# 2007 SUMMARY REPORT
# of
# Valley Lake
# Lake County, Illinois

*Prepared by the*

**LAKE COUNTY HEALTH DEPARTMENT**
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# EXECUTIVE SUMMARY


Valley Lake is a 12-acre man-made lake constructed in 1952. It is located within the Des Plaines River watershed, in unincorporated Lake County, about one mile east of Illinois Route 45. Most of Valley Lake is owned and managed by the Wildwood Park District. A spillway at the northeast corner of the lake drains to an underground storm sewer network that eventually reaches the Des Plaines River. Three stormwater inlets enter the lake from the west and south residential areas. Residential lots surround much of the lake except for two parks owned by the Wildwood Park District. The Wildwood Park District has two access locations, Valley North, located on the north end of the lake, and Valley South, at the south end of the lake. A swimming beach is at Valley South. Both areas offer fishing from shore and a picnic area. Only non-motorized boating is allowed on the lake, and access is limited to park district residents.

The lake was assessed for various water quality parameters from May-September, 2007. Water clarity in the lake was just above the county median of 3.28 feet, with an average Secchi depth of 5.05 feet. Since the 2000 sampling season the Secchi depth has increased nearly a foot and half from 3.19 feet. The 2007 total suspended solids (TSS) concentration was 8.3 mg/L and decreased over 30% from the 2000 average of 12.2 mg/L. This decrease in TSS correlates to the increase in Secchi transparency. In Valley Lake, the 2007 average conductivity was 1.5910 mS/cm which was a 35% increase from the 2000 value of 1.1750 mS/cm.

Nitrogen and phosphorus are the two nutrients that can limit plant and algal growth. The 2007 average epilimnetic total phosphorus concentration in Valley Lake was 0.095 mg/L, which was above the county median of 0.063 mg/L, but a 35% decrease from the 2000 concentration of 0.147 mg/L. The 2007 average total Kjeldahl nitrogen concentration was 1.21 mg/L which was a decrease from the 2000 concentration of 1.48 mg/L.

The aquatic plant community in the lake consisted of three species in July. Leafy Pondweed was the dominant species with *Vallisneria* sp. and *Chara* spp. (a macroalgae) also present. Plant diversity and density increased between 2000 and 2007. Leafy Pondweed and *Vallisneria* sp. were not found in 2000, and the plant coverage increased from 8% to 13%. The changes can probably be attributed to natural annual variation and the overall increase in water quality in the lake.

The shoreline was reassessed in 2007 for significant changes in erosion since 2000. Based on this assessment, some of the areas of no erosion were reclassified as slightly eroded and areas of slight were reclassified as moderate. Overall, 63% of the shoreline was eroding with 34% slight and 29% moderate. Shoreline erosion increased slightly on the lake from the initial 2000 assessment, both in overall erosion, and in severity where erosion was documented before. However, some shoreline areas improved due to the installment of rip rap or other forms of stabilization.

# LAKE FACTS

| | |
|---|---|
| **Lake Name:** | Valley Lake |
| **Historical Name:** | None |
| **Nearest Municipality:** | Grayslake |
| **Location:** | T45N, R11E, Sections 29, 30 |
| **Elevation:** | 764.0 feet |
| **Major Tributaries:** | None |
| **Watershed:** | Des Plaines River |
| **Sub-watershed:** | Upper Des Plaines River |
| **Receiving Water body:** | Des Plaines River |
| **Surface Area:** | 12.2 acres |
| **Shoreline Length:** | 0.7 miles |
| **Maximum Depth:** | 9.5 feet |
| **Average Depth:** | 4.75 feet (estimated) |
| **Lake Volume:** | 55.92 acre-feet (estimated) |
| **Lake Type:** | Man-made |
| **Watershed Area:** | 82.04 acres |
| **Major Watershed Land uses:** | Single Family Homes, Parks |
| **Bottom Ownership:** | Wildwood Park District |
| **Management Entities:** | Wildwood Park District |
| **Current and Historical uses:** | Fishing, swimming, and non-motorized boating |
| **Description of Access:** | No public access |

# SUMMARY OF WATER QUALITY

Valley Lake receives storm water runoff from an 82.04 acre watershed (Figure 1). Single-family homes cover the largest portion of land (68%) followed by as roads (9%) and multi-family homes (5%, Figure 2). The area directly surrounding Valley Lake was mostly single-family homes, with park areas on the south and north. The large amount of impervious surfaces associated with residential areas (rooftops, driveways, and roads) increase the amount of direct storm water runoff into a lake (Table 1).

Water samples were taken monthly from May through September at the deepest location in the lake (Figure 3). One sample was taken from the upper water layer (epilimnion) at three feet below the surface and another sample was taken three feet off of the bottom. Both were analyzed for nutrients, solids concentration, and other physical parameters (Appendix A).

Due to the shallow nature of Valley Lake, wind and wave action kept the waters mixed throughout the summer. Due to the similarity of water quality data between the epilimnion and hypolimnion only the epilimnion parameters will be discussed. The average dissolved oxygen (DO) concentration was 7.19 mg/L (Table 2), with the highest reading in June (13.16 mg/L) and the lowest in July (4.21 mg/L). Hypoxic conditions (where DO concentrations fell below 5.0 mg/L and fish populations are stressed) occurred in May below 7 feet, July below 3 feet, August below 4 feet, and September below 6 feet (Appendix B). Anoxic conditions (DO < 1.0 mg/L) were present in August below 4 feet. Since a bathymetric map does not exist for Valley Lake, it was not possible to determine the volume of the lake affected by these anoxic conditions. Creation of a bathymetric map will assist in various aspects of lake management, including assessing the future need of the aeration system in the lake.

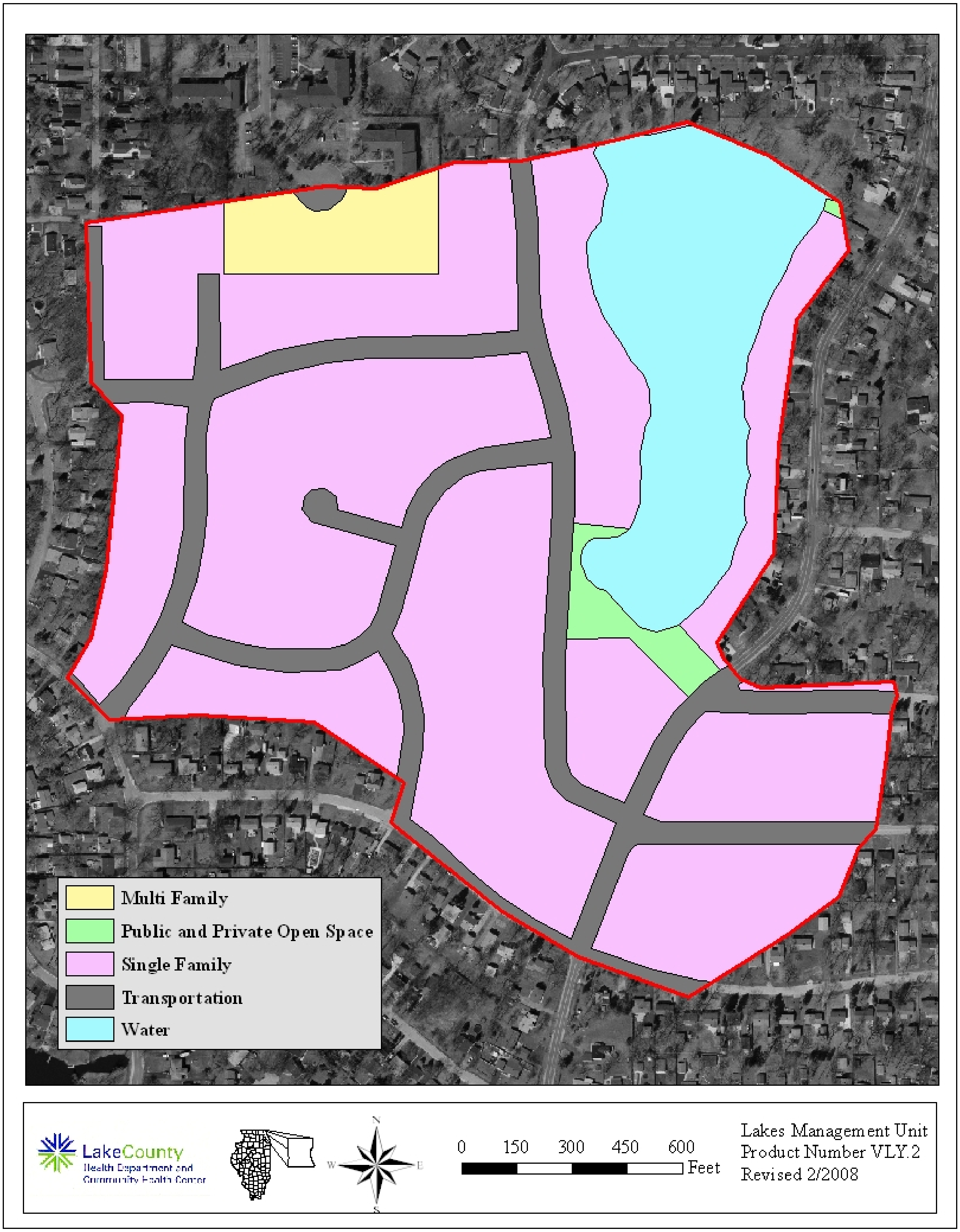
Total suspended solids (TSS) are made up of any type of solid particles in the water column, including algal cells and sediment. The average TSS concentration for Valley Lake in 2007 was 8.3 mg/L. This was above the Lake County median of 8.0 mg/L (Appendix E). The average TSS decreased by 30% since 2000 when the concentration was 12.2 mg/L. However the low plant density in this shallow system was the result of high TSS concentrations in the water column that block sunlight penetration needed for plant growth.

Secchi depth (water clarity) in Valley Lake was just above the county median (3.28 feet). The average Secchi depth in 2007 was 5.05 feet, which was an increase since the 2000 sampling season when the average was 3.19 feet. May 2007 had the deepest Secchi reading (9.51 feet) while September had the lowest reading (1.49 feet). A drastic change in water clarity occurred from June (9.19 feet) to July (2.78 feet) that can be attributed to rain fall. The Stormwater Management Commission rain gauge at Gages Lake recorded 19.75 inches of rain June to September. In addition, a blue-green algae bloom was noted in July that contributed to the low Secchi readings. These Secchi depths correlate to the amounts of TSS found at the same sampling times (Figure 4).

Valley Lake has participated in the Illinois Environmental Protection Agency's (IEPA) Volunteer Lake Monitoring Program (VLMP) since 2005. The VLMP Secchi depth averages over the past five years have been between 3.19 feet and 5.05 feet (Figure 5). The VLMP data

**Figure 1. Approximate watershed delineation for Valley Lake, 2007.**

**Figure 2. Approximate land use within the Valley Lake watershed, 2007.**



## Table 1. Approximate land uses and retention time for Valley Lake, 2007.

| Land Use | Acreage | % of Total |
|---|---|---|
| Multi Family | 3.00 | 3.65% |
| Public and Private Open Space | 1.31 | 1.59% |
| Single Family | 52.83 | 64.40% |
| Transportation | 13.00 | 15.85% |
| Water | 11.90 | 14.50% |
| **TOTAL** | **82.04** | **100.00%** |

| Land Use | Acreage | Runoff Coeff. | Estimated Runoff, acft. | % Total of Estimated Runoff |
|---|---|---|---|---|
| Multi Family | 3.00 | 0.30 | 2.47 | 3.21% |
| Public and Private Open Space | 1.31 | 0.15 | 0.54 | 0.70% |
| Single Family | 52.83 | 0.30 | 43.59 | 56.61% |
| Transportation | 13.00 | 0.85 | 30.39 | 39.47% |
| Water | 11.90 | 0.00 | 0.00 | 0.00% |
| **TOTAL** | **82.04** | | **76.99** | **100.00%** |

| | | |
|---|---|---|
| **Lake volume** | **55.92** | **acre-feet** |
| **Retention Time (years)= lake volume/runoff** | **0.73** | **years** |
| | **265.10** | **days** |

NOTE: Runoff calculations do not include the acreage of the lake itself, which is part of the total watershed area

**Figure 3. Access and water quality sampling sites on Valley Lake, 2007.**

# Table 2. Water quality data for Valley Lake, 2000 and 2007.

| 2007 | Epilimnion | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DATE | DEPTH | ALK | TKN | $NH_3$-N | $NO_2+NO_3$* | TP | SRP | TDS | $Cl^-$ | TSS | TS | TVS | SECCHI | COND | pH | DO |
| 09-May | 3 | 195 | 0.68 | <0.1 | 0.052 | 0.016 | <0.005 | NA | 438 | 1.5 | 1000 | 109 | 9.51[a] | 1.8610 | 7.89 | 6.77 |
| 13-Jun | 3 | 181 | 0.80 | <0.1 | 0.094 | 0.043 | <0.005 | NA | 406 | 2.8 | 972 | 159 | 9.19[a] | 1.7130 | 8.70 | 13.16 |
| 11-Jul | 3 | 162 | 1.30 | <0.1 | <0.05 | 0.112 | 0.016 | NA | 402 | 9.2 | 954 | 181 | 2.78 | 1.6820 | 8.29 | 4.21 |
| 08-Aug | 3 | 147 | 1.58 | <0.1 | 0.069 | 0.131 | 0.015 | NA | 340 | 13.0 | 790 | 134 | 2.30 | 1.4360 | 8.35 | 5.31 |
| 12-Sep | 3 | 165 | 1.71 | <0.1 | <0.05 | 0.173 | 0.012 | NA | 288 | 15.0 | 743 | 139 | 1.49 | 1.2640 | 8.39 | 6.48 |
| | **Average** | 170 | 1.21 | <0.1[k] | 0.072[k] | 0.095 | 0.014[k] | NA | 375 | 8.3 | 892 | 144 | 5.05[b] | 1.5912 | 8.32 | 7.19 |

| 2000 | Epilimnion | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DATE | DEPTH | ALK | TKN | $NH_3$-N | $NO_3$-N | TP | SRP | TDS | $Cl^-$ | TSS | TS | TVS | SECCHI | COND | pH | DO |
| 25-May | 3 | 168 | 1.22 | <0.1 | 0.090 | 0.062 | 0.007 | 670 | NA | 5.7 | 714 | 151 | 3.81 | 1.2730 | 8.42 | 10.90 |
| 29-Jun | 3 | 166 | 1.38 | <0.1 | 0.063 | 0.148 | 0.033 | 718 | NA | 17.0 | 727 | 185 | 2.72 | 1.1850 | 8.38 | 8.45 |
| 27-Jul | 3 | 151 | 1.78 | <0.1 | 0.068 | 0.209 | 0.027 | 648 | NA | 17.0 | 704 | 194 | 2.49 | 1.1360 | 8.35 | 7.90 |
| 31-Aug | 3 | 159 | 1.20 | 0.221 | <0.05 | 0.165 | 0.085 | 634 | NA | 13.0 | 691 | 168 | 3.22 | 1.1570 | 8.38 | 5.05 |
| 28-Sep | 3 | 160 | 1.84 | 0.442 | <0.05 | 0.151 | 0.053 | 612 | NA | 8.2 | 657 | 131 | 3.71 | 1.1260 | 7.88 | 6.19 |
| | **Average** | 161 | 1.48 | 0.332[k] | 0.074[k] | 0.147 | 0.041 | 656 | NA | 12.2 | 699 | 166 | 3.19 | 1.1754 | 8.28 | 7.70 |

**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
NO2+NO3 = Nitrite and Nitrate nitrogen, mg/L
TP = Total phosphorus, mg/L
SRP = Soluble reactive phosphorus, mg/L
TDS = Total dissolved solids, mg/L
$Cl^-$ = Chloride ions, 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

Note: "k" denotes that the actual value is known to be less than the value presented.
NA = Not Applicable
* = Prior to 2006 only Nitrate was analyzed
a = Secchi depth was obstructed by the bottom
b = Secchi disk was on the bottom at least one month and therefore the average could have been deeper

