

**2005 SUMMARY REPORT
of
Dog Training Pond**

Lake County, Illinois

Prepared by the

**LAKE COUNTY HEALTH DEPARTMENT
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EXECUTIVE SUMMARY

Dog Training Pond was formed in approximately 1903, originally as a gravel pit, and is now owned by the Lake County Forest Preserve District. The surrounding area is used as a dog exercise area, with a walking path around the perimeter and access points to allow the dogs to swim. No boating or swimming (other than by dogs) is allowed in the pond.

Water clarity in the pond was 9.04 feet in 2005, which was above the county median (3.9 feet), although clarity has decreased approximately 40% since 2001 (15.1 feet). As expected, the concentration of total suspended solids (TSS) increased with the decrease in water clarity. The 2005 average TSS was 2.5 mg/L, which still falls below the county median of 7.9 mg/L. The two key nutrients, phosphorus and nitrogen, were also below county medians. The total phosphorus (TP) average in the epilimnion was 0.022 mg/L, which was an increase from 2001 (0.015 mg/L). Total Kjeldahl nitrogen (TKN) average in the epilimnion was 0.785 mg/L, which was also an increase from 2001 (0.535 mg/L). Overall, the nutrients have seen an increase, but remain below the county medians. This increase may have been due to the low precipitation that led to the concentration of nutrients into a smaller volume of water, or by other identified sources.

While the aquatic plant diversity remained the same, the plants that composed the community shifted. Eurasian Watermilfoil emerged in 2005 in Dog Training Pond. This exotic, invasive species tends to overrun plant communities. It was found at 61% of the 18 sampling sites. Curlyleaf Pondweed is another exotic, invasive species that was found in 2001, but not seen in 2005. The presence of *Chara spp.*, a macroalgae, appeared to have decreased significantly from 2001 to 2005. Sago Pondweed appeared to have increased in abundance from June 2001 to June 2005. In 2001, Sago Pondweed was the most abundant species in September, being observed at 73% of the sampling sites. This change in the aquatic plant community is probably related to the change in nutrient conditions.

Shoreline erosion has increased since the previous assessment in 2001. In 2005, more of the shoreline was categorized as severely eroded than in 2001. Dogs entering and leaving in three of these severely eroding areas exacerbates the problem. Invasive shoreline plants are also still present from the 2001 survey, as no known management practices have been implemented to control or eliminate them. The land surrounding the pond continues to provide good habitat for many birds, as it consists of woodland, shrubs, and open prairie.

LAKE FACTS

Lake Name:	Dog Training Pond
Historical Name:	None
Nearest Municipality:	Village of Libertyville
Location:	T44N, R11E, Section 4
Elevation:	656.0 feet
Major Tributaries:	None
Watershed:	Des Plaines River
Sub-watershed:	Upper Des Plaines River
Receiving Waterbody:	None
Surface Area:	13.7 acres
Shoreline Length:	0.6 miles
Maximum Depth:	17.8 feet
Average Depth (est.):	9.5 feet
Lake Volume (est.):	130.4 acre-feet
Lake Type:	Gravel Pit
Watershed Area (est.):	21.9 acre
Major Watershed Land Uses:	Forest Preserve
Bottom Ownership:	LCFPD
Management Entities:	LCFPD
Current and Historical Uses:	Constructed in 1903. No Boating, swimming or Fishing. Used as a dog Exercise/training area.
Description of Access:	Path around pond with only Dogs allowed in pond. Fee required.

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 each month, while the hypolimnetic sample varied from 13-15 feet deep, as these samples are always taken three feet above the bottom, and the water level fluctuated throughout the season (Appendix C). Dog Training Pond was divided into an upper and lower water layer (epilimnion and hypolimnion) in May and June, with the strongest thermal stratification occurring in June. 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 values of 20 and higher generally do not allow mixing between layers. The size of this strongly stratified layer usually increases throughout the summer, but this was not the case in Dog Training Pond. From July to September, there was a deep-water layer, but it was not as strong as the layer in May and June. This pattern is most likely explained by the fact that the deep hole sampled is isolated, and does not mix with the rest of the pond. This pattern occurred in 2001 as well, and is indicative of a shallow system that is polymictic (lakes that mix several times throughout the season).

The average epilimnetic dissolved oxygen (DO) was 9.26 mg/L, while the average hypolimnetic DO level was 3.43 mg/L (Table 1). The epilimnion experienced adequate DO concentrations throughout the summer (> 5.0 mg/L). The highest hypolimnetic DO concentration was in May (13.52 mg/L), while July had the lowest concentration (0.55 mg/L). The hypoxic layer (where DO concentration is < 5.0 mg/L) went from non-existent in May to 11 feet in June, and increased throughout the rest of the season with the September maximum of 7 feet. 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). This pattern of decreased oxygen content as the summer progresses is normal. As water heats up, it is not able to hold as much oxygen. Also, as organisms start to die off and fall to the bottom to decay, more oxygen is used to breakdown the dead material. Anoxic conditions ($DO < 1.0$ mg/L) occurred from June to September in the hypolimnion. Under these conditions, very little aquatic life can survive.

Water clarity, measured by Secchi disk depth, decreased significantly from 2001 (15.1 feet) to 2005 (9.04 feet). This may have been due to a 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). An algal bloom was noted in July, and consequently Secchi depth dropped from 14.93 feet in June to 3.00 feet in July. The affect of reduced plant biomass reduced Secchi depth and also increased TSS concentrations. In 2001, the TSS average was 1.4 mg/L, while in 2005 the average TSS concentration was 2.5 mg/L. This 2005 TSS concentration still remains below the Lake County median of 7.9 mg/L (Appendix E). Also, the water level dropped just over a foot between May and September due to low amounts of precipitation

Figure 1. Water quality sampling point on Dog Training Pond, 2005.

