2002 SUMMARY REPORT
of
DRUMMOND LAKE

Lake County, Illinois

Prepared by the

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LAKE IDENTIFICATION AND LOCATION

Lake Name: Drummond Lake

State: IL

County: Lake

Nearest Municipality: Wauconda

Township/Range: T 44N, R 10E, S 19

Basin Name: Fox River Watershed

Subbasin Name: Mutton Creek Watershed

Major Tributaries: Mutton Creek

Receiving Water Bodies: Lake Napa Suwe

Surface Area: 20.7 acres

Shoreline Length: 0.97 miles

Maximum Depth: 5.0 feet

Mean Depth: 2.5 feet (estimated)

Storage Capacity: 51.8 acre-feet (estimated)

Lake Type: Manmade

EXECUTIVE SUMMARY

Drummond Lake is owned by the Lake County Forest Preserve District (LCFPD) and lies completely within Forest Preserve property. The lake appears to have been created by the flooding of a depressional area within the surrounding agricultural fields (Figure 1). This area was probably a wetland/creek area, however, after years of loosing crops to flooding, this area was probably left fallow and allowed to convert back to its previous state as a wetland. With the installation of the outlet structure on the southwest side of the lake, water depth was probably increased beyond natural levels. Drummond Lake drains west under Fairfield Road into a LCFPD pond and then into Lake Napa Suwe. As is true of nearly all Forest Preserve lakes, no boating (i.e., canoes, etc.) is permitted on Drummond Lake and only bank fishing is allowed. There are no defined access points and no parking facilities available at this site.

Overall, Drummond Lake has very poor water quality as compared to other County lakes. Dissolved oxygen concentrations are low and are near unhealthy levels for much of the summer (July, August, September). Secchi disk readings, a measurement of water clarity, were also troublesome. Average Secchi depth for Drummond Lake in 2002 was 0.58 feet and August's Secchi reading (0.53 feet) was one of the ten worst readings taken by the LMU in the last 5 years (467 readings). The two main factors contributing to the poor clarity are high nutrient concentrations and suspended sediment. In 2002, the average total phosphorus concentration in Drummond Lake was 0.151 mg/L, which is three times higher than the Lake County median value of 0.056 mg/L. These high phosphorus concentrations, which are causing summer long algae blooms, are directly related to internal phosphorus loading from sources such as sediment resuspension and decaying algae. The average total suspended solids concentration in Drummond Lake was 52.1 mg/L and was as high as 93.1 mg/L, which is almost fifteen times higher than the Lake County median concentration of 6.0 mg/L. These high concentrations of suspended sediment are greatly reducing clarity and contributing to the internal loading of nutrients in Drummond Lake.

Aquatic plant assessments revealed that there is very little aquatic plant growth in Drummond Lake for the entire study. The absence of any aquatic plants has negatively impacted many aspects of lake health, as a healthy aquatic plant population is critical to good lake health. Aquatic plants provide many water quality benefits such as sediment stabilization, competition with algae for available resources, and is an important source of habitat and food for wildlife such as fish and waterfowl.

Shoreline assessment revealed that all of Drummond Lake's shoreline is undeveloped. The undeveloped shoreline consisted of buffer (75%) wetland (10%) and shrub (15%). Assessments also revealed that erosion on Drummond Lake is also problematic with 77% of the shoreline in some state of erosion. A majority of the eroded shoreline was *moderately* eroded (46%) with some experiencing *Slight* erosion (31%). The most affected shoreline types regardless of development were lawn and shrub. This can be attributed to poor soil stabilization provided by turf grass on the lawns and the dominance of low quality, shallow rooted invasive species on the shrub areas.

LIMNOLOGICAL DATA – WATER QUALITY

Water samples collected from Drummond Lake were analyzed for a variety of water quality parameters. Since Drummond Lake is so shallow, samples were collected from a depth of 3 feet in May and June and at the surface from July through September at the deep hole location in the lake (Figure 1). Drummond Lake does not thermally stratify, which means the lake does not divide into a warm upper water layer (epilimnion) and cool lower water layer (hypolimnion) but instead stays well mixed. This is due to the shallow lake morphology, long fetch (the longest distance which wind blows across a lake unobstructed by land), and lack of aquatic plant growth. This mixing of water is reflected in the dissolved oxygen (DO) levels as well as other water quality data such as nutrient concentrations and water temperature. The complete data set for Drummond Lake can be found in Table 1, Appendix A and Appendix C.

