2007 SUMMARY REPORT
of
Sterling Lake

Lake County, Illinois

Prepared by the

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EXECUTIVE SUMMARY

Sterling Lake is an 84-acre gravel pit lake located in Van Patton Woods Forest Preserve in northern Lake County. Historically known as Vulcan Pit #1 and #2, this old gravel pit was mined from 1939 to the mid 1970's. The Lake County Forest Preserve District (LCFPD) purchased the lake site in the 1970's and implemented a major restoration that included shoreline grading and native plantings in 1989 and 1993. Boats with electric motors are allowed on the lake. A walking path surrounds the lake and connects to the Des Plaines River Trail. There are also picnic tables at several locations. Sterling Lake empties into the Des Plaines Rive but can also receive overflow from the Des Plaines River during flooding.

Sterling Lake was thermally stratified in June and August. The long and narrow nature of the lake allows for it to be easily mixed by the wind. Dissolved oxygen concentrations in the epilimnion did drop below 5.0 mg/L during June, which may have been caused by recent rain. Between the May and June sampling events more than five inches of rain was recorded by the Lakes Management Unit (LMU) at the Illinois Beach State Park SwimCast station. Anoxic conditions existed in June and August in the hypolimnion.

Water quality in Sterling Lake was very good. Secchi depth (water clarity) averaged 11.35 feet during 2007, which was above the Lake County median of 3.28 feet. This was an increase from the 2001 sampling when the Secchi depth averaged 6.86 feet. The concentrations of total suspended solids, which directly affect the water clarity, decreased from an average of 3.0 mg/L in 2001 to 2.1 mg/L in 2007. Both of these values were less than the Lake County epilimnetic median of 8.0 mg/L. Total phosphorus (TP) concentrations in Sterling Lake averaged lower than the Lake County median of 0.063 mg/L. The TP also decreased from 2001 when the TP averaged 0.016 mg/L to 0.010 mg/L in 2007.

Conductivity is a measurement of water's ability to conduct electricity and is correlated with chloride (Cl^-) concentrations. The Lake County epilimnetic median conductivity reading was 0.8038 milliSiemens/cm (mS/cm). During 2007, the Sterling Lake average epilimnetic conductivity reading was higher, at 0.9168 mS/cm. This was an 11% increase from the 2001 average of 0.8253 mS/cm. The Cl^- concentration in Sterling Lake was lower than the Lake County epilimnetic median of 158 mg/L during 2007 with a seasonal epilimnetic average of 145 mg/L.

There were a total of 18 plant species and one macro-algae (*Chara* spp.) found in Sterling Lake. The most common species was Sago Pondweed at 33% of the sampling sites, while *Chara* spp. was the second most abundant species at 32% of the sampling sites. In 2001 Eurasian Watermilfoil (EWM) was the most common aquatic plant at 35% of the sampling sites followed by Sago Pondweed at 31% of the sampling sites.

The Illinois Department of Natural Resources conducted fish surveys during 1984, 1989, 1991, 1993, 2000, 2004, and 2006. Annual fish stocking occurred from 1989 to 2006 and included Walleye, Channel Catfish, and Muskellunge. LMU staff did not find Zebra Mussels in 2003 but they were reported by Forest Preserve staff in 2001 and were found in 2007 during the LMU July plant sampling.

LAKE FACTS

Lake Name:	Sterling Lake
Historical Name:	Vulcan Pit #1 and #2
Nearest Municipality:	Wadsworth
Location:	T46N, R11E, Sections 9, 10, 15, and 16
Elevation:	668.0 feet
Major Tributaries:	None
Watershed:	Des Plaines River
Sub-watershed:	Upper Des Plaines River
Receiving Waterbody:	Des Plaines River
Surface Area:	83.9 acres
Shoreline Length:	2.7 miles
Maximum Depth:	27.0 feet
Average Depth:	13.5 feet (estimated)
Lake Volume:	1132.8 acre-feet (estimated)
Lake Type:	Borrow Pit
Watershed Area:	253.6 acres
Major Watershed Land Uses:	Public and Private Open Space and Wetland
Bottom Ownership:	Lake County Forest Preserve District (LCFPD)
Management Entities:	LCFPD
Current and Historical Uses:	Fishing
Description of Access:	Public access via Van Patton Woods Forest Preserve

SUMMARY OF WATER QUALITY

Water samples were collected monthly from May through September at the deepest point in the lake (Figure 1, Appendix A). Sterling Lake was sampled at depths of three feet and 22 to 23 feet, depending on water level, and the samples were analyzed for various water quality parameters (Appendix C).