# Table 2. Continued.

| 2007 | Hypolimnion | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DATE | DEPTH | ALK | TKN | $NH_3$-N | $NO_2$+$NO_3$* | TP | SRP | TDS | $Cl^-$ | TSS | TS | TVS | SECCHI | COND | pH | DO |
| 09-May | 7 | 196 | 0.73 | <0.1 | <0.05 | 0.027 | <0.005 | NA | 437 | 2.0 | 1020 | 144 | NA | 1.8570 | 7.72 | 4.83 |
| 13-Jun | 6 | 180 | 0.84 | <0.1 | 0.089 | 0.047 | <0.005 | NA | 407 | 4.1 | 978 | 166 | NA | 1.7140 | 8.70 | 13.30 |
| 11-Jul | 6 | 162 | 1.36 | <0.1 | <0.05 | 0.105 | 0.018 | NA | 405 | 8.8 | 949 | 171 | NA | 1.6810 | 8.26 | 3.85 |
| 08-Aug | 6 | 152 | 2.12 | 0.474 | <0.05 | 0.181 | 0.034 | NA | 350 | 15.0 | 809 | 132 | NA | 1.4620 | 7.86 | 0.10 |
| 12-Sep | 6 | 164 | 1.70 | <0.1 | <0.05 | 0.155 | 0.017 | NA | 287 | 15.0 | 739 | 141 | NA | 1.2650 | 8.34 | 4.96 |
| | **Average** | 171 | 1.35 | NA | 0.089[k] | 0.103 | 0.023[k] | NA | 377 | 9.0 | 899 | 151 | NA | 1.5958 | 8.18 | 5.41 |

| 2000 | Hypolimnion | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DATE | DEPTH | ALK | TKN | $NH_3$-N | $NO_3$-N | TP | SRP | TDS | $Cl^-$ | TSS | TS | TVS | SECCHI | COND | pH | DO |
| 25-May | 7 | 169 | 1.25 | <0.1 | 0.081 | 0.062 | 0.007 | 672 | NA | 5.7 | 733 | 158 | NA | 1.2740 | 8.40 | 10.60 |
| 29-Jun | 7 | 166 | <0.05 | <0.1 | 0.059 | 0.134 | 0.021 | 700 | NA | 16.0 | 723 | 184 | NA | 1.1870 | 8.22 | 6.89 |
| 27-Jul | 7 | 151 | 1.23 | <0.1 | 0.064 | 0.198 | 0.030 | 656 | NA | 19.0 | 708 | 185 | NA | 1.1380 | 8.28 | 7.42 |
| 31-Aug | 6 | 160 | 1.60 | 0.2 | <0.05 | 0.156 | 0.089 | 602 | NA | 13.0 | 677 | 148 | NA | 1.1600 | 8.33 | 4.55 |
| 28-Sep | 7 | 159 | 1.79 | 0.445 | 0.079 | 0.126 | 0.058 | 610 | NA | 8.6 | 642 | 107 | NA | 1.1260 | 7.89 | 6.12 |
| | **Average** | 161 | 1.47[k] | 0.322[k] | 0.07[k] | 0.135 | 0.041 | 648 | NA | 12.5 | 697 | 156 | NA | 1.1770 | 8.22 | 7.12 |

**Glossary**

ALK = Alkalinity, mg/L $CaCO_3$
TKN = Total Kjeldahl nitrogen, mg/L
$NH_3$-N = Ammonia nitrogen, mg/L
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DO = Dissolved oxygen, mg/L

Note: "k" denotes that the actual value is known to be less than the value presented.
NA = Not Applicable
* = Prior to 2006 only Nitrate was analyzed

**Figure 4. Total suspended solid (TSS) concentrations vs. Secchi disk depth for Valley Lake, 2007.**

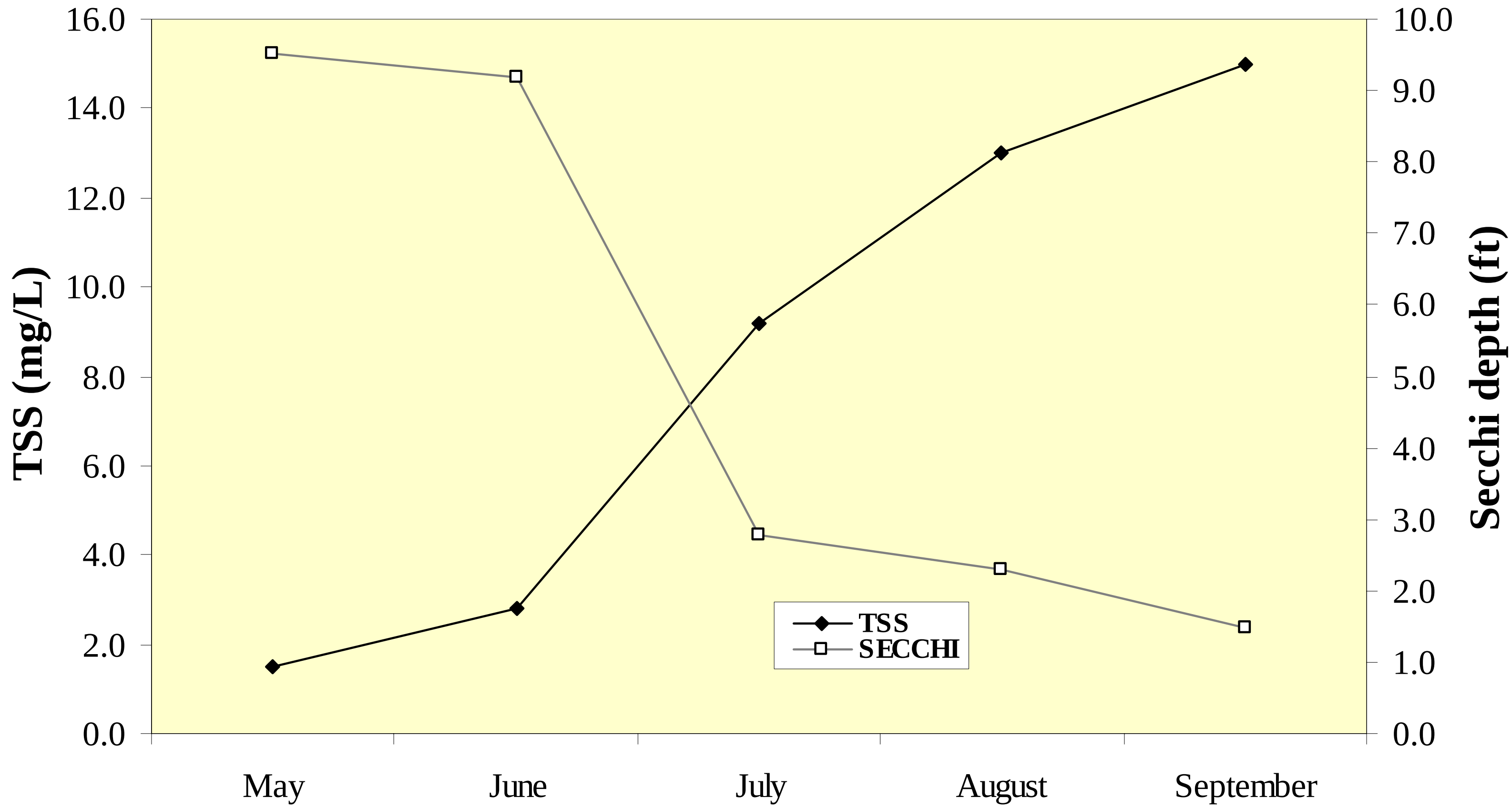
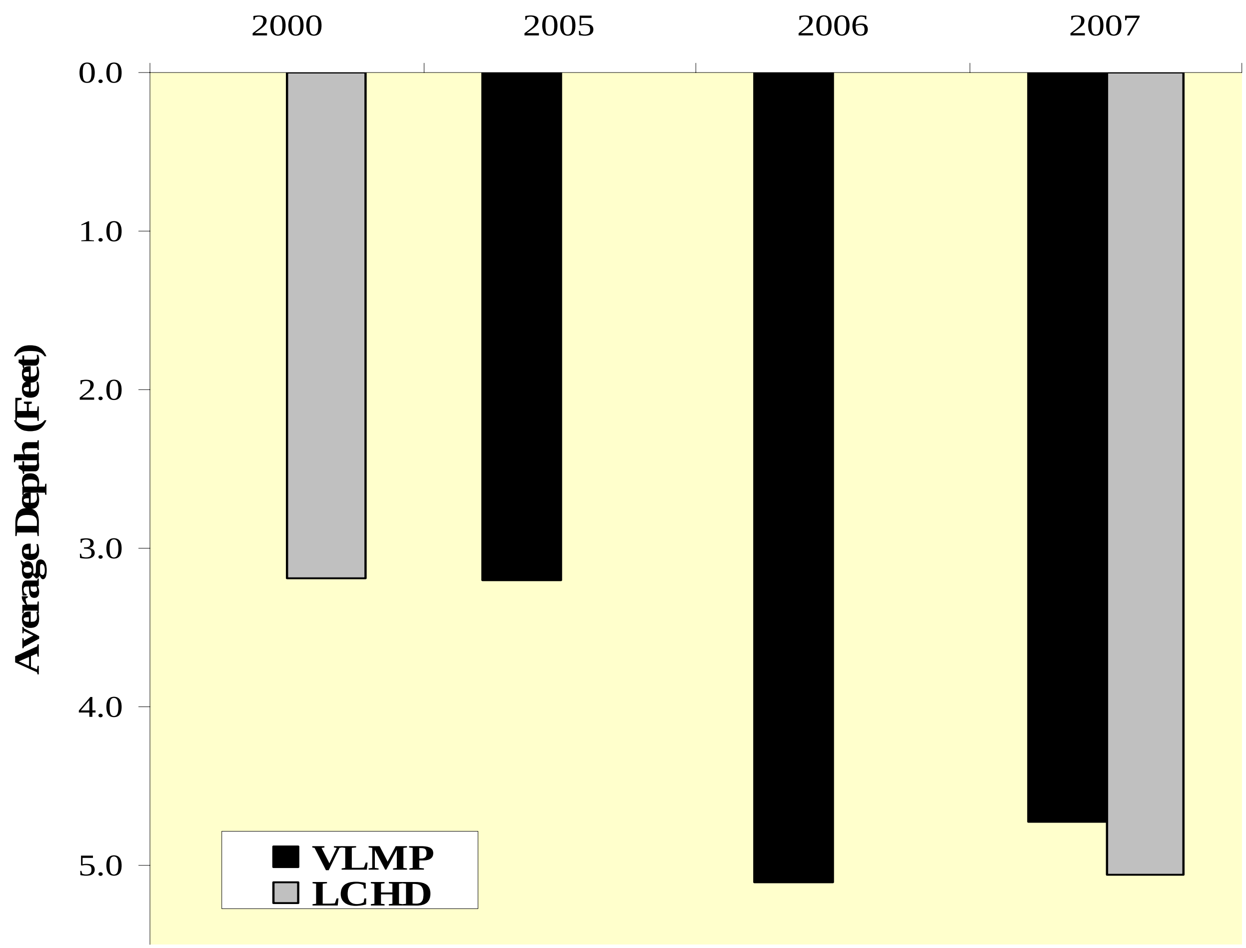


**Figure 5. Comparison of average Secchi disk depths between VLMP records and LCHD records from 2000-2007 for Valley Lake**



from 2005 through 2007 had an average Secchi depth of 4.34 feet while the LMU average from 2000 and 2007 was 4.12 feet. The volunteers at Valley Lake have provided exceptional and accurate data that is vital for the continued monitoring and management of this lake. The Lakes Management Unit would like to thank them for the efforts.

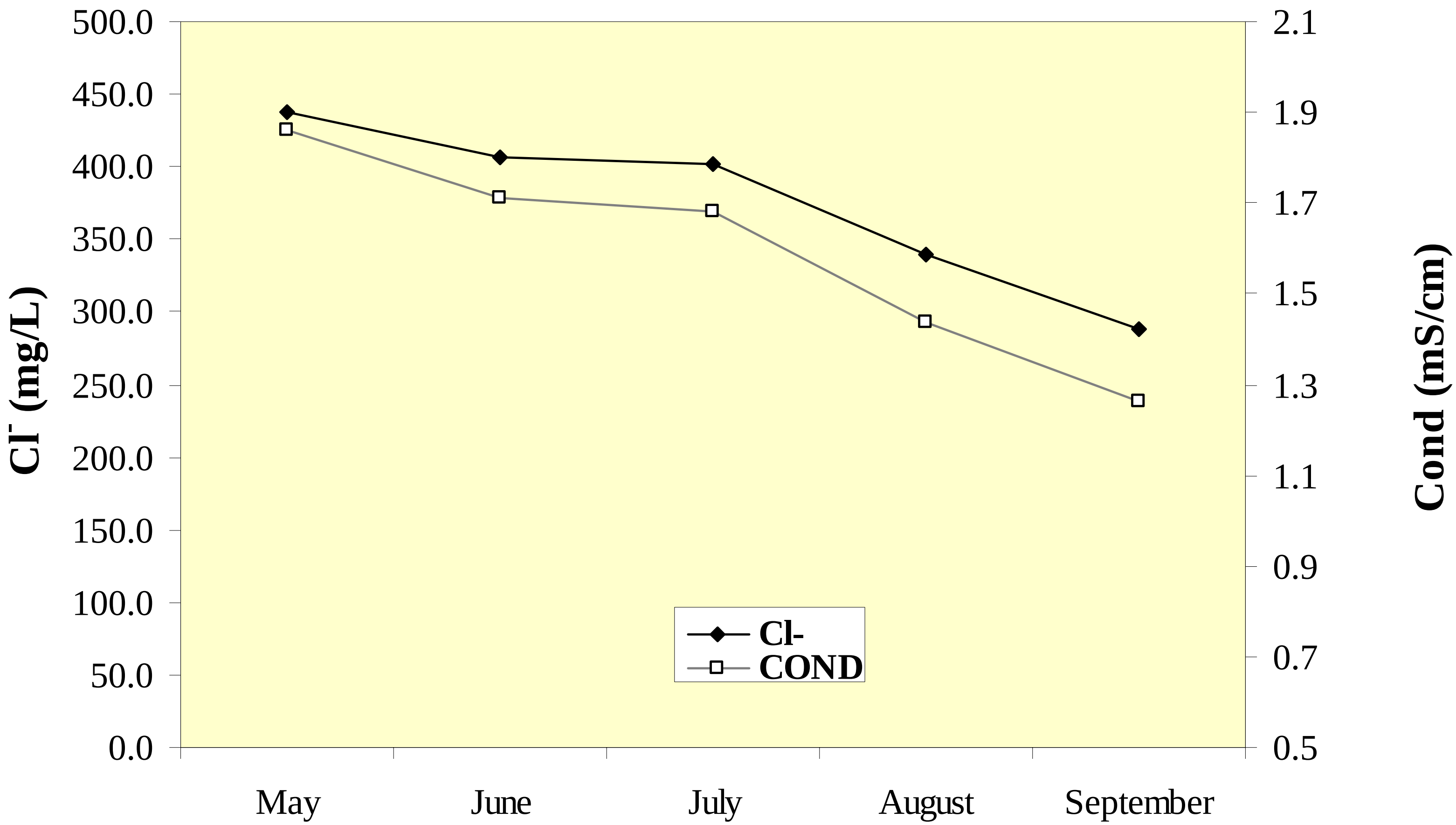
Conductivity is the measure of dissolved ions within water. An increase in conductivity amplifies waters ability to conduct electricity. In Valley Lake, average conductivity in 2007 was 1.5912 mS/cm. This was a 35% increase from the 2000 value of 1.1754 mS/cm and almost twice the county median (0.8038 mS/cm). Almost all of the lakes in the county are experiencing similar increases in conductivity for the same reason. Road salts used in winter road management runoff into lakes and build up since aquatic organisms cannot use them. This leads to an increase in both conductivity and chloride ion ($Cl^-$) concentrations, which are correlated (Figure 6). The median $Cl^-$ concentration in the county is 158 mg/L, but Valley Lake had a greater concentration (375 mg/L). Conductivity and $Cl^-$ concentrations decreased from May to August. This was most likely due to the road salts used in winter being diluted. Both conductivity and $Cl^-$ concentrations decreased throughout the summer, which is most likely correlated to the heavy precipitation which occurred July through August.

Another aspect of water quality is the nutrients within a water body, especially nitrogen (N) and phosphorus (P), as these are the two nutrients that can limit plant and algal growth. Carbon and light are the other factors that control plant and algal growth, but these are not normally limiting. In 2007, the average total phosphorus (TP) concentration in Valley Lake was 0.095 mg/L, which was above than the county median (0.063 mg/L). TP concentrations have decreased by about 55% since sampling in 2000 (0.147 mg/L). Most lakes in Lake County are phosphorus limited, however, Valley Lake was both phosphorus and nitrogen limited. In 2007, the lake was phosphorus limited in May and June, then limited in neither nutrient in July and August, and finally nitrogen limited in September. In 2000, the lake was phosphorus limited only in May and nitrogen limited in June, July, and August. In September 2000, the lake was limited by neither nutrient. When nitrogen limited, algae and other organisms can not utilize all the available phosphorus, thus more phosphorus is found in the water samples. Soluble reactive phosphorus (SRP) in a phosphorus limited system is quickly utilized by organisms, but not so in Valley Lake when it was nitrogen limited. This may explain the differences in TP and SRP between the years. It also makes the lake management potentially more difficult since reducing the TP in the lake may not be enough to control algae blooms. In a nitrogen limited system, blue-green algae can outcompete other algae species due to their ability to fix nitrogen from the atmosphere and not relying solely on nitrogen available in the water.