Dissolved oxygen concentrations in Drummond Lake are *poor*. In order to support aquatic life, DO concentrations should remain above 5.0 mg/L. If DO concentrations drop below this level for a prolonged period of time negative impacts, such as fish kills, can occur. In 2002, the average DO concentration in Drummond Lake was 6.83 mg/L. However, DO concentrations during much of the study (June, July, August, and September) were only near 6.0 mg/L. DO concentrations in May were much higher (10.6 mg/L) than the other months and thus skewed the average. One of the main contributors to Drummond Lake's DO problems are the widespread planktonic algae blooms during the summer months, which were especially problematic during the mid summer months of June, July, and August. At times, these blooms were so severe they created surface scums almost an inch thick on parts of the lake along with extremely foul odors. Although algae produce oxygen during biological processes (photosynthesis), they consume more oxygen (during respiration) during the night. This along with other factors, such as decomposition of dying algae (an oxygen consuming process), is creating a high biological oxygen demand (BOD) that is lowering the DO concentrations in the water column. These low DO conditions have had detrimental effects on other lake quality issues such as fishery health.

Secchi disk transparency is a direct indicator of water clarity as well as overall water quality. In general, the greater the Secchi disk depth, the clearer the water and better the water quality. Based on Secchi depth, Drummond Lake has very poor water quality. The 2002 average Secchi disk depth on Drummond Lake was 0.58 feet, which is substantially lower than the Lake County median Secchi disk depth of 3.81 feet. Monthly readings varied from 1.25 feet (May) to 0.53 feet (August). The August Secchi depth was one of the top ten worst readings ever taken by the LMU from 1998-2002 (458 out of 467 readings). The extremely poor water clarity of Drummond Lake is being caused by high concentrations of suspended organic and inorganic particles in the water column.

Total suspended solids (TSS) are a measurement of suspended particles such as algae and other organic matter as well as inorganic matter such as silt and clay. In 2002, average TSS on Drummond Lake was 52.1 mg/L, which is over *eight* times higher than the County median value of 6.0 mg/L. TSS increased from 27.0 mg/L in May to as high as

93.1 mg/L in July, which is over *fifteen* times higher than the County median value and the third worst TSS concentration recorded by the LMU from 1998-2002 (506 samples). These high concentrations of suspended solids have a direct impact on Secchi depth (clarity) (Figure 2). Calculated nonvolatile suspended solids (NVSS), which are the portion of the TSS that can be attributed to inorganic (soil particles) was 32.2 mg/L. This means that 62% of the TSS concentration (turbidity) can be related to suspended inorganic particles such as silts and clays. The other 38% can be attributed to organic particles such as algae. Monthly variations in NVSS correspond to changes in TSS, which further reinforces that a majority of Drummond Lake's clarity problems are from suspended soil particles (Figure 2). However, total volatile solids (TVS) concentrations, which are a measurement of suspended organic matter (such as algae), also correlated with peaks in TSS concentrations in July and August, when the algae blooms were at their worst. The high concentrations of suspended soil particles can be directly attributed to carp, which appear to be overly abundant in Drummond Lake, and excessive amounts of nutrients, which are triggering massive algae blooms. Additionally, carp can disrupt aquatic plant growth, which stabilize sediment and compete with algae for available resources thus improving water clarity/quality.

