2005 SUMMARY REPORT
of
Peterson Pond

Lake County, Illinois

Prepared by the

LAKE COUNTY HEALTH DEPARTMENT
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EXECUTIVE SUMMARY

Peterson Pond was formed around 1903, originally as a gravel pit, and is now owned by the Lake County Forest Preserve District. No boating (i.e., canoes, etc.) is permitted and only bank fishing is allowed on this lake. No development exists around the lake, except for a small footpath connecting this area with the Independence Grove Forest Preserve.

Water clarity in the pond was 5.55 feet in 2005, which was better than the county average (3.9 feet), but has declined by about 15% since 2001 (6.47 feet). As expected, the average total suspended solids (TSS) concentration increased slightly from 2001 (3.8 mg/L) to 2005 (4.0 mg/L). The 2005 TSS average still falls below the county average of 7.9 mg/L. The two key nutrients, phosphorus and nitrogen, were also below county medians. Total phosphorus (TP) average in the epilimnion was 0.027 mg/L, which was a small increase from 2001 (0.025 mg/L). Total Kjeldahl nitrogen (TKN) average in the epilimnion was 0.794 mg/L, which was also a slight increase from 2001 (0.699 mg/L). Overall, the nutrients have seen an increase, but remain below the county medians.

There was a slight shift in plant community composition from 2001 to 2005. These changes were probably due to natural variation in plant community composition from year to year. In 2005, there were four plant species found, with Eurasian Watermilfoil (EWM) being the most common (found at 60% of the sites). Curlyleaf Pondweed was the second most common, and was found at 30% of the sampling sites. EWM, Curlyleaf Pondweed and Sago Pondweed were all found in both 2001 and 2005. However, in 2001 Largeleaf Pondweed was found, while in 2005 American Pondweed was found and Largeleaf Pondweed was not. Also, in 2001 *Chara* spp., a macro algae, was found but was not found in 2005. EWM and Curlyleaf Pondweed are both invasive, non-native species that should be monitored as they have a tendency to spread and overtake native species. While it seems these two species have not increased in density from 2001, the change in sampling procedure between the two years makes analysis difficult.

During the 2001 shoreline assessment, the entire shoreline of Peterson Pond was classified as undeveloped, and the types of shoreline recorded were prairie (most dominant type), wetland, shrub, buffer and beach. Slight erosion was found on 43% of the shoreline. A reassessment in 2005 found a reduction in the area of slightly eroded shoreline on the northeast side of the pond. This may have been due to differences in staff readings between sampling years. Exotics are still present along the shoreline and it is recommended they be eliminated. The land surrounding the pond continues to provide good habitat for many birds as it consists of prairie, wetland and shrub. Habitat would be improved if exotic species were eliminated and replaced with native vegetation.

LAKE FACTS

Lake Name:	Peterson Pond
Historical Name:	None
Nearest Municipality:	Village of Libertyville
Location:	T46N, R11E, Section 19
Elevation:	660 feet
Major Tributaries:	None
Watershed:	Des Plaines River
Sub-watershed:	Upper Des Plaines River
Receiving Water body:	Bull Creek
Surface Area:	9.2 acres
Shoreline Length:	0.4 miles
Maximum Depth:	11.6 feet
Average Depth (est.):	5.8 feet
Lake Volume (est.):	74.5 acre-feet
Lake Type:	Gravel Pit
Watershed Area (est.):	18.3 acres
Major Watershed Land Uses:	Forest Preserve
Bottom Ownership:	LCFPD
Management Entities:	LCFPD
Current and Historical Uses:	Constructed as a gravel pit. Now owned by the LCFPD. No swimming or boating; Only bank fishing
Description of Access:	Bank access only

SUMMARY OF WATER QUALITY

Water samples were taken once a month at the deepest location in the pond, from May to September (Figure 1). Two samples were taken; one from the upper water layer (epilimnion) and one from the lower water layer (hypolimnion). They were analyzed for nutrients, solids concentration and other physical parameters (Appendix A). The epilimnetic sample was taken from three feet, while the hypolimnetic sample varied from 6-9 feet deep, as these samples are always taken three feet above the bottom, and the water level fluctuated throughout the season (Appendix C). Thermal stratification is measured in relative thermal resistance to mixing (RTRM). RTRM values that fall below 20 allow water within the entire waterbody to mix freely, while with values of 20 and higher resistance to mixing between layers increases. The size of this strongly stratified layer usually increases throughout the summer, but this was not the case in Peterson Pond. The pond was weakly stratified in May and June, and was mixing throughout the rest of the season, which signifies a polymictic lake (lake that mixes several times throughout the season).

The average epilimnetic dissolved oxygen (DO) concentration was 8.70 mg/L, while the average hypolimnetic DO concentration was 5.39 mg/L. The epilimnion experienced adequate levels of DO throughout the season, while the hypolimnion hovered right at the critical concentration (5.0 mg/L) for sunfish and bass (Table1). The hypoxic layer (1.0 mg/L to 5.0 mg/L) increased from approximately 10.5 feet in May, to approximately 8.0 feet in June, with a maximum of 6.5 feet in September. All water below these levels lacked adequate oxygen supply for most aquatic life. Because a bathymetric map does not exist for the pond, it is not possible to calculate the volume of water affected (See Appendix D1). The pond as a whole had lower DO concentrations in September (5.89 mg/L in the epilimnion; 5.19 mg/L in the hypolimnion), probably due to plant die off and decomposition, which consumes DO. Also, as water heats up throughout the summer, it is not able to hold as much oxygen. Anoxic conditions (DO < 1.0 mg/L) occurred in June at approximately 10.5 feet and below, and in August below 8.5 feet. Because the lake was constantly mixing throughout the summer, it is hard to determine how long these low concentrations persisted.

Water clarity, measured by Secchi disk depth, decreased about 30% from 2001 (6.47 feet) to 2005 (4.51 feet). This may have been due to an estimated decrease in plant biomass between sampling years. Since there were fewer plants, there may have been more algal growth, which adds to the total suspended solids (TSS) and reduces water clarity (Figure 2). The average TSS concentration increased slightly from 3.8 mg/L in 2001 to 4.0 mg/L in 2005, but still remains below the county median of 7.9 mg/L (Appendix E). In August and September, TSS levels were the highest of the season (5.5 mg/L and 5.7 mg/L), as were total phosphorus (TP) concentrations (0.037 mg/L and 0.041 mg/L). Increases in these two constituents will lead to an increase in algal concentrations. Also, the water level dropped just over a foot between May and September 2005 due to low amounts of precipitation that led to drought-like conditions. This lowered amount of water input to the pond concentrated any suspended solids and nutrients into a smaller water volume. The average TP concentration in the epilimnion increased slightly from 2001 (0.025

mg/L) to 2005 (0.027 mg/L). However, this is still well below the Lake County epilimnetic TP median of 0.063 mg/L. The TP concentrations in the hypolimnion also increased from 0.027 mg/L in 2001, to 0.035 mg/L in 2005, but concentrations were also well below the hypolimnetic Lake County median of 0.174 mg/L. These relatively low concentrations may be due to the pond's small, undeveloped watershed (Figure 3; Figure 4). Total Kjeldahl nitrogen (TKN) average in the epilimnion was 0.794 mg/L, which was also an increase from 2001 (0.699 mg/L). In order to compare the availability of N and P, a ratio of total nitrogen to total phosphorus (TN:TP) is used. This ratio indicates if P or N limits the plant and algal growth in the lake. Lakes with TN:TP ratios of more than 15:1 are usually limited by P. Those lakes with ratios less than 10:1 are usually N limited. Peterson Pond had a TN:TP ratio of 43:1 indicating P limitation. Most lakes throughout Lake County are phosphorus limited.

Another way to look at phosphorus levels and how they affect productivity of the pond is to use a Trophic State Index (TSI) based on phosphorus (TSIp). TSIp values are commonly used to classify and compare lake productivity levels (trophic state). Within a lake, the higher the phosphorus levels, the greater the amount of plant and algal biomass. This leads to a higher TSIp and corresponding trophic state. Based on a TSIp value of 52, Peterson Pond was classified as eutrophic ($\geq$50, $\leq$70 TSI). A eutrophic lake is defined as an over productive system that has above average nutrient levels and high plant and algal biomass (growth). Based on a Secchi TSI of 55, the pond is also classified as eutrophic, which gives an overall trophic state of eutrophic. Based on the TSIp, Peterson Pond ranked 27th out of the 162 lakes studied by the Lakes Management Unit between 2000-2005 (Table 2). Although this is a drop in rank from 2001 (TSIp = 50.3; ranked 20th), the present value still illustrates the good quality of the pond.

The Illinois Environmental Protection Agency has assessment indices to classify Illinois lakes for their ability to support aquatic life, swimming, or recreational uses. The guidelines consider several aspects, such as water clarity, phosphorus concentrations and aquatic plant coverage. Peterson Pond fully supports aquatic life, and swimming uses, and partially supports recreational uses, according to these guidelines. The overall use support category for the pond is that of full support.

Figure 1. Water quality sampling point on Peterson Pond, 2005.

