2007 SUMMARY REPORT
of
Third Lake

Lake County, Illinois

Prepared by the

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LAKE FACTS

Lake Name:	Third Lake
Historical Name:	Chittenden Lake
Nearest Municipality:	Village of Third Lake
Location:	T45N, R10E, Sections 13 and 24
Elevation:	766.2 feet
Major Tributaries:	Mill Creek
Watershed:	Des Plaines River
Sub-watershed:	Mill Creek
Receiving Waterbody:	Grandwood Park Lake
Surface Area:	155.5 acres
Shoreline Length:	2.0 miles
Maximum Depth:	65.4 feet
Average Depth:	20.5 feet
Lake Volume:	3123.0 acre-feet
Lake Type:	Glacial
Watershed Area:	8,552.7 acres
Major Watershed Land Uses:	Single Family and Agricultural
Bottom Ownership:	Private, Public (Village of Third Lake, Lake County Forest Preserve)
Management Entities:	Village of Third Lake
Current and Historical Uses:	Swimming, fishing, and boating.
Description of Access:	Boat access locations are private, open to the public (with a fee), walk in access thorough LCFPD property.

In 2005, Third Lake was chosen to be one of seven "sentinel" lakes in the county that the Lakes Management Unit (LMU) will monitor annually for five years, beginning with the 2005 season. This report summarizes the water quality sampling results and aquatic plant surveys conducted in 2007 on Third Lake. Similar reports have been written on data collected in 1993, 1998, 1999, 2000, 2005, and 2006 and are available from the LMU. The following report does not cover lake history and discussion of the watershed, as other reports have.

SUMMARY OF WATER QUALITY

Water samples were collected from April through early November at the deepest point in the lake (Figure 1; Appendix A). Third Lake was sampled at three feet below the surface and three feet above the bottom (Table 1) and the samples were analyzed for various water quality parameters (Appendix C). In addition, Third Lake has participated in the Volunteer Lake Monitoring Program (VLMP) since 2001.

Third Lake was thermally stratified from May through October 2007. The lake was strongly stratified at approximately the 14 foot depth through September. The thermocline (the transition region between the epilimnion and the hypolimnion) remained strong until October, when turnover was taking place and water temperatures throughout the water column grew closer together. The thermocline was still present at approximately 50 feet. Technical problems with the compressors during the season resulted in inadequate air flow to the aerators. As a result the dissolved oxygen (DO) concentrations in the epilimnion were lower than expected (Appendix B). Anoxic conditions (DO < 1 mg/L) existed from June through October in the hypolimnion. The anoxic boundary was at its shallowest in August at approximately 14 feet (26.1% of the lake volume) and deepest in June at approximately 56 feet (13.5% of the lake volume). Repairs to the compressors will be made prior to the 2008 season to ensure higher DO concentrations throughout the water column.

Secchi disk depth (water clarity) averaged 7.85 feet during 2007, which was above the Lake County median of 3.28 feet (Appendix D). Although similar to 2005 (7.83 feet), it was a decrease from 2006 (9.44 feet). The VLMP Secchi depth over the past seven years has averaged from 5.16 feet to 9.09 feet (Figure 2). The 2007 average was the lowest the VLMP has recorded. Water clarity is related to the amount of total suspended solids (TSS) in the water column. Increases in the Secchi depth correspond with decreases in the average TSS (Figure 3). The 2007 average epilimnetic TSS of 4.2 mg/L was an increase from the averages in 2006 (3.5 mg/L) and 2005 (3.6 mg/L). The 2007 average epilimnetic TSS was lower than the Lake County median of 8.0 mg/L. The increase in TSS and decrease in Secchi depth averages were caused by the rain during June, July, and August. The Lake County Stormwater Management Commission (SMC) recorded 12.0 inches of rain between the May and August sampling events which likely brought in a large pulse of nutrient rich water from the large watershed. The water level increased by 2 inches from May to June and by another 8.5 inches from June to July. The overall seasonal change in the lake level was a drop of 4.8 inches.

A 2007 average epilimnetic total phosphorus (TP) concentration of 0.035 mg/L was up from the 2006 average of 0.22 mg/L and the 2005 average of 0.019 mg/L. It was also below the county median of 0.063 mg/L. The 2007 seasonal hypolimnetic average of 0.399 mg/L was above the

county median of 0.163 mg/l. This was a significant decrease from the 2006 hypolimnetic average TP of 0.175 mg/L, but below the 2005 average of 0.526 mg/L. Much of this fluctuation may have been due to environmental affects, such as rain events or water temperature. These influence the thermal stratification and turnover of the lake, and therefore vary between years. Phosphorus can be released from sediment through biological or mechanical processes, or from plant or algae as they die. In addition, more of the lake volume anoxic than previous years, thus potentially more bottom surface area exposed to anoxic conditions. This explains why the TP concentrations were higher in the hypolimnion. Third Lake had a TN:TP ratio of 60:1 in 2007 and 96:1 in 2006 and 2005. This indicates the lake was phosphorus limited, which means any addition of phosphorus could result in increases in plant and algae biomass. Most lakes in Lake County are phosphorus limited. The trophic state of Third Lake based on phosphorus concentration during 2007 was eutrophic with a TSIp score of 55.2, while in 2005 and 2006 the trophic state was mesotrophic with TSIp scores of 46.6 and 48.8. Third Lake ranked 43rd out of 163 lakes in Lake County based on average TP concentrations (Table 2).

The Illinois Environmental Protection Agency (IEPA) has assessment indices to classify Illinois lakes for their ability to support aquatic life and recreational uses. The guidelines consider several aspects such as water clarity, phosphorus concentrations (TSIp), and aquatic plant coverage. According to this index, Third Lake provides *Full* support of aquatic life and recreational activities. The lake provides *Full* overall use.

Third Lake continues to have high concentrations of nitrate-nitrogen from April through June. The April concentration of 2.16 mg/L was thirteen times higher than the county epilimnetic median of 0.150 mg/L. The 2007 average concentration was 0.991 mg/L, which was an increase from the 2006 average of 0.980 mg/L and the 2005 average of 0.820 mg/L. Beginning in 2006, due to the purchase of a new analyzer, the lab began measuring nitrogen as nitrate + nitrite (instead of just nitrate). This change in analyzing should be of little significance since nitrite is quickly converted to nitrate under oxic conditions. The majority of the nitrate-nitrogen may be entering the lake from the Avon-Fremont Drainage ditch during spring and early summer runoff.

Conductivity is a measurement of water's ability to conduct electricity and is positively correlated with chloride (Cl^-) concentration. The Lake County median conductivity for near surface samples was 0.8038 milliSiemens/cm (mS/cm). During 2007, the average epilimnetic conductivity reading for Third Lake was 53% higher at 1.2371 mS/cm. This was a decrease from 2006 (1.4910 mS/cm) and 2005 (1.4877 mS/cm). The hypolimnetic conductivity readings have shown a steady increase over the last three years. The 2007 average Cl^- concentration in Third Lake was above the Lake County median (158 mg/L), with a seasonal average of 245 mg/L. This was a decrease from the 2006 (312 mg/L) and 2005 (318 mg/L) average. This decrease was likely due to the more than 26 inches of rain that was recorded at the SMC rain gauge in Gages Lake from May to October. Stormwater runoff from impervious surfaces such as roads and parking lots can deliver high concentrations of this Cl^- to nearby lakes and ponds, with road salts being a main source. A study done in Canada reported 10% of aquatic species are harmed by prolonged exposure to Cl^- concentrations greater than 220 mg/L. Additionally, shifts in algal populations were associated with Cl^- concentrations as low as 12 mg/l. Therefore, lakes can be negatively impacted by high Cl^- concentrations and it is important to keep the use of road

salts to a minimum within the watershed. Proper application procedures and alternative methods can be used to keep these concentrations under control.

Figure 1. Water quality sampling site on Third Lake, 2007.