Algae need light and nutrients, most importantly carbon, nitrogen (N) and phosphorus (P), to grow. Light and carbon are not normally in short supply (limiting). This means that nutrients (N&P) are usually the limiting factors in algal growth. To compare the availability of these nutrients, a ratio of total nitrogen to total phosphorus is used (TN: TP). Ratios <10:1 indicate nitrogen is limiting. Ratios of >15:1 indicate phosphorus is limiting. Ratios >10:1, <15:1 indicate that there is enough of both nutrients for excessive algal growth. Most lakes in the County are phosphorus limited. In these phosphorus-limited lakes even a small addition of P can trigger algae blooms. In 2002, Drummond Lake had an average TN: TP ratio of 15:1, which means that Drummond Lake has sufficient amounts of both nutrients to support algae growth. Furthermore, the N:P ratio was stable throughout the study. This is evident in the season long planktonic algae blooms observed on Drummond Lake during the 2002 study.

The phosphorus concentrations in Drummond Lake are *high*. The average TP concentration was 0.151 mg/L in 2002, which is almost three times the median TP concentration for Lake County lakes (0.056 mg/L). High TP concentrations can be attributed to high levels of nutrient rich suspended sediment and organic sources (algae). These high TP concentrations are directly causing nuisance algae blooms, which are further exacerbating the lake's nutrient problems and poor water clarity (i.e., Secchi depth) (Figure 3). There were also above average concentrations of soluble reactive phosphorus (SRP), which is a readily available form of phosphorus that is released into the water column by dying algae. SRP is normally not present in the surface waters of lakes in detectable concentrations because it is utilized immediately. However, since Drummond Lake has excessive concentrations of phosphorus for most of the summer, not all of the SRP is utilized once released.

Another input of phosphorus maybe from sources outside of the lake (external). These external inputs consist of a variety of sources. They can include fertilizer runoff, failing septic systems, geese feces, and erosion. For Drummond Lake the main outside source of TP would be from agricultural runoff entering the lake. However, water elevation measurements indicate that very little water flows into Drummond Lake over the course of the summer. Peak TP concentrations were in July and August, which does not correlate with monthly rainfall data from the same time period (Figure 4). Additionally, these peaks do not correspond to changes in water elevations. This may indicate that a majority of Drummond Lake's TP is from internal sources.

Nitrate (NO_3-N) and ammonia (NH_3-N) concentrations were below detectable concentrations for much of the study with June the only month having detectable concentrations of both forms of nitrogen. Drummond Lake has more than enough phosphorus and nitrogen for most of the summer to support algae blooms. However, in June there was a drop in the amount of phosphorus in the lake, which caused the lake to become phosphorus limited. As a result, nitrogen was not being utilized, which caused a build up in the water column. This is supported by total Kjeldahl nitrogen concentrations (TKN), an organic form of nitrogen, which were much lower in June compared to other months of the study (i.e., the more algae in the water column the more TKN).

Another way to look at nutrient concentrations and how they affect the productivity of a lake is the use of a Trophic State Index (TSI) based on average phosphorus concentrations. The TSI can be based on phosphorus concentration, chlorophyll *a*, and Secchi depth to classify and compare lake productivity levels (trophic state). The phosphorus TSI is setup so the higher the phosphorus concentration, the greater amount of algal biomass and as a result, a higher trophic state. Based on a TSI phosphorus value of 76.5, Drummond Lake is classified as *hypereutropic* ($\geq$70 TSI). This means that the lake is a highly productive system that has excessive nutrient levels and high algal biomass (growth). For comparison, most lakes in the County are eutrophic (TSI values $\geq$50 <70). Out of all of the lakes in Lake Country studied by the LMU since 1998, Drummond Lake ranks 89 out of 103 lakes based on phosphorus TSI (Table 2, Appendix A). Additionally, the Secchi TSI, which is normally lower (better) than the phosphorus TSI, was 80.2 (*hypereutrophic)* due to the extremely poor Secchi readings on Drummond Lake.