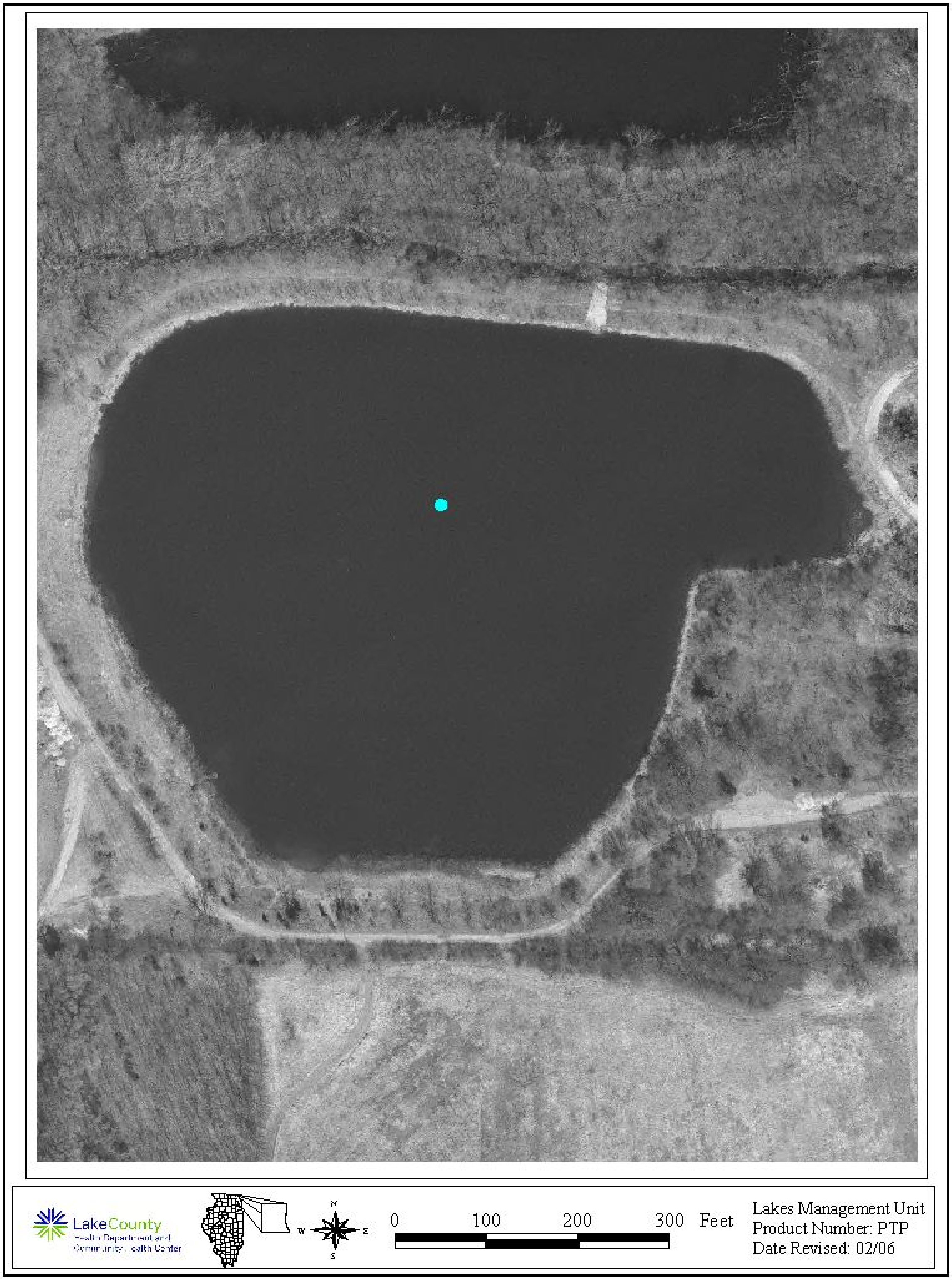

Table 1. Water quality data for Peterson Pond, 2001 and 2005.

2005	Epilimnion														
DATE	DEPTH	ALK	TKN	NH3-N	NO3-N	TP	SRP	TDS	Cl^-	TSS	TS	TVS	SECCHI	COND	pH	DO
10-May	3	145	0.728	<0.1	<0.05	0.023	<0.005	NA	164	3.7	539	84	5.18	0.9179	8.27	9.66
14-Jun	3	95	0.738	<0.1	<0.05	0.013	<0.005	NA	165	2.7	500	92	7.87	0.8796	8.56	8.20
12-Jul	3	73	0.688	<0.1	<0.05	0.023	<0.005	NA	171	2.6	527	127	2.30	0.8544	9.17	11.30
9-Aug	3	76	0.898	<0.1	<0.05	0.037	<0.005	NA	176	5.5	533	131	3.90	0.8710	9.72	8.44
13-Sep	3	86	0.920	<0.1	<0.05	0.041	<0.005	NA	178	5.7	538	122	3.28	0.8890	9.40	5.89
	Average	95	0.794	<0.1	<0.05	0.027	<0.005	NA	171	4.0	527	111	4.51	0.8824	9.02	8.70

2001	Epilimnion															
DATE	DEPTH	ALK	TKN	NH_3-N	NO_3-N	TP	SRP	TDS	Cl^-	TSS	TS	TVS	SECCHI	COND	pH	DO
5/1/01	3	158	<0.500	<0.1	<0.05	0.027	<0.005	478	NA	3.8	513	168	4.95	0.8353	8.15	9.12
5-Jun	3	141	0.659	<0.1	<0.05	0.035	0.005	520	NA	8.5	507	119	3.64	0.8055	8.11	8.71
10-Jul	3	114	0.634	<0.1	<0.05	0.018	<0.005	451	NA	1.7	509	139	8.83	0.7757	8.37	8.25
7-Aug	3	95	0.650	<0.1	<0.05	0.020	<0.005	436	NA	2.2	494	149	8.07	0.7621	8.57	8.41
5-Sep	3	125	0.854	<0.1	<0.05	0.023	0.006	454	NA	2.6	484	84	6.86	0.8322	8.37	8.96
	Average	127	0.699[k]	<0.1	<0.05	0.025	0.002[k]	468	NA	3.8	501	132	6.47	0.8022	8.31	8.69

Glossary

ALK = Alkalinity, mg/L $CaCO_3$
TKN = Total Kjeldahl nitrogen, mg/L
NH_3-N = Ammonia nitrogen, mg/L
NO_3-N = Nitrate nitrogen, mg/L
TP = Total phosphorus, mg/L
SRP = Soluble reactive phosphorus, mg/L
TDS = Total dissolved solids, mg/L
Cl^- = Chloride, 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

NA = Not Applicable

Note: "k" denotes that the actual value is known to be less than the value presented.

Table 1. Continued.

2005	Hypolimnion															
DATE	DEPTH	ALK	TKN	NH3-N	NO3-N	TP	SRP	TDS	Cl^-	TSS	TS	TVS	SECCHI	COND	pH	DO
10-May	9	150	0.758	<0.1	<0.05	0.032	<0.005	NA	164	6.9	548	88	NA	0.9246	7.90	6.80
14-Jun	8	109	0.810	<0.1	<0.05	0.016	<0.005	NA	164	3.8	518	106	NA	0.9227	7.73	4.71
12-Jul	8	75	0.745	<0.1	<0.05	0.031	<0.005	NA	171	5.0	516	117	NA	0.8519	8.73	5.87
9-Aug	7	77	0.894	<0.1	<0.05	0.052	<0.005	NA	174	13.0	511	110	NA	0.8722	9.34	4.38
13-Sep	6	86	0.974	<0.1	<0.05	0.042	<0.005	NA	178	6.1	538	122	NA	0.8894	9.38	5.19
	Average	99	0.836	<0.1	<0.05	0.035	<0.005	NA	170	7.0	526	109	NA	0.8922	8.62	5.39

2001	Hypolimnion															
DATE	DEPTH	ALK	TKN	NH_3-N	NO_3-N	TP	SRP	TDS	Cl^-	TSS	TS	TVS	SECCHI	COND	pH	DO
5/1/01	9	161	<0.500	<0.1	<0.05	0.026	<0.005	490	NA	7.8	521	167	NA	0.8441	7.77	7.58
5-Jun	9	142	0.665	<0.1	<0.05	0.027	0.005	512	NA	9.8	503	120	NA	0.8056	8.09	8.56
10-Jul	9	120	0.728	<0.1	<0.05	0.027	<0.005	452	NA	4.5	498	139	NA	0.7861	7.74	6.02
7-Aug	9	105	0.770	<0.1	<0.05	0.026	<0.005	444	NA	5.5	506	160	NA	0.7921	7.78	4.44
5-Sep	10	129	0.828	<0.1	<0.05	0.027	0.007	508	NA	4.7	520	99	NA	0.8861	7.64	4.25
	Average	131	0.748^k	<0.1	<0.05	0.027	0.002^k	481	NA	6.5	510	137	NA	0.8228	7.80	6.17

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
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COND = Conductivity, milliSiemens/cm
DO = Dissolved oxygen, mg/L

NA = Not Applicable

Note: "k" denotes that the actual value is known to be less than the value presented.

Figure 2. Total suspended solids (TSS) concentration vs. Secchi depth in Peterson Pond, 2005.