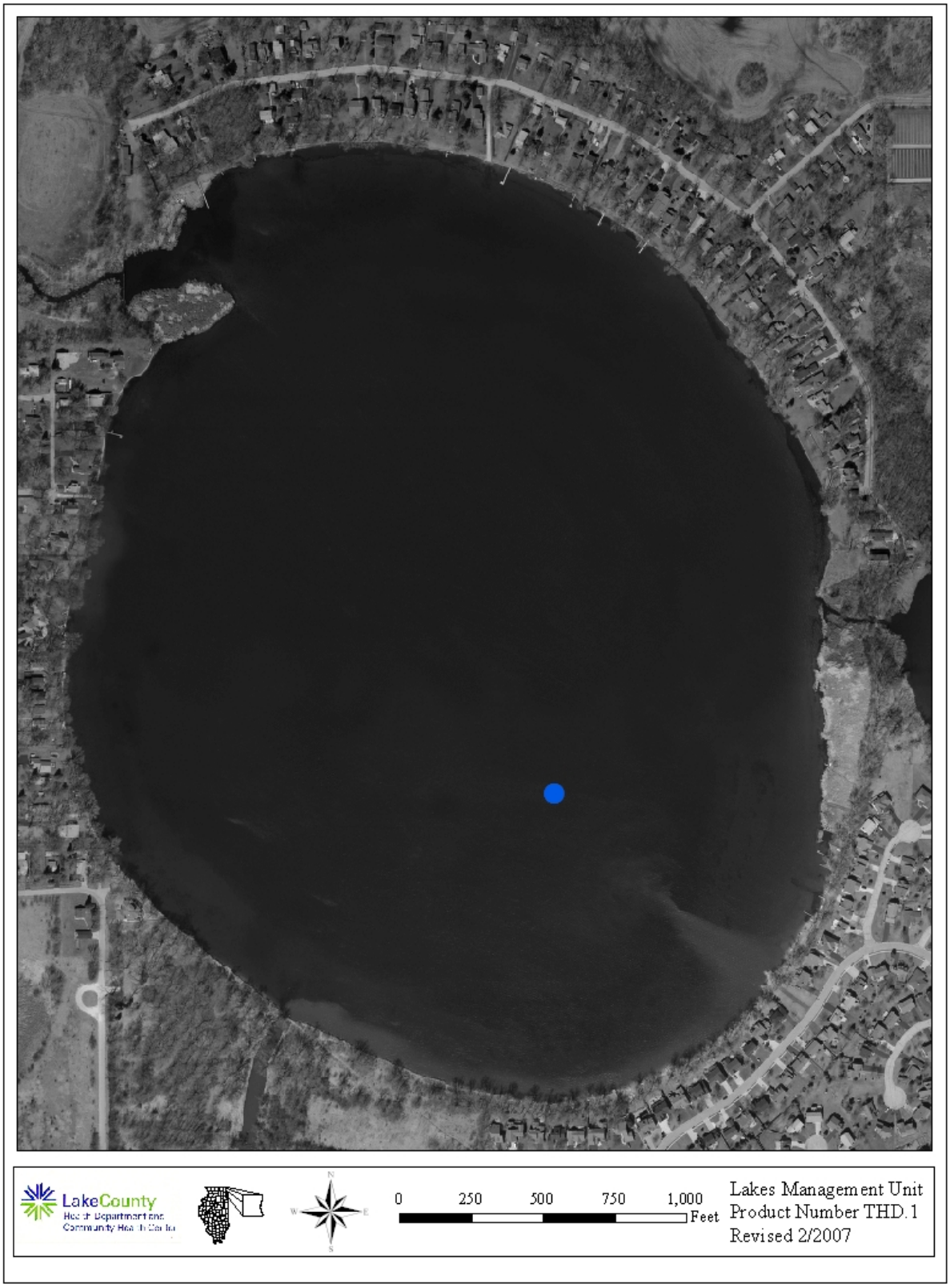

Table 1. Water quality data for Third Lake, 2000, 2005, and 2007.

2007	Epilimnion														
DATE	DEPTH	ALK	TKN	NH_3-N	NO_2+NO_3-N	TP	SRP	Cl^-	TSS	TS	TVS	SECCHI	COND	pH	DO
17-Apr	3	181	1.22	0.207	2.160	0.044	0.009	339	2.3	976	163	10.66	1.6030	7.85	11.27
16-May	3	194	1.00	0.163	1.870	0.023	<0.005	336	2.5	950	157	11.48	1.6330	7.96	8.97
20-Jun	3	160	1.13	0.100	1.650	0.028	<0.005	235	3.8	775	193	5.41	1.2250	8.11	6.69
18-Jul	3	154	1.14	<0.1	0.799	0.043	<0.005	248	6.0	763	171	7.71	1.2450	8.54	8.61
15-Aug	3	134	1.00	<0.1	0.080	0.041	<0.005	173	5.5	566	122	5.57	0.9280	8.24	8.08
19-Sep	3	175	1.04	<0.1	0.071	0.048	<0.005	160	6.5	587	127	4.92	0.9405	8.30	10.52
24-Oct	3	184	0.99	0.124	0.305	0.015	<0.005	221	3.1	695	116	9.19	1.0850	7.57	7.04
	Average	169	1.07	0.149[k]	0.991	0.035	0.009[k]	245	4.2	759	150	7.85	1.2371	8.08	8.74

2006	Epilimnion														
DATE	DEPTH	ALK	TKN	NH_3-N	NO_2+NO_3-N	TP	SRP	Cl^-	TSS	TS	TVS	SECCHI	COND	pH	DO
12-Apr	3	158	1.47	0.148	2.100	0.021	<0.005	334	4.1	941	140	10.83	1.5840	7.84	11.44
17-May	3	167	1.21	0.155	1.970	0.020	<0.005	318	1.1	911	138	12.63	1.5400	8.04	9.12
21-Jun	3	166	1.03	<0.1	1.280	0.021	<0.005	302	1.3	971	229	11.84	1.5140	8.47	7.71
19-Jul	3	140	1.08	<0.1	0.646	0.012	<0.005	310	4.6	921	191	7.05	1.4820	8.74	9.26
16-Aug	3	112	1.09	<0.1	0.255	0.018	<0.005	325	4.9	936	227	6.10	1.4810	8.73	9.41
20-Sep	3	121	1.04	<0.1	0.222	0.023	<0.005	306	5.6	838	144	6.63	1.4150	8.60	8.93
01-Nov	3	157	1.10	0.287	0.390	0.040	0.015	291	2.6	839	136	10.99	1.4210	7.98	8.96
	Average	146	1.15	0.197[k]	0.980	0.022	0.015[k]	312	3.5	908	172	9.44	1.4910	8.34	9.26

2005	Epilimnion														
DATE	DEPTH	ALK	TKN	NH_3-N	NO_3-N*	TP	SRP	Cl^-	TSS	TS	TVS	SECCHI	COND	pH	DO
12-Apr	3	175	1.08	<0.1	1.710	0.015	<0.005	303	3.9	875	150	8.56	1.4680	7.91	10.31
18-May	3	178	1.11	<0.1	1.290	0.021	<0.005	308	2.7	897	158	10.47	1.5090	7.55	9.56
22-Jun	3	168	1.09	<0.1	0.697	0.019	<0.005	319	3.9	918	185	5.28	1.5140	8.00	8.40
20-Jul	3	136	1.04	<0.1	0.123	0.015	<0.005	331	5.5	904	168	5.18	1.5080	8.11	8.58
17-Aug	3	118	0.98	<0.1	<0.05	0.024	<0.005	328	4.3	867	168	5.28	1.4730	8.78	8.51
21-Sep	3	116	0.82	<0.1	<0.05	0.021	<0.005	323	3.1	846	171	8.40	1.4440	8.73	8.14
19-Oct	3	146	0.85	<0.1	0.304	0.018	<0.005	314	2.0	818	122	11.65	1.4980	7.60	8.00
	Average	148	1.00	<0.1	0.820[k]	0.019	<0.005	318	3.6	875	160	7.83	1.4877	8.10	8.79

Glossary

ALK = Alkalinity, mg/L $CaCO_3$
TKN = Total Kjeldahl nitrogen, mg/L
NH_3-N = Ammonia nitrogen, mg/L
NO_2+NO_3-N = Nitrate + Nitrite nitrogen, mg/L
NO_3-N = Nitrate + Nitrite nitrogen, mg/L
TP = Total phosphorus, mg/L
SRP = Soluble reactive phosphorus, mg/L
Cl^- = Chloride, mg/L
TDS = Total dissolved solids, mg/L
TSS = Total suspended solids, mg/L
TS = Total solids, mg/L
TVS = Total volatile solids, mg/L
SECCHI = Secchi disk depth, ft.
COND = Conductivity, milliSiemens/cm
DO = Dissolved oxygen, mg/L

k = Denotes that the actual value is known to be less than the value presented.
NA= Not applicable
* = Prior to 2006 only Nitrate - nitrogen was analyzed

Table 1. Continued.