The average total Kjeldahl nitrogen (TKN) concentration in Valley Lake in 2007 (1.21 mg/L) decreased from 2000 (1.48 mg/L). The average nitrate+nitrite concentration (0.072 mg/L) was about the same as the 2000 average for nitrate (0.074 mg/L). Average ammonia ($NH_3$-N) concentrations decreased, from 0.332 mg/L in 2000 to below the detection limit (<0.1 mg/L) throughout the summer in 2007.

Another way to look at phosphorus levels and how they affect productivity of the lake is to use a Trophic State Index (TSI) based on phosphorus (TSIp) and Secchi disk depth (TSIs). TSIp values are commonly used to classify and compare lake productivity levels (trophic state).

**Figure 6. Chloride ($Cl^-$) concentration vs. conductivity for Valley Lake, 2007.**



The higher the phosphorus levels the greater the amount of plant and algal biomass, which leads to a higher TSIp and corresponding trophic state. Based on a TSIp value of 69.8, Valley Lake was classified as eutrophic ($\geq$50, <70 TSI). A eutrophic lake is defined as a productive system that has above average nutrient levels and the potential to produce high algal biomass (growth). This was a great improvement from the 2000 TSIp value of 76.2 that ranked the lake as hypereutrophic (>70 TSI). Based on a Secchi TSI of 60.6, Valley Lake was also classified as eutrophic. Overall, the trophic state of the lake was eutrophic. Based on the TSIp, Valley Lake ranks 105th out of 163 lakes studied by the Lakes Management Unit (LMU) from 2000-2007 (Table 3). This was an increase since 2000 when the lake was ranked 82nd out of 87 lakes sampled.

TSI values along with other water quality parameters can be used to make other analyses based on use impairment indices established by the IEPA. Based on the IEPA indices, Valley Lake had *Partial* support for recreational use and *Full* support for aquatic life use. Based on these indices, this lake provided *Partial* overall use support.

## SUMMARY OF AQUATIC MACROPHYTES

An aquatic plant (macrophyte) survey was conducted in July of 2007. In previous years, the sampler, with the goal of covering most of the lake and finding all species present, chose sampling sites randomly. While this method worked well, a new sampling technique was implemented in 2005, and therefore was used this year on Valley Lake. Sampling sites were based on a grid system created by mapping software (ArcGIS), with each site located 60 meters apart. On Valley Lake, there were 52 sampling sites in 2007 (Figure 7). There were 3 aquatic plant species found with Leafy Pondweed having the highest density (10% of the sites). *Vallisneria* and *Chara* spp. (a macroalgae) were found at 6% and 2% of the sites, respectively (Table 4a). Plants need at least 1% of surface light levels in order to survive. Plants were found down to a depth of 6 feet, which relates to the 1% light level depth of 8 feet. Out of the 52 sample sites, plants were found at 7 of them (13%) (Table 4b).

These sample sites covered the entire lake, and therefore the lake had approximately 13% plant coverage, with none topped out (plants reaching and crowding the surface of the lake). This coverage, while low, was an improvement from 2000 when only *Chara* spp. was found at 8% of sample sites in May, and no other plants were found throughout the rest of the season. Ideally, a lake should have 30-40% plant coverage in order to sustain a healthy fishery, according to the Illinois Department of Natural Resources (IDNR). Valley Lake has a lower than recommended plant community. Because Valley Lake is shallow and receives direct storm water runoff from its watershed, it experiences a high nutrient and TSS load, which makes it difficult to improve water clarity. It is recommended that no herbicide treatments occur in the lake until aquatic plant densities increase. Water clarity will subsequently increase, possibly resulting in nuisance conditions as historically seen in the lake. Thus, the lake's management plan should be drafted to address these issues.

Plant diversity increased by one species between 2000 and 2007 (Table 5). *Vallisneria* was found in 2007 and not in 2000. This was an improvement in the plant community since *Vallisneria* is a beneficial, native species. The changes can probably be attributed to the

**Table 3. Lake County average TSI phosphorous (TSIp) ranking 2000-2007.**

| RANK | LAKE NAME | TP AVE | TSIp |
|---|---|---|---|
| 1 | Lake Carina | 0.0100 | 37.35 |
| 2 | Sterling Lake | 0.0100 | 37.35 |
| 3 | Independence Grove | 0.0114 | 39.24 |
| 4 | Sand Pond (IDNR) | 0.0132 | 41.36 |
| 5 | Cedar Lake | 0.0157 | 41.60 |
| 6 | Windward Lake | 0.0158 | 43.95 |
| 7 | Pulaski Pond | 0.0180 | 45.83 |
| 8 | Timber Lake (North) | 0.0180 | 45.83 |
| 9 | Fourth Lake | 0.0182 | 45.99 |
| 10 | West Loon Lake | 0.0182 | 45.99 |
| 11 | Lake Kathyrn | 0.0200 | 47.35 |
| 12 | Lake of the Hollow | 0.0200 | 47.35 |
| 13 | Banana Pond | 0.0202 | 47.49 |
| 14 | Lake Minear | 0.0204 | 47.63 |
| 15 | Bangs Lake | 0.0212 | 48.17 |
| 16 | Cross Lake | 0.0220 | 48.72 |
| 17 | Dog Pond | 0.0222 | 48.85 |
| 18 | Stone Quarry Lake | 0.0230 | 49.36 |
| 19 | Cranberry Lake | 0.0234 | 49.61 |
| 20 | Deep Lake | 0.0240 | 49.98 |
| 21 | Druce Lake | 0.0244 | 50.22 |
| 22 | Little Silver Lake | 0.0246 | 50.33 |
| 23 | Round Lake | 0.0254 | 50.80 |
| 24 | Lake Leo | 0.0256 | 50.91 |
| 25 | Dugdale Lake | 0.0274 | 51.89 |
| 26 | Peterson Pond | 0.0274 | 51.89 |
| 27 | Lake Miltmore | 0.0276 | 51.99 |
| 28 | East Loon Lake | 0.0280 | 52.20 |
| 29 | Lake Zurich | 0.0282 | 52.30 |
| 30 | Lake Fairfield | 0.0296 | 53.00 |
| 31 | Gray's Lake | 0.0302 | 53.29 |
| 32 | Highland Lake | 0.0302 | 53.29 |
| 33 | Hook Lake | 0.0302 | 53.29 |
| 34 | Lake Catherine (Site 1) | 0.0308 | 53.57 |
| 35 | Lambs Farm Lake | 0.0312 | 53.76 |
| 36 | Old School Lake | 0.0312 | 53.76 |
| 37 | Sand Lake | 0.0316 | 53.94 |
| 38 | Sullivan Lake | 0.0320 | 54.13 |
| 39 | Lake Linden | 0.0326 | 54.39 |
| 40 | Countryside Lake | 0.0332 | 54.66 |
| 41 | Gages Lake | 0.0338 | 54.92 |
| 42 | Hendrick Lake | 0.0344 | 55.17 |
| 43 | Third Lake | 0.0346 | 55.24 |
| 44 | Diamond Lake | 0.0372 | 56.30 |
| 45 | Channel Lake (Site 1) | 0.0380 | 56.60 |
| 46 | Ames Pit | 0.0390 | 56.98 |

# Table 3. Continued.

| RANK | LAKE NAME | TP AVE | TSIp |
|---|---|---|---|
| 47 | White Lake | 0.0408 | 57.63 |
| 48 | Sun Lake | 0.0410 | 57.70 |
| 49 | Potomac Lake | 0.0424 | 58.18 |
| 50 | Duck Lake | 0.0426 | 58.25 |
| 51 | Old Oak Lake | 0.0428 | 58.32 |
| 52 | Deer Lake | 0.0434 | 58.52 |
| 53 | Schreiber Lake | 0.0434 | 58.52 |
| 54 | Nielsen Pond | 0.0448 | 58.98 |
| 55 | Turner Lake | 0.0458 | 59.30 |
| 56 | Seven Acre Lake | 0.0460 | 59.36 |
| 57 | Willow Lake | 0.0464 | 59.48 |
| 58 | Lucky Lake | 0.0476 | 59.85 |
| 59 | Davis Lake | 0.0476 | 59.85 |
| 60 | East Meadow Lake | 0.0478 | 59.91 |
| 61 | College Trail Lake | 0.0496 | 60.45 |
| 62 | Lake Lakeland Estates | 0.0524 | 61.24 |
| 63 | Butler Lake | 0.0528 | 61.35 |
| 64 | West Meadow Lake | 0.0530 | 61.40 |
| 65 | Heron Pond | 0.0545 | 61.80 |
| 66 | Little Bear Lake | 0.0550 | 61.94 |
| 67 | Lucy Lake | 0.0552 | 61.99 |
| 68 | Lake Christa | 0.0576 | 62.60 |
| 69 | Lake Charles | 0.0580 | 62.70 |
| 70 | Crooked Lake | 0.0608 | 63.38 |
| 71 | Waterford Lake | 0.0610 | 63.43 |
| 72 | Lake Naomi | 0.0616 | 63.57 |
| 73 | Lake Tranquility S1 | 0.0618 | 63.62 |
| 74 | Werhane Lake | 0.0630 | 63.89 |
| 75 | Liberty Lake | 0.0632 | 63.94 |
| 76 | Countryside Glen Lake | 0.0642 | 64.17 |
| 77 | Lake Fairview | 0.0648 | 64.30 |
| 78 | Leisure Lake | 0.0648 | 64.30 |
| 79 | Tower Lake | 0.0662 | 64.61 |
| 80 | Wooster Lake | 0.0663 | 64.63 |
| 81 | St. Mary's Lake | 0.0666 | 64.70 |
| 82 | Mary Lee Lake | 0.0682 | 65.04 |
| 83 | Hastings Lake | 0.0684 | 65.08 |
| 84 | Honey Lake | 0.0690 | 65.21 |
| 85 | Spring Lake | 0.0726 | 65.94 |
| 86 | ADID 203 | 0.0730 | 66.02 |
| 87 | Bluff Lake | 0.0734 | 66.10 |
| 88 | Harvey Lake | 0.0766 | 66.71 |
| 89 | Broberg Marsh | 0.0782 | 67.01 |
| 90 | Echo Lake | 0.0792 | 67.19 |
| 91 | Sylvan Lake | 0.0794 | 67.23 |
| 92 | Big Bear Lake | 0.0806 | 67.45 |

## Table 3. Continued.

| RANK | LAKE NAME | TP AVE | TSIp |
|---|---|---|---|
| 93 | Petite Lake | 0.0834 | 67.94 |
| 94 | Timber Lake (South) | 0.0848 | 68.18 |
| 95 | Lake Marie (Site 1) | 0.0850 | 68.21 |
| 96 | North Churchill Lake | 0.0872 | 68.58 |
| 97 | Grand Avenue Marsh | 0.0874 | 68.61 |
| 98 | Grandwood Park, Site II, Outflow | 0.0876 | 68.65 |
| 99 | North Tower Lake | 0.0878 | 68.68 |
| 100 | South Churchill Lake | 0.0896 | 68.97 |
| 101 | Rivershire Pond 2 | 0.0900 | 69.04 |
| 102 | McGreal Lake | 0.0914 | 69.26 |
| 103 | International Mine and Chemical Lake | 0.0948 | 69.79 |
| 104 | Eagle Lake (Site I) | 0.0950 | 69.82 |
| **105** | **Valley Lake** | **0.0950** | **69.82** |
| 106 | Dunns Lake | 0.0952 | 69.85 |
| 107 | Fish Lake | 0.0956 | 69.91 |
| 108 | Lochanora Lake | 0.0960 | 69.97 |
| 109 | Owens Lake | 0.0978 | 70.23 |
| 110 | Woodland Lake | 0.0986 | 70.35 |
| 111 | Island Lake | 0.0990 | 70.41 |
| 112 | McDonald Lake 1 | 0.0996 | 70.50 |
| 113 | Longview Meadow Lake | 0.1024 | 70.90 |
| 114 | Long Lake | 0.1029 | 70.96 |
| 115 | Lake Barrington | 0.1053 | 71.31 |
| 116 | Redwing Slough, Site II, Outflow | 0.1072 | 71.56 |
| 117 | Lake Forest Pond | 0.1074 | 71.59 |
| 118 | Bittersweet Golf Course #13 | 0.1096 | 71.88 |
| 119 | Fox Lake (Site 1) | 0.1098 | 71.90 |
| 120 | Osprey Lake | 0.1108 | 72.04 |
| 121 | Bresen Lake | 0.1126 | 72.27 |
| 122 | Round Lake Marsh North | 0.1126 | 72.27 |
| 123 | Deer Lake Meadow Lake | 0.1158 | 72.67 |
| 124 | Taylor Lake | 0.1184 | 72.99 |
| 125 | Columbus Park Lake | 0.1226 | 73.49 |
| 126 | Nippersink Lake (Site 1) | 0.1240 | 73.66 |
| 127 | Grass Lake (Site 1) | 0.1288 | 74.21 |
| 128 | Lake Holloway | 0.1322 | 74.58 |
| 129 | Lakewood Marsh | 0.1330 | 74.67 |
| 130 | Summerhill Estates Lake | 0.1384 | 75.24 |
| 131 | Redhead Lake | 0.1412 | 75.53 |
| 132 | Forest Lake | 0.1422 | 75.63 |
| 133 | Antioch Lake | 0.1448 | 75.89 |
| 134 | Slocum Lake | 0.1496 | 76.36 |
| 135 | Drummond Lake | 0.1510 | 76.50 |
| 136 | Pond-a-Rudy | 0.1514 | 76.54 |
| 137 | Lake Matthews | 0.1516 | 76.56 |
| 138 | Buffalo Creek Reservoir | 0.1550 | 76.88 |

# Table 3. Continued.

| RANK | LAKE NAME | TP AVE | TSIp |
|---|---|---|---|
| 139 | Pistakee Lake (Site 1) | 0.1592 | 77.26 |
| 140 | Salem Lake | 0.1650 | 77.78 |
| 141 | Half Day Pit | 0.1690 | 78.12 |
| 142 | Lake Eleanor Site II, Outflow | 0.1812 | 79.13 |
| 143 | Lake Farmington | 0.1848 | 79.41 |
| 144 | ADID 127 | 0.1886 | 79.71 |
| 145 | Lake Louise Inlet | 0.1938 | 80.10 |
| 146 | Grassy Lake | 0.1952 | 80.20 |
| 147 | Dog Bone Lake | 0.1990 | 80.48 |
| 148 | Redwing Marsh | 0.2072 | 81.06 |
| 149 | Stockholm Lake | 0.2082 | 81.13 |
| 150 | Bishop Lake | 0.2156 | 81.63 |
| 151 | Hidden Lake | 0.2236 | 82.16 |
| 152 | Fischer Lake | 0.2278 | 82.43 |
| 153 | Lake Napa Suwe (Outlet) | 0.2304 | 82.59 |
| 154 | Patski Pond (outlet) | 0.2512 | 83.84 |
| 155 | Oak Hills Lake | 0.2792 | 85.36 |
| 156 | Loch Lomond | 0.2954 | 86.18 |
| 157 | McDonald Lake 2 | 0.3254 | 87.57 |
| 158 | Fairfield Marsh | 0.3264 | 87.61 |
| 159 | ADID 182 | 0.3280 | 87.69 |
| 160 | Slough Lake | 0.4134 | 91.02 |
| 161 | Flint Lake Outlet | 0.4996 | 93.75 |
| 162 | Rasmussen Lake | 0.5025 | 93.84 |
| 163 | Albert Lake, Site II, outflow | 1.1894 | 106.3 |