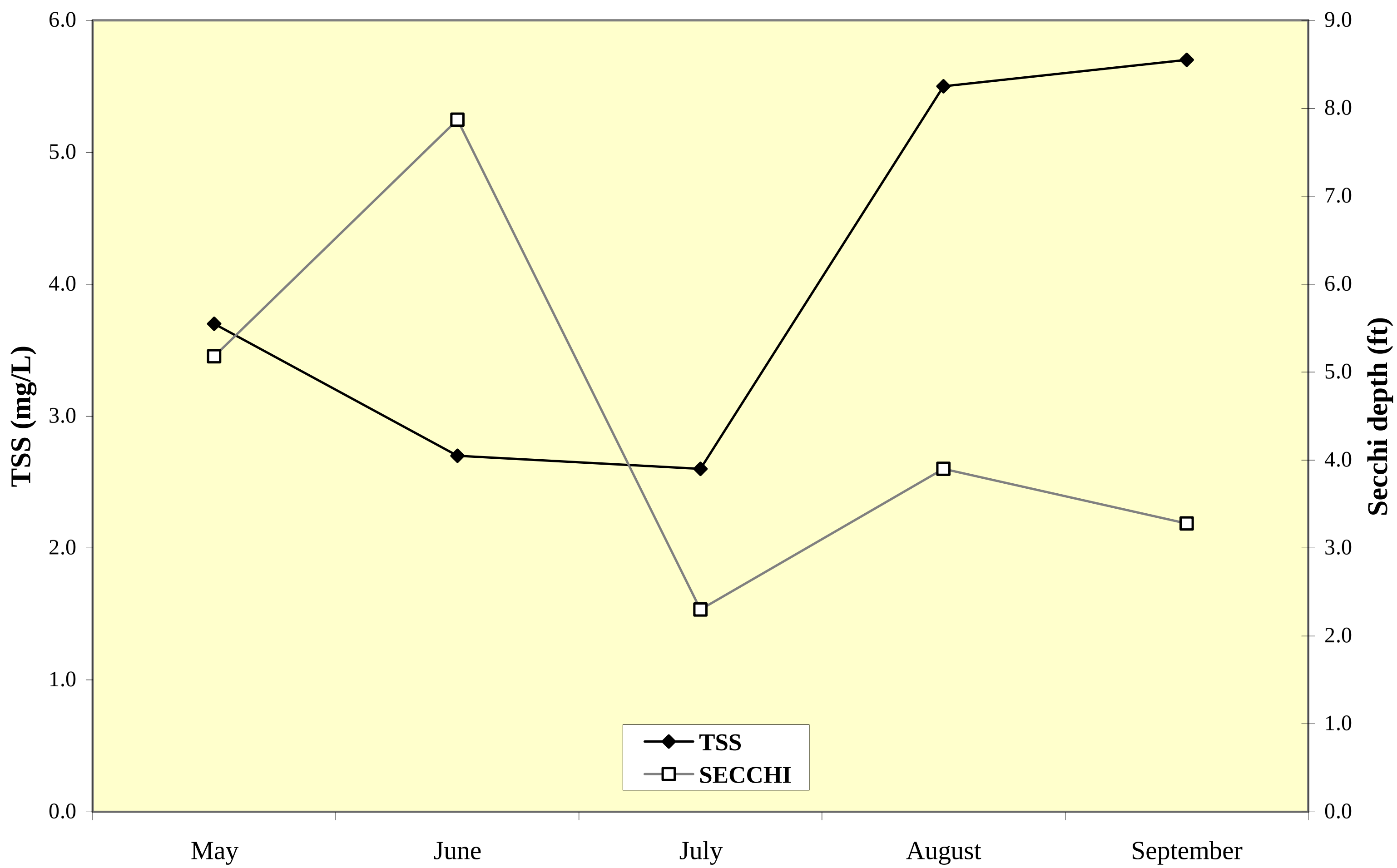


Figure 3. Approximate watershed delineation for Peterson Pond, 2005.

Figure 4. Approximate land use in the Peterson Pond watershed, 2005.

Table 2. Lake County average TSI phosphorous (TSIp) ranking, 2000-2005.

RANK	LAKE NAME	TP AVE	TSIp
1	Windward Lake	0.0158	43.9
2	Sterling Lake	0.0162	44.3
3	Lake Minear	0.0165	44.6
4	Pulaski Pond	0.0180	45.8
5	Fourth Lake	0.0182	46.0
6	West Loon Lake	0.0182	46.0
7	Cedar Lake	0.0183	46.1
8	Third Lake	0.0190	46.6
9	Lake Carina	0.0193	46.9
10	Independence Grove	0.0194	46.9
11	Lake Kathyrn	0.0200	47.3
12	Lake of the Hollow	0.0200	47.3
13	Banana Pond	0.0202	47.5
14	Cross Lake	0.0220	48.7
15	Dog Training Pond	0.0222	48.9
16	Sand Pond	0.0230	49.4
17	Stone Quarry Lake	0.0230	49.4
18	Bangs Lake	0.0233	49.6
19	Cranberry Lake	0.0236	49.7
20	Deep Lake	0.0240	50.0
21	Druce Lake	0.0244	50.2
22	Little Silver Lake	0.0246	50.3
23	Round Lake	0.0254	50.8
24	Lake Leo	0.0256	50.9
25	Timber Lake	0.0270	51.7
26	Dugdale Lake	0.0274	51.9
27	**Peterson Pond**	**0.0274**	**51.9**
28	Lake Miltmore	0.0276	52.0
29	Ames Pit	0.0278	52.1
30	East Loon Lake	0.0280	52.2
31	Lake Zurich	0.0282	52.3
32	Lake Fairfield	0.0296	53.0
33	Gray's Lake	0.0302	53.3
34	Highland Lake	0.0302	53.3
35	Hook Lake	0.0302	53.3
36	Lake Catherine (Site 1)	0.0308	53.6
37	Lambs Farm Lake	0.0312	53.8
38	Old School Lake	0.0312	53.8
39	Sand Lake	0.0316	53.9
40	Waterford Lake	0.0318	54.0
41	Potomac Lake	0.0318	54.0
42	Sullivan Lake	0.0320	54.1

Table 2. Continued.

RANK	LAKE NAME	TP AVE	TSIp
43	Wooster Lake	0.0324	54.3
44	Gages Lake	0.0338	54.9
45	Hendrick Lake	0.0356	55.7
46	Diamond Lake	0.0372	56.3
47	Channel Lake (Site 1)	0.0380	56.6
48	Sun Lake	0.0410	57.7
49	Lake Linden	0.0420	58.0
50	Old Oak Lake	0.0428	58.3
51	Schreiber Lake	0.0434	58.5
52	Nielsen Pond	0.0448	59.0
53	Turner Lake	0.0458	59.3
54	Seven Acre Lake	0.0460	59.4
55	Willow Lake	0.0464	59.5
56	Lucky Lake	0.0476	59.9
57	Davis Lake	0.0476	59.9
58	East Meadow Lake	0.0478	59.9
59	College Trail Lake	0.0496	60.4
60	Countryside Lake	0.0512	60.9
61	Lake Lakeland Estates	0.0524	61.2
62	Butler Lake	0.0528	61.3
63	Lake Christa	0.0530	61.4
64	West Meadow Lake	0.0530	61.4
65	Deer Lake	0.0542	61.7
66	Heron Pond	0.0545	61.8
67	Little Bear Lake	0.0550	61.9
68	Lucy Lake	0.0552	62.0
69	Lake Charles	0.0580	62.7
70	White Lake	0.0588	62.9
71	Lake Naomi	0.0616	63.6
72	Lake Tranquility S1	0.0618	63.6
73	Werhane Lake	0.0630	63.9
74	Liberty Lake	0.0632	63.9
75	Countryside Glen Lake	0.0642	64.2
76	Leisure Lake	0.0648	64.3
77	Hastings Lake	0.0664	64.7
78	St. Mary's Lake	0.0666	64.7
79	Mary Lee Lake	0.0682	65.0
80	Honey Lake	0.0690	65.2
81	Redwing Slough, Site II, Outflow	0.0718	65.8
82	North Tower Lake	0.0718	65.8
83	Lake Fairview	0.0724	65.9
84	Spring Lake	0.0726	65.9
85	ADID 203	0.0730	66.0
86	Bluff Lake	0.0734	66.1

Table 2. Continued.

RANK	LAKE NAME	TP AVE	TSIp
87	Long Lake	0.0761	66.6
88	Harvey Lake	0.0766	66.7
89	Broberg Marsh	0.0782	67.0
90	Echo Lake	0.0792	67.2
91	Sylvan Lake	0.0794	67.2
92	Big Bear Lake	0.0806	67.4
93	Petite Lake	0.0834	67.9
94	Lake Marie (Site 1)	0.0850	68.2
95	North Churchill Lake	0.0872	68.6
96	Grandwood Park, Site II, Outflow	0.0876	68.6
97	South Churchill Lake	0.0896	69.0
98	Rivershire Pond 2	0.0900	69.0
99	McGreal Lake	0.0914	69.3
100	International Mine and Chemical Lake	0.0948	69.8
101	Eagle Lake (Site I)	0.0950	69.8
102	Dunns Lake	0.0952	69.8
103	Lake Barrington	0.0956	69.9
104	Lochanora Lake	0.0960	70.0
105	Owens Lake	0.0978	70.2
106	Woodland Lake	0.0986	70.4
107	Island Lake	0.0990	70.4
108	Duck Lake	0.0996	70.5
109	Tower Lake	0.1000	70.6
110	Crooked Lake	0.1014	70.8
111	Fish Lake	0.1022	70.9
112	Longview Meadow Lake	0.1024	70.9
113	Lake Forest Pond	0.1074	71.6
114	Bittersweet Golf Course #13	0.1096	71.9
115	Fox Lake (Site 1)	0.1098	71.9
116	Bresen Lake	0.1126	72.3
117	Round Lake Marsh North	0.1126	72.3
118	Timber Lake S	0.1128	72.3
119	Deer Lake Meadow Lake	0.1158	72.7
120	Taylor Lake	0.1184	73.0
121	Grand Avenue Marsh	0.1194	73.1
122	Columbus Park Lake	0.1226	73.5
123	Nippersink Lake (Site 1)	0.1240	73.7
124	Grass Lake (Site 1)	0.1288	74.2
125	Lake Holloway	0.1322	74.6
126	Lakewood Marsh	0.1330	74.7
127	Summerhill Estates Lake	0.1384	75.2
128	Redhead Lake	0.1412	75.5

Table 2. Continued.