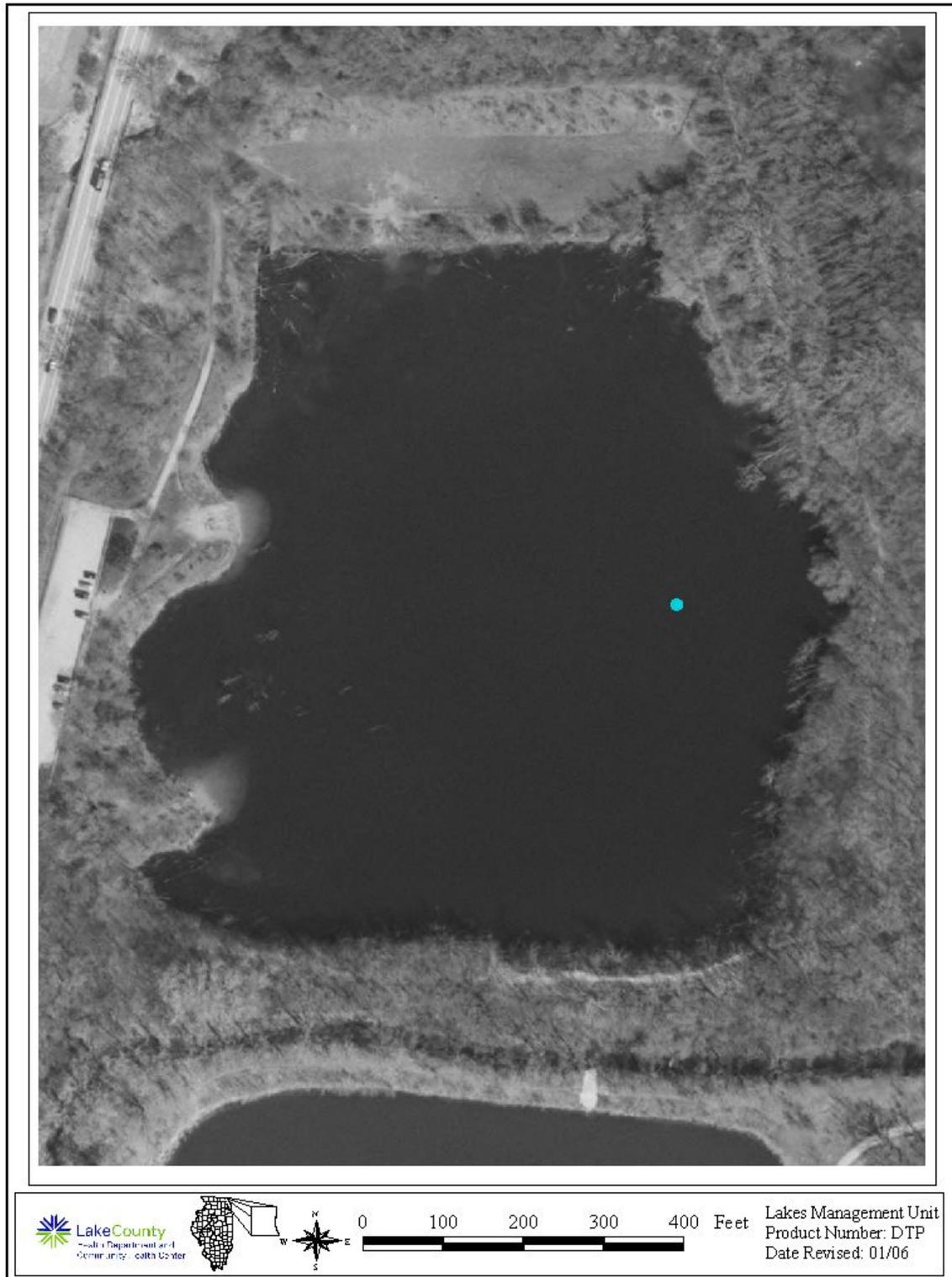


Table 1. Water quality data for Dog Training Pond, 2001 and 2005.

2005		Eplimmion														
DATE	DEPTH	ALK	TKN	NH ₃ -N	NO ₃ -N	TP	SRP	TDS ^c	Cl ⁻	TSS	TS	TVS	SECCHI	COND	pH	DO
10-May	3	152	0.628	<0.1	<0.05	0.013	<0.005	NA	60.5	1.00	353	69	16.08	0.589	8.39	11.12
14-Jun	3	126	0.690	<0.1	<0.05	0.018	<0.005	NA	62.9	<1.00	336	72	14.93	0.573	8.52	8.83
12-Jul	3	120	0.766	<0.1	<0.05	0.034	<0.005	NA	63.3	1.80	347	88	3.00	0.558	8.66	10.43
9-Aug	3	116	0.929	<0.1	<0.05	0.023	<0.005	NA	66.6	3.60	336	81	5.60	0.561	9.27	8.52
13-Sep	3	118	0.910	<0.1	<0.05	0.023	<0.005	NA	66.1	3.50	343	84	5.57	0.570	9.31	7.40
Average		126	0.785	<0.1	<0.05	0.022	<0.005	NA	63.9	2.48	343	79	9.04	0.5701	8.83	9.26

2001		Eplimmion														
DATE	DEPTH	ALK	TKN	NH ₃ -N	NO ₃ -N	TP	SRP	TDS	Cl ⁻	TSS	TS	TVS	SECCHI	COND	pH	DO
1-May	3	172	<0.5	<0.1	<0.05	0.016	<0.005	370	NA	1.7	375	98	11.25	0.6521	8.33	11.4
5-Jun	3	130	0.500	<0.1	<0.05	0.018	<0.005	362	NA	1.1	358	86	17.60	0.5797	8.61	10.7
10-Jul	3	104	0.530	<0.1	<0.05	<0.01	<0.005	320	NA	<1.0	345	91	15.88	0.5405	9.13	10.6
7-Aug	3	105	0.551	<0.1	<0.05	0.010	<0.005	328	NA	<1.0	352	102	15.00	0.5541	9.04	8.7
5-Sep	3	121	0.558	<0.1	<0.05	0.014	<0.005	344	NA	<1.0	349	76	15.70	0.5698	8.73	7.5
Average		126	0.535 ^k	<0.1	<0.05	0.015	<0.005	345	NA	1.4 ^k	356	91	15.09	0.5792	8.77	9.8

Glossary

ALK = Alkalinity, mg/L CaCO₃
 TKN = Total Kjeldahl nitrogen, mg/L
 NH₃-N = Ammonia nitrogen, mg/L
 NO₃-N = 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

Table 1. Continued.