2007	Hypolimnion														
DATE	DEPTH	ALK	TKN	NH_3-N	NO_2+NO_3-N	TP	SRP	Cl^-	TSS	TS	TVS	SECCHI	COND	pH	DO
17-Apr	60	179	1.13	0.287	1.840	0.032	0.013	344	1.4	980	153	NA	1.6270	7.7	10.22
16-May	60	196	1.78	0.960	1.190	0.144	0.125	346	1.2	943	143	NA	1.6420	7.18	2.65
20-Jun	60	211	2.39	1.690	0.487	0.346	0.307	346	3.5	1010	195	NA	1.6540	6.97	0.18
18-Jul	60	221	2.58	2.060	0.059	0.476	0.415	348	5.1	983	164	NA	1.6530	6.98	0.13
15-Aug	61	236	3.24	2.690	<0.05	0.573	0.547	346	3	1020	206	NA	1.6550	6.71	0.12
19-Sep	60	238	3.29	2.760	0.051	0.588	0.503	343	3.9	982	172	NA	1.6580	6.72	0.12
24-Oct	60	239	3.88	2.930	0.052	0.633	0.595	317	10	880	121	NA	1.5240	6.79	0.14
	Average	217	2.61	1.911	0.613[k]	0.399	0.358	341	4.0	971	165	NA	1.6304	7.01	1.94

2006	Hypolimnion														
DATE	DEPTH	ALK	TKN	NH_3-N	NO_2+NO_3-N	TP	SRP	Cl^-	TSS	TS	TVS	SECCHI	COND	pH	DO
12-Apr	55	159	1.29	0.254	1.970	0.032	0.009	340	2.8	956	158	NA	1.5960	7.64	10.47
17-May	57	171	2.08	0.920	1.340	0.134	0.084	337	2.6	924	137	NA	1.5910	6.97	0.36
21-Jun	57	174	1.93	0.972	1.180	0.138	0.106	328	2.3	989	207	NA	1.6010	6.89	0.19
19-Jul	57	181	2.52	1.450	0.548	0.163	0.127	339	2.3	995	206	NA	1.6330	6.73	0.17
16-Aug	57	183	2.27	1.470	0.315	0.138	0.103	342	3.8	976	175	NA	1.6270	6.71	0.15
20-Sep	59	212	3.42	2.680	<0.05	0.580	0.536	345	4.0	973	170	NA	1.6410	6.78	0.16
01-Nov	56	158	1.13	0.302	0.414	0.040	0.014	293	3.1	852	155	NA	1.4240	7.94	8.55
	Average	177	2.09	1.150	0.825[k]	0.175	0.140	332	3.0	952	173	NA	1.5876	7.09	2.86

2005	Hypolimnion														
DATE	DEPTH	ALK	TKN	NH_3-N	NO_3-N*	TP	SRP	Cl^-	TSS	TS	TVS	SECCHI	COND	pH	DO
12-Apr	61	175	1.25	0.365	1.630	0.016	0.013	302	2.1	874	148	NA	1.4590	7.36	7.18
18-May	62	189	1.76	0.967	0.991	0.124	0.091	303	1.7	870	135	NA	1.4800	6.79	0.66
22-Jun	59	209	2.89	2.020	<0.05	0.525	0.461	303	2.9	916	192	NA	1.4670	6.61	0.00
20-Jul	60	215	3.10	2.000	0.082	0.471	0.413	303	7.9	897	164	NA	1.4740	6.58	0.04
17-Aug	59	234	4.00	3.140	<0.05	0.762	0.689	301	5.1	913	194	NA	1.4870	6.62	0.01
21-Sep	60	256	5.00	4.030	<0.05	1.140	1.080	300	4.0	875	138	NA	1.4980	5.80	0.06
19-Oct	59	235	3.73	3.080	<0.05	0.641	0.564	299	15.0	863	112	NA	1.5325	6.43	0.15
	Average	216	3.10	2.229	0.901[k]	0.526	0.473	302	5.5	887	155	NA	1.4854	6.60	1.16

Glossary

ALK = Alkalinity, mg/L $CaCO_3$	TDS = Total dissolved solids, mg/L
TKN = Total Kjeldahl nitrogen, mg/L	TSS = Total suspended solids, mg/L
NH_3-N = Ammonia nitrogen, mg/L	TS = Total solids, mg/L
NO_2+NO_3-N = Nitrate + Nitrite nitrogen, mg/L	TVS = Total volatile solids, mg/L
NO_3-N = Nitrate + Nitrite nitrogen, mg/L	SECCHI = Secchi disk depth, ft.
TP = Total phosphorus, mg/L	COND = Conductivity, milliSiemens/cm
SRP = Soluble reactive phosphorus, mg/L	DO = Dissolved oxygen, mg/L
Cl^- = Chloride, mg/L	

k = Denotes that the actual value is known to be less than the value presented.
NA= Not applicable
* = Prior to 2006 only Nitrate - nitrogen was analyzed

Figure 2. Yearly Secchi depth averages from VLMP and LCHD records for Third Lake.