TSI values along with other water quality parameters can be used to compare water quality standards as well as use impairment indexes established by the Illinois Environmental Protection Agency (IEPA). These indexes rate a given lake based on several water quality parameters. Based on the above average phosphorus concentrations, Drummond Lake was listed as having a *Moderate* violation of Illinois water quality standards. Additionally, there were violations for high nitrogen concentrations as well as TSS (NVSS) and presence of exotic species (Eurasian water milfoil and curly leaf pondweed). Based on the IEPA Swimming Use Index, Drummond Lake is categorized as

Nonsupport. This is due to poor Secchi disk readings and high phosphorus levels, which lead to high algal biomass (increased turbidity) and decreased visibility. Drummond Lake's average Secchi disk was only 9.7 inches, which is well below the IDPH's recommendation of 48 inches. Based on the Recreational Use Index, Drummond Lake was also categorized as *Nonsupport*. This is due to a high TSI value and high levels of suspended solids, which result in poor visibility and contribute to an overall reduction in use of the lake. Drummond Lake provides *Partial* support based on the Aquatic Life Use index despite the fact that Drummond Lake has poor dissolved oxygen concentrations and very little aquatic plant growth. Based on the average of all of the use impairment indices, Drummond Lake is listed as providing *Nonsupport* for Overall Use.

LIMNOLOGICAL DATA - AQUATIC PLANT ASSESSMENT

Aquatic plant surveys were conducted every month for the duration of the study (Table 3) (*Appendix A* for methodology). However, no surveys were made of these shoreline species and all data is purely observational. The extent to which aquatic plants grow is largely dictated by light availability. Aquatic plants need at least 1% of surface light levels in order to survive. Based on light penetration measurements, aquatic plant could have grown to a depth of 3.5 feet. A healthy aquatic plant population is critical to good lake health. Aquatic vegetation provides important wildlife habitat and food sources. Additionally, aquatic plants provide many water quality benefits such as sediment stabilization and competition with algae for available resources. Aquatic plant growth on Drummond Lake is almost *nonexistent* with overall coverage (bottom area) estimated at <10% (Table 4). Poor clarity substrate type and carp activity may be possible explanations for the lack of aquatic plant growth. However, even the parts of the lake with a more suitable substrate did not have an appreciable amount of growth. Due to their disruptive feeding habits, carp uproot aquatic vegetation preventing establishment. As a result, Drummond Lake is experiencing a variety of water quality problems including poor clarity, increased turbidity, nuisance algae blooms, and poor fishery health.

The plants that the LMU did find during surveys were of poor quality and included the aquatic nuisance species Eurasian water milfoil along with other weedy species such as coontail and curly leaf pondweed. Floristic quality index (FQI) (Swink and Wilhelm 1994) is a rapid assessment metric designed to evaluate the closeness that the flora of an area is to that of undisturbed conditions. It can be used to: 1) identify natural areas, 2) compare the quality of different sites or different locations within a single site, 3) monitor long-term floristic trends, and 4) monitor habitat restoration efforts. Each submersed and floating aquatic plant species (emergent shoreline species were not counted) in the lake is assigned a number between 1 and 10 (10 indicating the plant species most sensitive to disturbance). Nonnative species were also counted in the FQI calculations for Lake County lakes. These numbers are then averaged and multiplied by the square root of the number of species present to calculate an FQI. A high FQI number indicates that there are a large number of sensitive, high quality plant species present in the lake. A low FQI indicates that there are a low number of species and possibly lower quality species

present in the lake. In 2002, Drummond Lake had a FQI of 5.0 and ranks 77 out of the 86 lakes that the LMU has FQI data. For comparison, the average FQI of lakes studied by the LMU in 2000-2002 was 14.2.

Table 3. Aquatic and shoreline plants on Drummond Lake, May-Sept. 2002.

Aquatic Plants	
Coontail	*Ceratophyllum demersum*
Eurasian Water Milfoil	*Myriophyllum spicatum*
Curlyleaf Pondweed	*Potamogeton crispus*
Sago Pondweed	*Potamogeton pectinatus*
Shoreline Plants	
Common Buckthorn	*Rhamnus cathartica*
Common Cattail	*Typha latifolia*
Common Reed	*Phragmites australis*
Multiflora Rose	*Rosa multiflora*
Purple Loosestrife	*Lythrum salicaria*
Reed Canary Grass	*Phalaris arundinacea*

LIMNOLOGICAL DATA – SHORELINE ASSESSMENT

Shoreline assessment was conducted at Drummond Lake on July 10, 2002. Shorelines were assessed for a variety of criteria (*Appendix B* for methodology). All of Drummond Lake's shoreline is undeveloped. This undeveloped shoreline was made up of three main types: shrub (15%), wetland (10%), and buffer (75%)(Figure 5). The dominance of these three types of shoreline is encouraging as they normally contain plants with deep root systems that are less prone to erosion and provide good wildlife habitat. However, a majority of the shoreline of Drummond Lake is plagued by nuisance weed species such reed canary grass, common buckthorn, common reed, and purple loosestrife.