2005	Hypolimnion															
DATE	DEPTH	ALK	TKN	NH ₃ -N	NO ₃ -N	TP	SRP	TDS ^c	Cl ⁻	TSS	TS	TVS	SECCHI	COND	pH	DO
10-May	15	162	0.648	<0.1	<0.05	0.020	<0.005	NA	60.5	1.50	363	68	NA	0.597	8.34	13.52
14-Jun	14	151	0.862	0.117	<0.05	0.041	0.014	NA	61.3	1.70	353	76	NA	0.614	7.36	1.92
12-Jul	13	131	1.14	<0.1	<0.05	0.112	0.036	NA	63.1	8.80	354	93	NA	0.564	8.16	0.55
9-Aug	13	121	1.28	<0.1	<0.05	0.062	<0.005	NA	65.7	7.20	345	89	NA	0.592	8.02	0.56
13-Sep	13	122	1.42	<0.1	<0.05	0.070	<0.005	NA	66.9	9.20	349	92	NA	0.587	8.40	0.62
Average		137	1.07	0.117 ^k	<0.05	0.061	0.025 ^k	NA	63.5	5.68	353	84	NA	0.591	8.06	3.43

2001	Hypolimnion															
DATE	DEPTH	ALK	TKN	NH ₃ -N	NO ₃ -N	TP	SRP	TDS	Cl ⁻	TSS	TS	TVS	SECCHI	COND	pH	DO
1-May	15	182	<0.5	<0.1	<0.05	0.053	0.007	372	NA	4.3	379	99	NA	0.6683	7.26	6.4*
5-Jun	15	131	<0.5	<0.1	<0.05	0.014	<0.005	369	NA	<1.0	367	90	NA	0.5812	8.58	10.7*
10-Jul	15	147	0.758	<0.1	<0.05	0.032	<0.005	366	NA	2.6	376	99	NA	0.5989	7.66	3.9*
7-Aug	13	122	0.650	<0.1	<0.05	0.015	<0.005	328	NA	<1.0	367	114	NA	0.5787	8.27	3.1*
5-Sep	14	128	0.664	<0.1	<0.05	0.023	<0.005	350	NA	1.6	362	86	NA	0.5729	8.64	6.3
Average		142	0.691 ^k	<0.1	<0.05	0.027	0.007 ^k	357	NA	2.8 ^k	370	98	NA	0.6000	8.08	6.1

Glossary

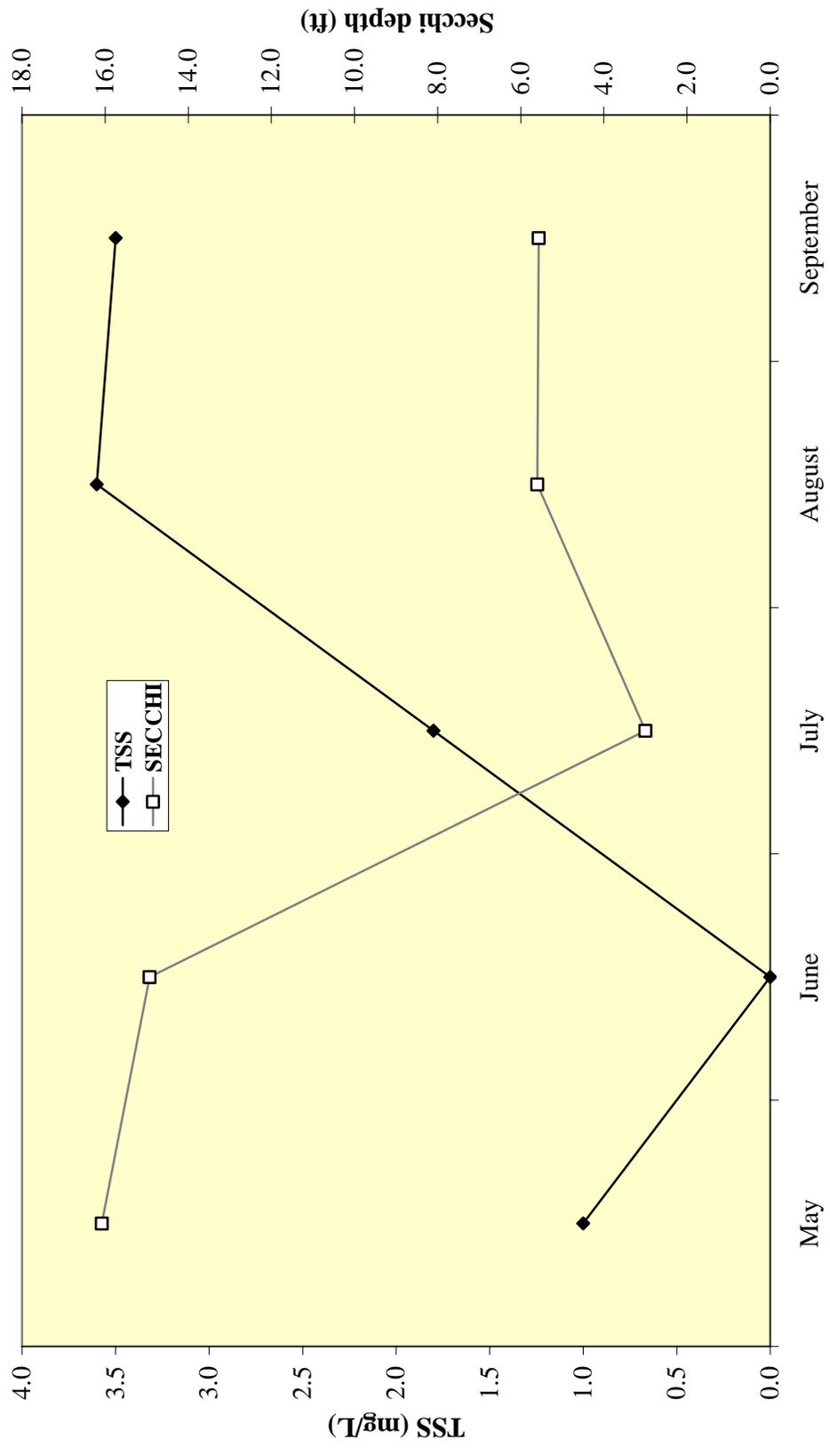
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SECCHI = Secchi disk depth, ft.
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Note: "k" denotes that the actual value is known to be less than the value presented.