**Figure 7. Aquatic plant sampling grid illustrating plant density on Valley Lake, July 2007.**

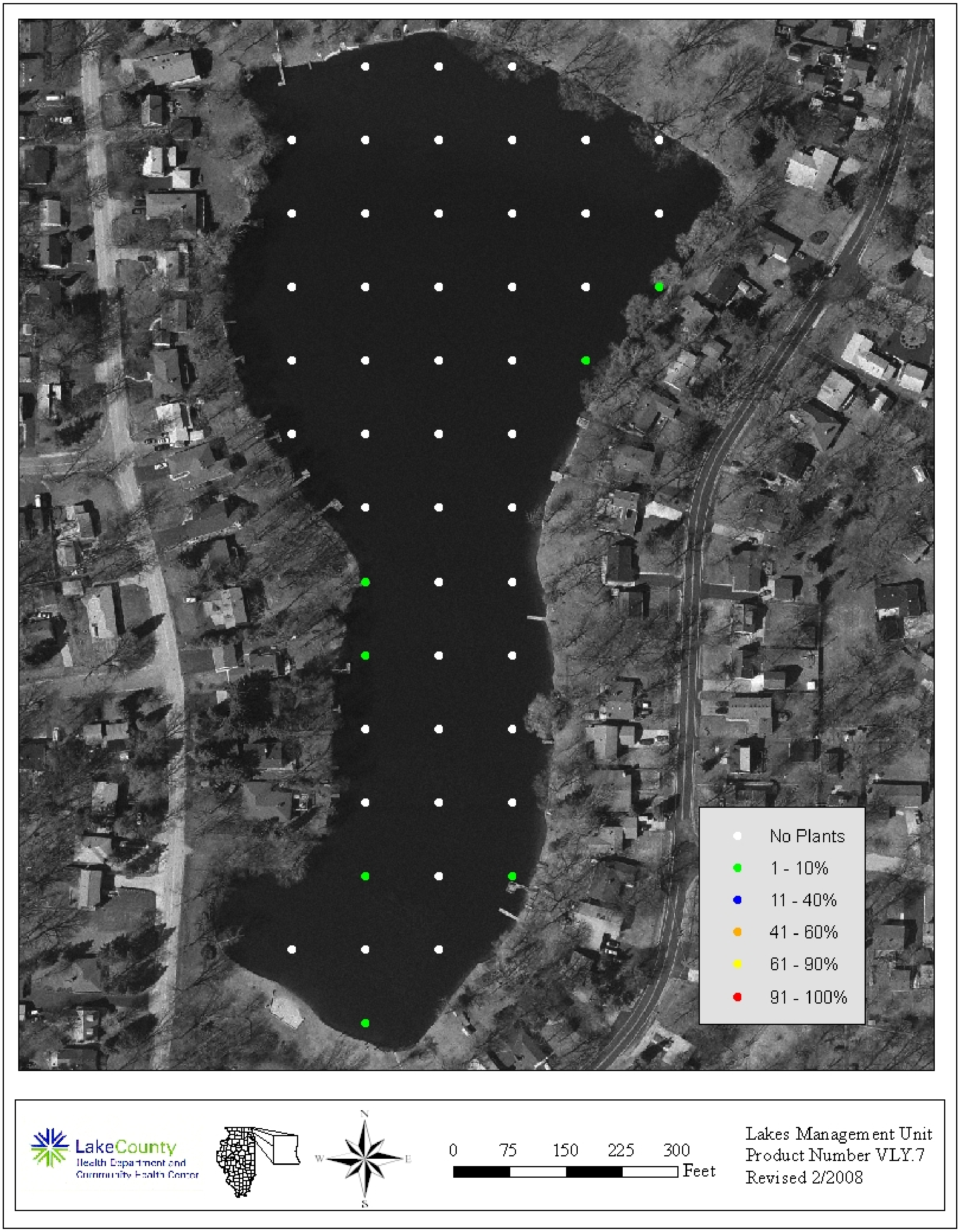


**Table 4a. Aquatic plant species found at the 52 sampling sites on Valley Lake, 2007. Maximum depth that plants were found was feet 6.0.**

| Plant Density | Chara | Leafy Pondweed | Vallisneria |
|---|---|---|---|
| Absent | 51 | 47 | 49 |
| Present | 1 | 5 | 3 |
| Common | 0 | 0 | 0 |
| Abundant | 0 | 0 | 0 |
| Dominant | 0 | 0 | 0 |
| % Plant Occurrence | 2% | 10% | 6% |

**Table 4b. Distribution of rake density across all sampling sites.**

| Rake Density (coverage) | # of Sites | % of Sites |
|---|---|---|
| No Plants | 45 | 87% |
| >0-10% | 7 | 13% |
| 10-40% | 0 | 0% |
| 40-60% | 0 | 0% |
| 60-90% | 0 | 0% |
| >90% | 0 | 0% |
| Total Sites with Plants | 7 | 13% |
| Total # of Sites | 52 | 100% |

**Table 5. Aquatic plant species found in Valley Lake in 2007.**

| | |
|---|---|
| Chara (Macro algae) | *Chara spp.* |
| Leafy Pondweed | *Potamogeton foliosus* |
| Vallisneria | *Vallisneria spp.* |

decrease in Grass Carp population (according to residents) allowing seed beds to grow. Another positive condition was that Valley Lake continues to harbor no exotic, invasive aquatic plant species. An even larger increase in plant diversity and density would further help Valley Lake deal with the storm water runoff and became a clearer lake.

Floristic Quality Index (FQI) is a rapid assessment tool designed to evaluate the closeness of the flora of an area to undisturbed conditions. Each floating or submersed aquatic plant is assigned a number between 1 and 10 (10 indicating the plant species most sensitive to disturbance). An FQI is calculated by multiplying the average of these numbers by the square root of the number of these plant species found in the lake. A high FQI number indicates that there is a large number of sensitive, high quality plant species present in the lake. Non-native species were also included in the FQI calculations for Lake County lakes. The average FQI for 2000-2007 Lake County lakes was 13.6. Valley Lake had a FQI of 9.9 in 2007, which ranked it 104$^{th}$ out of the 152 lakes recorded (Table 6). This was a large increase since the 2000 survey was conducted, when the FQI was 0.0. This was due to only a macroalgae, and no macrophytes, being found in 2000, while two native macrophyte species were found in 2007.

## SUMMARY OF SHORELINE CONDITION

In 2000 an assessment was conducted to determine the condition of the shoreline at the water/land interface. The entire shoreline was developed, with 70% classified as lawn (mowed turf grass to the water's edge). The two other major shoreline types were rip-rap (7%) and seawall (5%). Beach made up 4% of the total shoreline. Approximately 61% of the shoreline was eroding with 51% classified as slight and 10% classified as moderate. The shoreline was reassessed in 2007 for significant changes in erosion since 2000. Based on this assessment, some of the areas of no erosion were reclassified as slight and areas of slight were reclassified as moderate (Figure 8). Overall, 63% of the shoreline was eroding with 34% slight and 29% moderate. Continued neglect of these shorelines could lead to further erosion, resulting not only in a loss of property, but additional soil inputs into the water that negatively affect water quality.

It is much easier and less costly to mitigate slightly eroding shorelines than those with severe erosion. Repairing these shorelines by installing riparian buffer strips with native plants will help restore the quality of Valley Lake in a variety of ways. First, the new native plants can stabilize the shoreline to prevent future erosion. Second, there will be an increase in habitat for wildlife to a shoreline that is otherwise limited. Thirdly, buffer habitat will help filter pollutants and nutrients before entering the lake, increasing water quality.

## SUMMARY OF WILDLIFE AND HABITAT CONDITIONS

Visual wildlife observations were made on a monthly basis during water quality and plant sampling activities. Primarily birds common in residential lake settings were found on and around Valley Lake. Enhancing habitat for terrestrial wildlife such as birds and small mammals can be accomplished through the addition of shoreline buffer zones and is recommended as one aspect of shoreline protection. Erecting birdhouses and allowing brush or trees that have fallen into the water to remain creates habitat for birds, fish, reptiles, and amphibians.

**Table 6. Floristic quality index (FQI) of lakes in Lake County, calculated with exotic species (w/Adventives) and with native species only (native).**

| RANK | LAKE NAME | FQI (w/A) | FQI (native) |
|---|---|---|---|
| 1 | Cedar Lake | 35.1 | 37.3 |
| 2 | Deep Lake | 33.9 | 35.4 |
| 3 | Cranberry Lake | 30.1 | 31.0 |
| 4 | Round Lake Marsh North | 29.1 | 29.9 |
| 5 | East Loon Lake | 28.4 | 29.9 |
| 6 | Sullivan Lake | 28.2 | 29.7 |
| 7 | Deer Lake | 28.2 | 29.7 |
| 8 | Little Silver Lake | 27.9 | 30.0 |
| 9 | Schreiber Lake | 26.8 | 27.6 |
| 10 | West Loon Lake | 26.0 | 27.6 |
| 11 | Cross Lake | 25.2 | 27.8 |
| 12 | Independence Grove | 24.6 | 27.5 |
| 13 | Sterling Lake | 24.5 | 26.9 |
| 14 | Bangs Lake | 24.5 | 26.2 |
| 15 | Lake Zurich | 24.0 | 26.0 |
| 16 | Lakewood Marsh | 23.8 | 24.7 |
| 17 | Lake of the Hollow | 23.8 | 26.2 |
| 18 | Round Lake | 23.5 | 25.9 |
| 19 | Fourth Lake | 23.0 | 24.8 |
| 20 | Druce Lake | 22.8 | 25.2 |
| 21 | Sun Lake | 22.7 | 24.5 |
| 22 | Countryside Glen Lake | 21.9 | 22.8 |
| 23 | Butler Lake | 21.4 | 23.1 |
| 24 | Duck Lake | 21.1 | 22.9 |
| 25 | Wooster Lake | 20.8 | 22.6 |
| 26 | Timber Lake (North) | 20.8 | 22.8 |
| 27 | Davis Lake | 20.5 | 21.4 |
| 28 | Broberg Marsh | 20.5 | 21.4 |
| 29 | ADID 203 | 20.5 | 20.5 |
| 30 | McGreal Lake | 20.2 | 22.1 |
| 31 | Lake Kathryn | 19.6 | 20.7 |
| 32 | Redhead Lake | 19.3 | 21.2 |
| 33 | Owens Lake | 19.3 | 20.2 |
| 34 | Fish Lake | 19.3 | 21.2 |
| 35 | Turner Lake | 18.6 | 21.2 |
| 36 | Salem Lake | 18.5 | 20.2 |
| 37 | Lake Miltmore | 18.4 | 20.3 |
| 38 | Hendrick Lake | 17.7 | 17.7 |
| 39 | Summerhill Estates Lake | 17.1 | 18.0 |
| 40 | Seven Acre Lake | 17.0 | 15.5 |
| 41 | Gray's Lake | 16.9 | 19.8 |
| 42 | Third Lake | 16.8 | 18.7 |
| 43 | Lake Barrington | 16.7 | 17.7 |
| 44 | Bresen Lake | 16.6 | 17.8 |

## Table 6. Continued.

| Rank | Lake Name | FQI (w/A) | FQI (native) |
|---|---|---|---|
| 45 | Windward Lake | 16.3 | 17.6 |
| 46 | Lake Napa Suwe | 16.3 | 17.4 |
| 47 | Diamond Lake | 16.3 | 17.4 |
| 48 | Long Lake | 16.1 | 18.0 |
| 49 | Dog Bone Lake | 15.7 | 15.7 |
| 50 | Redwing Slough | 15.6 | 16.6 |
| 51 | Osprey Lake | 15.5 | 17.3 |
| 52 | Lake Fairview | 15.2 | 16.3 |
| 53 | Heron Pond | 15.1 | 15.1 |
| 54 | North Churchill Lake | 15.0 | 15.0 |
| 55 | Lake Tranquility (S1) | 15.0 | 17.0 |
| 56 | Island Lake | 14.7 | 16.6 |
| 57 | Dog Training Pond | 14.7 | 15.9 |
| 58 | Highland Lake | 14.5 | 16.7 |
| 59 | Taylor Lake | 14.3 | 16.3 |
| 60 | Grand Avenue Marsh | 14.3 | 16.3 |
| 61 | Eagle Lake (S1) | 14.0 | 15.1 |
| 62 | Dugdale Lake | 14.0 | 15.1 |
| 63 | Longview Meadow Lake | 13.9 | 13.9 |
| 64 | Hook Lake | 13.4 | 15.5 |
| 65 | Bishop Lake | 13.4 | 15.0 |
| 66 | Ames Pit | 13.4 | 15.5 |
| 67 | Old School Lake | 13.1 | 15.1 |
| 68 | McDonald Lake 2 | 13.1 | 14.3 |
| 69 | Mary Lee Lake | 13.1 | 15.1 |
| 70 | Buffalo Creek Reservoir | 13.1 | 14.3 |
| 71 | White Lake | 12.7 | 14.7 |
| 72 | Timber Lake (South) | 12.7 | 14.7 |
| 73 | Old Oak Lake | 12.7 | 14.7 |
| 74 | Dunn's Lake | 12.7 | 13.9 |
| 75 | Stone Quarry Lake | 12.5 | 12.5 |
| 76 | Sand Lake | 12.5 | 14.8 |
| 77 | Hastings Lake | 12.5 | 14.8 |
| 78 | Echo Lake | 12.5 | 14.8 |
| 79 | Stockholm Lake | 12.1 | 13.5 |
| 80 | Pond-A-Rudy | 12.1 | 12.1 |
| 81 | Lambs Farm Lake | 12.1 | 14.3 |
| 82 | Lake Leo | 12.1 | 14.3 |
| 83 | Lake Carina | 12.1 | 14.3 |
| 84 | Honey Lake | 12.1 | 14.3 |
| 85 | Lake Matthews | 12.0 | 12.0 |
| 86 | Harvey Lake | 11.8 | 13.0 |
| 87 | Flint Lake | 11.8 | 13.0 |
| 88 | Rivershire Pond 2 | 11.5 | 13.3 |
| 89 | Lake Linden | 11.3 | 11.3 |
| 90 | Lake Charles | 11.3 | 13.4 |

## Table 6. Continued.

| Rank | Lake Name | FQI (w/A) | FQI (native) |
|---|---|---|---|
| 91 | Antioch Lake | 11.3 | 13.4 |
| 92 | Pulaski Pond | 11.2 | 12.5 |
| 93 | Lake Naomi | 11.2 | 12.5 |
| 94 | West Meadow Lake | 11.0 | 11.0 |
| 95 | Tower Lake | 11.0 | 11.0 |
| 96 | Redwing Marsh | 11.0 | 11.0 |
| 97 | Lake Minear | 11.0 | 13.9 |
| 98 | Nielsen Pond | 10.7 | 12.0 |
| 99 | Lake Holloway | 10.6 | 10.6 |
| 100 | Countryside Lake | 10.5 | 12.1 |
| 101 | Crooked Lake | 10.2 | 12.5 |
| 102 | Lake Lakeland Estates | 10.0 | 11.5 |
| 103 | College Trail Lake | 10.0 | 10.0 |
| **104** | **Valley Lake** | **9.9** | **9.9** |
| 105 | Werhane Lake | 9.8 | 12.0 |
| 106 | Little Bear Lake | 9.5 | 11.0 |
| 107 | Big Bear Lake | 9.5 | 11.0 |
| 108 | Loch Lomond | 9.4 | 12.1 |
| 109 | Sylvan Lake | 9.2 | 9.2 |
| 110 | Columbus Park Lake | 9.2 | 9.2 |
| 111 | Lake Fairfield | 9.0 | 10.4 |
| 112 | Grandwood Park Lake | 9.0 | 11.0 |
| 113 | Fischer Lake | 9.0 | 11.0 |
| 114 | McDonald Lake 1 | 8.9 | 10.0 |
| 115 | South Churchill Lake | 8.5 | 8.5 |
| 116 | Lucy Lake | 8.5 | 9.8 |
| 117 | Lake Farmington | 8.5 | 9.8 |
| 118 | Lake Christa | 8.5 | 9.8 |
| 119 | East Meadow Lake | 8.5 | 8.5 |
| 120 | Woodland Lake | 8.1 | 9.9 |
| 121 | Bittersweet Golf Course #13 | 8.1 | 8.1 |
| 122 | Lake Louise | 7.5 | 8.7 |
| 123 | Lake Eleanor | 7.5 | 8.7 |
| 124 | Fairfield Marsh | 7.5 | 8.7 |
| 125 | Banana Pond | 7.5 | 9.2 |
| 126 | Albert Lake | 7.5 | 8.7 |
| 127 | Slough Lake | 7.1 | 7.1 |
| 128 | Rasmussen Lake | 7.1 | 7.1 |
| 129 | Patski Pond | 7.1 | 7.1 |
| 130 | Lucky Lake | 7.0 | 7.0 |
| 131 | Lake Forest Pond | 6.9 | 8.5 |
| 132 | Leisure Lake | 6.4 | 9.0 |
| 133 | Peterson Pond | 6.0 | 8.5 |
| 134 | Slocum Lake | 5.8 | 7.1 |
| 135 | Grassy Lake | 5.8 | 7.1 |
| 136 | Gages Lake | 5.8 | 10.0 |

## Table 6. Continued.

| Rank | Lake Name | FQI (w/A) | FQI (native) |
|---|---|---|---|
| 137 | Deer Lake Meadow Lake | 5.2 | 6.4 |
| 138 | Oak Hills Lake | 5.0 | 5.0 |
| 139 | Liberty Lake | 5.0 | 5.0 |
| 140 | IMC Lake | 5.0 | 7.1 |
| 141 | Drummond Lake | 5.0 | 7.1 |
| 142 | ADID 127 | 5.0 | 5.0 |
| 143 | Sand Pond (IDNR) | 3.5 | 5.0 |
| 144 | Forest Lake | 3.5 | 5.0 |
| 145 | Half Day Pit | 2.9 | 5.0 |
| 146 | Lochanora Lake | 2.5 | 5.0 |
| 147 | Willow Lake | 0.0 | 0.0 |
| 148 | Waterford Lake | 0.0 | 0.0 |
| 149 | St. Mary's Lake | 0.0 | 0.0 |
| 150 | Potomac Lake | 0.0 | 0.0 |
| 151 | North Tower Lake | 0.0 | 0.0 |
| 152 | Hidden Lake | 0.0 | 0.0 |
| | ***Mean*** | **13.6** | **14.9** |
| | ***Median*** | **12.5** | **14.3** |

**Figure 8. Shoreline erosion on Valley Lake, 2007**

In 2004 the IDNR conducted an electrofishing survey to remove Grass Carp and assess the fishery of Valley Lake. A total of 361 fish were collected representing six species. The most common species collected was Largemouth Bass (54%) followed by Bluegill (42%). Other species found included Black Crappie, Channel Catfish, Common Carp, and Grass Carp. The IDNR recommended stocking 375 non-vulnerable catfish annually, conducting another assessment in 2009, and allowing the vegetation to grow until the coverage exceeds 20%.