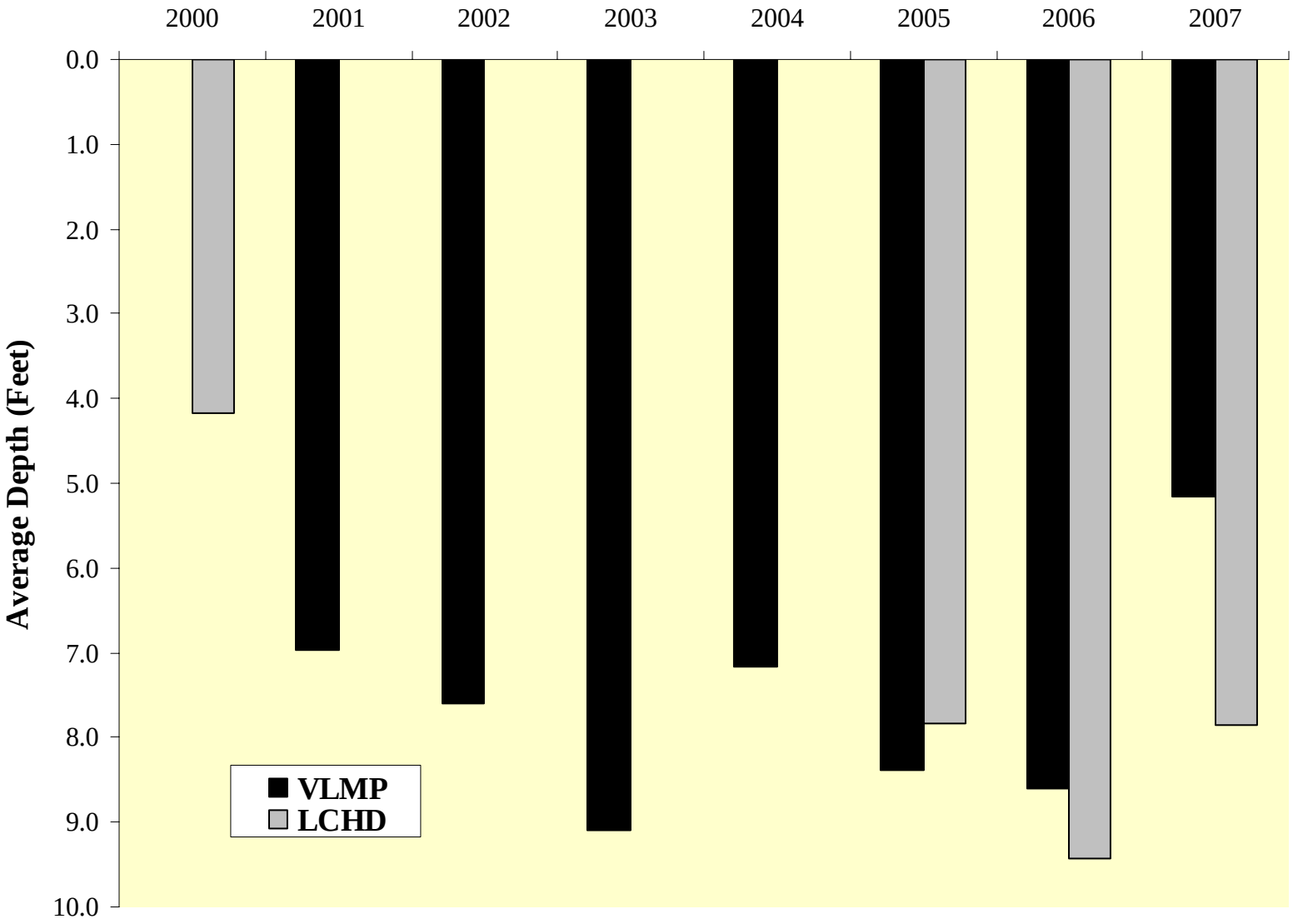

Figure 3. Total suspended solid (TSS) concentrations vs. Secchi depth for Third Lake, 2000 - 2007.

Table 2. Lake County average TSI phosphorous (TSIp) ranking 2000-2007.

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

Table 2. Continued.

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

Table 2. Continued.

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

Table 2. Continued.

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

SUMMARY OF AQUATIC MACROPHYTES

An aquatic plant (macrophyte) survey was conducted in June and August of 2007. Sampling sites were based on a grid system created by mapping software (ArcMap), with each site located 60 meters apart. On Third Lake, there were 97 sites sampled in June (Figure 4) and 95 sites sampled in August (Figure 5). The maximum depth plants were found was 7.0 feet in June and 8.5 feet in August. Aquatic plants will not photosynthesize at water depths with less than 1% of the available sunlight at the surface. During 2007, the depth of the 1% light level ranged from 8 feet (September) to 18 feet (May). There was a total of ten aquatic plant species and one macro-algae species found between the two sampling events (Table 3). Sago Pondweed was the most dominant species found at 24% of the sampling sites both months (Table 4a, b). *Chara* sp. was the second most common species found in June at 17% of the sampling sites and Spiny Naiad was the second most common species found in August at 21% of the sampling sites. Eurasian Watermilfoil (EWM) was found at 16% of the sites in June and 20% of the sites in August. This was a decrease from 2006 when EWM was the most dominant species both months.

To maintain a healthy sunfish/bass fishery, the Illinois Department of Natural Resources (IDNR) recommends plant coverage be 30% to 40% across the lake bottom. The 2007 surveys found approximately 58% and approximately 59% of the sites sampled had aquatic plants (Table 4c). It was calculated that approximately 31% of the lake bottom was covered by plants.

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. A high FQI number indicates that there were large numbers of sensitive, high quality plant species present in the lake. Non-native species were also included in the FQI calculations for Lake County lakes. The average FQI for 2000-2007 Lake County lakes was 13.6 (Table 5). Third Lake had a FQI of 16.8 in 2007, which is a decrease from 2005 (19.6) and an increase from 2006 (14.1).

Figure 4. Aquatic plant sampling grid that illustrates plant density on Third Lake, June 2007.

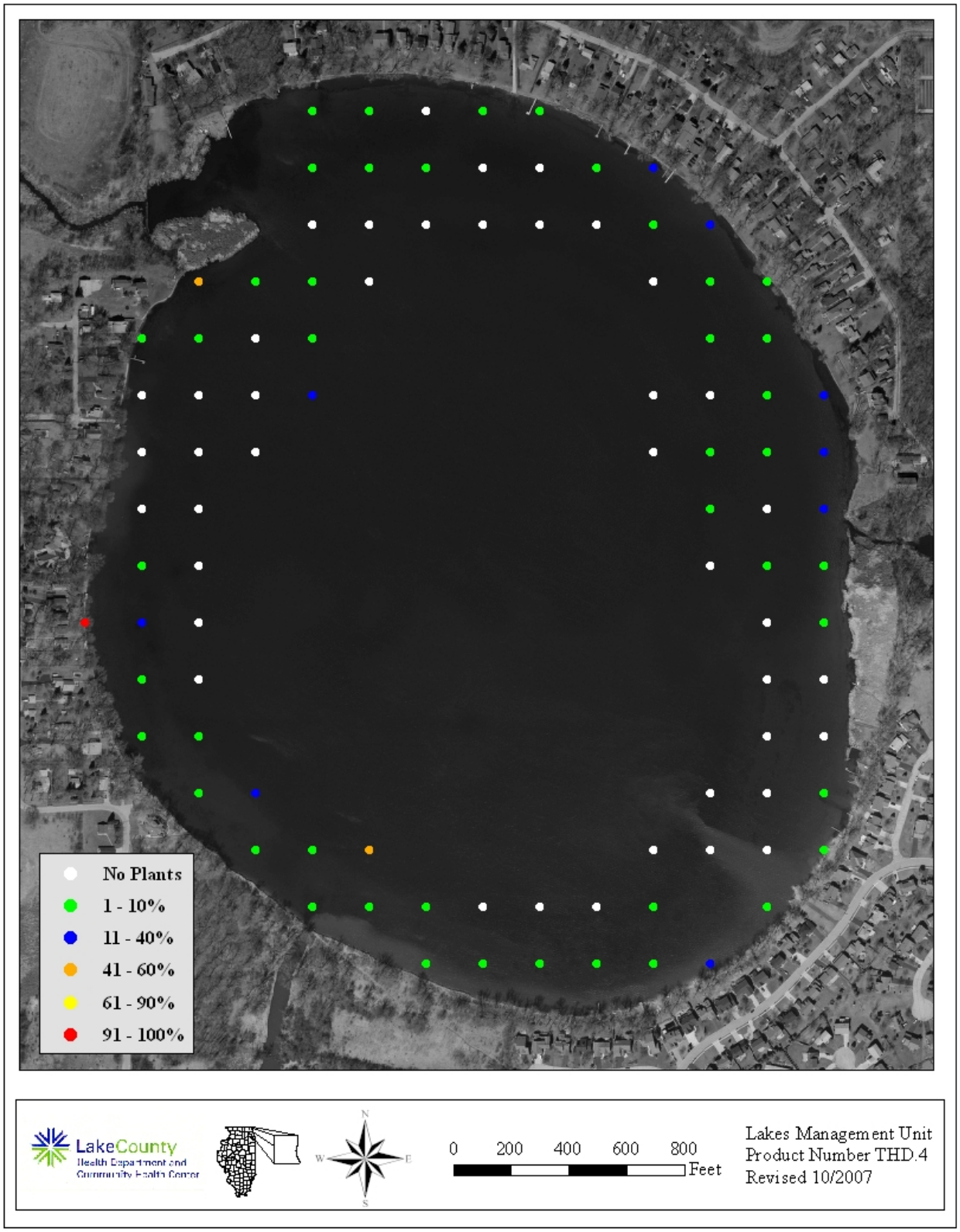

Figure 5. Aquatic plant sampling grid that illustrates plant density on Third Lake, August 2007.