NA = Not Applicable

* Average between two DO readings.

**Figure 2. Total suspended solids (TSS) concentration vs. Secchi depth in Dog Training Pond, 2005.
June TSS was < 1.0 mg/L.**



that led to drought-like conditions. This lowered amount of water into the pond concentrated any suspended solids and nutrients into a smaller water volume. Total phosphorus (TP) concentrations in the epilimnion also increased from 2001 (0.015 mg/L) to 2005 (0.022 mg/L), probably due to the reasons just mentioned. However, this years TP concentration is still well below the Lake County epilimnetic TP median of 0.063 mg/L. The TP concentrations in the hypolimnion also increased (0.027 mg/L in 2001; 0.061 mg/L in 2005), but this years concentration was also well below the hypolimnetic Lake County median of 0.174 mg/L (Table 1). These relatively low concentrations may be due to the nature of the ponds small, undeveloped watershed (Figure 3; Figure 4). 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 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. Dog Training Pond has a TN:TP ratio of 38:1, indicating P limitation. Most lakes throughout Lake County are phosphorus limited (Appendix C).

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). The higher the phosphorus levels, the greater the amount of algal biomass, which leads to a higher TSIp and corresponding trophic state. Based on a TSIp value of 52, Dog Training Pond is classified as eutrophic (≥ 50 , ≤ 70 TSI). A eutrophic lake is defined as an over productive system that has above average nutrient levels and high algal biomass (growth). Based on a Secchi TSI of 45, the pond is classified as mesotrophic (moderately productive). Overall, the trophic state is borderline between eutrophic and mesotrophic and is dependant on which parameter is used to calculate the TSI. Based on the phosphorus TSI, Dog Training Pond ranks 15th out of the 162 lakes studied by the Lakes Management Unit between 2000-2005 (Table 2). Although this is a drop in rank from 2000 (TSIp = 42.7; ranked 1st), 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. Dog Training 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 3. Approximate watershed delineation of Dog Training Pond, 2005.



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

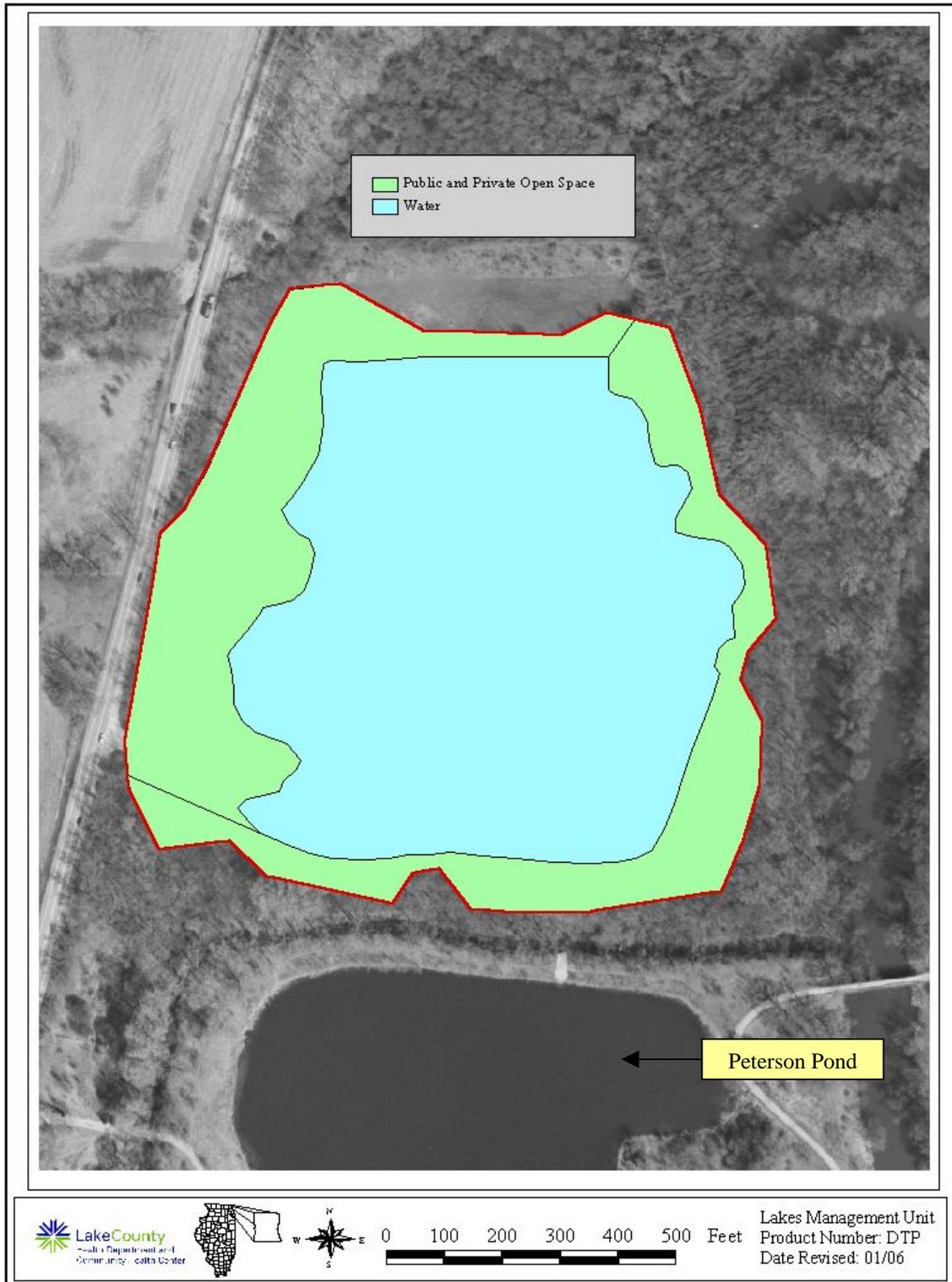


Table 2. Lake County average TSI phosphorous (TSIp) ranking, 2000-2005.