# LAKE MANAGEMENT RECOMMENDATIONS

Valley Lake experienced some improvements in water quality since the last study was conducted in 2000, including a decrease in both nitrogen and phosphorus concentrations. In addition, no exotic aquatic plants were found in 2007. Also, Valley Lake has participated in the VLMP program since 2005 providing data for years the LMU is not sampling. In addition to continued participation in the program, the LMU recommends a permanent staff gauge be installed to monitor the lake level each month. While progress is occurring, there are still actions that can be taken to improve the quality of the lake.

- **Creating a Bathymetric Map**

  A bathymetric (depth contour) map is an essential tool in effective lake management since it provides information on the morphometric features such as depth, surface area, volume, etc. Valley Lake does not have a current bathymetric map with volumetric calculations. Maps can be created by the LMU (Appendix D1).

- **Enhance wildlife habitat conditions on a lake**

  With the lake being in a residential setting with the majority of the shoreline developed, wildlife habitat is limited. Enhancing habitat for terrestrial wildlife such as birds and small mammals can be accomplished through the addition of shoreline buffer zones, which were noted on some lots, and are recommended as one aspect of shoreline protection (Appendix D2).

- **Lakes with shoreline erosion**

  There are areas around the lake with erosion. These eroded areas should be remediated to prevent additional loss of shoreline and prevent continued degradation of the water quality through sediment inputs. When possible, the shorelines should be repaired using natural vegetation instead of riprap or seawalls (Appendix D3).

- **Aquatic Plant Management**

  A key to a healthy lake is a well-balanced aquatic plant population. Aquatic plants compete with algae for nutrients and stabilize bottom substrate, which in turn improves water clarity. Putting together a good aquatic plant management plan should not be rushed. The plan should be based on the management goals of the lake and involve usage issues, habitat maintenance/restoration, and limitations of the lake. Follow up is critical for an aquatic plant management plan to achieve long-term success. A good aquatic plant management plan considers both the short and long-term needs of the lake. In the case of Valley Lake an increase in aquatic plants is essential in reaching the goal of a healthy lake. However, historical data shows that over abundance of aquatic plants is possible. The long term aquatic plant management for this lake should include a plan addressing this issue (Appendix D4).

- **Reduce Conductivity and Chloride Concentrations**

  The average conductivity reading in Valley Lake has increased since 2000. In addition, the chloride concentration was above the county median and high enough to potentially impact aquatic life. The use of road salts for winter road management is a major contributor to chloride concentrations and conductivity. Proper application procedures and alternative methods can be used to keep these concentrations under control (Appendix D5).

- **Grant program opportunities**
  There are opportunities to receive grants to help accomplish some of the management recommendations listed above (Appendix F).

# APPENDIX A. METHODS FOR FIELD DATA COLLECTION AND LABORATORY ANALYSES

## Water Sampling and Laboratory Analyses

Two water samples were collected once a month from May through September. Sample locations were at the deepest point in the lake (see sample site map), three feet below the surface, and 3 feet above the bottom. Samples were collected with a horizontal Van Dorn water sampler. Approximately three liters of water were collected for each sample for all lab analyses. After collection, all samples were placed in a cooler with ice until delivered to the Lake County Health Department lab, where they were refrigerated. Analytical methods for the parameters are listed in Table A1. Except nitrate nitrogen, all methods are from the Eighteenth Edition of Standard Methods, (eds. American Public Health Association, American Water Works Association, and Water Pollution Control Federation, 1992). Methodology for nitrate nitrogen was taken from the 14th edition of Standard Methods. Dissolved oxygen, temperature, conductivity and pH were measured at the deep hole with a Hydrolab DataSonde® 4a. Photosynthetic Active Radiation (PAR) was recorded using a LI-COR® 192 Spherical Sensor attached to the Hydrolab DataSonde® 4a. Readings were taken at the surface and then every two feet until reaching the bottom.

## Plant Sampling

In order to randomly sample each lake, mapping software (ArcMap 9.1) overlaid a grid pattern onto a 2006 aerial photo of Lake County and placed points 60 or 30 meters apart, depending on lake size. Plants were sampled using a garden rake fitted with hardware cloth. The hardware cloth surrounded the rake tines and is tapered two feet up the handle. A rope was tied to the end of the handle for retrieval. At designated sampling sites, the rake was tossed into the water, and using the attached rope, was dragged across the bottom, toward the boat. After pulling the rake into the boat, plant coverage was assessed for overall abundance. Then plants were individually identified and placed in categories based on coverage. Plants that were not found on the rake but were seen in the immediate vicinity of the boat at the time of sampling were also recorded. Plants difficult to identify in the field were placed in plastic bags and identified with plant keys after returning to the office. The depth of each sampling location was measured either by a hand-held depth meter, or by pushing the rake straight down and measuring the depth along the rope or rake handle. One-foot increments were marked along the rope and rake handle to aid in depth estimation.

## Shoreline Assessment

In previous years a complete assessment of the shoreline was done. However, this year we did a visual estimate to determine changes in the shoreline. The degree of shoreline erosion was categorically defined as none, slight, moderate, or severe. Below are brief descriptions of each category.

None – Includes man-made erosion control such as beach, rip-rap and sea wall.

Slight – Minimal or no observable erosion; generally considered stable; no erosion control practices will be recommended with the possible exception of small problem areas noted within an area otherwise designated as “slight”.

Moderate – Recession is characterized by past or recently eroded banks; area may exhibit some exposed roots, fallen vegetation or minor slumping of soil material; erosion control practices may be recommended although the section is not deemed to warrant immediate remedial action.

Severe – Recession is characterized by eroding of exposed soil on nearly vertical banks, exposed roots, fallen vegetation or extensive slumping of bank material, undercutting, washouts or fence posts exhibiting realignment; erosion control practices are recommended and immediate remedial action may be warranted.

## Wildlife Assessment

Species of wildlife were noted during visits to each lake. When possible, wildlife was identified to species by sight or sound. However, due to time constraints, collection of quantitative information was not possible. Thus, all data should be considered anecdotal.
Some of the species on the list may have only been seen once, or were spotted during their migration through the area.

**Table A1. Analytical methods used for water quality parameters.**

| ***Parameter*** | ***Method*** |
|---|---|
| Temperature | Hydrolab DataSonde® 4a or YSI 6600 Sonde® |
| Dissolved oxygen | Hydrolab DataSonde ®4a or YSI 6600 Sonde® |
| Nitrate and Nitrite nitrogen | USEPA 353.2 rev. 2.0<br>EPA-600/R-93/100<br>Detection Limit = 0.05 mg/L |
| Ammonia nitrogen | SM 18th ed. Electrode method, #4500 $NH_3$-F<br>Detection Limit = 0.1 mg/L |
| Total Kjeldahl nitrogen | SM 18th ed, 4500-$N_{org}$ C<br>Semi-Micro Kjeldahl, plus 4500 $NH_3$-F<br>Detection Limit = 0.5 mg/L |
| pH | Hydrolab DataSonde® 4a, or YSI 6600 Sonde®<br>Electrometric method |
| Total solids | SM 18th ed, Method #2540B |
| Total suspended solids | SM 18th ed, Method #2540D<br>Detection Limit = 0.5 mg/L |
| Chloride | SM 18th ed, Method #4500C1-D |
| Total volatile solids | SM 18th ed, Method #2540E, from total solids |
| Alkalinity | SM 18th ed, Method #2320B, patentiometric titration curve method |
| Conductivity | Hydrolab DataSonde® 4a or YSI 6600 Sonde® |
| Total phosphorus | SM 18th ed, Methods #4500-P B 5 and #4500-P E<br>Detection Limit = 0.01 mg/L |
| Soluble reactive phosphorus | SM 18th ed, Methods #4500-P B 1 and #4500-P E<br>Detection Limit = 0.005 mg/L |
| Clarity | Secchi disk |
| Color | Illinois EPA Volunteer Lake Monitoring Color Chart |
| Photosynthetic Active Radiation (PAR) | Hydrolab DataSonde® 4a or YSI 6600 Sonde®, LI-COR® 192 Spherical Sensor |

# APPENDIX B. MULTI-PARAMETER DATA FOR VALLEY LAKE, 2007.

**Valley Lake 2007 Multiparameter data**

| Date MMDDYY | Text Depth feet | Dep25 feet | Temp øC | DO mg/l | DO% Sat | SpCond mS/cm | pH Units | PAR æE/s/mý | Depth of Light Meter feet | % Light Transmission Average | Extinction Coefficient |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | 0.392 |
| 50907 | 0 | 0.31 | 19.89 | 7.00 | 79.5 | 1.868 | 7.89 | 3362 | Surface | | |
| 50907 | 1 | 1.13 | 19.83 | 6.83 | 77.5 | 1.867 | 7.92 | 3296 | Surface | 100% | |
| 50907 | 2 | 2.08 | 18.70 | 6.78 | 75.2 | 1.862 | 7.90 | 1367 | 0.33 | 41% | 2.667 |
| 50907 | 3 | 3.08 | 18.43 | 6.77 | 74.7 | 1.861 | 7.89 | 837 | 1.33 | 25% | 0.369 |
| 50907 | 4 | 4.05 | 18.17 | 6.67 | 73.2 | 1.858 | 7.89 | 1113 | 2.30 | 33% | -0.124 |
| 50907 | 5 | 5.07 | 17.99 | 6.49 | 71.0 | 1.859 | 7.87 | 790 | 3.32 | 23% | 0.103 |
| 50907 | 6 | 6.06 | 17.93 | 6.08 | 66.4 | 1.861 | 7.84 | 667 | 4.31 | 20% | 0.039 |
| 50907 | 7 | 7.10 | 17.61 | 4.83 | 52.4 | 1.857 | 7.72 | 534 | 5.35 | 16% | 0.042 |
| 50907 | 8 | 8.08 | 17.31 | 2.49 | 26.8 | 1.861 | 7.58 | 454 | 6.33 | 14% | 0.026 |
| 50907 | 9 | 9.12 | 17.15 | 1.61 | 17.2 | 1.864 | 7.53 | 408 | 7.37 | 12% | 0.014 |

| Date MMDDYY | Text Depth feet | Dep25 feet | Temp øC | DO mg/l | DO% Sat | SpCond mS/cm | pH Units | PAR æE/s/mý | Depth of Light Meter feet | % Light Transmission Average | Extinction Coefficient |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | 0.486 |
| 61307 | 0 | 0.30 | 23.83 | 13.17 | 159.4 | 0.001 | 8.69 | 3475 | Surface | | |
| 61307 | 1 | 1.04 | 24.77 | 12.88 | 159.6 | 1.714 | 8.69 | 2814 | Surface | 100% | |
| 61307 | 2 | 1.95 | 24.51 | 12.81 | 157.9 | 1.715 | 8.70 | 1411 | 0.20 | 50% | 3.452 |
| 61307 | 3 | 2.92 | 24.48 | 13.16 | 162.1 | 1.713 | 8.70 | 1233 | 1.17 | 44% | 0.115 |
| 61307 | 4 | 3.95 | 24.40 | 13.43 | 165.2 | 1.714 | 8.71 | 981 | 2.20 | 35% | 0.104 |
| 61307 | 5 | 5.04 | 24.34 | 13.37 | 164.3 | 1.714 | 8.71 | 746 | 3.29 | 27% | 0.083 |
| 61307 | 6 | 5.96 | 24.29 | 13.30 | 163.3 | 1.714 | 8.70 | 642 | 4.21 | 23% | 0.036 |
| 61307 | 7 | 7.09 | 24.24 | 12.99 | 159.4 | 1.713 | 8.68 | 522 | 5.34 | 19% | 0.039 |
| 61307 | 8 | 7.97 | 24.14 | 11.70 | 143.3 | 1.720 | 8.60 | 434 | 6.22 | 15% | 0.030 |
| 61307 | 9 | 8.92 | 23.85 | 7.23 | 88.1 | 1.736 | 8.26 | 341 | 7.17 | 12% | 0.034 |

| Date MMDDYY | Text Depth feet | Dep25 feet | Temp øC | DO mg/l | DO% Sat | SpCond mS/cm | pH Units | PAR æE/s/mý | Depth of Light Meter feet | % Light Transmission Average | Extinction Coefficient |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | 0.570 |
| 71107 | 0 | 0.38 | 26.41 | 5.73 | 70.4 | 1.677 | 8.32 | 3640 | Surface | | |
| 71107 | 1 | 1.03 | 26.45 | 5.64 | 69.4 | 1.677 | 8.36 | 3391 | Surface | 100% | |
| 71107 | 2 | 2.01 | 26.37 | 5.18 | 63.6 | 1.678 | 8.38 | 1465 | 0.26 | 43% | 3.228 |
| 71107 | 3 | 3.06 | 26.15 | 4.21 | 51.5 | 1.682 | 8.29 | 813 | 1.31 | 24% | 0.450 |
| 71107 | 4 | 4.02 | 26.12 | 4.00 | 48.9 | 1.683 | 8.27 | 442 | 2.27 | 13% | 0.268 |
| 71107 | 5 | 5.01 | 26.08 | 4.14 | 50.5 | 1.682 | 8.28 | 250 | 3.26 | 7% | 0.175 |
| 71107 | 6 | 6.03 | 25.98 | 3.85 | 47.0 | 1.681 | 8.26 | 132 | 4.28 | 4% | 0.149 |
| 71107 | 7 | 7.01 | 25.95 | 3.80 | 46.2 | 1.682 | 8.26 | 67 | 5.26 | 2% | 0.129 |
| 71107 | 8 | 8.06 | 25.94 | 3.68 | 44.8 | 1.681 | 8.24 | 39 | 6.31 | 1.2% | 0.086 |
| 71107 | 9 | 9.01 | 25.91 | 3.40 | 41.4 | 1.684 | 8.20 | 22 | 7.26 | 0.6% | 0.079 |

| Date MMDDYY | Text Depth feet | Dep25 feet | Temp øC | DO mg/l | DO% Sat | SpCond mS/cm | pH Units | PAR æE/s/mý | Depth of Light Meter feet | % Light Transmission Average | Extinction Coefficient |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | 0.681 |
| 80807 | 0 | 0.23 | 25.79 | 11.76 | 143.0 | 1.483 | 8.79 | 1944 | Surface | | |
| 80807 | 1 | 1.02 | 27.58 | 9.95 | 125.0 | 1.426 | 8.73 | 1810 | Surface | 100% | |
| 80807 | 2 | 2.04 | 27.18 | 8.17 | 101.9 | 1.428 | 8.60 | 599 | 0.29 | 33% | 3.813 |
| 80807 | 3 | 3.02 | 26.67 | 5.31 | 65.6 | 1.436 | 8.35 | 359 | 1.27 | 20% | 0.403 |
| 80807 | 4 | 4.04 | 26.04 | 0.33 | 4.0 | 1.441 | 7.98 | 175 | 2.29 | 10% | 0.314 |
| 80807 | 5 | 5.02 | 25.88 | 0.13 | 1.6 | 1.441 | 7.89 | 71 | 3.27 | 4% | 0.276 |
| 80807 | 6 | 6.07 | 25.72 | 0.10 | 1.2 | 1.462 | 7.86 | 25 | 4.32 | 1.4% | 0.242 |
| 80807 | 7 | 7.06 | 25.48 | 0.06 | 0.8 | 1.490 | 7.80 | 11 | 5.31 | 0.6% | 0.155 |
| 80807 | 8 | 8.01 | 25.13 | 0.13 | 1.5 | 1.578 | 7.69 | 6 | 6.26 | 0.3% | 0.097 |
| 80807 | 9 | 9.01 | 24.89 | 0.12 | 1.4 | 1.601 | 7.60 | 2 | 7.26 | 0% | 0.151 |