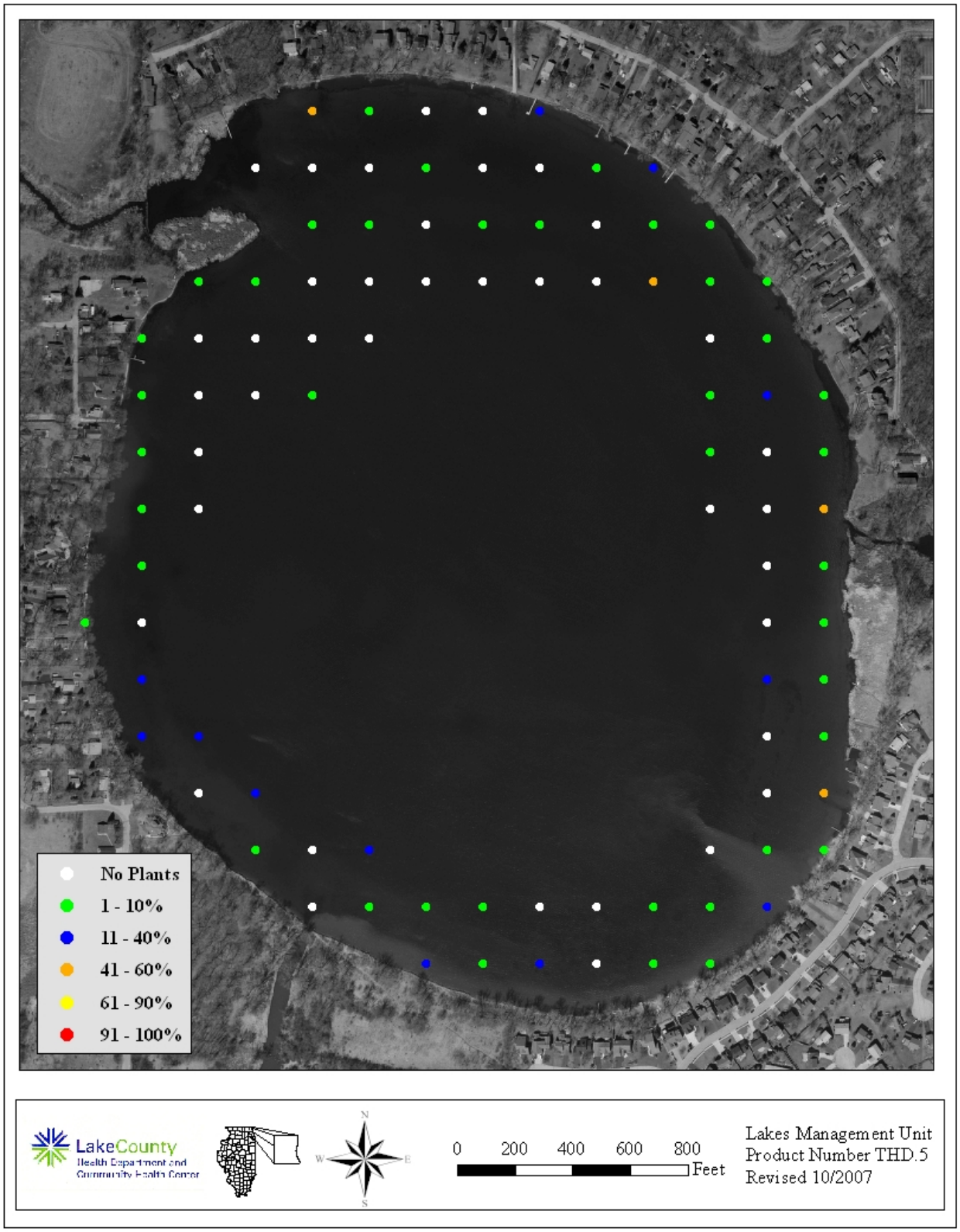

Table 3. Aquatic plant species found in Third Lake in 2007.

Coontail	*Ceratophyllum demersum*
Chara	*Chara* spp.
Flatstem Pondweed	*Potamogeton zosteriformis*
Illinois Pondweed	*Potamogeton illinoensis*
Sago Pondweed	*Potamogeton pectinatus*
Eurasian Water Milfoil^	*Myriophyllum spicatum*
Slender Naiad	*Najas flexilis*
Spiny Naiad	*Najas marina*
Spatterdock	*Nuphar variegata*
White Water Lily	*Nymphaea tuberosa*
Vallisneria (eel grass)	*Vallisneria americana*

^ Exotic plant

Table 4a. Aquatic plant species found at the 97 sampling sites on Third Lake in June, 2007. The maximum depth that plants were found was 7.0 feet.

June									
Plant Density	Chara	Coontail	Eurasian Watermilfoil	Flatstem Pondweed	Illinois Pondweed	Sago Pondweed	Slender Naiad	Spiny Naiad	Vallisneria
Absent	81	91	82	96	95	73	93	90	96
Present	9	4	15	1	2	20	4	7	1
Common	5	1	0	0	0	3	0	0	0
Abundant	1	1	0	0	0	1	0	0	0
Dominant	1	0	0	0	0	0	0	0	0
% Plant Occurrence	16.5	6.2	15.5	1.0	2.1	24.7	4.1	7.2	1.0

Table 4b. Aquatic plant species found at the 95 sampling sites on Third Lake in August 2007. The maximum depth that plants were found was 8.5 feet.

August									
Plant Density	Coontail	Eurasian Watermilfoil	Flatstem Pondweed	Illinois Pondweed	Sago Pondweed	Southern Naiad	Spadderdock	Spiny Naiad	White Water Lily
Absent	94	76	92	85	72	92	94	75	92
Present	1	15	3	9	19	3	0	14	3
Common	0	3	0	1	4	0	1	3	0
Abundant	0	1	0	0	0	0	0	3	0
Dominant	0	0	0	0	0	0	0	0	0
% Plant Occurrence	1.1	20.0	3.2	10.5	24.2	3.2	1.1	21.1	3.2

Table 4c. Distribution of rake density across all sampling sites.

June		
Rake Density (Coverage)	# of Sites	%
No plants	41	42.3%
>0 to 10%	44	45.4%
>10 to 40%	9	9.3%
>40 to 60%	2	2.1%
>60 to 90%	0	0.0%
>90%	1	1.0%
Total Sites with Plants	56	57.7%
Total # of Sites	97	100.0%

August		
Rake Density (Coverage)	# of Sites	%
No plants	39	41.1%
>0 to 10%	40	42.1%
>10 to 40%	12	12.6%
>40 to 60%	4	4.2%
>60 to 90%	0	0.0%
>90%	0	0.0%
Total Sites with Plants	56	58.9%
Total # of Sites	95	100.0%

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

Table 5. Continued.

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

Table 5. Continued.

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

Table 5. Continued.

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

APPENDIX A. METHODS FOR FIELD DATA COLLECTION AND LABORATORY ANALYSES

Water Sampling and Laboratory Analyses

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

Plant Sampling

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

Wildlife Assessment

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

Table A1. Analytical methods used for water quality parameters.

Parameter	***Method***
Temperature	Hydrolab DataSonde® 4a or YSI 6600 Sonde®
Dissolved oxygen	Hydrolab DataSonde ®4a or YSI 6600 Sonde®
Nitrate and Nitrite nitrogen	USEPA 353.2 rev. 2.0 EPA-600/R-93/100 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
Chloride	SM 18th ed, Method #4500C1-D
Total volatile solids	SM 18th ed, Method #2540E, from total solids
Alkalinity	SM 18th ed, Method #2320B, patentiometric titration curve method
Conductivity	Hydrolab DataSonde® 4a or YSI 6600 Sonde®
Total phosphorus	SM 18th ed, Methods #4500-P B 5 and #4500-P E 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 THIRD LAKE IN 2007.