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 Kathryn	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 Dog Training Pond there were 18 sampling sites (Figure 5).

Overall, there were a total of eight plant species found, with Sago Pondweed being the most common (found at 72% of the sites). Eurasian Watermilfoil was the second most common, being found at 61% of the sample sites (Table 3a). Plants need at least 1% of surface light levels in order to photosynthesize and survive. During sampling, plants were found down to depths of 12.5 feet, while the 1% light level was determined to be at approximately 15 feet, which correlates fairly well. Out of the 18 sampling sites, plants were found at 15 (83%) (Table 3a; Figure 5). This was most likely due to the deep light penetration that allowed growth in the deeper portions of the pond.

There was an overall shift in species composition from 2001 to 2005. While species diversity stayed the same, different species composed the community. This was probably due to natural variation in plant community composition from year to year, as well as changes in water quality parameters. Most species found in the pond this year were native, beneficial plants, such as Sago Pondweed, *Chara spp.*, American Pondweed and Elodea. The only non-native species found was Eurasian Watermilfoil (EWM). This species was not found during the last sampling period in 2001. It may have been introduced from nearby Peterson Pond that had EWM in 2001 and again in 2005. While Peterson Pond is not in the Dog Training Pond watershed, people or animals could have transferred it. EWM should be monitored as it has a tendency to spread and overtake native species. The plant community has shifted to less pondweed species, and the appearance of EWM and Elodea (Table 4). One positive aspect of the plant community in 2005 was that the non-native species Curlyleaf Pondweed was no longer present. It was found in small percentages in 2001, but was not found at all in 2005 (Table 3a).

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 average FQI for 2000-2005 Lake County lakes is 13.1. Dog Training Pond had a FQI of 14.7, and is ranked 64th out of 151 lakes in the county.

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

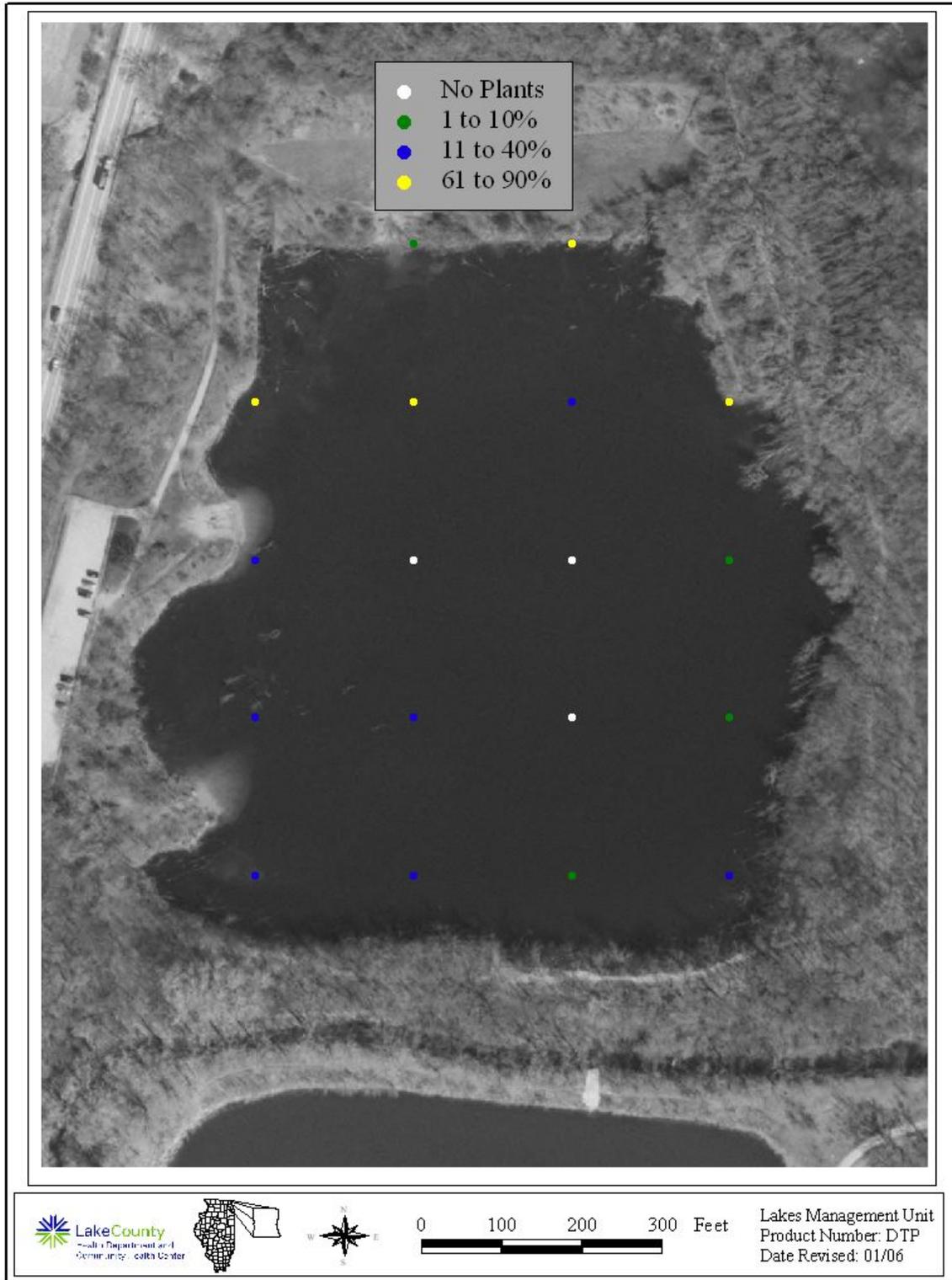


Table 3a. Aquatic plant species found at the 18 sampling sites on Dog Training Pond, 2005. Maximum depth that plants were found was 12.5 feet.