Shoreline was also analyzed for the presence of erosion. The occurrence of erosion on Drummond Lake is *high*. Overall, 77% (3,831 feet) of the shoreline on Drummond Lake had some type of erosion (Figure 6). A majority of the eroded shoreline was assessed as having *Moderate* erosion (46%) with another large portion assessed as S*light* (31%). No shoreline was assessed as having *Severe* erosion. The most affected shoreline type was buffer, which accounted for 64% of total erosion. The buffer areas that have experienced erosion were found to be moderately to steeply sloped. Additionally, these buffer areas, which normally have less erosion, were found to be overrun with the invasive species that have poor (shallow) root systems and offer little stabilization benefit.

LIMNOLOGICAL DATA – WILDLIFE ASSESSMENT

Wildlife observations were made on a monthly basis during water quality and plant sampling actives (Table 5). No surveys were made and all observations were visual. Wildlife habitat on Drummond Lake is above average for a Lake County lake. On much of the area around the lake there are healthy populations of mature trees that provide good habitat for a variety of bird species. Additionally, there are large expanses of shrub areas that provide habitat for smaller bird and mammal species. There are two beaver huts on the southeastern part of the lake in addition to deadfall scattered along the shores. The shoreline types at Drummond Lake are shrub, wetland, and buffer, which all can provide good habitat for a variety of wildlife. Staff frequently observed great blue herons and great egrets utilizing the stump fields. Additionally, LMU staff sighted common terns, a State endangered bird. However, one area of concern is the overwhelming presence of invasive species (purple loosestrife, common buckthorn, and reed canary grass) along the shores of Drummond. The exotic nuisance species were found 76% of the shoreline transects.

Due to the low DO concentrations and overall shallow depth of the lake, the fishery of Drummond Lake is probably in poor health. The lake is more than likely dominated by species tolerant to low DO conditions, such as carp. LMU observations confirm that carp are overly abundant. Carp can cause a variety of water quality problems including resuspension of sediment and nutrients, disruption of the aquatic plant community, and low DO conditions. Additionally, this disruptive nature slowly deteriorates the quality of

the lake's fishery until conditions are only suitable for their own (the carp's) survival. If there are to be any measurable improvements in the water quality of Drummond Lake, the carp problem must be addressed.

Table 5. Wildlife species observed on Drummond Lake, May – Sept. 2002.

Birds	
Double-crested Cormorant	*Phalacrocorax auritus*
Canada Goose	*Branta canadensis*
Mallard	*Anas platyrhnchos*
Common Tern*	*Sterna hirundo*
Great Egret	*Casmerodius albus*
Great Blue Heron	*Ardea herodias*
Red-tailed Hawk	*Buteo jamaicensis*
Barn Swallow	*Hirundo rustica*
American Crow	*Corvus brachyrhynchos*
Blue Jay	*Cyanocitta cristata*
Catbird	*Dumetella carolinensis*
American Robin	*Turdus migratorius*
Yellow Warbler	*Dendroica petechia*
Common Yellowthroat	*Geothlypis trichas*
Red-winged Blackbird	*Agelaius phoeniceus*
Northern Cardinal	*Cardinalis cardinalis*
House Finch	*Carpodacus mexicanus*
Song Sparrow	*Melospiza melodia*
Amphibians	
Western Chorus Frog	*Pseudacris triseriata triseriata*
Reptiles	
Painted Turtle	*Chrysemys picta*
Snapping Turtle	*Chelydra serpentina*
Mammals	
Muskrat	*Ondatra zibethicus*
White-tailed Deer	*Odocoileus virginianus*