Sterling Lake was thermally stratified in June and August. Thermal stratification is when a lake divides into an upper, warm water layer (epilimnion) and a lower, cold-water layer (hypolimnion). When stratified, the epilimnetic and hypolimnetic waters do not mix, and the hypolimnion typically experiences anoxic conditions (where DO concentrations drop below 1 mg/L). The long and narrow nature of the lake likely caused the lake to be easily mixed by the wind. Even though Sterling Lake was stratified in June and August, the thermocline (transitional area between the epilimnion and hypolimnion) was deep, 16 feet in June and 20 feet in August.

A dissolved oxygen (DO) concentration of 5.0 mg/L is considered adequate to support a sunfish/bass fishery, since these fish can suffer oxygen stress below this amount. DO concentrations in the epilimnion dropped below 5.0 mg/L during June (Appendix B). This could have been caused by recent rain. Between the May and June sampling events more than five inches of rain was recorded by the Lakes Management Unit (LMU) at the Illinois Beach State Park (IBSP) SwimCast station along the Lake Michigan shore. This rain event could have washed in organic debris and fecal matter from animals (i.e. geese) that live along the shore causing an increase in bacterial activity, thus consuming oxygen. Anoxic conditions (DO < 1.0 mg/L) existed in June and August in the hypolimnion. This is a normal phenomenon in lakes that stratify. The anoxic boundary was at 20 feet in June and 22 feet in August. Since an accurate bathymetric map with volumetric calculations does not exist for Sterling Lake, it was not possible to determine the volume of the lake that was anoxic during 2007.

Secchi disk depth (water clarity) averaged 11.35 feet during 2007 and 6.86 feet during 2001 (Table 1). Both of these readings were above the Lake County median of 3.28 feet (Appendix E). The increase in water clarity from 2001 was a result of a decrease in total suspended solids (TSS) in the water column in 2007. TSS is composed of nonvolatile suspended solids, non-organic clay or sediment materials, and volatile suspended solids, algae and other organic matter. In 2007 the average TSS in the epilimnion was 2.1 mg/L, while in 2001 it averaged 3.0 mg/L. Both years were below the county median of 8.0 mg/L. A possible reason for the decrease in TSS could be the presence of Zebra Mussels. Staff from the Lake County Forest Preserve District (LCFPD) noted their presence in 2001, however in 2003 the Lakes Management Unit (LMU) did not find the mussels but they were found in 2007 during the LMU July plant sampling.

Another factor affecting water clarity was the amount of nutrients in the water. Typically lakes are either phosphorus (P) or nitrogen (N) limited. This means one of the nutrients is in short supply and any addition of that nutrient to the lake will result in an increase of plant and/or algal growth. Most lakes in Lake County are phosphorus limited. To compare the availability of nitrogen and phosphorus, a ratio of total nitrogen to total phosphorus (TN:TP) was used. Ratios less than or equal to 10:1 indicate nitrogen is limiting, ratios greater than or equal to 15:1

Figure 1. Access and water quality sampling site on Sterling Lake, 2007.

Table 1. Water quality data for Sterling Lake, 2001 and 2007.

2007	Epilimnion															
DATE	DEPTH	ALK	TKN	NH_3-N	NO_2+NO_3-N	TP	SRP	Cl^-	TDS	TSS	TS	TVS	SECCHI	COND	pH	DO
15-May	3	180	0.57	<0.1	0.084	0.010	<0.005	143	NA	2.4	536	129	8.79	0.9370	8.22	8.29
19-Jun	3	171	0.53	<0.1	<0.05	<0.010	<0.005	143	NA	1.5	587	193	14.30	0.9160	8.35	2.93
17-Jul	3	164	0.52	<0.1	<0.05	<0.010	<0.005	148	NA	1.6	549	146	15.42	0.9300	8.43	9.15
14-Aug	3	150	0.54	<0.1	<0.05	<0.010	<0.005	148	NA	1.9	535	151	11.35	0.8970	8.55	9.25
18-Sep	3	161	0.54	<0.1	<0.05	<0.010	<0.005	143	NA	2.9	550	159	6.89	0.9040	8.35	13.91
	Average	165	0.54	<0.1	0.084^k	0.010^k	<0.005	145	NA	2.1	551	156	11.35	0.9168	8.38	8.71

2001	Epilimnion															
DATE	DEPTH	ALK	TKN	NH_3-N	NO_3-N*	TP	SRP	Cl^-	TDS	TSS	TS	TVS	SECCHI	COND	pH	DO
06-May	3	170	0.77	0.114	0.085	0.012	<0.005	NA	462	2.6	517	148	7.84	0.7970	8.39	9.09
03-Jun	3	172	0.92	0.116	0.165	0.016	<0.005	NA	484	3.0	517	147	6.59	0.8471	8.35	8.18
08-Jul	3	154	0.60	<0.1	0.102	0.018	<0.005	NA	508	2.3	525	148	9.06	0.8329	8.56	7.44
05-Aug	3	149	0.56	<0.1	<0.05	0.020	<0.005	NA	466	3.4	536	172	5.64	0.8189	8.66	7.43
09-Sep	3	151	0.58	<0.1	<0.05	0.015	<0.005	NA	462	3.7	547	171	5.15	0.8306	8.82	9.87
	Average	159	0.69	0.115^k	0.117^k	0.016	<0.005	NA	476	3.0	528	157	6.86	0.8253	8.56	8.40