RANK	LAKE NAME	TP AVE	TSIp
129	Antioch Lake	0.1448	75.9
130	Forest Lake	0.1470	76.1
131	Valley Lake	0.1470	76.1
132	Slocum Lake	0.1496	76.4
133	Drummond Lake	0.1510	76.5
134	Pond-a-Rudy	0.1514	76.5
135	Lake Matthews	0.1516	76.6
136	Buffalo Creek Reservoir	0.1550	76.9
137	Pistakee Lake (Site 1)	0.1592	77.3
138	Salem Lake	0.1650	77.8
139	Half Day Pit	0.1690	78.1
140	McDonald Lake 1	0.1722	78.4
141	Lake Eleanor Site II, Outflow	0.1812	79.1
142	Lake Farmington	0.1848	79.4
143	ADID 127	0.1886	79.7
144	Lake Louise Inlet	0.1938	80.1
145	Grassy Lake	0.1952	80.2
146	Fischer Lake	0.1978	80.4
147	Dog Bone Lake	0.1990	80.5
148	Redwing Marsh	0.2072	81.1
149	Stockholm Lake	0.2082	81.1
150	Bishop Lake	0.2156	81.6
151	Hidden Lake	0.2236	82.2
152	Lake Napa Suwe (Outlet)	0.2304	82.6
153	Patski Pond (outlet)	0.2512	83.8
154	Slough Lake	0.2634	84.5
155	McDonald Lake 2	0.2706	84.9
156	Oak Hills Lake	0.2792	85.4
157	Loch Lomond	0.2954	86.2
158	Fairfield Marsh	0.3264	87.6
159	ADID 182	0.3280	87.7
160	Flint Lake Outlet	0.4996	93.8
161	Rasmussen Lake	0.5025	93.8
162	Albert Lake, Site II, outflow	1.1894	106.3

SUMMARY OF AQUATIC MACROPHYTES

An aquatic plant survey was conducted in early June of 2005. Sample sites were based on a grid system created by mapping software (ArcGIS), with each site located 60 meters (200 feet) apart. On Peterson Pond there were 10 sampling sites (Figure 5). Overall, there were four plant species found, with Eurasian Watermilfoil (EWM) being the most common (found at 60% of the sites). Curlyleaf Pondweed was the second most common, and was found at 30% of the sampling sites (Table 3a). Plants need at least 1% of surface light levels in order to photosynthesize. During sampling, plants were found down to 9.5 feet while light level was over 1% at the pond bottom of 11 feet. These depths correlate fairly well. Plants may have been growing at a deeper depth than 9.5 feet, but the sampling technique did not detect them. Out of the 10 sampling sites, plants were found at six (60%) (Table 3a; Figure 5).

There was a slight shift in plant community composition from the study done in 2001. These changes were probably due to natural variation in plant community composition from year to year, since no known management of the aquatic plants occurs. EWM, Curlyleaf Pondweed and Sago Pondweed were all found in both 2001 and 2005. However, in 2001 Largeleaf Pondweed was found, while in 2005 American Pondweed was found and Largeleaf Pondweed was not (Table 4). Also, in 2001 *Chara* spp., a macro algae, was found but was not found in 2005. EWM and Curlyleaf Pondweed are both invasive, non-native species that should be monitored as they have a tendency to spread and overtake native species. While it seems these two species have not increased in density from 2001, the change in sampling procedure makes that hard to tell. An important discovery was made in 2001. Milfoil Weevils (*Euhrychiopsi lecontei*) were found on EWM. These weevils were spotted again in 2005, with damage also observed on EWM stems. *E. lecontei* is a native weevil, which feeds almost exclusively on milfoil species. It was originally discovered while investigating declines of EWM in a Vermont lake in the early 1990s. It was discovered in northeastern Illinois lakes in 1995. Currently, the LCHD-Lakes Management Unit has documented *E. lecontei* in 37 Lake County lakes. Some of these lakes have seen declines in EWM populations in recent years.

Figure 5. Aquatic plant sampling grid that illustrates plant density in Peterson Pond, 2005.

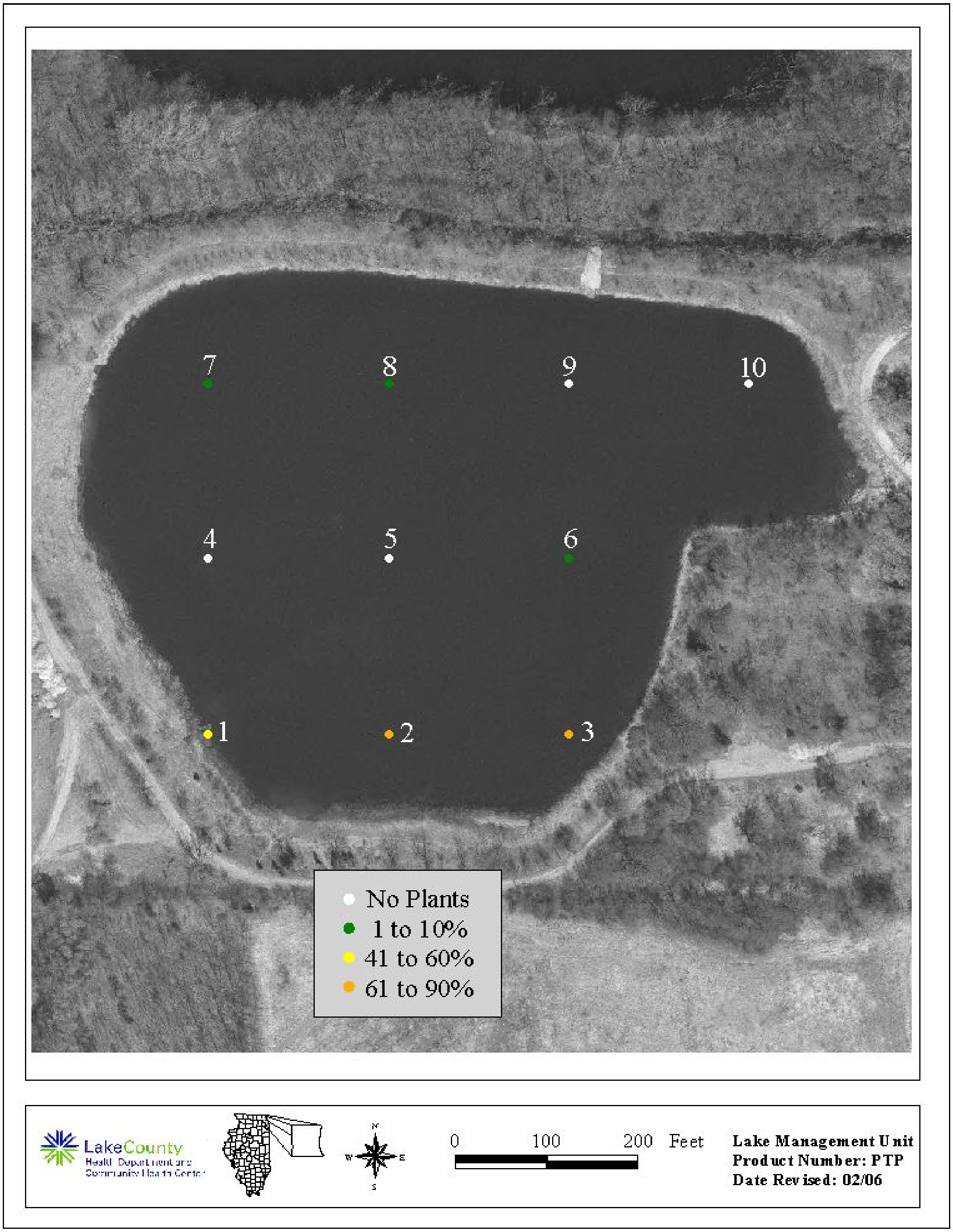


Table 3a. Aquatic plant species found at the 10 sampling sites on Peterson Pond, 2005. Maximum depth that plants were found was 9.5 feet.

Plant Density	American Pondweed	Curlyleaf Pondweed	Eurasian Watermilfoil	Sago Pondweed
Present	0	3	3	1
Common	1	0	0	1
Abundant	0	0	1	0
Dominant	0	0	2	0
% Plant Occurrence	10	30	60	20

Table 3b. Distribution of rake density across all sample sites.

Rake Density (coverage)	# of Sites	% of Sites
No Plants	4	40
>0-10%	3	30
10-40%	0	0
40-60%	2	20
60-90%	1	10
>90%	0	0
Total Sites with Plants	6	60
Total # of Sites	10	100

Table 4. Aquatic plant species found in Peterson Pond, 2005.