Plant Density	American Pondweed	Chara	Coontail	Elodea	Eurasian Watermilfoil	Horned Pondweed	Sago Pondweed	Small Leaf Pondweed
Present	1	5	4	1	5	0	9	1
Common	0	1	1	0	2	1	1	0
Abundant	0	0	0	0	4	0	3	0
Dominant	0	0	0	0	0	0	0	0
% Plant Occurrence	5.6	33.3	27.8	5.6	61.1	5.6	72.2	5.6

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

Rake Density (coverage)	# of Sites	% of Sites
No Plants	3	16.7
>0-10%	4	22.2
10-40%	7	38.9
40-60%	0	0.0
60-90%	4	22.2
>90%	0	0.0
Total Sites with Plants	15	83.3
Total # of Sites	18	100.0

Table 4. Aquatic plant species found in Dog Training Pond, 2005.

Coontail	<i>Ceratophyllum demersum</i>
Chara (Macro alga)	<i>Chara spp.</i>
American Pondweed	<i>Potamogeton nodosus</i>
American Elodea	<i>Elodea canadensis</i>
Eurasian Watermilfoil ^	<i>Myriophyllum spicatum</i>
Sago Pondweed	<i>Potamogeton pectinatus</i>
Small Pondweed	<i>Potamogeton pusillus</i>
Horned Pondweed	<i>Zannichellia palustris</i>
^ Exotic Plant	

SUMMARY OF SHORELINE CONDITION

The only portion of the shoreline considered developed is where the parking lot was installed, which covers approximately 5% of the shoreline. The rest was undeveloped and within Forest Preserve boundaries. A reassessment of the comprehensive survey performed in 2001 found that erosion problems have increased on the pond. Areas that were considered slightly eroded are now considered moderately or severely eroded, and the one small area that had no erosion in 2001 is now categorized as eroded at some level. Dogs enter and leave the water at several of the severely eroded locations, which aggravates the present erosion. As stated in the 2001 report, plans for mitigating these shorelines would need to accommodate the access of dogs and owners. Invasive shoreline plants also still exist and should be removed.

SUMMARY OF WILDLIFE AND HABITAT CONDITION

Wildlife observations were made during May and June sampling. Several bird species were observed including Blue Jays, Cardinals, Kingfishers, Geese, Gulls, Cormorants, and Mallards. No reptile or small mammal species were noted, and is probably attributed to the presence of dogs. Good habitat exists, but the presence of dogs (and owners) likely reduces the use of the area by some wildlife. No fish surveys were completed by the LCHD in 2005, although many small Bluegills were noted throughout the season.

LAKE MANAGEMENT RECOMMENDATIONS

Dog Training Pond continues to have relatively low TP concentrations, even though there was an increase since 2001. Water clarity also decreased, but still remains above the county median. The pond offers good habitat for wildlife as well as recreational activities for dogs and their owners.

Creating a bathymetric map

The creation of a current bathymetric (depth contour) map on Dog Training Pond would aid in lake management practices. For example, the ability to calculate how much water volume is experiencing low DO concentrations, and therefore the amount of stress fish and other aquatic life is experiencing. With new technology available through the LMU, 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).

Shoreline erosion

Shoreline erosion has increased in severity since the last assessment in 2001. Dogs enter and leave the water at several of these severely eroded locations, which exacerbates the problem. Plans for mitigating these shorelines would need to accommodate the access of dogs and owners. (See Appendix D2 for more details)

Eliminate or control exotic species

Invasive shoreline plant species such as Buckthorn and Purple Loosestrife were 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 D3 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 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.

<i>Parameter</i>	<i>Method</i>
Temperature	Hydrolab DataSonde® 4a or YSI 6600 Sonde®
Dissolved oxygen	Hydrolab DataSonde® 4a or YSI 6600 Sonde®
Nitrate nitrogen	Brucine method Standard Methods (SM) 14 th ed 419D Detection Limit = 0.05 mg/L
Ammonia nitrogen	SM 18 th ed. Electrode method, #4500 NH ₃ -F Detection Limit = 0.1 mg/L
Total Kjeldahl nitrogen	SM 18 th 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 18 th ed, Method #2540B
Total suspended solids	SM 18 th ed, Method #2540D Detection Limit = 0.5 mg/L
Total dissolved solids	SM 18 th ed, Method #2540C
Total volatile solids	SM 18 th ed, Method #2540E, from total solids
Alkalinity	SM 18 th ed, Method #2320B, potentiometric titration curve method
Conductivity	Hydrolab DataSonde® 4a or YSI 6600 Sonde®
Total phosphorus	SM 18 th ed, Methods #4500-P B 5 and #4500-P E Detection Limit = 0.01 mg/L
Soluble reactive phosphorus	SM 18 th 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 DOG TRAINING POND
IN 2005**