Third Lake 2007 Multiparameter data

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 0.52
41707	72717	0.25	0.45	7.12	11.77	100.7	1.606	7.79	1564	Surface		
41707	72803	1	0.98	7.12	11.7	100	1.605	7.82	1420	Surface	100%	
41707	72907	2	1.99	7.05	11.61	99.1	1.604	7.83	354	0.24	25%	5.79
41707	72958	3	3.02	7.04	11.27	96.2	1.603	7.85	250	1.27	18%	0.27
41707	73045	4	3.96	6.94	11.4	97	1.608	7.82	175	2.21	12%	0.16
41707	73148	6	5.96	6.72	11.56	97.9	1.608	7.82	111	4.21	8%	0.11
41707	73320	8	7.9	6.62	11.26	95.2	1.608	7.81	62	6.15	4%	0.09
41707	73410	10	9.99	6.54	11.38	96	1.607	7.8	36	8.24	3%	0.07
41707	73503	12	12.01	6.35	11.52	96.7	1.608	7.79	18	10.26	1.3%	0.07
41707	73551	14	13.96	6.21	11.45	95.8	1.607	7.78	10	12.21	0.7%	0.05
41707	73639	16	16.03	6.1	11.33	94.4	1.609	7.77	6	14.28	0.4%	0.04
41707	73805	18	17.98	6.09	11.16	93.1	1.606	7.77	3	16.23	0.2%	0.04
41707	73907	20	19.76	6.07	11.27	93.9	1.609	7.76	1	18.01	0.1%	0.06
41707	73958	22	21.94	5.91	11.28	93.6	1.607	7.76	1	20.19	0.1%	0.00
41707	74051	24	24.04	5.57	11.4	93.8	1.607	7.75	1	22.29	0.1%	0.00
41707	74146	26	25.95	5.47	11.25	92.3	1.608	7.75	0	24.2		
41707	74236	28	28	5.36	10.99	89.9	1.609	7.75	0	26.25		
41707	74331	30	29.97	5.27	11.26	91.9	1.613	7.74	0	28.22		
41707	74428	32	31.97	5.03	10.96	88.9	1.612	7.74	0	30.22		
41707	74537	34	34.01	4.64	10.95	88	1.613	7.73	0	32.26		
41707	74830	36	35.96	4.56	10.99	88.2	1.617	7.73	0	34.21		
41707	74950	38	37.97	4.35	11.12	88.7	1.615	7.73	0	36.22		
41707	75039	40	40	4.24	11.03	87.7	1.615	7.73	0	38.25		
41707	75236	42	42.01	4.19	10.62	84.3	1.617	7.73	0	40.26		
41707	75340	44	44.07	4.1	10.82	85.7	1.621	7.72	0	42.32		
41707	75428	46	46.02	4.1	11.03	87.4	1.624	7.72	0	44.27		
41707	75530	48	47.99	4.1	10.76	85.2	1.62	7.72	0	46.24		
41707	75623	50	49.99	4.07	10.97	86.9	1.622	7.72	0	48.24		
41707	75722	52	51.99	4.03	10.5	83	1.621	7.72	0	50.24		
41707	75855	54	53.99	4.01	10.44	82.5	1.624	7.71	0	52.24		
41707	75957	56	56.03	4	10.47	82.7	1.623	7.71	0	54.28		
41707	80114	58	57.99	3.98	10.33	81.6	1.627	7.7	0	56.24		
41707	80208	60	59.98	3.98	10.22	80.7	1.627	7.7	0	58.23		
41707	80325	62	62	3.98	10.24	80.8	1.628	7.7	0	60.25		

Third Lake 2007 Multiparameter data

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 0.35
51607	73822	0.25	0.26	17.96	9.14	101.6	0.5776	7.65	1129	Surface		
51607	73912	1	1.03	18.05	9.09	99.3	1.632	7.82	844	Surface	100%	
51607	74007	2	2.01	18.08	9.03	98.8	1.632	7.9	233	0.26	28%	4.95
51607	74129	3	2.98	18.07	8.97	98	1.633	7.96	241	1.23	29%	-0.03
51607	74259	4	4.03	18.08	8.93	97.7	1.631	7.99	177	2.28	21%	0.14
51607	74400	6	6.05	18.08	8.92	97.6	1.635	8.01	111	4.3	13%	0.11
51607	74501	8	8	18.08	8.87	96.9	1.633	8.03	74	6.25	9%	0.06
51607	74600	10	10.03	18.07	8.99	98.3	1.633	8.04	46	8.28	5%	0.06
51607	74732	12	11.99	18.06	8.93	97.5	1.635	8.06	32	10.24	4%	0.04
51607	74828	14	13.95	17.94	8.83	96.2	1.633	8.06	23	12.2	3%	0.03
51607	75010	16	16	14.64	8.51	86.5	1.62	7.91	13	14.25	2%	0.04
51607	75113	18	18.08	14.26	8.41	84.8	1.623	7.89	8	16.33	0.9%	0.03
51607	75216	20	20	12.3	8.15	78.6	1.613	7.78	4	18.25	0.5%	0.04
51607	75356	22	22.02	9.78	8.65	78.7	1.617	7.66	3	20.27	0.4%	0.01
51607	75445	24	24.02	8.93	8.94	79.8	1.618	7.63	2	22.27	0.2%	0.02
51607	75549	26	26.04	7.78	9.37	81.4	1.627	7.59	1	24.29	0.1%	0.03
51607	75716	28	28.04	7.07	9.73	83	1.627	7.57	1	26.29	0.1%	0.00
51607	75824	30	30.04	6.36	9.7	81.3	1.633	7.54	1	28.29	0.1%	0.00
51607	80011	32	32.01	5.68	9.86	81.2	1.62	7.53	0	30.26		
51607	80140	34	34	5.25	10.12	82.5	1.617	7.52	0	32.25		
51607	80243	36	36.04	5.01	9.78	79.2	1.624	7.49	0	34.29		
51607	80336	38	37.92	4.84	9.85	79.4	1.625	7.49	0	36.17		
51607	80435	40	40.03	4.67	9.63	77.3	1.628	7.47	0	38.28		
51607	80629	42	41.95	4.56	9.29	74.4	1.627	7.44	0	40.2		
51607	80732	44	44.03	4.47	9.12	72.9	1.629	7.42	0	42.28		
51607	80839	46	46	4.44	8.57	68.4	1.63	7.39	0	44.25		
51607	80925	48	47.97	4.37	8.33	66.4	1.63	7.37	0	46.22		
51607	81015	50	50.06	4.35	7.88	62.7	1.626	7.35	0	48.31		
51607	81111	52	51.96	4.25	7.65	60.8	1.631	7.34	0	50.21		
51607	81226	54	54	4.18	6.9	54.7	1.636	7.3	0	52.25		
51607	81411	56	55.97	4.14	5.19	41.1	1.635	7.25	0	54.22		
51607	81512	58	58.07	4.12	4.03	31.9	1.642	7.22	0	56.32		
51607	81556	60	60.04	4.11	2.65	20.9	1.642	7.18	0	58.29		
51607	81645	62	62.03	4.1	1.51	11.9	1.643	7.16	0	60.28		

Third Lake 2007 Multiparameter data

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 0.36
62007	72940	0.25	0.28	24.97	6.96	86.4	1.224	8.24	3354	Surface		
62007	73101	1	1.03	24.99	6.85	85	1.224	8.16	3230	Surface	100%	
62007	73214	2	2.02	24.99	6.67	82.8	1.224	8.13	1164	0.27	36%	3.78
62007	73402	3	3.01	24.99	6.69	83.1	1.225	8.11	717	1.26	22%	0.38
62007	73519	4	3.98	24.95	6.69	83	1.223	8.09	529	2.23	16%	0.14
62007	73706	6	5.99	24.91	6.53	81	1.224	8.07	180	4.24	6%	0.25
62007	73808	8	8.03	24.85	6.51	80.6	1.225	8.06	107	6.28	3%	0.08
62007	73933	10	10.02	24.65	6.52	80.4	1.223	8.05	54	8.27	2%	0.08
62007	74043	12	12.03	24.34	6.38	78.3	1.219	8.04	28	10.28	0.9%	0.06
62007	74245	14	14	21.51	3.22	37.4	1.287	7.71	13	12.25	0.4%	0.06
62007	74426	16	16.01	17.14	3.75	39.9	1.503	7.67	6	14.26	0.2%	0.05
62007	74911	18	18	13.41	4.74	46.6	1.6	7.57	4	16.25	0.1%	0.02
62007	75018	20	19.95	9.14	6.46	57.7	1.613	7.45	2	18.2	0.1%	0.04
62007	75110	22	22.01	8.84	6.52	57.8	1.612	7.43	1	20.26	0.0%	0.03
62007	75254	24	24.04	8.67	6.58	58.1	1.615	7.42	1	22.29	0.0%	0.00
62007	75436	26	26.01	8.54	6.54	57.5	1.623	7.41	1	24.26	0.0%	0.00
62007	75554	28	27.94	8.34	6.58	57.6	1.621	7.38	0	26.19		
62007	75703	30	30.03	8.25	6.48	56.6	1.62	7.36	0	28.28		
62007	80122	32	32.04	8.19	6.54	57	1.622	7.34	0	30.29		
62007	80220	34	34.01	8.09	6.53	56.8	1.623	7.27	0	32.26		
62007	80359	36	36.04	8.01	6.51	56.5	1.625	7.26	0	34.29		
62007	80536	38	38.03	7.79	6.54	56.4	1.626	7.24	0	36.28		
62007	80722	40	39.95	7.71	6.52	56.2	1.63	7.23	0	38.2		
62007	80915	42	41.99	7.34	6.4	54.7	1.632	7.21	0	40.24		
62007	81024	44	44.07	7	6.45	54.6	1.629	7.21	0	42.32		
62007	81132	46	46.02	6.49	5.78	48.3	1.632	7.18	0	44.27		
62007	81221	48	48.01	5.72	6.45	52.9	1.634	7.19	0	46.26		
62007	81326	50	50.03	4.97	5.19	41.8	1.634	7.13	0	48.28		
62007	81435	52	51.98	4.65	3.88	31	1.639	7.09	0	50.23		
62007	81602	54	53.98	4.48	2.89	23	1.641	7.05	0	52.23		
62007	81732	56	56.03	4.33	0.43	3.4	1.649	7	0	54.28		
62007	81906	58	58.4	4.31	0.2	1.6	1.651	6.97	0	56.65		
62007	81958	60	60.05	4.28	0.18	1.4	1.654	6.97	0	58.3		
62007	82045	62	62.03	4.26	0.17	1.3	1.657	6.94	0	60.28		