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 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^-	TDS	TSS	TS	TVS	SECCHI	COND	pH	DO
15-May	23	179	0.551	<0.1	0.089	0.014	<0.005	143	NA	6.4	537	130	NA	0.9330	8.06	6.95
19-Jun	22	183	0.864	0.360	0.058	0.014	<0.005	141	NA	5.0	596	189	NA	0.9270	7.74	0.40
17-Jul	22	166	0.655	0.171	<0.05	0.014	<0.005	144	NA	7.6	541	141	NA	0.9360	8.11	4.92
14-Aug	22	163	0.796	0.273	<0.05	0.013	<0.005	147	NA	5.2	581	189	NA	0.9290	8.00	0.81
18-Sep	22	162	0.526	<0.1	<0.05	<0.010	<0.005	143	NA	3.6	533	153	NA	0.9040	8.29	13.31
	Average	171	0.68	0.268[k]	0.074[k]	0.014[k]	<0.005	144	NA	5.6	558	160	NA	0.9258	8.04	5.28

2001	Hypolimnion															
DATE	DEPTH	ALK	TKN	NH_3-N	NO_3-N[*]	TP	SRP	Cl^-	TDS	TSS	TS	TVS	SECCHI	COND	pH	DO
06-May	21	171	0.78	0.115	0.097	0.021	<0.005	NA	446	4.0	521	142	NA	0.7900	8.19	8.77
03-Jun	23	186	1.58	0.718	<0.05	0.07	0.011	NA	479	41.2	546	155	NA	0.8525	7.56	0.18
08-Jul	21	190	1.11	0.423	<0.05	0.035	0.008	NA	511	8.3	531	145	NA	0.8555	7.66	1.02
05-Aug	21	187	1.26	0.558	<0.05	0.049	<0.005	NA	498	13.0	531	156	NA	0.8604	7.59	0.07
09-Sep	22	179	1.35	0.632	<0.05	0.049	<0.005	NA	482	13.3	517	146	NA	0.8892	7.44	0.08
	Average	183	1.22	0.489	0.097[k]	0.045	0.010[k]	NA	483	16.0	529	149	NA	0.8495	7.69	2.02

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 nitrogen, mg/L
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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

indicate phosphorus is limiting, and ratios greater than 10:1, but less than 15:1 indicate there are enough of both nutrients to facilitate excess algae or plant growth. Sterling Lake had a TN:TP ratio of 47:1 in 2001 and 56:1 in 2007, indicating the lake was strongly phosphorous limited. TP in the epilimnion was only detectable by the lab analysis in May. Nitrogen, as well as carbon, naturally occur in high concentrations and come from a variety of sources (soil, air, etc.), which are more difficult to control than sources of phosphorus. Lakes that are phosphorus-limited may be easier to manage, since controlling phosphorus is more feasible than controlling nitrogen or carbon.

Total Kjeldahl nitrogen (TKN) is a measure of organic nitrogen, and is typically bound up in plant and algae cells. Total Kjeldahl nitrogen (TKN) concentration averages for both the epilimnion and hypolimnion in 2007 decreased from 2001. The near surface samples in 2001 had a TKN average of 0.69 mg/L, which decreased to 0.54 mg/L in 2007. The TKN averages in the hypolimnion decreased from 1.22 mg/L in 2001 to 0.68 mg/L in 2007. Ammonia nitrogen (NH_3-N) concentrations also decreased from 2001 to 2007. The epilimnetic concentration in 2001 averaged 0.115 mg/L, while the 2007 average was below the detection limit. The hypolimnion average decreased from 0.489 mg/L in 2001 to 0.268 mg/L in 2007.

Total phosphorus (TP) concentrations in 2007 in Sterling Lake averaged lower than the Lake County epilimnetic median of 0.063 mg/L and hypolimnetic median of 0.177 mg/L. The epilimnetic average TP had decreased since 2001 when the average was 0.016 mg/L and the hypolimnetic average TP has decreased from 0.097 mg/L. The 2007 TP was only at a detectable level in the epilimnion in May causing the seasonal average TP of < 0.010 mg/L and 0.014 mg/L in the hypolimnion. The most probable reason for the extremely low levels of TP was the presence of Zebra Mussels. Another factor could be the lake's recent origin since nutrients and sediment have not had long periods of time to accumulate in the lake.