Eurasian Watermilfoil ^	*Myriophyllum spicatum*
Curlyleaf Pondweed ^	*Potamogeton crispus*
American Pondweed	*Potamogeton nodosus*
Sago Pondweed	*Potamogeton pectinatus*

^Exotic species

Floristic Quality Index (FQI) is a rapid assessment tool designed to evaluate the closeness of the flora of an area to that of undisturbed conditions. It can be used to: 1) identify natural areas, 2) compare the quality of different sites or different locations within a single site, 3) monitor long-term floristic trends, and 4) monitor habitat restoration efforts (Nichols, 1999). 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 are 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 median FQI for 2000-2005 Lake County lakes was 13.1. Peterson Pond had an FQI of 6.0, and ranked 132nd out of 151 lakes in the county (Table 5). This is a decline in rank from 2001 (96th out of 150) when the pond had a FQI of 11.5.

SUMMARY OF SHORELINE CONDITION

During the 2001 shoreline assessment, the entire shoreline of Peterson Pond was classified as undeveloped, and the types of shoreline recorded were prairie (most dominant type), wetland, shrub, buffer and beach. Slight erosion was found on 43% of the shoreline. A reassessment in 2005 found a reduction in the area of slightly eroded shoreline on the northeast side of the pond (Figure 6). This may have been due to differences in staff readings, or an increase in shoreline plant species that helped stabilize the eroding soil.

In 2001, the presence of invasive, aggressive plant species was noted along the majority of the shoreline. Common Reed (*Phragmites australis*), Teasel (*Dipsacus sylvestris*), and Reed Canary Grass (*Phalaris arundinacea*) were identified most often. These aggressive plants can crowd out native, beneficial plants. The removal of these species is still recommended.

SUMMARY OF WILDLIFE AND HABITAT CONDITION

The area surrounding Peterson Pond was considered good habitat due to a mix of prairie, wetland and woods. The fact that the shoreline was undeveloped also created good habitat.

Wildlife observations were made during May and June sampling. Several bird species were observed including Gold Finches, Yellow Warblers, Kingfishers, and Cardinals. American Toads and the Milfoil Weevil (*E. lecontei*) were also noted. While an official fish survey was not conducted, Bluegill, Largemouth Bass, topminnows and carp were observed.

Table 5. 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	35.6	37.8
2	Deep Lake	33.9	35.4
3	Round Lake Marsh North	29.1	29.9
4	East Loon Lake	28.4	29.9
5	Cranberry Lake	28.3	28.3
6	Sullivan Lake	28.2	29.7
7	Deer Lake	27.9	30.2
8	Little Silver Lake	27.9	30.0
9	Schreiber Lake	26.8	27.6
10	Redwing Slough	26.0	26.9
11	West Loon Lake	26.0	27.6
12	Timber Lake (North)	25.5	27.1
13	Cross Lake	25.2	27.8
14	Wooster Lake	25.2	26.9
15	Lake Zurich	24.0	26.0
16	Lake of the Hollow	23.8	26.2
17	Lakewood Marsh	23.8	24.7
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	Sterling Lake	21.8	24.1
24	Butler Lake	21.4	23.1
25	Bangs Lake	21.2	23.7
26	ADID 203	20.5	20.5
27	Broberg Marsh	20.5	21.4
28	Davis Lake	20.5	21.4
29	McGreal Lake	20.2	22.1
30	Lake Kathryn	19.6	20.7
31	Third Lake	19.6	21.7
32	Owens Lake	19.3	20.2
33	Redhead Lake	19.3	21.2
34	Lake Minear	18.8	20.6
35	Turner Lake	18.6	21.2
36	Salem Lake	18.5	20.2
37	Lake Miltmore	18.4	20.3
38	Fish Lake	18.1	20.0
39	McDonald Lake 1	17.7	18.7
40	Potomac Lake	17.3	18.5
41	Hendrick Lake	17.2	19.0
42	Duck Lake	17.1	19.1

Table 5. Continued.

Rank	Lake Name	FQI (w/A)	FQI (native)
43	Summerhill Estates Lake	17.1	18.0
44	Ames Pit	17.0	18.0
45	Seven Acre Lake	17.0	15.5
46	Grand Avenue Marsh	16.9	18.7
47	Gray's Lake	16.9	19.8
48	White Lake	16.9	18.7
49	Bresen Lake	16.6	17.8
50	Waterford Lake	16.6	17.8
51	Diamond Lake	16.3	17.4
52	Lake Barrington	16.3	17.4
53	Lake Napa Suwe	16.3	17.4
54	Windward Lake	16.3	17.6
55	Fischer Lake	16.0	18.1
56	Dog Bone Lake	15.7	15.7
57	Independence Grove	15.5	16.7
58	Long Lake	15.5	17.3
59	Tower Lake	15.2	17.6
60	Heron Pond	15.1	15.1
61	Lake Linden	15.1	16.5
62	Lake Tranquility (S1)	15.0	17.0
63	North Churchill Lake	15.0	15.0
64	Dog Training Pond	14.7	15.9
65	Island Lake	14.7	16.6
66	Highland Lake	14.5	16.7
67	Lake Fairview	14.3	16.3
68	Taylor Lake	14.3	16.3
69	Dugdale Lake	14.0	15.1
70	Eagle Lake (S1)	14.0	15.1
71	Longview Meadow Lake	13.9	13.9
72	Bishop Lake	13.4	15.0
73	Hook Lake	13.4	15.5
74	Timber Lake (South)	13.4	15.5
75	Buffalo Creek Reservoir	13.1	14.3
76	Mary Lee Lake	13.1	15.1
77	Old School Lake	13.1	15.1
78	Dunn's Lake	12.7	13.9
79	Old Oak Lake	12.7	14.7
80	Echo Lake	12.5	14.8
81	Sand Lake	12.5	14.8
82	Stone Quarry Lake	12.5	12.5
83	Honey Lake	12.1	14.3

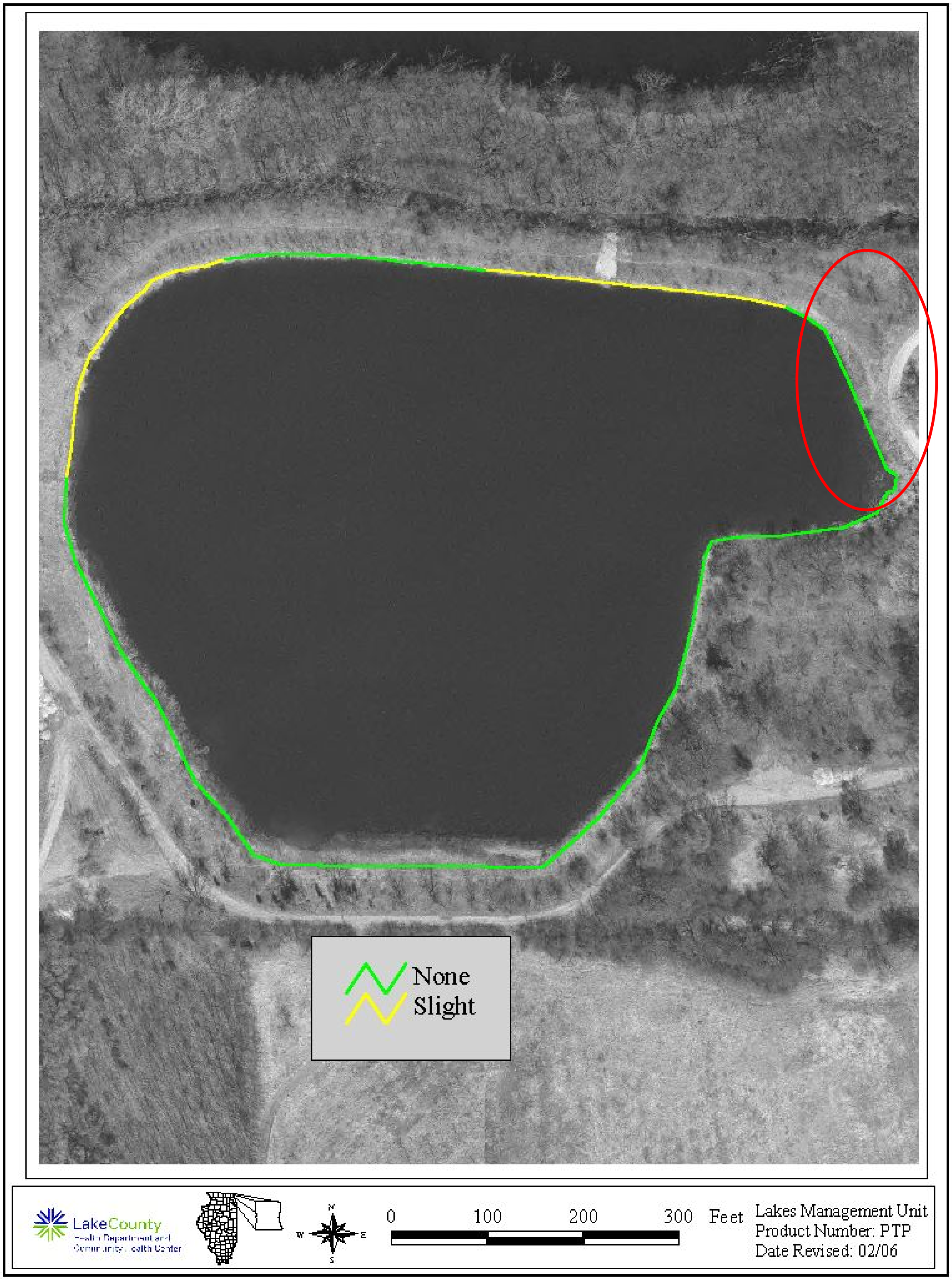
Table 5. Continued.