Third Lake 2007 Multiparameter data

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 0.51
71807	72856	0.25	0.29	24.92	8.92	106.5	1.245	8.45	2222	Surface		
71807	73002	1	1.01	24.93	8.54	102	1.244	8.49	3100	Surface	100%	
71807	73117	2	1.99	24.94	8.65	103.4	1.244	8.52	724	0.24	23%	6.06
71807	73312	3	3.1	24.93	8.61	102.9	1.245	8.54	365	1.35	12%	0.51
71807	73427	4	4.06	24.92	8.76	104.7	1.245	8.55	250	2.31	8%	0.16
71807	73611	6	6.04	24.88	8.79	104.9	1.245	8.56	270	4.29	9%	-0.02
71807	73822	8	7.95	24.84	8.68	103.6	1.245	8.57	154	6.2	5%	0.09
71807	73955	10	10.03	24.69	8.41	100.1	1.247	8.56	90	8.28	3%	0.06
71807	74138	12	12.06	24.1	7.51	88.4	1.248	8.48	46	10.31	1%	0.07
71807	74420	14	14.01	23.28	5.64	65.3	1.266	8.32	22	12.26	0.7%	0.06
71807	74619	16	16.1	18.08	0.3	3.1	1.401	7.67	12	14.35	0.4%	0.04
71807	74938	18	18.08	12.39	2.74	25.3	1.571	7.41	8	16.33	0.3%	0.02
71807	75105	20	20.04	10.53	3.51	31.2	1.59	7.38	4	18.29	0.1%	0.04
71807	75247	22	22.04	10.31	3.67	32.5	1.59	7.34	3	20.29	0.1%	0.01
71807	75708	24	23.9	10.17	3.85	33.9	1.592	7.27	2	22.15	0.1%	0.02
71807	75933	26	26	10.09	3.9	34.3	1.594	7.23	1	24.25	0.0%	0.03
71807	80255	28	27.96	9.98	3.79	33.2	1.598	7.2	0	26.21		
71807	80358	30	29.94	9.86	3.98	34.8	1.594	7.19	0	28.19		
71807	80558	32	32.09	9.78	4	34.9	1.598	7.18	0	30.34		
71807	80813	34	33.96	9.69	3.98	34.7	1.601	7.18	0	32.21		
71807	80942	36	35.97	9.58	3.92	34	1.604	7.17	0	34.22		
71807	81124	38	37.96	9.39	4.02	34.7	1.619	7.17	0	36.21		
71807	81420	40	40	9.25	3.95	34.1	1.605	7.18	0	38.25		
71807	81607	42	41.92	9.08	4.13	35.5	1.608	7.18	0	40.17		
71807	81725	44	44.08	8.87	4	34.1	1.61	7.18	0	42.33		
71807	81951	46	45.95	8.43	3.76	31.8	1.614	7.18	0	44.2		
71807	82152	48	48.03	7.19	2.69	22	1.628	7.15	0	46.28		
71807	82346	50	50.02	5.92	1.25	9.9	1.637	7.1	0	48.27		
71807	82459	52	51.96	5.32	0.48	3.8	1.642	7.07	0	50.21		
71807	82638	54	53.91	4.88	0.14	1.1	1.645	7.04	0	52.16		
71807	82810	56	56.02	4.69	0.14	1	1.645	7.03	0	54.27		
71807	83002	58	57.93	4.59	0.13	1	1.652	7	0	56.18		
71807	83047	60	60	4.52	0.13	1	1.653	6.98	0	58.25		
71807	83249	62	61.97	4.42	0.12	0.9	1.673	6.88	0	60.22		

Third Lake 2007 Multiparameter data

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 0.66
81507	73931	0.25	0.27	26.1	8.24	100.3	0.9249	8.31	464	Surface		
81507	74050	1	0.99	26.15	8.16	99.3	0.9281	8.27	339	Surface	100%	
81507	74223	2	2.03	26.16	8.25	100.6	0.9281	8.25	118	0.28	35%	3.77
81507	74359	3	3.01	26.16	8.08	98.5	0.928	8.24	44	1.26	13%	0.78
81507	74527	4	4.04	26.16	7.98	97.3	0.9284	8.23	29	2.29	9%	0.18
81507	74712	6	6.03	26.16	7.97	97.2	0.9282	8.22	14	4.28	4%	0.17
81507	74847	8	8	26.1	7.51	91.4	0.9315	8.15	6	6.25	2%	0.14
81507	75030	10	10	25.86	5.81	70	0.9243	7.84	1	8.25	0.3%	0.22
81507	75148	12	12.02	25.51	5.47	65.9	0.9393	7.8	1	10.27	0.3%	0.00
81507	75315	14	14.12	23.28	0.34	3.9	1.009	7.48	1	12.37	0.3%	0.00
81507	75501	16	16	19.34	0.14	1.5	1.274	7.38	0	14.25		
81507	75611	18	18	14.61	0.19	1.8	1.537	7.23	0	16.25		
81507	75824	20	19.97	12.45	0.34	3.2	1.554	7.13	0	18.22		
81507	80015	22	22.29	11.69	0.57	5.2	1.563	7.09	0	20.54		
81507	80123	24	23.99	11.4	0.8	7.3	1.562	7.07	0	22.24		
81507	80247	26	25.98	11.31	0.87	7.8	1.562	7.05	0	24.23		
81507	80512	28	27.95	11.27	0.84	7.6	1.561	7.02	0	26.2		
81507	80621	30	30.02	11.22	0.7	6.3	1.564	7	0	28.27		
81507	80721	32	31.99	11.13	0.74	6.6	1.566	6.99	0	30.24		
81507	80824	34	34.04	11.06	0.58	5.2	1.572	6.97	0	32.29		
81507	80923	36	35.99	10.92	0.57	5.1	1.568	6.96	0	34.24		
81507	81018	38	38	10.76	0.58	5.1	1.571	6.95	0	36.25		
81507	81121	40	39.98	10.64	0.47	4.2	1.575	6.94	0	38.23		
81507	81211	42	42	10.41	0.4	3.5	1.577	6.93	0	40.25		
81507	81332	44	44.05	10.14	0.13	1.2	1.58	6.92	0	42.3		
81507	81432	46	46.07	9.5	0.13	1.1	1.589	6.9	0	44.32		
81507	81524	48	48.12	8.65	0.12	1	1.599	6.9	0	46.37		
81507	81644	50	50.02	7.54	0.13	1.1	1.615	6.88	0	48.27		
81507	81740	52	51.95	6.81	0.13	1	1.624	6.87	0	50.2		
81507	81827	54	54	6.19	0.13	1	1.629	6.86	0	52.25		
81507	81943	56	55.89	5.54	0.13	1	1.64	6.83	0	54.14		
81507	82042	58	58	5.09	0.13	1	1.649	6.78	0	56.25		
81507	82201	60	60.03	4.93	0.12	0.9	1.649	6.74	0	58.28		
81507	82245	62	61.98	4.72	0.12	1	1.661	6.68	0	60.23		
81507	82337	64	63.96	4.68	0.12	1	1.659	6.62	0	62.21		