| Date MMDDYY | Text Depth feet | Dep25 feet | Temp øC | DO mg/l | DO% Sat | SpCond mS/cm | pH Units | PAR æE/s/mý | Depth of Light Meter feet | % Light Transmission Average | Extinction Coefficient |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | 0.901 |
| 91207 | 0 | 0.36 | 20.29 | 6.94 | 75.4 | 1.265 | 8.26 | 3209 | Surface | | |
| 91207 | 1 | 1.14 | 20.33 | 6.88 | 74.8 | 1.264 | 8.35 | 3008 | Surface | 100% | |
| 91207 | 2 | 1.98 | 20.33 | 6.85 | 74.5 | 1.263 | 8.39 | 970 | 0.23 | 32% | 4.921 |
| 91207 | 3 | 2.93 | 20.28 | 6.48 | 70.4 | 1.264 | 8.39 | 373 | 1.18 | 12% | 0.810 |
| 91207 | 4 | 3.92 | 20.18 | 5.71 | 61.9 | 1.264 | 8.38 | 136 | 2.17 | 5% | 0.465 |
| 91207 | 5 | 4.95 | 20.14 | 5.23 | 56.6 | 1.265 | 8.36 | 48 | 3.20 | 2% | 0.325 |
| 91207 | 6 | 6.05 | 20.09 | 4.96 | 53.7 | 1.265 | 8.34 | 18 | 4.30 | 0.6% | 0.228 |
| 91207 | 7 | 7.02 | 20.09 | 4.84 | 52.4 | 1.265 | 8.34 | 8 | 5.27 | 0.3% | 0.154 |
| 91207 | 8 | 8.03 | 20.09 | 4.85 | 52.5 | 1.265 | 8.34 | 4 | 6.28 | 0% | 0.110 |
| 91207 | 9 | 9.01 | 20.09 | 4.77 | 51.6 | 1.266 | 8.34 | 1 | 7.26 | 0% | 0.191 |

# APPENDIX C. INTERPRETING YOUR LAKE'S WATER QUALITY DATA.

Lakes possess a unique set of physical and chemical characteristics that will change over time. These in-lake water quality characteristics, or parameters, are used to describe and measure the quality of lakes, and they relate to one another in very distinct ways. As a result, it is virtually impossible to change any one component in or around a lake without affecting several other components, and it is important to understand how these components are linked.

The following pages will discuss the different water quality parameters measured by Lake County Health Department staff, how these parameters relate to each other, and why the measurement of each parameter is important. The median values (the middle number of the data set, where half of the numbers have greater values, and half have lesser values) of data collected from Lake County lakes from 2000-2005 will be used in the following discussion.

**Temperature and Dissolved Oxygen:**

Water temperature fluctuations will occur in response to changes in air temperatures, and can have dramatic impacts on several parameters in the lake. In the spring and fall, lakes tend to have uniform, well-mixed conditions throughout the water column (surface to the lake bottom). However, during the summer, deeper lakes will separate into distinct water layers. As surface water temperatures increase with increasing air temperatures, a large density difference will form between the heated surface water and colder bottom water. Once this difference is large enough, these two water layers will separate and generally will not mix again until the fall. At this time the lake is thermally stratified. The warm upper water layer is called the ***epilimnion***, while the cold bottom water layer is called the ***hypolimnion***. In some shallow lakes, stratification and destratification can occur several times during the summer. If this occurs the lake is described as polymictic. Thermal stratification also occurs to a lesser extent during the winter, when warmer bottom water becomes separated from ice-forming water at the surface until mixing occurs during spring ice-out.

Monthly temperature profiles were established on each lake by measuring water temperature every foot (lakes ≤ 15 feet deep) or every two feet (lakes > 15 feet deep) from the lake surface to the lake bottom. These profiles are important in understanding the distribution of chemical/biological characteristics and because increasing water temperature and the establishment of thermal stratification have a direct impact on dissolved oxygen (DO) concentrations in the water column. If a lake is shallow and easily mixed by wind, the DO concentration is usually consistent throughout the water column. However, shallow lakes are typically dominated by either plants or algae, and increasing water temperatures during the summer speeds up the rates of photosynthesis and decomposition in surface waters. When many of the plants or algae die at the end of the growing season, their decomposition results in heavy oxygen consumption and can lead to an oxygen crash. In deeper, thermally stratified lakes, oxygen production is greatest in the top portion of the lake, where sunlight drives photosynthesis, and oxygen consumption is greatest near the bottom of a lake, where sunken organic matter accumulates and decomposes. The oxygen difference between the top and bottom water layers can be dramatic, with plenty of oxygen near the surface, but practically none near the bottom. The oxygen profiles measured during the water quality study can illustrate if this is occurring. This is important because the absence of oxygen (anoxia) near the lake bottom can have adverse effects in eutrophic lakes resulting in the chemical release of phosphorus from lake sediment and the production of hydrogen sulfide (rotten egg smell) and other gases in the bottom waters. Low oxygen conditions in the upper water of a lake can also be problematic since all aquatic organisms need oxygen to live. Some oxygen may be present in the water, but at too low a concentration to sustain aquatic life. Oxygen is needed by all plants, virtually all algae and for many chemical reactions that are important in lake functioning. Most adult sport-fish such as largemouth bass and bluegill require at least 3 mg/L of DO in the water to survive. However, their offspring require at least 5 mg/L DO as they are more sensitive to DO stress. When DO concentrations drop below 3 mg/L, rough fish such as carp and green sunfish are favored and over time will become the dominant fish species.

External pollution in the form of oxygen-demanding organic matter (i.e., sewage, lawn clippings, soil from shoreline erosion, and agricultural runoff) or nutrients that stimulate the growth of excessive organic matter (i.e., algae and plants) can reduce average DO concentrations in the lake by increasing oxygen consumption. This can have a detrimental impact on the fish community, which may be squeezed into a very small volume of water as a result of high temperatures in the epilimnion and low DO levels in the hypolimnion.

**Nutrients:**

*Phosphorus:*
For most Lake County lakes, phosphorus is the nutrient that limits plant and algae growth. This means that any addition of phosphorus to a lake will typically result in algae blooms or high plant densities during the summer. The source of phosphorus to a lake can be external or internal (or both). External sources of phosphorus enter a lake through point (i.e., storm pipes and wastewater discharge) and non-point runoff (i.e., overland water flow). This runoff can pick up large amounts of phosphorus from agricultural fields, septic systems or impervious surfaces before it empties into the lake.

Internal sources of phosphorus originate within the lake and are typically linked to the lake sediment. In lakes with high oxygen levels (oxic), phosphorus can be released from the sediment through plants or sediment resuspension. Plants take up sediment-bound phosphorus through their roots, releasing it in small amounts to the water column throughout their life cycles, and in large amounts once they die and begin to decompose. Sediment resuspension can occur through biological or mechanical means. Bottom-feeding fish, such as common carp and black bullhead can release phosphorus by stirring up bottom sediment during feeding activities and can add phosphorus to a lake through their fecal matter. Sediment resuspension, and subsequent phosphorus release, can also occur via wind/wave action or through the use of artificial aerators, especially in shallow lakes. In lakes that thermally stratify, internal phosphorus release can occur from the sediment through chemical means. Once oxygen is depleted (anoxia) in the hypolimnion, chemical reactions occur in which phosphorus bound to iron complexes in the sediment becomes soluble and is released into the water column. This phosphorus is trapped in the hypolimnion and is unavailable to algae until fall turnover, and can cause algae blooms once it moves into the sunlit surface water at that time. Accordingly, many of the lakes in Lake County are plagued by dense algae blooms and excessive, exotic plant coverage, which negatively affect DO levels, fish communities and water clarity.

Lakes with an average phosphorus concentration greater than 0.05 mg/L are considered nutrient rich. The median near surface total phosphorus (TP) concentration in Lake County lakes from 2000-2005 is 0.063 mg/L and ranged from a non-detectable minimum of <0.010 mg/L on five lakes to a maximum of 3.880 mg/L on Albert Lake. The median anoxic TP concentration in Lake County lakes from 2000-2005 was 0.174 mg/L and ranged from a minimum of 0.012 mg/L in West Loon Lake to a maximum of 3.880 mg/L in Taylor Lake.

The analysis of phosphorus also included soluble reactive phosphorus (SRP), a dissolved form of phosphorus that is readily available for plant and algae growth. SRP is not discussed in great detail in most of the water quality reports because SRP concentrations vary throughout the season depending on how plants and algae absorb and release it. It gives an indication of how much phosphorus is available for uptake, but, because it does not take all forms of phosphorus into account, it does not indicate how much phosphorus is truly present in the water column. TP is considered a better indicator of a lake's nutrient status because its concentrations remain more stable than soluble reactive phosphorus. However, elevated SRP levels are a strong indicator of nutrient problems in a lake.

*Nitrogen:*
Nitrogen is also an important nutrient for plant and algae growth. Sources of nitrogen to a lake vary widely, ranging from fertilizer and animal wastes, to human waste from sewage treatment plants or failing septic systems, to groundwater, air and rainfall. As a result, it is very difficult to control or reduce nitrogen inputs to a lake. Different forms of nitrogen are present in a lake under different oxic conditions. $NH_4^+$ (ammonium) is released from decomposing organic material under anoxic conditions and accumulates in the hypolimnion of thermally stratified lakes. If $NH_4^+$ comes into contact with oxygen, it is immediately converted to $NO_2$ (nitrite) which is then oxidized to $NO_3^-$ (nitrate). Therefore, in a thermally stratified lake, levels of $NH_4^+$ would only be elevated in the hypolimnion and levels of $NO_3^-$ would only be elevated in the epilimnion. Both $NH_4^+$ and $NO_3^-$ can be used as a nitrogen source by aquatic plants and algae. Total Kjeldahl nitrogen (TKN) is a measure of organic nitrogen plus ammonium. Adding the concentrations of TKN and nitrate together gives an indication of the amount of total nitrogen present in the water column. If inorganic nitrogen ($NO_3^-$, $NO_2^-$, $NH_4^+$) concentrations exceed 0.3 mg/L in spring, sufficient nitrogen is available to support summer algae blooms. However, low nitrogen levels do not guarantee limited algae growth the way low phosphorus levels do. Nitrogen gas in the air can dissolve in lake water and blue-green algae can "fix" atmospheric nitrogen, converting it into a usable form. Since other types of algae do not have the ability to do this, nuisance blue-green algae blooms are typically associated with lakes that are nitrogen limited (i.e., have low nitrogen levels).

The ratio of TKN plus nitrate nitrogen to total phosphorus (TN:TP) can indicate whether plant/algae growth in a lake is limited by nitrogen or phosphorus. Ratios of less than 10:1

suggest a system limited by nitrogen, while lakes with ratios greater than 20:1 are limited by phosphorus.  It is important to know if a lake is limited by nitrogen or phosphorus because any addition of the limiting nutrient to the lake will, likely, result in algae blooms or an increase in plant density.

**Solids:**

Although several forms of solids (total solids, total suspended solids, total volatile solids, total dissolved solids) were measured each month by the Lakes Management Staff, total suspended solids (TSS) and total volatile solids (TVS) have the most impact on other variables and on the lake as a whole.  TSS are particles of algae or sediment suspended in the water column.  High TSS concentrations can result from algae blooms, sediment resuspension, and/or the inflow of turbid water, and are typically associated with low water clarity and high phosphorus concentrations in many lakes in Lake County.  Low water clarity and high phosphorus concentrations, in turn, exacerbate the high TSS problem by leading to reduced plant density (which stabilize lake sediment) and increased occurrence of algae blooms.  The median TSS value in epilimnetic waters in Lake County is 7.9 mg/L, ranging from below the 1 mg/L detection limit (10 lakes) to 165 mg/L in Fairfield Marsh.

TVS represents the fraction of total solids that are organic in nature, such as algae cells, tiny pieces of plant material, and/or tiny animals (zooplankton) in the water column.  High TVS values indicate that a large portion of the suspended solids may be made up of algae cells.  This is important in determining possible sources of phosphorus to a lake.  If much of the suspended material in the water column is determined to be resuspended sediment that is releasing phosphorus, this problem would be addressed differently than if the suspended material was made up of algae cells that were releasing phosphorus.  The median TVS value was 132 mg/L, ranging from 34 mg/L in Pulaski Pond to 298 mg/L in Fairfield Marsh.

Total dissolved solids (TDS) are the amount of dissolved substances, such as salts or minerals, remaining in water after evaporation.   These dissolved solids are discussed in further detail in the *Alkalinity* and *Conductivity* sections of this document. TDS concentrations were measured in Lake County lakes prior to 2004, but was discontinued due to the strong correlation of TDS to conductivity and chloride concentrations.

**Water Clarity:**

Water clarity (transparency) is not a chemical property of lake water, but is often an indicator of a lake's overall water quality.  It is affected by a lake's water color, which is a reflection of the amount of total suspended solids and dissolved organic chemicals.  Thus, transparency is a measure of particle concentration and is measured with a Secchi disk.  Generally, the lower the clarity or Secchi depth, the poorer the water quality.  A decrease in Secchi depth during the summer occurs as the result of an increase in suspended solids (algae or sediment) in the water column.  Aquatic plants play an important role in the level of water clarity and can, in turn, be negatively affected by low clarity levels. Plants increase clarity by competing with algae for resources and by stabilizing sediments to prevent sediment resuspension.  A lake with a healthy plant community will almost always have higher water clarity than a lake without plants. Additionally, if the plants in a lake are removed (through herbicide treatment or the stocking of grass carp), the lake will probably become dominated by algae and Secchi depth will decrease. This makes it very difficult for plants to become re-established due to the lack of available sunlight and the lake will, most likely, remain turbid. Turbidity will be accelerated if the lake is very shallow and/or common carp are present.  Shallow lakes are more susceptible to sediment resuspension through wind/wave action and are more likely to experience clarity problems if plants are not present to stabilize bottom sediment.

Common Carp are prolific fish that feed on invertebrates in the sediment. Their feeding activities stir up bottom sediment and can dramatically decrease water clarity in shallow lakes.  As mentioned above, lakes with low water clarity are, generally, considered to have poor water quality.  This is because the causes and effects of low clarity negatively impact the plant and fish communities, as well as the levels of phosphorus in a lake.  The detrimental impacts of low Secchi depth to plants has already been discussed.  Fish populations will suffer as water clarity decreases due to a lack of food and decreased ability to successfully hunt for prey.  Bluegills are planktivorous fish and feed on invertebrates that inhabit aquatic plants.  If low clarity results in the disappearance of plants, this food source will disappear too.  Largemouth Bass and Northern Pike are piscivorous fish that feed on other fish and hunt by sight.  As the water clarity decreases, these fish species find it more difficult to see and ambush prey and may decline in size as a result.  This could eventually lead to an imbalance in the fish community.  Phosphorus release from resuspended sediment could increase as water clarity and plant density decrease. This would then result in increased algae blooms, further reducing Secchi depth and aggravating all problems just discussed.  The average Secchi depth for Lake County lakes is 3.17 feet.  From 2000-2005, Fairfield Marsh and Patski Pond had the lowest Secchi depths (0.33 feet) and Bangs Lake had the highest (29.23 feet).  As an example of the difference in Secchi depth based on plant coverage, South Churchill Lake, which had no plant coverage and large numbers of Common Carp in 2003 had an average Secchi depth of 0.73 feet (over four times lower than the county average), while Deep Lake, which had a diverse plant community and few carp had an average 2003 Secchi depth of 12.48 feet (almost four times higher than the county average).

Another measure of clarity is the use of a light meter.  The light meter measures the amount of light at the surface of the lake and the amount of light at each depth in the water column.  The amount of attenuation and absorption (decreases) of light by the water column are major factors controlling temperature and potential photosynthesis.  Light intensity at the lake surface varies seasonally and with cloud cover, and decreases with depth.  The deeper into the water column light penetrates, the deeper potential plant growth.  The maximum depth at which algae and plants can grow underwater is usually at the depth where the amount of light available is reduced to 0.5%-1% of the amount of light available at the lake surface.  This is called the euphotic (sunlit) zone.  A general rule of thumb in Lake County is that the 1% light level is about 1 to 3 times the Secchi disk depth.