Rank	Lake Name	FQI (w/A)	FQI (native)
84	Lake Leo	12.1	14.3
85	Lambs Farm Lake	12.1	14.3
86	Pond-A-Rudy	12.1	12.1
87	Stockholm Lake	12.1	13.5
88	Lake Matthews	12.0	12.0
89	McDonald Lake 2	12.0	12.0
90	Flint Lake	11.8	13.0
91	Harvey Lake	11.8	13.0
92	Rivershire Pond 2	11.5	13.3
93	Antioch Lake	11.3	13.4
94	Lake Charles	11.3	13.4
95	Lake Naomi	11.2	12.5
96	Pulaski Pond	11.2	12.5
97	Lake Christa	11.0	12.7
98	Redwing Marsh	11.0	11.0
99	West Meadow Lake	11.0	11.0
100	Nielsen Pond	10.7	12.0
101	Lake Holloway	10.6	10.6
102	Lake Carina	10.2	12.5
103	College Trail Lake	10.0	10.0
104	Lake Lakeland Estates	10.0	11.5
105	Crooked Lake	9.8	12.0
106	Hastings Lake	9.8	12.0
107	Werhane Lake	9.8	12.0
108	Big Bear Lake	9.5	11.0
109	Little Bear Lake	9.5	11.0
110	Loch Lomond	9.4	12.1
111	Sand Pond (IDNR)	9.4	12.1
112	Columbus Park Lake	9.2	9.2
113	Sylvan Lake	9.2	9.2
114	Grandwood Park Lake	9.0	11.0
115	Lake Fairfield	9.0	10.4
116	East Meadow Lake	8.5	8.5
117	Lake Farmington	8.5	9.8
118	Lucy Lake	8.5	9.8
119	South Churchill Lake	8.5	8.5
120	Bittersweet Golf Course #13	8.1	8.1
121	Woodland Lake	8.1	9.9
122	Albert Lake	7.5	8.7
123	Banana Pond	7.5	9.2
124	Fairfield Marsh	7.5	8.7
125	Lake Eleanor	7.5	8.7

Table 5. Continued.

Rank	Lake Name	FQI (w/A)	FQI (native)
126	Lake Louise	7.5	8.7
127	Patski Pond	7.1	7.1
128	Rasmussen Lake	7.1	7.1
129	Lucky Lake	7.0	7.0
130	Lake Forest Pond	6.9	8.5
131	Leisure Lake	6.4	9.0
132	**Peterson Pond**	**6.0**	**8.5**
133	Countryside Lake	5.8	7.1
134	Gages Lake	5.8	10.0
135	Grassy Lake	5.8	7.1
136	Slocum Lake	5.8	7.1
137	Deer Lake Meadow Lake	5.2	6.4
138	ADID 127	5.0	5.0
139	Drummond Lake	5.0	7.1
140	IMC	5.0	7.1
141	Liberty Lake	5.0	5.0
142	Oak Hills Lake	5.0	5.0
143	Slough Lake	5.0	5.0
144	North Tower Lake	4.9	7.0
145	Forest Lake	3.5	5.0
146	Half Day Pit	2.9	5.0
147	Lochanora Lake	2.5	5.0
148	Hidden Lake	0.0	0.0
149	St. Mary's Lake	0.0	0.0
150	Valley Lake	0.0	0.0
151	Willow Lake	0.0	0.0
	Mean	**14.0**	**15.4**
	Median	**13.1**	**14.8**

Figure 6. Shoreline erosion on Peterson Pond, 2005. The red circle indicates the area of shoreline that improved from the 2001 assessment.



LAKE MANAGEMENT RECOMMENDATIONS

Peterson Pond had good overall water quality. TP concentrations remained fairly low and Secchi depth was still above the county median. Also, shoreline erosion seems to have improved from the assessment performed in 2001. The pond offered good habitat due to its undeveloped shoreline, and also provided a place for people to fish.

Creating a bathymetric map

The creation of a bathymetric (depth contour) map of Peterson Pond would aide in lake management practices. For example, the ability to calculate how much water volume was experiencing low DO concentrations, and therefore the amount of stress fish and other aquatic life were experiencing. With new technology available through the Lakes Management Unit, it is possible to create a detailed depth contour map that includes the calculation of plant density throughout the lake (See Appendix D1 for more details).

Eliminate or control exotic species

The Milfoil Weevil was found in Peterson Pond in 2000. The density of these weevils does not seem to be having the desired affect on EWM, because it continued at a high rate in 2005. Also, the weevils do not affect the other invasive species; Curlyleaf Pondweed. Invasive shoreline plant species such as *Phragmites* and Reed Canary Grass were also observed. Removal of these species is recommended and should be paired with a plan for erosion control as they do provide some bank stabilization (See Appendix D2 for more details).

Participate in the Volunteer Lake Monitoring Program

Detailed ecosystem information is vital to understanding the workings of a lake. The more data collected, the better a lake can be understood. Data can be used to create and implement a conservation and/or restoration plan. While the LMU does collect a lot of data during the years the lake is studied, gaps can be filled with data collected by volunteers. The Volunteer Lake Management Program (VLMP) is a program that relies on volunteers to gather a variety of information on their chosen lake. An example of data that a volunteer can collect is water depth, by installing and monitoring a staff gauge (See Appendix D3 for more details).

Assess your lake's fishery

There is no record of a fish survey being performed on the pond. It would be beneficial to the management of the lake to have one conducted, especially since people fish from the shoreline (See Appendix D4 for more details).

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 (ArcGIS 3.2) overlaid a grid pattern onto a 2004 aerial photo of Lake County and placed points 60 meters apart. 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.

Plankton Sampling

Plankton was sampled at the same location as water quality samples. Using the Hydrolab DataSonde® 4a 1% light level depth (depth where the water light is 1% of the surface irradiance) was determined. A plankton net/tow, with 80μm mesh, was then lowered to the pre-determined 1% light level depth and retrieved vertically. On the way up the water column, plankton are collected within a small cup on the bottom of the tow. The collected sample was then emptied into a pre-labeled brown plastic bottle. The net was rinsed with deionized water into the bottle in order to ensure all the plankton were collected. The sample was then transferred to a graduated cylinder to measure the amount of milliliters (mL) that the sample was. The sample was then returned to the bottle and preserved with Lugol's iodine solution (5 drops/mL). The sample bottle was then closed and stored in a cooler until returning to the lab, where it was transferred to the refrigerator until enumeration. Enumeration was performed within three months, but ideally within one month, under a microscope. Sample bottle was inverted several times to ensure proper homogenization. An automated pipette was used to retrieve 1 mL of sample, which was then placed on a Sedgewick Rafter slide. This is a microscope slide on which a rectangular chamber has been constructed, measuring 50 mm x 20 mm in area and with a depth of 1 mm. The slide was then placed under the microscope and counted at a 20X magnification. Twenty fields of view were randomly counted with all species within each field counted. Through calculations, it was determined how many of each species were in 1 mL of lake water.

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 nitrogen	Brucine method Standard Methods (SM) 14th ed 419D Detection Limit = 0.05 mg/L
Ammonia nitrogen	SM 18th ed. Electrode method, #4500 NH_3-F Detection Limit = 0.1 mg/L
Total Kjeldahl nitrogen	SM 18th ed, 4500-N_{org} C Semi-Micro Kjeldahl, plus 4500 NH_3-F Detection Limit = 0.5 mg/L
pH	Hydrolab DataSonde® 4a, or YSI 6600 Sonde® Electrometric method
Total solids	SM 18th ed, Method #2540B
Total suspended solids	SM 18th ed, Method #2540D Detection Limit = 0.5 mg/L
Total dissolved solids	SM 18th ed, Method #2540C
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 Detection Limit = 0.01 mg/L
Soluble reactive phosphorus	SM 18th ed, Methods #4500-P B 1 and #4500-P E 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 PETERSON POND IN 2005

Date MMDDYY	Time HHMMSS	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 0.93
51005	122733	0.25	0.48	19.22	9.47	106.5	0.9164	8.28	3583	Surface		
51005	122836	1	0.95	19.23	9.54	107.3	0.9172	8.29	3629	Surface	100%	
51005	123006	2	2.03	19.07	9.45	105.9	0.9173	8.29	634	0.28	17%	6.23
51005	123104	3	2.99	18.45	9.66	106.9	0.9179	8.27	1232	1.24	34%	-0.69
51005	123209	4	3.95	17.75	9.65	105.3	0.9177	8.25	1299	2.20	36%	-0.06
51005	123314	5	5.03	17.26	9.25	99.9	0.9186	8.22	1009	3.28	28%	0.23
51005	123450	6	6.01	16.48	9.26	98.4	0.9157	8.18	811	4.26	22%	0.22
51005	123551	7	7.03	13.76	8.94	89.7	0.9186	8.13	629	5.28	17%	0.25
51005	123654	8	7.99	13.15	8.24	81.5	0.9223	8.05	456	6.24	13%	0.34
51005	123843	9	9.01	12.65	6.80	66.5	0.9246	7.90	383	7.26	11%	0.17
51005	124037	10	10.02	12.04	6.21	59.9	0.9279	7.80	283	8.27	8%	0.30
51005	124147	11	10.97	11.92	4.21	40.5	0.9258	7.66	199	9.22	5%	0.37