Third Lake 2007 Multiparameter data

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 0.56
91907	75213	0.25	0.25	19.33	10.44	111.3	0.9399	8.23	3092	Surface		
91907	75307	1	0.97	19.31	10.43	111.1	0.9403	8.26	3054	Surface	100%	
91907	75424	2	2.04	19.29	10.38	110.7	0.9401	8.29	778	0.29	25%	4.72
91907	75522	3	3.02	19.28	10.52	112.1	0.9405	8.3	433	1.27	14%	0.46
91907	75625	4	4.04	19.29	10.56	112.6	0.9405	8.32	204	2.29	7%	0.33
91907	75726	6	5.99	19.27	10.53	112.2	0.9406	8.32	90	4.24	2.9%	0.19
91907	75835	8	7.99	19.24	10.5	111.8	0.9408	8.32	41	6.24	1.3%	0.13
91907	75943	10	9.97	19.2	10.49	111.6	0.9412	8.32	15	8.22	0.5%	0.12
91907	80042	12	11.98	18.91	10.19	107.8	0.9429	8.28	6	10.23	0.2%	0.09
91907	80154	14	14.01	18.03	9.02	93.6	0.9477	8.18	3	12.26	0.1%	0.06
91907	80302	16	15.98	17.09	6.87	70	0.9881	7.9	1	14.23	0.0%	0.08
91907	80412	18	17.99	14.78	0.5	4.9	1.346	7.37	1	16.24	0.0%	0.00
91907	80516	20	20.01	13.46	0.54	5.1	1.435	7.28	1	18.26	0.0%	0.00
91907	80639	22	21.93	13.12	0.53	5	1.452	7.22	0	20.18		
91907	80743	24	23.98	12.91	0.54	5	1.462	7.19	0	22.23		
91907	80847	26	25.96	12.79	0.46	4.3	1.467	7.15	1	24.21		
91907	80945	28	27.97	12.73	0.33	3.1	1.472	7.13	0	26.22		
91907	81056	30	30.01	12.69	0.28	2.6	1.476	7.1	0	28.26		
91907	81204	32	32.01	12.57	0.25	2.3	1.482	7.08	0	30.26		
91907	81321	34	33.98	12.53	0.36	3.4	1.482	7.05	0	32.23		
91907	81451	36	35.98	12.47	0.36	3.3	1.484	7.03	0	34.23		
91907	81606	38	37.97	12.39	0.2	1.9	1.491	7.01	0	36.22		
91907	81656	40	39.98	12.33	0.09	0.9	1.495	7	0	38.23		
91907	81752	42	41.98	12.2	0.15	1.4	1.502	6.99	0	40.23		
91907	81901	44	43.95	11.98	0.14	1.3	1.52	6.98	0	42.2		
91907	81958	46	45.96	11.63	0.12	1.1	1.528	6.97	0	44.21		
91907	82052	48	48.01	9.69	0.14	1.2	1.581	6.94	0	46.26		
91907	82155	50	49.96	8.12	0.13	1.1	1.611	6.9	0	48.21		
91907	82308	52	51.96	6.71	0.14	1.2	1.63	6.88	0	50.21		
91907	82433	54	53.93	6.04	0.13	1.1	1.64	6.86	0	52.18		
91907	82524	56	55.94	5.62	0.12	0.9	1.648	6.81	0	54.19		
91907	82612	58	58.04	5.32	0.13	1	1.657	6.74	0	56.29		
91907	82708	60	59.97	5.16	0.12	0.9	1.658	6.72	0	58.22		
91907	82755	62	61.96	5.02	0.12	0.9	1.664	6.65	0	60.21		

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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 0.66
102407	74008	0.25	0.34	13.94	7.26	72.4	1.0870	7.57	3063	Surface		
102407	74104	1	1.05	13.95	7.17	71.5	1.0870	7.57	2974	Surface	100%	
102407	74155	2	2.03	13.95	7.12	71	1.0860	7.57	464	0.28	16%	6.63
102407	74251	3	2.94	13.94	7.04	70.1	1.0850	7.57	224	1.19	8%	0.61
102407	74354	4	3.98	13.94	7.01	69.9	1.0850	7.57	175	2.23	6%	0.11
102407	74449	6	5.93	13.95	6.99	69.7	1.0850	7.57	86	4.18	3%	0.17
102407	74540	8	8.00	13.96	6.99	69.7	1.0850	7.57	44	6.25	1.48%	0.11
102407	74658	10	10.05	13.95	7.02	70	1.0850	7.58	21	8.3	0.71%	0.09
102407	74748	12	12.08	13.95	7.03	70.1	1.0850	7.58	11	10.33	0.37%	0.06
102407	74845	14	14.01	13.95	6.95	69.3	1.0850	7.58	6	12.26	0.20%	0.05
102407	74928	16	16.20	13.95	6.96	69.4	1.0860	7.58	2	14.45	0.07%	0.08
102407	75027	18	17.97	13.95	6.93	69.1	1.0850	7.58	2	16.22	0.07%	0.00
102407	75123	20	19.97	13.95	6.94	69.2	1.0850	7.59	1	18.22	0.03%	0.04
102407	75221	22	22.02	13.95	6.88	68.6	1.0850	7.59	1	20.27	0.03%	0.00
102407	75336	24	23.95	13.94	6.91	68.9	1.0850	7.6	0	22.2		
102407	75620	26	25.90	13.93	6.92	69	1.0850	7.6	0	24.15		
102407	75709	28	28.10	13.91	6.87	68.5	1.0850	7.61	0	26.35		
102407	75754	30	29.93	13.93	6.89	68.6	1.0850	7.61	0	28.18		
102407	75848	32	31.93	13.88	6.92	68.9	1.0850	7.61	0	30.18		
102407	80002	34	34.05	13.87	6.93	69	1.0850	7.62	0	32.3		
102407	80055	36	35.99	13.75	6.96	69.1	1.0860	7.61	0	34.24		
102407	80137	38	38.19	13.48	7.08	69.9	1.0850	7.62	0	36.44		
102407	80221	40	39.95	13.14	7.15	69.9	1.0880	7.62	0	38.2		
102407	80314	42	41.96	12.92	6.77	66.0	1.1040	7.58	0	40.21		
102407	80404	44	43.97	12.43	6.76	65.2	1.1290	7.53	0	42.22		
102407	80502	46	45.90	11.90	5.17	49.3	1.1800	7.42	0	44.15		
102407	80610	48	47.99	11.14	2.71	25.3	1.3020	7.23	0	46.24		
102407	80707	50	50.01	9.05	0.33	3	1.4630	7.11	0	48.26		
102407	80746	52	51.98	8.09	0.09	0.7	1.4810	7.07	0	50.23		
102407	80909	54	53.96	6.90	0.17	1.4	1.5080	6.98	0	52.21		
102407	81041	56	56.03	6.09	0.15	1.3	1.5210	6.86	0	54.28		
102407	81143	58	58.01	5.90	0.16	1.3	1.5220	6.82	0	56.26		
102407	81249	60	60.04	5.81	0.14	1.2	1.5240	6.79	0	58.29		
102407	81346	62	62.03	5.71	0.14	1.3	1.525	6.77	0	60.28		

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

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

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

Temperature and Dissolved Oxygen:

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

Monthly temperature profiles were established on each lake by measuring water temperature every foot (lakes $\leq$ 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. WATER QUALITY STATISTICS FOR ALL LAKE COUNTY LAKES.

2000 - 2007 Water Quality Parameters, Statistics Summary

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

No 2002 IEPA Chain Lakes

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

No 2002 IEPA Chain Lakes.

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

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

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

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

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

LCHD Lakes Management Unit ~ 12/17/2007

LakeCounty
Health Department and
Community Health Center

APPENDIX E. GRANT PROGRAM OPPORTUNITES.

Table E1. Potential Grant Opportunities

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

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

Table E1. Continued

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

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