**Alkalinity, Conductivity, Chloride, pH:**

*Alkalinity:*

Alkalinity is the measurement of the amount of acid necessary to neutralize carbonate ($CO_3^{=}$) and bicarbonate ($HCO_3^-$) ions in the water, and represents the buffering capacity of a body of water. The alkalinity of lake water depends on the types of minerals in the surrounding soils and in the bedrock. It also depends on how often the lake water comes in contact with these minerals. If a lake gets groundwater from aquifers containing limestone minerals such as calcium carbonate ($CaCO_3$) or dolomite ($CaMgCO_3$), alkalinity will be high. The median alkalinity in Lake County lakes (162 mg/L) is considered moderately hard according to the hardness classification scale of Brown, Skougstad and Fishman (1970). Because hard water (alkaline) lakes often have watersheds with fertile soils that add nutrients to the water, they usually produce more fish and aquatic plants than soft water lakes. Since the majority of Lake County lakes have a high alkalinity they are able to buffer the adverse effects of acid rain.

*Conductivity and Chloride:*

Conductivity is the inverse measure of the resistance of lake water to an electric flow. This means that the higher the conductivity, the more easily an electric current is able to flow through water. Since electric currents travel along ions in water, the more chemical ions or dissolved salts a body of water contains, the higher the conductivity will be. Accordingly, conductivity has been correlated to total dissolved solids and chloride ions. The amount of dissolved solids or conductivity of a lake is dependent on the lake and watershed geology, the size of the watershed flowing into the lake, the land uses within that watershed, and evaporation and bacterial activity. Many Lake County lakes have elevated conductivity levels in May, but not during any other month. This was because chloride, in the form of road salt, was washing into the lakes with spring rains, increasing conductivity. Most road salt is sodium chloride, calcium chloride, potassium chloride, magnesium chloride or ferrocyanide salts. Beginning in 2004, chloride concentrations are one of the parameters measured during the lake studies. Increased chloride concentrations may have a negative impact on aquatic organisms. Conductivity changes occur seasonally and with depth. For example, in stratified lakes the conductivity normally increases in the hypolimnion as bacterial decomposition converts organic materials to bicarbonate and carbonate ions depending on the pH of the water. These newly created ions increase the conductivity and total dissolved solids. Over the long term, conductivity is a good indicator of potential watershed or lake problems if an increasing trend is noted over a period of years. It is also important to know the conductivity of the water when fishery assessments are conducted, as electroshocking requires a high enough conductivity to properly stun the fish, but not too high as to cause injury or death.

*pH:*

pH is the measurement of hydrogen ion ($H^+$) activity in water. The pH of pure water is neutral at 7 and is considered acidic at levels below 7 and basic at levels above 7. Low pH levels of 4-5 are toxic to most aquatic life, while high pH levels (9-10) are not only toxic to aquatic life but may also result in the release of phosphorus from lake sediment. The presence of high plant densities can increase pH levels through photosynthesis, and lakes dominated by a large amount of plants or algae can experience large fluctuations in pH levels from day to night, depending on the rates of photosynthesis and respiration. Few, if any pH problems exist in Lake County lakes. Typically, the flooded gravel mines in the county are more acidic than the glacial lakes as they have less biological activity, but do not usually drop below pH levels of 7. The median near surface pH value of Lake County lakes is 8.30, with a minimum of 7.06 in Deer Lake and a maximum of 10.28 in Round Lake Marsh North.

**Eutrophication and Trophic State Index:**

The word *eutrophication* comes from a Greek word meaning “well nourished.” This also describes the process in which a lake becomes enriched with nutrients. Over time, this is a lake’s natural aging process, as it slowly fills in with eroded materials from the surrounding watershed and with decaying plants. If no human impacts disturb the watershed or the lake, natural eutrophication can take thousands of years. However, human activities on a lake or in the watershed accelerate this process by resulting in rapid soil erosion and heavy phosphorus inputs. This accelerated aging process on a lake is referred to as cultural eutrophication. The term trophic state refers to the amount of nutrient enrichment within a lake system. *Oligotrophic* lakes are usually deep and clear with low nutrient levels, little plant growth and a limited fishery. *Mesotrophic* lakes are more biologically productive than oligotrophic lakes and have moderate nutrient levels and more plant growth. A lake labeled as *eutrophic* is high in nutrients and can support high plant densities and large fish populations. Water clarity is typically poorer than oligotrophic or mesotrophic lakes and dissolved oxygen problems may be present. A *hypereutrophic* lake has excessive nutrients, resulting in nuisance plant or algae growth. These lakes are often pea-soup green, with poor water clarity. Low dissolved oxygen may also be a problem, with fish kills occurring in shallow, hypereutrophic lakes more often than less enriched lakes. As a result, rough fish (tolerant of low dissolved oxygen levels) dominate the fish community of many hypereutrophic lakes. The categorization of a lake into a certain trophic state should not be viewed as a “good to bad” categorization, as most lake residents rate their lake based on desired usage. For example, a fisherman would consider a plant-dominated, clear lake to be desirable, while a water-skier might prefer a turbid lake devoid of plants. Most lakes in Lake County are eutrophic or hypereutrophic. This is primarily as a result of cultural eutrophication. However, due to the fertile soil in this area, many lakes (especially man-made) may have started out under eutrophic conditions and will never attain even mesotrophic conditions, regardless of any amount of money put into the management options. This is not an excuse to allow a lake to continue to deteriorate, but may serve as a reality check for lake owners attempting to create unrealistic conditions in their lakes.

The Trophic State Index (TSI) is an index which attaches a score to a lake based on its average total phosphorus concentration, its average Secchi depth (water transparency) and/or its average chlorophyll *a* concentration (which represent algae biomass). It is based on the principle that as phosphorus levels increase, chlorophyll *a* concentrations increase and Secchi depth decreases. The higher the TSI score, the more nutrient-rich a lake is, and once a score is obtained, the lake can then be designated as oligotrophic, mesotrophic or eutrophic. Table 1 (below) illustrates the Trophic State Index using phosphorus concentration and Secchi depth.

**Table 1. Trophic State Index (TSI).**

| Trophic State | TSI score | Total Phosphorus (mg/L) | Secchi Depth (feet) |
|---|---|---|---|
| Oligotrophic | <40 | ≤ 0.012 | >13.12 |
| Mesotrophic | ≥40<50 | >0.012 ≤ 0.024 | ≥6.56<13.12 |
| Eutrophic | ≥50<70 | >0.024 ≤ 0.096 | ≥1.64<6.56 |
| Hypereutrophic | ≥70 | >0.096 | < 1.64 |

# APPENDIX D. LAKE MANAGEMENT OPTIONS.

## *D1. Option for Creating a Bathymetric Map*

A bathymetric (depth contour) map is an essential tool for effective lake management since it provides critical information about the physical features of the lake, such as depth, surface area, volume, etc. This information is particularly important when intensive management techniques (i.e., chemical treatments for plant or algae control, dredging, fish stocking, etc.) are part of the lake's overall management plan. Some bathymetric maps for lakes in Lake County do exist, but they are frequently old, outdated and do not accurately represent the current features of the lake. Maps can be created by the Lake County Health Department - Lakes Management Unit (LMU). LMU recently purchased a BioSonics DT-X™ Echosounder. With this equipment the creation of an accurate bathymetric map of almost any size lake in the county is possible. Costs vary, but can range from $2,000-5,000 depending on lake size.

## *D2. Options to Enhance Wildlife Habitat Conditions on a Lake*

**Option 1: Increase Habitat Cover**

One of the best ways to increase habitat cover is to leave a minimum 25-foot buffer between the edge of the water and any mowed grass. Allow native plants to grow or plant native vegetation along shorelines, including emergent vegetation such as cattails, rushes, and bulrushes. This will provide cover from predators and provide nesting structure for many wildlife species and their prey.

Brush piles also make excellent wildlife habitat. They provide cover as well as food resources for many species. Brush piles are easy to create and will last for several years. They should be place at least 10 feet away from the shoreline to prevent any debris from washing into the lake. Trees that have fallen on the ground or into the water are beneficial by harboring food and providing cover for many wildlife species. In a lake, fallen trees provide excellent cover for fish, basking sites for turtles, and perches for herons and egrets. Increasing habitat cover should not be limited to the terrestrial environment. Native aquatic vegetation, particularly along the shoreline, can provide cover for fish and other wildlife. Finally, by increasing habitat, wildlife is attracted to and uses the area as a place to raise their young. However, if vegetation is allowed to grow, lake access and visibility may be limited. If this occurs, a small path can be made to the shoreline.

**Option 2: Increase Natural Food Supply**

This can be accomplished in conjunction with Option 1. Habitats with a diversity of native plants will provide an ample food supply for wildlife. Food comes in a variety of forms, from seeds to leaves or roots to invertebrates that live on or are attracted to the plants. Beneficial aquatic plants are particularly important to waterfowl in the spring and fall, as they replenish energy reserves lost during migration. Supplying natural foods artificially (i.e., birdfeeders, nectar feeders, corn cobs, etc.) will attract wildlife and in most cases does not harm the animals. However, "people food" such as bread should be avoided. Care should be given to maintain clean feeders and birdbaths to minimize disease outbreaks. Providing food for wildlife will increase the likelihood they will use the area. Migrating wildlife can be attracted with a natural food supply, primarily from seeds, but also from insects, aquatic plants or small fish.

## *D3. Options for Lakes with Shoreline Erosion*

### **Option 1: Install a Seawall**

Seawalls are designed to prevent shoreline erosion on lakes in a similar manner they are used along coastlines to prevent beach erosion or harbor siltation. Today, seawalls are generally constructed of steel, although in the past seawalls were made of concrete or wood (frequently old railroad ties). A new type of construction material being used is vinyl or PVC. Vinyl seawalls will not rust over time.

If installed properly and in the appropriate areas (i.e., shorelines with severe erosion) seawalls provide effective erosion control. Seawalls are made to last many years and have relatively low maintenance. However, seawalls are disadvantageous for several reasons. One of the main disadvantages is that they are expensive, since a professional contractor and heavy equipment are needed for installation. Also, if any fill material is placed in the floodplain along the shoreline, compensatory storage may also be needed. Compensatory storage is the process of excavating in a portion of a property or floodplain to compensate for the filling of another portion. Permits and surveys are needed whether replacing old seawall or installing a new one. Seawalls also provide little habitat for fish or wildlife. Because there is no structure for fish, wildlife, or their prey, few animals use shorelines with seawalls. In addition, poor water clarity that may be caused by resuspension of sediment from deflected wave action contributes to poor fish and wildlife habitat, since sight feeding fish and birds (i.e., bass, herons, and kingfishers) are less successful at catching prey. This may contribute to a lake's poor fishery (i.e., stunted fish populations).

### **Option 2: Install Rock Rip-Rap or Gabions**

Rip-rap is the procedure of using rocks to stabilize shorelines. Size of the rock depends on the severity of the erosion, distance to rock source, and aesthetic preferences. Generally, four to eight inch diameter rocks are used. Gabions are wire cages or baskets filled with rock. They provide similar protection as rip-rap, but are less prone to displacement. They can be stacked, like blocks, to provide erosion control for extremely steep slopes.

Rip-rap and gabions can provide good shoreline erosion control. Rocks can absorb some of the wave energy while providing a more aesthetically pleasing appearance than seawalls. If installed properly, rip-rap and gabions will last for many years. Maintenance is relatively low, however, undercutting of the bank can cause sloughing of the rip-rap and subsequent shoreline. Fish and wildlife habitat can also be provided if large (not small) boulders are used. A major disadvantage of rip-rap is the initial expense of installation and associated permits. Installation is expensive since a licensed contractor and heavy equipment are generally needed to conduct the work. Permits are required if replacing existing or installing new rip-rap or gabions and must be acquired prior to work beginning.

**Option 3: Create a Buffer Strip**

Another effective, more natural method of controlling shoreline erosion is to create a buffer strip with existing or native vegetation. Native plants have deeper root systems than turfgrass and thus hold soil more effectively. Native plants also provide positive aesthetics and good wildlife habitat. Allowing vegetation to naturally propagate the shoreline would be the most cost effective, depending on the severity of erosion and the composition of the current vegetation. Stabilizing the shoreline with vegetation is most effective on slopes less than 2:1 to 3:1, horizontal to vertical, or flatter. Usually a buffer strip of at least 25 feet is recommended, however, wider strips (50 or even 100 feet) are recommended on steeper slopes or areas with severe erosion problems.

Buffer strips can be one of the least expensive means to stabilize shorelines. If no permits or heavy equipment are needed (i.e., no significant earthmoving or filling is planned), the property owner can complete the work without the need of professional contractors. Once established (typically within 3 years), a buffer strip of native vegetation will require little maintenance and may actually reduce the overall maintenance of the property, since the buffer strip will not have to be continuously mowed, watered, or fertilized. Buffer strips may slow the velocity of floodwaters, thus preventing shoreline erosion. Native plants also can withstand fluctuating water levels more effectively than commercial turfgrass. In addition, many wildlife species prefer the native shoreline vegetation habitat and various species are even dependent on native shoreline vegetation for their existence. In addition to the benefits of increased wildlife use, a buffer strip planted with a variety of native plants may provide a season long show of colors from flowers, leaves, seeds, and stems. This is not only aesthetically pleasing to people, but also benefits wildlife and the overall health of the lake's ecosystem.

There are few disadvantages to native shoreline vegetation. Certain species (i.e., cattails) can be aggressive and may need to be controlled occasionally. If stands of shoreline vegetation become dense enough, access and visibility to the lake may be compromised to some degree. However, small paths could be cleared to provide lake access or smaller plants could be planted in these areas.

**Option 4: Install Biolog, Fiber Roll, or Straw Blanket with Plantings**

These products are long cylinders of compacted synthetic or natural fibers wrapped in mesh. The rolls are staked into shallow water. Biologs, fiber rolls, and straw blankets provide erosion control that secure the shoreline in the short-term and allow native plants to establish which will eventually provide long-term shoreline stabilization. They are most often made of bio-degradable materials, which break down by the time the natural vegetation becomes established (generally within 3 years). They provide additional strength to the shoreline, absorb wave energy, and effectively filter run-off from watershed sources. They are most effective in areas where plantings alone are not effective due to existing erosion.

**Option 5: Install A-Jacks®**

A-Jacks® are made of two pieces of pre-cast concrete when fitted together resemble a playing jacks. These structures are installed along the shoreline and covered with soil and/or an erosion control product. Native vegetation is then planted on the backfilled area. They can be used in areas where severe erosion does not justify a buffer strip alone.
The advantage to A-Jacks® is that they are quite strong and require low maintenance once installed. In addition, once native vegetation becomes established the A-Jacks® cannot be seen. A disadvantage is that installation cost can be high since labor is intensive and requires some heavy equipment. A-Jacks® need to be pre-made and hauled in from the manufacturing site.

## *D4. Options for Aquatic Plant Management*

**Option 1: Aquatic Herbicides**

Aquatic herbicides are the most common method to control nuisance vegetation/algae. When used properly, they can provide selective and reliable control. Products cannot be licensed for use in aquatic situations unless there is less than a 1 in 1,000,000 chance of any negative effects on human health, wildlife, and the environment. Prior to herbicide application, licensed applicators should evaluate the lake's vegetation and, along with the lake's management plan, choose the appropriate herbicide and treatment areas, and apply the herbicides during appropriate conditions (i.e., low wind speed, DO concentration, temperature).

When used properly, aquatic herbicides can be a powerful tool in management of excessive vegetation. Often, aquatic herbicide treatments can be more cost effective in the long run compared to other management techniques. The fisheries and waterfowl populations of the lake would benefit greatly due to an increase in quality habitat and food supply. Dense stands of plants would be thinned out and improve spawning habitat and food source availability for fish. By implementing a good management plan with aquatic herbicides, usage opportunities of the lake would increase.

The most obvious drawback of using aquatic herbicides is the input of chemicals into the lake. Even though the United States Environmental Protection Agency (USEPA) approved these chemicals for use, human error can make them unsafe and bring about undesired outcomes. If not properly used, aquatic herbicides can remove too much vegetation from the lake. Another problem associated with removing too much vegetation is the loss of sediment stabilization by plants, which can lead to increased turbidity and resuspension of nutrients. After the initial removal, there is a possibility for regrowth of vegetation. Upon regrowth, weedy plants such as Eurasian Watermilfoil and Coontail quickly reestablish, form dense stands, and prevent the growth of desirable species. This causes a decrease in plant biodiversity. Over-removal, and possible regrowth of nuisance vegetation that may follow will drastically impair recreational use of the lake.