Date MMDDYY	Time HHMMSS	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 1.21
61405	122928	0.25	0.60	26.85	8.16	106.6	0.8802	8.50	1422	Surface		
61405	123123	1	1.14	26.88	8.16	106.7	0.8801	8.54	3759	Surface	100%	
61405	123246	2	2.03	26.89	8.14	106.5	0.8798	8.55	330	0.28	9%	8.69
61405	123541	3	3.05	26.89	8.20	107.2	0.8798	8.55	1424	1.30	38%	-1.43
61405	123731	4	4.07	26.85	8.26	107.9	0.8795	8.56	1409	2.32	37%	0.01
61405	123929	5	5.02	26.84	8.21	107.3	0.8796	8.55	937	3.27	25%	0.43
61405	124135	6	6.02	26.44	7.08	91.9	0.8867	8.34	871	4.27	23%	0.07
61405	124302	7	7.01	25.66	5.92	75.7	0.9064	8.02	713	5.26	19%	0.20
61405	124527	8	7.93	24.48	4.71	58.9	0.9240	7.72	437	6.18	12%	0.53
61405	124730	9	9.00	23.38	3.89	47.7	0.9293	7.60	447	7.25	12%	-0.02
61405	124911	10	10.03	22.17	2.29	27.5	0.9375	7.46	277	8.28	7%	0.46
61405	125058	11	11.11	20.81	0.66	7.7	0.9418	7.31	182	9.36	5%	0.39

Date MMDDYY	Time HHMMSS	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 0.24
71205	121815	0.25	0.25	27.10	11.41	148.0	0.8548	9.14	1521	Surface		
71205	121837	1	1.05	27.10	11.28	146.1	0.8548	9.16	1212	Surface	100%	
71205	122035	2	1.99	27.11	11.38	147.6	0.8543	9.17	480	0.24	40%	3.86
71205	122255	3	3.02	27.10	11.30	146.4	0.8540	9.17	238	1.27	20%	0.68
71205	122450	4	4.03	27.10	11.18	144.8	0.8539	9.17	340	2.28	28%	-0.35
71205	122738	5	5.05	27.08	11.01	142.6	0.8539	9.16	373	3.30	31%	-0.09
71205	122907	6	6.06	26.80	8.34	107.5	0.8538	8.94	318	4.31	26%	0.16
71205	123022	7	6.95	26.64	7.24	93.1	0.8531	8.85	266	5.20	22%	0.20
71205	123212	8	8.03	26.30	5.87	75.0	0.8537	8.73	174	6.28	14%	0.39
71205	123742	9	9.02	25.96	4.47	56.7	0.8515	8.58	90	7.27	7%	0.67
71205	124127	10	9.95	25.65	2.61	32.9	0.8536	8.36	36	8.20	3%	0.99

Date MMDDYY	Time HHMMSS	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 0.38
80905	113216	0.25	0.34	27.75	8.52	111.5	0.8727	9.52	3952	Surface		
80905	113319	1	1.12	27.65	8.57	112.0	0.8731	9.60	3690	Surface	100%	
80905	113423	2	2.11	27.42	8.30	108.0	0.8730	9.67	1794	0.36	49%	2.00
80905	113518	3	3.01	26.93	8.44	108.8	0.8714	9.72	1475	1.26	40%	0.22
80905	113618	4	4.02	26.85	8.51	109.7	0.8714	9.72	912	2.27	25%	0.48
80905	113722	5	5.08	26.70	7.68	98.7	0.8704	9.64	632	3.33	17%	0.35
80905	113843	6	6.04	26.60	6.60	84.7	0.8704	9.55	476	4.29	13%	0.30
80905	113940	7	7.06	26.30	4.38	55.8	0.8712	9.33	350	5.31	9%	0.30
80905	114035	8	8.08	26.01	2.03	25.7	0.8712	9.05	196	6.33	5%	0.57
80905	114147	9	9.09	25.78	0.45	5.7	0.8721	8.85	125	7.34	3%	0.45
80905	114243	10	10.02	25.42	0.27	3.4	0.8740	8.81	60	8.27	2%	0.79

Date MMDDYY	Time HHMMSS	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 0.45
91305	100216	0.25	0.36	24.24	6.19	76.4	0.8894	9.35	1030	Surface		
91305	100312	1	1.05	24.26	5.95	73.5	0.8890	9.37	928	Surface	100%	
91305	100411	2	2.03	24.26	5.96	73.6	0.8889	9.39	381	0.28	41%	3.18
91305	100506	3	3.03	24.24	5.89	72.7	0.8886	9.40	428	1.28	46%	-0.12
91305	100558	4	4.03	24.24	5.74	70.8	0.8888	9.41	208	2.28	22%	0.72
91305	100701	5	5.00	24.23	5.72	70.6	0.8891	9.42	110	3.25	12%	0.66
91305	100753	6	6.04	24.19	5.19	64.0	0.8894	9.38	65	4.29	7%	0.51
91305	100858	7	7.04	24.10	3.97	48.9	0.8897	9.26	41	5.29	4%	0.46
91305	100954	8	7.94	23.99	2.89	35.5	0.8900	9.16	27	6.19	3%	0.46
91305	101103	9	9.02	23.75	1.42	17.4	0.8905	8.98	16	7.27	2%	0.48

APPENDIX C. INTERPRETING YOUR LAKES 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 $\leq$ 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 Eliminate or Control Exotic Species

Option 1: Biological Control

Biological control (bio-control) is a means of using natural relationships already in place to limit, stop, or reverse an exotic species' expansion. In most cases, insects that prey upon the exotic plants in its native ecosystem are imported. Since there is a danger of bringing another exotic species into the ecosystem, state and federal agencies require testing before any bio-control species are released or made available for purchase. Control of exotics by a natural mechanism is preferable to chemical treatments, however there are few exotics that can be controlled by biological means. Insects, being part of the same ecological system as the exotic plant (i.e., the beetles and weevils with Purple Loosestrife) are more likely to provide long-term control. Chemical treatments are usually non-selective while bio-control measures target specific plant species. Bio-control can also be expensive and labor intensive.

Option 2: Control by Hand

Controlling exotic plants by hand removal is most effective on small areas (< 1 acre) and if done prior to heavy infestation. Some exotics, such as Purple Loosestrife and Reed Canary Grass, can be controlled to some degree by digging, cutting, or mowing if done early and often during the year. Digging may be required to ensure the entire root mass is removed. Spring or summer is the best time to cut or mow, since late summer and fall is when many of the plant seeds disperse. Proper disposal of excavated plants is important since seeds may persist and germinate even after several years. Once exotic plants are removed, the disturbed ground should be planted with native vegetation and closely monitored since regrowth of the removed species is common. Many exotic species, such as Purple Loosestrife, Buckthorn, and Garlic Mustard are proficient at colonizing disturbed sites. This method can be labor intensive but costs are low.

Option 3: Herbicide Treatment

Chemical treatments can be effective at controlling exotic plant species, and works best on individual plants or small areas already infested with the plant. In some areas where individual spot treatments are prohibitive or impractical (i.e., large expanses of a wetland or woodland), chemical treatments may not be an option because in order to chemically treat the area, a broadcast application would be needed. Because many of the herbicides are not selective, meaning they kill all plants they contact, this may be unacceptable if native plants are found in the proposed treatment area.

Herbicides are commonly used to control nuisance shoreline vegetation by applying it to green foliage or cut stems. They provide a fast and effective way to control or eliminate nuisance vegetation by killing the root of the plant, preventing regrowth. Products are applied by either spraying or wicking (wiping) solution on plant surfaces. Spraying is used when large patches of undesirable vegetation are targeted. Herbicides are sprayed on growing foliage using a hand-held or backpack sprayer. Wicking is used when selected plants are to be removed from a group of plants. It is best to apply herbicides when plants are actively growing, such as in the late spring/early summer, but before formation of seed heads. Herbicides are often used in conjunction with other methods, such as cutting or mowing, to achieve the best results. Proper use of these products is critical to their success. Always read and follow label directions.

D3. Participate in the Volunteer Lake Monitoring Program

In 1981, the Illinois Volunteer Lake Monitoring Program (VLMP) was established by the Illinois Environmental Protection Agency (Illinois EPA) to gather fundamental information on Illinois' inland lakes, and to provide an educational program for citizens. Approximately 165 lakes (of 3,041 lakes in Illinois) are sampled annually by approximately 300 volunteers. The volunteers are lakeshore residents, lake owners/managers, members of environmental groups, public water supply personnel, and/or citizens with interest in a particular lake.

The VLMP relies on volunteers to gather a variety of information on their chosen lake. The primary measurement is Secchi disk depth. Analysis of the Secchi disk measurement provides an indication of the general water quality condition of the lake, as well as the amount of usable habitat available for fish and other aquatic life.

Microscopic plants and animals, water color, and suspended sediments are factors that interfere with light penetration through the water column and lessen the Secchi disk depth. As a rule, one to three times the Secchi depth is considered the lighted zone of the lake. In this region of the lake there is enough light to allow plants to grow and produce oxygen. Water below the lighted zone can be expected to have little or no dissolved oxygen. Other observations such as water color, suspended algae and sediment, aquatic plants, and odor are also recorded. The sampling season is May through October with volunteer measurements taken twice a month. After volunteers have completed one year of the basic monitoring program, they are qualified to participate in the Expanded Monitoring Program. In the expanded program, volunteers are trained to collect water samples that are shipped to the Illinois EPA laboratory for analysis of total and volatile suspended solids, total phosphorus, nitrate-nitrite nitrogen and ammonia nitrogen. Other parameters that are part of the expanded program include dissolved oxygen, temperature, and zebra mussel monitoring. Additionally, chlorophyll *a* monitoring has been added to the regiment for selected lakes.