Date	Time	Text	Depth	Temp	DO	DO%	SpCond	pH	PAR	Light Meter	% Light	Extinction
MMDDYY	HHMMSS	feet	øC	mg/l	Sat	mS/cm	Units	æE/s/mý	feet	Average	Coefficient	
51005	104535	0.25	17.56	11.20	121.6	0.5885	8.36	3345	Surface		0.21	
51005	104548	1	17.55	11.23	121.9	0.5883	8.37	3119	Surface	100%		
51005	104706	2	17.53	11.24	122.0	0.5883	8.38	3481	-0.63	112%	0.17	
51005	104850	3	17.56	11.14	121.0	0.5885	8.39	3456	0.22	111%	0.01	
51005	105004	4	17.54	10.98	119.1	0.5879	8.39	1721	1.23	55%	0.69	
51005	105131	6	17.50	11.15	120.9	0.5879	8.39	1469	2.26	47%	0.15	
51005	105400	8	15.85	11.63	121.8	0.5918	8.32	1091	4.24	35%	0.15	
51005	105546	10	14.36	12.84	130.3	0.5984	8.34	817	6.24	26%	0.14	
51005	105731	12	13.54	13.61	135.4	0.5980	8.35	602	8.22	19%	0.15	
51005	105914	14	13.08	13.90	137.1	0.5967	8.35	409	10.29	13%	0.19	
51005	110053	16	12.78	13.51	132.4	0.5968	8.33	320	12.24	10%	0.13	
51005	110233	18	12.58	13.63	132.9	0.5968	8.32	271	14.26	9%	0.08	

Date	Time	Text	Depth	Temp	DO	DO%	SpCond	pH	PAR	Light Meter	% Light	Extinction
MMDDYY	HHMMSS	feet	øC	mg/l	Sat	mS/cm	Units	æE/s/mý	feet	Average	Coefficient	
61405	110456	0.25	26.44	8.76	113.5	0.5733	8.46	2681	Surface		0.60	
61405	110619	1	26.45	8.73	113.2	0.5730	8.50	4093	Surface	100%		
61405	110742	2	26.47	8.72	113.0	0.5728	8.51	1805	0.26	44%	3.15	
61405	110912	3	26.47	8.74	113.4	0.5725	8.52	106	1.19	3%	3.05	
61405	111024	4	26.47	8.83	114.4	0.5727	8.53	1899	2.27	46%	-2.67	
61405	111133	6	26.38	8.67	112.2	0.5719	8.52	738	4.26	18%	0.47	
61405	111337	8	24.20	8.34	103.9	0.5876	8.22	668	6.30	16%	0.05	
61405	111547	10	22.51	6.39	77.0	0.6014	7.90	476	8.26	12%	0.17	
61405	111748	12	20.70	3.30	38.4	0.6121	7.55	466	10.29	11%	0.01	
61405	112006	14	20.03	1.97	22.6	0.6150	7.37	319	12.29	8%	0.19	
61405	112319	16	19.94	1.73	19.8	0.6152	7.27	39	14.25	1%	1.07	

Date	Time	Text	Depth	Temp	DO	DO%	SpCond	pH	PAR	Light Meter	% Light	Extinction
MMDDYY	HHMMSS		feet	øC	mg/l	Sat	mS/cm	Units	æE/s/mý	feet	Transmission	Coefficient
71205	102559	0.25	0.37	26.55	10.29	131.9	0.5578	8.65	1010	Surface	Average	1.03
71205	102716	1	1.13	26.56	10.35	132.7	0.5577	8.66	962	Surface	100%	
71205	102802	2	2.03	26.58	10.25	131.4	0.5575	8.66	175	0.28	18%	6.09
71205	102909	3	3.01	26.57	10.63	136.3	0.5575	8.66	178	1.26	19%	-0.02
71205	102959	4	4.01	26.57	10.35	132.7	0.5575	8.67	127	2.26	13%	0.34
71205	103141	6	6.00	26.44	8.75	111.9	0.5592	8.58	101	4.25	10%	0.12
71205	103406	8	8.05	26.05	5.66	71.9	0.5628	8.33	81	6.30	8%	0.11
71205	103514	10	10.02	25.63	2.51	31.6	0.5665	8.07	52	8.27	5%	0.22
71205	103720	12	11.96	25.33	0.96	12.0	0.5688	7.84	27	10.21	3%	0.34
71205	103910	14	14.06	23.76	0.15	1.9	0.5798	7.62	11	12.31	1%	0.43
71205	104119	16	15.91	21.38	0.15	1.7	0.6133	7.20	4	14.16	0%	0.55

Date	Time	Text	Depth	Temp	DO	DO%	SpCond	pH	PAR	Light Meter	% Light	Extinction
MMDDYY	HHMMSS		feet	øC	mg/l	Sat	mS/cm	Units	æE/s/mý	feet	Transmission	Coefficient
80905	102205	0.25	0.32	27.47	8.16	106.1	0.5637	9.18	3455	Surface	Average	0.59
80905	102259	1	0.98	27.48	8.22	106.9	0.5631	9.19	3428	Surface	100%	
80905	102343	2	2.10	27.43	8.25	107.3	0.5626	9.22	1543	0.35	45%	2.28
80905	102442	3	3.05	27.20	8.54	110.6	0.5609	9.27	1145	1.30	33%	0.31
80905	102549	4	4.16	27.09	8.49	109.7	0.5610	9.28	869	2.41	25%	0.25
80905	102737	6	6.01	26.89	7.16	92.2	0.5618	9.25	515	4.26	15%	0.28
80905	102852	8	8.00	26.52	4.97	63.6	0.5657	9.04	301	6.25	9%	0.27
80905	103032	10	9.91	26.14	2.66	33.8	0.5683	8.82	163	8.16	5%	0.32
80905	103316	12	12.07	25.70	0.65	8.2	0.5710	8.51	71	10.32	2%	0.38
80905	103457	14	14.01	22.63	0.13	1.5	0.6088	7.40	29	12.26	1%	0.46