**Option 2: Mechanical Harvesting**

Mechanical harvesting involves the cutting and removal of nuisance aquatic vegetation by large specialized boats with underwater cutting bars. The total removal or over removal (neither of which should never be the plan of any management entity) of plants by mechanical harvesting should never be attempted. To avoid complete or over removal, the management entity should have a harvesting plan that determines where and how much vegetation is to be removed.

Mechanical harvesting can be a selective means to reduce stands of nuisance vegetation in a lake. Typically, plants cut low enough to restore recreational use and limit or prevent regrowth. This practice normally improves habitat for fish and other aquatic organisms.
High initial investment, extensive maintenance, and high operational costs have led to decreased use. Mechanical harvesters cannot be used in less than 2-4 feet of water (depending on draft of the harvester) and cannot maneuver well in tight places. The harvested plant material must be disposed of properly to a place that can accommodate large quantities of plants and prevent any from washing back into the lake. Fish, mussels, turtles and other aquatic organisms are commonly caught in the harvester and injured or even removed from the lake in the harvesting process. After the initial removal, there is a possibility for vegetation regrowth. If complete/over removal does occur several problems can result. One problem is the loss of sediment stabilization by plants, which can lead to increased turbidity and resuspension of nutrients. Another problem with mechanical harvesting, even if properly done, is that it can be a nonselective process.

**Option 3: Hand Removal**

Hand removal of excessive aquatic vegetation is a commonly used management technique. Hand removal is normally used in small ponds/lakes and limited areas for selective vegetation removal. Areas surrounding piers and beaches are commonly targeted areas. Typically tools such as rakes and cutting bars are used to remove vegetation. Hand removal is a quick, inexpensive, and selective way to remove nuisance vegetation. There are few negative attributes to hand removal. One negative implication is labor. Depending on the extent of infestation, removal of a large amount of vegetation can be quite tiresome. Another drawback can be disposal. Finding a site for numerous residents to dispose of large quantities of harvested vegetation can sometimes be problematic.

**Option 4: Reestablishing Native Aquatic Vegetation**

Revegetation should only be done when existing nuisance vegetation, such as Eurasian Watermilfoil, are under control using one of the above management options. If the lake has poor clarity due to excessive algal growth or turbidity, these problems must be addressed before a revegetation plan is undertaken. At maximum, planting depth light levels must be greater than 1-5% of the surface light levels for plant growth and photosynthesis.

There are two methods by which reestablishment can be accomplished. The first is use of existing plant populations to revegetate other areas within the lake. The second method of reestablishment is to import native plants from an outside source. A variety of plants can be ordered from nurseries that specialize in native aquatic plants. By revegetating newly opened areas that were once infested with nuisance species, the lake will benefit in several ways. There are few negative impacts to revegetating a lake. One possible drawback is the possibility of new vegetation expanding to nuisance levels and needing control. However, this is an unlikely outcome.  Another drawback could be the high costs of extensive revegetation with imported plants.

## *D5.  Options to Reduce Conductivity and Chloride Concentrations*

Road salt (sodium chloride) is the most commonly used winter road de-icer. While recent advances in the technology of salt spreaders have increased the efficiency to allow more even distribution, the effect to the surrounding environment has come into question. Whether it is used on highways for public safety or on your sidewalk and driveway to ensure your own safety, the main reason for road salt's popularity is that it is a low cost option. However, it could end up costing you more in the long run from the damages that result from its application.

Excess salt can effect soil and in turn plant growth. This can lead to the die-off of beneficial native plant species that cannot tolerate high salt levels, and lead to the increase of non-native, and/or invasive species that can.

Road salts end up in waterways either directly or through groundwater percolation. The problem is that animals do not use chloride and therefore it builds up in a system. This can lead to decreases in dissolved oxygen, which can lead to a loss of biodiversity.

The Lakes Management Unit monitors the levels of salts in surface waters in the county by measuring conductivity and chloride concentrations (which are correlated to each other). There has been an overall increase in salt levels that has been occurring over the past couple of decades. These increases could have detrimental effects on plants, fish and animals living and using the water.

What can you do to help maintain or reduce chloride levels?

### Option 1. Proper Use on Your Property

Ultimately, the less you use of any product, the better.  Physically removing as much snow and ice as possible before applying a de-icing agent is the most important step.  Adding more products before removing what has already melted can result in over application, meaning unnecessary chemicals ending up in run-off to near by streams and lakes.

### Option 2. Examples of Alternatives

While alternatives may contain chloride, they tend to work faster at lower temperatures and therefore require less application to achieve the same result that common road salt would.

Calcium, Magnesium or Potassium Chloride

- Aided by the intense heat evolved during its dissolution, these are used as ice-melting compounds.

Calcium Magnesium Acetate (CMA)

- Mixture of dolomic lime and acetic acid; can also be made from cheese whey and may have even better ice penetration.

- Benefits: low corrosion rates, safe for concrete, low toxicity and biodegradable, stays on surfaces longer (fewer applications necessary).
- Multi-Purpose: use straight, mix with sodium chloride, sand or as a liquid
- Negatives: slow action at low temperatures, higher cost.

Agricultural Byproducts

- Usually mixed with calcium chloride to provide anti-corrosion properties.
- Lower the freezing point of the salt they are added to.
- as a pre-wetting (anti-ice) agent, it's like a Teflon treatment to which ice and snow will not stick.

Local hardware and home improvement stores should carry at least one salt alternative. Some names to look for: Zero Ice Melt Jug, Vaporizer, Ice Away, and many others. Check labels or ask a sales associate before you buy in order to ensure you are purchasing a salt alternative.

**Option 3. Talk to Your Municipality About Using an Alternative**

Many municipalities are testing or already using alternative products to keep the roads safe. Check with your municipality and encourage the use of these products.

# APPENDIX E. WATER QUALITY STATISTICS FOR ALL LAKE COUNTY LAKES.

# 2000 - 2007 Water Quality Parameters, Statistics Summary

| | ALKoxic <=3ft00-2007 | |
|---|---|---|
| Average | **167.3** | |
| Median | **162.0** | |
| Minimum | **64.9** | **IMC** |
| Maximum | **330.0** | **Flint Lake** |
| STD | **42.0** | |
| n = | **803** | |

| | ALKanoxic 2000-2007 | |
|---|---|---|
| Average | **200** | |
| Median | **193** | |
| Minimum | **103** | **Heron Pond** |
| Maximum | **470** | **Lake Marie** |
| STD | **48** | |
| n = | **253** | |

| | Condoxic <=3ft00-2007 | |
|---|---|---|
| Average | **0.8856** | |
| Median | **0.8038** | |
| Minimum | **0.2542** | **Broberg Marsh** |
| Maximum | **6.8920** | **IMC** |
| STD | **0.5243** | |
| n = | **802** | |

| | Condanoxic 2000-2007 | |
|---|---|---|
| Average | **1.0035** | |
| Median | **0.8340** | |
| Minimum | **0.3210** | **Lake Kathyrn** |
| Maximum | **7.4080** | **IMC** |
| STD | **0.7787** | |
| n = | **252** | |

| | NO3-N, Nitrate+Nitrite,oxic <=3ft00-2007 | |
|---|---|---|
| Average | **0.515** | |
| Median | **0.150** | |
| Minimum | **<0.05** | ***ND** |
| Maximum | **9.670** | **South Churchill Lake** |
| STD | **1.082** | |
| n = | **808** | |

*ND = Many lakes had non-detects (74.5%)
Only compare lakes with detectable
concentrations to the statistics above
Beginning in 2006, Nitrate+Nitrite was measured.

| | NH3-Nanoxic 2000-2007 | |
|---|---|---|
| Average | **2.070** | |
| Median | **1.340** | |
| Minimum | **<0.1** | ***ND** |
| Maximum | **18.400** | **Taylor Lake** |
| STD | **2.296** | |
| n = | **252** | |

*ND = 19.8% Non-detects from 28 different lakes

| | pHoxic <=3ft00-2007 | |
|---|---|---|
| Average | **8.31** | |
| Median | **8.31** | |
| Minimum | **7.07** | **Bittersweet #13** |
| Maximum | **10.28** | **Round Lake Marsh North** |
| STD | **0.44** | |
| n = | **797** | |

| | pHanoxic 2000-2007 | |
|---|---|---|
| Average | **7.22** | |
| Median | **7.21** | |
| Minimum | **6.24** | **Banana Pond** |
| Maximum | **8.48** | **Heron Pond** |
| STD | **0.41** | |
| n = | **252** | |

| | All Secchi 2000-2007 | |
|---|---|---|
| Average | **4.57** | |
| Median | **3.28** | |
| Minimum | **0.33** | **Fairfield Marsh, Patski Pond** |
| Maximum | **21.33** | **Bangs Lake** |
| STD | **3.81** | |
| n = | **750** | |

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# 2000 - 2007 Water Quality Parameters, Statistics Summary (continued)

| | TKNoxic<br><=3ft00-2007 | |
|---|---|---|
| Average | **1.457** | |
| Median | **1.220** | |
| Minimum | **<0.1** | ***ND** |
| Maximum | **10.300** | **Fairfield Marsh** |
| STD | **0.830** | |
| n = | **808** | |

*ND = 4.5% Non-detects from 16 different lakes

| | TKNanoxic<br>2000-2007 | |
|---|---|---|
| Average | **2.910** | |
| Median | **2.320** | |
| Minimum | **<0.5** | ***ND** |
| Maximum | **21.000** | **Taylor Lake** |
| STD | **2.272** | |
| n = | **252** | |

*ND = 2.8% Non-detects from 4 different lakes

| | TPoxic<br><=3ft00-2007 | |
|---|---|---|
| Average | **0.100** | |
| Median | **0.063** | |
| Minimum | **<0.01** | ***ND** |
| Maximum | **3.880** | **Albert Lake** |
| STD | **0.171** | |
| n = | **808** | |

*ND = 2.4% Non-detects from 7 different lakes
(Carina, Minear,& Stone Quarry)

| | TPanoxic<br>2000-2007 | |
|---|---|---|
| Average | **0.294** | |
| Median | **0.177** | |
| Minimum | **0.012** | **Indep. Grove and W. Loon Lake** |
| Maximum | **3.800** | **Taylor Lake** |
| STD | **0.380** | |
| n = | **252** | |

| | TSSall<br><=3ft00-2007 | |
|---|---|---|
| Average | **15.5** | |
| Median | **8.0** | |
| Minimum | **<0.1** | ***ND** |
| Maximum | **165.0** | **Fairfield Marsh** |
| STD | **20.3** | |
| n = | **814** | |

*ND = 1.8% Non-detects from 11 different lakes

| | TVSoxic<br><=3ft00-2007 | |
|---|---|---|
| Average | **135.3** | |
| Median | **132.0** | |
| Minimum | **34.0** | **Pulaski Pond** |
| Maximum | **298.0** | **Fairfield Marsh** |
| STD | **39.9** | |
| n = | **758** | |

No 2002 IEPA Chain Lakes

| | TDSoxic<br><=3ft00-2004 | |
|---|---|---|
| Average | **470** | |
| Median | **454** | |
| Minimum | **150** | **Lake Kathryn, White** |
| Maximum | **1340** | **IMC** |
| STD | **169** | |
| n = | **745** | |

No 2002 IEPA Chain Lakes.

| | CLanoxic<br><=3ft00-2007 | |
|---|---|---|
| Average | **232** | |
| Median | **119** | |
| Minimum | **41** | **Timber Lake (N)** |
| Maximum | **2390** | **IMC** |
| STD | **400** | |
| n = | **102** | |

| | CLoxic<br><=3ft00-2007 | |
|---|---|---|
| Average | **211** | |
| Median | **158** | |
| Minimum | **30** | **White Lake** |
| Maximum | **2760** | **IMC** |
| STD | **247** | |
| n = | **411** | |

77 of 163 lakes had anoxic conditions
Anoxic conditions are defined <=1 mg/l D.O.
pH Units are equal to the -Log of [H] ion activity
Conductivity units are in MilliSiemens/cm
Secchi Disk depth units are in feet
All others are in mg/L

Minimums and maximums are based on data from all lakes from 2000-2007 (n=1363).

Average, median and STD are based on data from the most recent water quality sampling year for each lake.

LCHD Lakes Management Unit ~ 12/17/2007

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# APPENDIX F.  GRANT PROGRAM OPPORTUNITES

## Table F1. Potential Grant Opportunities

| Grant Program Name | Funding Source | Contact Information | Funding Focus: Water Quality/ Wetland | Habitat | Erosion | Flooding | Cost Share |
|---|---|---|---|---|---|---|---|
| Challenge Grant Program | USFWS | 847-381-2253 or 309-793-5800 | | X | X | | |
| Chicago Wilderness Small Grants | CW | 312-346-8166 ext. 30 | | | | | None |
| Partners in Conservation (formerly C2000) | IDNR | http://dnr.state.il.us/orep/c2000/ | | X | | | None |
| Conservation Reserve Program | NRCS | http://www.nrcs.usda.gov/programs/crp/ | | X | | | Land |
| Ecosystems Program | IDNR | http://dnr.state.il.us/orep/c2000/ecosystem/ | | X | | | None |
| Emergency Watershed Protection | NRCS | http://www.nrcs.usda.gov/programs/ewp/ | | | X | X | None |
| Five Star Challenge | NFWF | http://www.nfwf.org/AM/Template.cfm | | X | | | None |
| Illinois Flood Mitigation Assistance Program | IEMA | http://www.state.il.us/iema/construction.htm | | | | X | None |
| Great Lakes Basin Program | GLBP | http://www.glc.org/basin/stateproj.html?st=il | X | | X | | None |
| Illinois Clean Energy Community Foundation | ICECF | http://www.illinoiscleanenergy.org/ | | X | | | |
| Illinois Clean Lakes Program | IEPA | http://www.epa.state.il.us/water/financial-assistance/index.html | | | | | None |
| Lake Education Assistance Program (LEAP) | IEPA | http://www.epa.state.il.us/water/conservation-2000/leap/index.html | X | | | | $500 |

CW = Chicago Wilderness
ICECF = Illinois Clean Energy Community Foundation
IEMA = Illinois Emergency Management Agency
IEPA = Illinois Environmental Protection Agency
IDNR = Illinois Department of Natural Resources
IDOA = Illinois Department of Agriculture
LCSMC = Lake County Stormwater Management Commission
LCSWCD = Lake County Soil and Water Conservation District
NFWF = National Fish and Wildlife Foundation
NRCS = Natural Resources Conservation Service
USACE = United States Army Corps of Engineers
USFWS = United States Fish and Wildlife Service

**Table F1. Continued**

| Grant Program Name | Funding Source | Contact Information | Funding Focus: Water Quality/ Wetland | Habitat | Erosion | Flooding | Cost Share |
|---|---|---|---|---|---|---|---|
| Northeast Illinois Wetland Conservation Account | USFWF | 847-381-2253 | X | | | | |
| Partners for Fish and Wildlife | USFWS | http://ecos.fws.gov/partners/ | | X | | | > 50% |
| River Network's Watershed Assistance Grants Program | River Network | http://www.rivernetwork.org | X | X | X | | na |
| Section 206: Aquatic Ecosystems Restoration | USACE | 312-353-6400, 309-794-5590 or 314-331-8404 | | X | | | 35% |
| Section 319: Non-Point Source Management Program | IEPA | http://www.epa.state.il.us/water/financial-assistance/non point.html | X | X | | | >40% |
| Section 1135: Project Modifications for the Improvement of the Environment | USACE | 312-353-6400, 309-794-5590 or 314-331-8404 | | X | | | 25% |
| Stream Cleanup And Lakeshore Enhancement (SCALE) | IEPA | http://www.epa.state.il.us/water/watershed/scale.html | X | X | | | None |
| Streambank Stabilization & Restoration (SSRP) | IDOA/ LCSWCD | http://www.agr.state.il.us/Environment/conserv/ or call LCSWCD at (847) 223-1056 | | X | X | | 25% |
| Watershed Management Boards | LCSMC | http://www.co.lake.il.us/smc/projects/wmb/default.asp | X | | X | X | 50% |
| Wetlands Reserve Program | NRCS | http://www.nrcs.usda.gov/programs/wrp/ | X | X | | | Land |
| Wildlife Habitat Incentive Program | NRCS | http://www.nrcs.usda.gov/programs/whip/ | | X | | | Land |

CW = Chicago Wilderness
ICECF = Illinois Clean Energy Community Foundation
IEMA = Illinois Emergency Management Agency
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IDOA = Illinois Department of Agriculture
LCSMC = Lake County Stormwater Management Commission
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NFWF = National Fish and Wildlife Foundation
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USACE = United States Army Corps of Engineers
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