For information, please contact:

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(312) 386-8700

D4. Options to Assess Your Lake's Fishery

Many lakes have a fish-stocking program in which fish are stocked every year or two to supplement fish species already occurring in the lake or to introduce additional fish species into the system. However, few lakes that participate in stocking check the progress or success of these programs with regular fish surveys. Lake managers should have information about whether or not funds delegated to fish stocking are being well spent, and it is difficult to determine how stocked fish species are surviving and reproducing or how they are affecting the rest of the fish community without a comprehensive fish assessment.

A simple, inexpensive way to collect information on the status of a fishery is to sample anglers actively involved in recreational fishing on the lake and evaluate the types, numbers and sizes of fish caught. Such information provides insight on the status of fish populations in the lake, as well as a direct measure of the quality of fishing and the fishing experience. However, the numbers and types of fish sampled by anglers are limited, focusing on game and catchable-sized fish. Thus, in order to obtain a comprehensive assessment of the fish community, including non-game fish species, more quantitative methods such as gill netting, trap netting, seining, trawling, angling (hook and line fishing) and electroshocking must be employed. Each method has its advantages and limitations, and frequently multiple gears are employed. The best gear and sampling methods depend on the target species and life stage, the types of information desired, and the environment to be sampled.

It is best to monitor fish populations annually. The best time of year depends on the sampling method, the target fish species, and the types of data to be collected. In many lakes and regions, the best time to sample fish is during the fall turnover period after thermal stratification breaks down and the lake is completely mixed because: (1) young-of-year (YOY) and age 1+ (one year or older) fish of most target species should be present and vulnerable to most standard collection gear, including seines, trap nets and electroshockers; (2) species that dwell in the hypolimnion during the summer may be more vulnerable to capture during fall overturn; and (3) lower water temperatures in the fall can help reduce sampling-related mortality. Sampling locations are also species, life stage, and gear dependent. As with sampling methods and time, locations should be selected to maximize capture efficiency for the target species of interest and provide the greatest gain in information for the least amount of sampling effort.

The Illinois Department of Natural Resources (IDNR) will perform a fish survey at no charge on most public and some private water bodies. In order to determine if your lake is eligible for a survey by the IDNR, contact Frank Jakubecik, Fisheries Biologist, at (815) 675-2319. If a lake is not eligible for an IDNR fish survey or if a more comprehensive survey is desired, contact the Lakes Management Unit for a list of consultants.

APPENDIX E. WATER QUALITY STATISTICS FOR ALL LAKE COUNTY LAKES

2000 - 2005 Water Quality Parameters, Statistics Summary

	ALK (oxic) <=3ft 2000-2005	
Average	**167.0**	
Median	**162.0**	
Minimum	**64.9**	**IMC**
Maximum	**330.0**	**Flint Lake**
STD	**42.2**	
n =	**803**	

	ALK (anoxic) 2000-2005	
Average	**205**	
Median	**194**	
Minimum	**103**	**Heron Pond**
Maximum	**470**	**Lake Marie**
STD	**53**	
n =	**265**	

	Cond (oxic) <=3ft 2000-2005	
Average	**0.8536**	
Median	**0.7748**	
Minimum	**0.2305**	**White Lake**
Maximum	**6.8920**	**IMC**
STD	**0.5203**	
n =	**808**	

	Cond (anoxic) 2000-2005	
Average	**0.9606**	
Median	**0.8210**	
Minimum	**0.3031**	**White Lake**
Maximum	**7.4080**	**IMC**
STD	**0.7611**	
n =	**265**	

	NO3-N (oxic) <=3ft 2000-2005	
Average	**0.480**	
Median	**0.116**	
Minimum	**<0.05**	***ND**
Maximum	**9.670**	**South Churchill Lake**
STD	**1.019**	
n =	**808**	

*ND = Many lakes had non-detects (69%)
Only compare lakes with detectable
concentrations to the statistics above

	NH3-N (anoxic) 2000-2005	
Average	**2.296**	
Median	**1.560**	
Minimum	**<0.1**	***ND**
Maximum	**18.400**	**Taylor Lake**
STD	**2.483**	
n =	**265**	

*ND = 21% Non-detects from 32 different lakes

	pH (oxic) <=3ft 2000-2005	
Average	**8.31**	
Median	**8.30**	
Minimum	**7.06**	**Deer Lake**
Maximum	**10.28**	**Round Lake Marsh North**
STD	**0.46**	
n =	**807**	

	pH (anoxic) 2000-2005	
Average	**7.11**	
Median	**7.13**	
Minimum	**5.80**	**Third Lake**
Maximum	**8.48**	**Heron Pond**
STD	**0.41**	
n =	**265**	

	All Secchi 2000-2005	
Average	**4.39**	
Median	**3.17**	
Minimum	**0.33**	**Fairfield Marsh, Patski Pond**
Maximum	**29.23**	**Bangs Lake**
STD	**3.65**	
n =	**740**	

81 of 161 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

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2000 - 2005 Water Quality Parameters, Statistics Summary continued

	TKN (oxic) <=3ft 2000-2005	
Average	**1.457**	
Median	**1.220**	
Minimum	**<0.5**	***ND**
Maximum	**10.300**	**Fairfield Marsh**
STD	**0.831**	
n =	**808**	

*ND = 5% Non-detects from 19 different lakes

	TKN (anoxic) 2000-2005	
Average	**3.067**	
Median	**2.270**	
Minimum	**<0.5**	***ND**
Maximum	**21.000**	**Taylor Lake**
STD	**2.467**	
n =	**265**	

*ND = 5% Non-detects from 7 different lakes

	TP (oxic) <=3ft 2000-2005	
Average	**0.098**	
Median	**0.063**	
Minimum	**<0.01**	**From 5 Lakes**
Maximum	**3.880**	**Albert Lake**
STD	**0.168**	
n =	**795**	

*ND = 0.1% Non-detects from 5 different lakes
(Bangs, Cedar, Carina, Minear,& Stone Quarry)

	TP (anoxic) 2000-2005	
Average	**0.320**	
Median	**0.174**	
Minimum	**0.012**	**West Loon Lake**
Maximum	**3.800**	**Taylor Lake**
STD	**0.412**	
n =	**265**	

	TSS (all) <=3ft 2000-2005	
Average	**15.3**	
Median	**7.9**	
Minimum	**<0.1**	***ND**
Maximum	**165.0**	**Fairfield Marsh**
STD	**20.3**	
n =	**815**	

*ND = 2% Non-detects from 10 different lakes

	TVS (oxic) <=3ft 2000-2005	
Average	**136.0**	
Median	**132.0**	
Minimum	**34.0**	**Pulaski Pond**
Maximum	**298.0**	**Fairfield Marsh**
STD	**40.4**	
n =	**758**	

No 2002 IEPA Chain Lakes

	TDS (oxic) <=3ft 2000-2004	
Average	**470**	
Median	**454**	
Minimum	**150**	**Lake Kathryn, White**
Maximum	**1340**	**IMC**
STD	**169**	
n =	**745**	

No 2002 IEPA Chain Lakes, Data from 00-04.

	CL (anoxic) 2004-2005	
Average	**277**	
Median	**102**	
Minimum	**53**	**Banana Pond**
Maximum	**2390**	**IMC**
STD	**489**	
n =	**66**	

	CL (oxic) <=3ft 2004-2005	
Average	**243.8**	
Median	**183.0**	
Minimum	**51.7**	**Heron Pond**
Maximum	**2760.0**	**IMC**
STD	**339.4**	
n =	**197**	

LakeCounty
Health Department and
Community Health Center

APPENDIX F. GRANT PROGRAM OPPORTUNITIES

Grant Program Name	Funding Source	Funding Focus			Cost Share	Typical Award
		Water Quality	Flooding	Habitat		
Challenge Grant Program	USFWS			X	>50%	<$10,000
Chicago Wilderness Small Grants Program	CW			X	None	$15,000
Conservation 2000 (C2000)	IDNR			X	None	$10,000 to $500,000
Conservation Reserve Program	NRCS			X	Land	Variable
Five Star Challenge Grant	NFWF			X	None	$5,000 to $20,000
Flood Mitigation Assistance Program	IEMA		X		25%	$200,000
Habitat Restoration Program for the Fox Watershed	LCSWCD			X	25%	<$1,000K
Illinois Clean Lakes Program (ICLP)	IEPA	X			>50%	$5,000 to $30,000
Illinois Clean Energy Community Foundation	ICECF			X	None	Variable
Lakes Education Assistance Grant Program (LEAP)	IEPA	X			None	$500
Northeast Illinois Wetland Conservation Account	USFWS	X		X	>50%	$600 to $200,000
Partners for Fish and Wildlife Program	USFWS			X	>50%	$3,000
Section 206: Aquatic Ecosystem Restoration	USACE			X	35%	<$1,000,000
Section 319: Non-Point Source Management Program	IEPA	X		X	>40%	Variable
STAG Grants	LCSMC	X			None	Variable
Stream Cleanup And Lakeshore Enhancement (SCALE)	IEPA	X			None	$2,000
Streambank Stabilization and Restoration Program (SSRP)	LCSWCD	X		X	25%	Variable
Unincorporated Lake County Drainage Fund	LCPBD		X		>50%	$5,000 to $10,000
Wildlife Habitat Incentives Program	NRCS			X	Land	Variable
Watershed Management Board	LCSMC	X	X	X	>50%	$5K to $10K
Wetland Reserve Program	NRCS			X	Land	Variable

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
LCPBD = Lake County Planning, Building,
and Development Department
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