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
91305	110908	0.25	0.26	24.92	7.42	92.7	0.5712	9.25	1776	Surface		
91305	110953	1	0.95	24.94	7.58	94.7	0.5703	9.28	1438	Surface	100%	
91305	111143	2	2.03	24.84	7.39	92.1	0.5703	9.30	294	0.28	20%	5.67
91305	111334	3	3.04	24.81	7.32	91.2	0.5702	9.31	298	1.29	21%	-0.01
91305	111504	4	3.97	24.81	7.49	93.3	0.5711	9.32	278	2.22	19%	0.07
91305	111728	6	6.04	24.63	6.28	78.0	0.5711	9.29	194	4.29	13%	0.17
91305	112101	8	7.98	24.25	4.38	54.1	0.5758	9.12	125	6.23	9%	0.23
91305	112158	10	9.98	23.86	2.49	30.5	0.5798	8.90	65	8.23	5%	0.33
91305	112406	12	11.99	23.65	1.22	14.9	0.5834	8.72	48	10.24	3%	0.15
91305	112548	14	14.00	22.48	0.15	1.8	0.5899	8.10	22	12.25	2%	0.39
91305	112659	16	16.04	19.52	0.15	1.7	0.8123	6.93	2	14.29	0%	1.18

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	$\geq 40 < 50$	$> 0.012 \leq 0.024$	$\geq 6.56 < 13.12$
Eutrophic	$\geq 50 < 70$	$> 0.024 \leq 0.096$	$\geq 1.64 < 6.56$
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 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, as steel will.

If installed properly and in the appropriate areas (i.e., shorelines with severe erosion) seawalls provide effective erosion control. Seawalls are made to last numerous 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 in of another portion of the floodplain. Permits and surveys are needed whether replacing and old seawall or installing a new one. Seawalls also provide no 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 term for 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. Prior to the initiation of work permits and/or surveys from the appropriate government agencies need to be obtained.

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 no 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. Also, many fish and wildlife species prefer the native shoreline vegetation habitat. Various wildlife species are even dependent upon shoreline vegetation for their existence. In addition to the benefits of increased fish and wildlife use, a buffer strip planted with a variety of native plants may provide a season long show of various 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 terrestrial sources. They are most effective in areas where plantings alone are not effective due to already severe erosion.

Option 5: Install A-Jacks

A-Jacks® are made of two pieces of pre-cast concrete when fitted together resemble a child's 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. The 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.

D3. 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 and the 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 is common. This can be labor intensive however, costs are low. Many exotic species, such as purple loosestrife, buckthorn, and garlic mustard are proficient at colonizing disturbed sites.

Option 3: Herbicide Treatment

Chemical treatments can be effective at controlling exotic plant species. However, chemical treatment 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.

APPENDIX E. WATER QUALITY STATISTICS FOR ALL LAKE COUNTY LAKES

2000 - 2005 Water Quality Parameters, Statistics Summary

ALK (oxic) <=3ft 2000-2005		ALK (anoxic) 2000-2005	
Average	167.0	Average	205
Median	162.0	Median	194
Minimum	64.9 IMC	Minimum	103 Heron Pond
Maximum	330.0 Flint Lake	Maximum	470 Lake Marie
STD	42.2	STD	53
n =	803	n =	265

Cond (oxic) <=3ft 2000-2005		Cond (anoxic) 2000-2005	
Average	0.8536	Average	0.9606
Median	0.7748	Median	0.8210
Minimum	0.2305 White Lake	Minimum	0.3031 White Lake
Maximum	6.8920 IMC	Maximum	7.4080 IMC
STD	0.5203	STD	0.7611
n =	808	n =	265

NO3-N (oxic) <=3ft 2000-2005		NH3-N (anoxic) 2000-2005	
Average	0.480	Average	2.296
Median	0.116	Median	1.560
Minimum	<0.05 *ND	Minimum	<0.1 *ND
Maximum	9.670 South Churchill Lake	Maximum	18.400 Taylor Lake
STD	1.019	STD	2.483
n =	808	n =	265

*ND = Many lakes had non-detects (69%)

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

Only compare lakes with detectable concentrations to the statistics above

pH (oxic) <=3ft 2000-2005		pH (anoxic) 2000-2005	
Average	8.31	Average	7.11
Median	8.30	Median	7.13
Minimum	7.06 Deer Lake	Minimum	5.80 Third Lake
Maximum	10.28 Round Lake Marsh North	Maximum	8.48 Heron Pond
STD	0.46	STD	0.41
n =	807	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			TKN (anoxic) 2000-2005		
Average	1.457		Average	3.067	
Median	1.220		Median	2.270	
Minimum	<0.5	*ND	Minimum	<0.5	*ND
Maximum	10.300	Fairfield Marsh	Maximum	21.000	Taylor Lake
STD	0.831		STD	2.467	
n =	808		n =	265	
*ND = 5% Non-detects from 19 different lakes			*ND = 5% Non-detects from 7 different lakes		

TP (oxic) <=3ft 2000-2005			TP (anoxic) 2000-2005		
Average	0.098		Average	0.320	
Median	0.063		Median	0.174	
Minimum	<0.01	From 5 Lakes	Minimum	0.012	West Loon Lake
Maximum	3.880	Albert Lake	Maximum	3.800	Taylor Lake
STD	0.168		STD	0.412	
n =	795		n =	265	
*ND = 0.1% Non-detects from 5 different lakes (Bangs, Cedar, Carina, Minear, & Stone Quarry)					

TSS (all) <=3ft 2000-2005			TVS (oxic) <=3ft 2000-2005		
Average	15.3		Average	136.0	
Median	7.9		Median	132.0	
Minimum	<0.1	*ND	Minimum	34.0	Pulaski Pond
Maximum	165.0	Fairfield Marsh	Maximum	298.0	Fairfield Marsh
STD	20.3		STD	40.4	
n =	815		n =	758	
*ND = 2% Non-detects from 10 different lakes			No 2002 IEPA Chain Lakes		

TDS (oxic) <=3ft 2000-2004			CL (anoxic) 2004-2005		
Average	470		Average	277	
Median	454		Median	102	
Minimum	150	Lake Kathryn, White	Minimum	53	Banana Pond
Maximum	1340	IMC	Maximum	2390	IMC
STD	169		STD	489	
n =	745		n =	66	
No 2002 IEPA Chain Lakes, Data from 00-04.					

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	



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
IEEMA = 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