EXISTING LAKE QUALITY PROBLEMS AND MANAGEMENT SUGGESTIONS

Drummond Lake has *below average* water quality due to high nutrient and suspended sediment concentrations in addition to low DO levels. These are common problems throughout Lake County especially in shallow, manmade lakes that have an overabundance of carp. Despite the fact that Drummond Lake is a low-use site, these lake quality problems should still be addressed not only to improve conditions in Drummond, but also to prevent continual impacts to down stream sources such as Lake Napa Suwe and Island Lake. However, all aspects of Drummond Lake are not in poor condition. The lake does provide good habitat for a variety of wildlife species including State endangered bird species.

- *Shoreline Erosion*

  The overall occurrence of erosion on Drummond Lake was *high*. As stated previously, Drummond Lake has erosion on 77% of its shoreline. The main cause of this erosion is lack of suitable shoreline vegetation. The most eroded shoreline type was found to be the buffer areas that separate the adjacent agricultural fields from the lake. These buffer areas are dominated by shallow rooted, invasive vegetation, which are unable to properly stabilize the soil. Erosion is contributing to water quality problems such as sedimentation, nutrient enrichment and nuisance algae blooms. If left unattended, the erosion problem will continue to worsen, further aggravating related water quality issues. The use of more naturalized shoreline types such as buffer strips of deep-rooted native vegetation could greatly improve the shoreline conditions at Drummond Lake. These buffers should extend into the lake utilizing emergent vegetation such as arrowhead and Pickerel weed, which will help to dissipate wave action. This will benefit not only the water quality of Drummond Lake, but also improve the wildlife habitat surrounding the lake.

- *Invasive Species*

  Three exotic invasive species that are found along Drummond Lake's shoreline that are of concern are buckthorn, reed canary grass, and purple loosestrife. All of these species provide minimal food or habitat benefit to wildlife. Furthermore, all three species are extremely aggressive and displace desirable, native vegetation, which has led to further loss of food and habitat. Unfortunately, all three of these species have become well established along the shores of the lake. These noxious weeds can be controlled using several different management techniques (i.e., burning, herbicides).

- *Unhealthy Aquatic Plant Community*

  One key to a healthy lake is a healthy aquatic plant population, which Drummond Lake does not have. The number of species found in the lake was well below average. Furthermore, the densities of these five species were very low and the community is dominated by low quality species (Eurasian water milfoil, curly leaf pondweed, and coontail). For overall lake health it is considered beneficial to have aquatic plant coverage between 30-40% of the bottom area. Drummond Lake has less than 10% coverage. The negative impacts associated with the absence of a healthy aquatic plant community are wide spread and include those on water quality and fishery health. The lack of quality aquatic plants, and subsequent loss of water quality, is more than likely the result of carp activity lack of clarity and substrate type. Establishment of a healthy aquatic plant community is essential in improving the overall quality of Drummond Lake. Aquatic vegetation will stabilize sediment and help to reduce algae blooms, which will help to improve water clarity. Additionally, these vegetated areas will provide valuable fish and wildlife habitat. This is a long-term process and involves other management practices such as the elimination of carp, which are possibly the biggest limiting factor in plant growth for Drummond Lake. After the carp problem is brought under control, aquatic revegetation can begin. Since Drummond Lake already has plants (just not enough), once the conditions are right these plants will expand into other parts of the lake. However, steps must be taken to ensure that Eurasian water milfoil does not dominate the newly expanded plant community.

- *Lack of a Quality Bathymetric Map*

  There has never been a bathymetric (contour) map made for Drummond Lake. These maps can be of great use to fishermen as well as lake managers. Bathymetric data can show where possible problematic areas may be located (i.e., shallow areas). Bathymetric maps can also provide volumetric data that can be utilized for management techniques such as aeration, dredging, and volumetric applications of products such as herbicides and rotenone (a fish toxicant). These practices cannot be properly executed without a good bathymetric map and accompanying data. These maps can be easily made using different methods. All lakes in the County should have a current, good quality bathymetric map and Drummond Lake is no exception.