)ether	µg/Kg-dry	< 13.6	< 9.97				
Bis(2-chloroisopropyl)ether	µg/Kg-dry	< 13.6	< 9.97				
Bis(2-ethylhexyl)phthalate	µg/Kg-dry	300	270				
Butyl benzyl phthalate	µg/Kg-dry	< 68.2	< 49.8				
Carbazole	µg/Kg-dry	< 115	< 83.8				
Chrysene	µg/Kg-dry	**749**	**636**	166	1290		
Di-n-butyl phthalate	µg/Kg-dry	< 97.2	< 71				
Di-n-octyl phthalate	µg/Kg-dry	< 68.2	< 49.8				
Dibenz(a,h)anthracene	µg/Kg-dry	**130**	**130**	33	NR		
Diethyl phthalate	µg/Kg-dry	< 133	< 97.1				
Dimethyl phthalate	µg/Kg-dry	< 116	< 84.8				
Fluoranthene	µg/Kg-dry	**1550**	**1540**	423	2230		
Fluorene	µg/Kg-dry	< 116	< 84.5	77.4	536		
Hexachlorobenzene	µg/Kg-dry	< 128	< 93.2				
Hexachlorobutadiene	µg/Kg-dry	< 103	< 75.3				

Table 8. Results of sediment analysis from Buffalo Creek Reservoir, 2013 (Provided by Cardno JF New, November 2013).

		Sample ID		MacDonald, 2000		Mitzelfelt, 1996	
Analyte	Units	BUF1 9/16/13 12:25 PM	BUF2 9/16/13 2:10 PM	TEC	PEC	Elevated	Highly Elevated
Hexachlorocyclopentadiene	µg/Kg-dry	< 341	< 249				
Hexachloroethane	µg/Kg-dry	< 79	< 57.7				
Indeno(1,2,3-cd)pyrene	µg/Kg-dry	940	880				
Isophorone	µg/Kg-dry	< 80.2	< 58.5				
m,p-Cresol	µg/Kg-dry	< 77	< 56.2				
N-Nitrosodi-n-propylamine	µg/Kg-dry	< 21.4	< 15.6				
N-Nitrosodimethylamine	µg/Kg-dry	< 91.7	< 67				
N-Nitrosodiphenylamine	µg/Kg-dry	< 341	< 249				
Naphthalene	µg/Kg-dry	< 94.6	< 69.1	176	561		
Nitrobenzene	µg/Kg-dry	< 163	< 119				
o-Cresol	µg/Kg-dry	< 90.8	< 66.3				
Pentachlorophenol	µg/Kg-dry	< 136	< 99.7				
Phenanthrene	**µg/Kg-dry**	**330**	**400**	204	1170		
Phenol	µg/Kg-dry	< 85.3	< 62.3				
Pyrene	**µg/Kg-dry**	**1170**	**1200**	195	1520		
2,4,5-TP (Silvex)	µg/Kg-dry	< 169	< 125				
2,4-D	µg/Kg-dry	< 203	< 150				
Cyanide	mg/Kg-dry	<1.67	<1.01			n/a	n/a
Percent Moisture	% (Percent)	66.8	54.7				