Total phosphorous can be used to calculate the trophic state index (TSIp), which classifies lakes according to the overall level of nutrient enrichment. The TSIp score falls within the range of one of four categories: hypereutrophic, eutrophic, mesotrophic and oligotrophic. Hypereutrophic lakes are those with excessive nutrients, nuisance algae growth reminiscent of "pea soup," and have a TSI score greater than 70. Lakes with a TSI score of 50 or greater are classified as eutrophic or nutrient rich and are productive lakes in terms of aquatic plants and/or algae. Mesotrophic and oligotrophic lakes have lower nutrient levels. These are very clear lakes, with little algal growth. Most lakes in Lake County are eutrophic. The trophic state of Sterling Lake in terms of its phosphorus concentration during 2001 was mesotrophic, with a TSIp score of 44.3. In 2007 the TSIp score was lower at 37.4, therefore classifying the lake as mesotrophic. Sterling Lake ranked 2nd out of 163 lakes in Lake County based on average TP concentrations (Table 2). The TSIp score likely would be lower then presented since the TP level was undetectable from June through September.

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, Sterling Lake provided *Full* support of aquatic life and recreational activities. The lake also provided *Full* overall use.

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	0.0135	39.24
4	Sand Pond (IDNR)	0.0165	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

Conductivity is a measurement of water's ability to conduct electricity and is correlated with chloride (Cl^-) concentrations. Compared to lakes in undeveloped areas, lakes with residential and/or urban land uses in their watershed often have higher conductivity readings and higher Cl^- concentrations because of the use of road salts. Stormwater runoff from impervious surfaces such as roads and parking lots can deliver high concentrations of this Cl^- to nearby waterbodies. Transportation was approximately 2% of the landuse within the watershed of Sterling Lake and contributed approximately 19% of the estimated runoff. The Lake County epilimnetic median conductivity reading was 0.8038 milliSiemens/cm (mS/cm). During 2007, the Sterling Lake average epilimnetic conductivity reading was higher, at 0.9168 mS/cm. This was an 11% increase from the 2001 average of 0.8253 mS/cm. In addition, Cl^- concentration in Sterling Lake was lower than the Lake County epilimnetic median of 158 mg/L during 2007, with an epilimnetic average of 145 mg/L. A study done in Canada reported 10% of aquatic species were harmed by prolonged exposure to chloride concentrations greater than 220 mg/L. Additionally, shifts in algal populations in lakes were associated with chloride concentrations as low as 12 mg/l. Therefore, lakes can be negatively impacted by the high Cl^- concentrations.

There were external sources affecting Sterling Lake such as stormwater from the 253.6 acres within its watershed (Figure 2). Public and private open space (54%), forest and grassland (6%), and agriculture (5%) were the major land uses within the watershed (Figure 3). Public and private open space (76%) and transportation (19%) were the land uses contributing the highest percentages of estimated runoff (Table 3). It is important to keep in mind that although the amount of estimated runoff from certain areas may be low, they can still deliver high concentrations of Cl^-, TSS, and TP. The retention time (the amount of time it takes for water entering a lake to flow out of it again) of Sterling Lake was calculated to be approximately 14.8 years.

SUMMARY OF AQUATIC MACROPHYTES

An aquatic plant (macrophyte) survey was conducted in July of 2007. Sampling sites were based on a grid system created by mapping software (ArcMap), with each site located 60 meters apart for a total of 95 sites. Fifty-four sites were sampled and plants were found at 28 sites (Figure 4), at a maximum depth of 12.0 feet (Table 4a, b). Once plants were not found at a site, any sites deeper were not sampled. Overall, a total of 18 plant species and one macro-algae (*Chara* spp.) were found (Table 5). The most common species was Sago Pondweed at 33% of the sampling sites, while *Chara* spp. was the second most abundant species at 32% of the sampling sites. Species composition was slightly lower in 2001 when 16 aquatic plant species and one macro-algae were found. The two species found in 2007 and not 2001 were Illinois Pondweed and Largeleaf Pondweed. In 2001 Eurasian Watermilfoil (EWM) was the most common aquatic plant at 35% of the sampling sites followed by Sago Pondweed at 31% of the sampling sites. In addition to EWM, Curlyleaf Pondweed was also found in Sterling Lake. In 2007 EWM was found at 15% of the sampling sites and CLP was found at 4% of the sampling sites. EWM was concentrated in the bay by the boat launch on the west side of the lake and the southwest shore of the lake. Both of these exotics compete with native plants, eventually crowding them out, providing little or poor natural diversity in addition to limited use by wildlife. Removal or control of exotic species is recommended. To maintain a healthy sunfish/bass fishery the

Figure 2. Approximate watershed delineation for Sterling Lake, 2007.

Figure 3. Approximate land use within the Sterling Lake watershed, 2007.

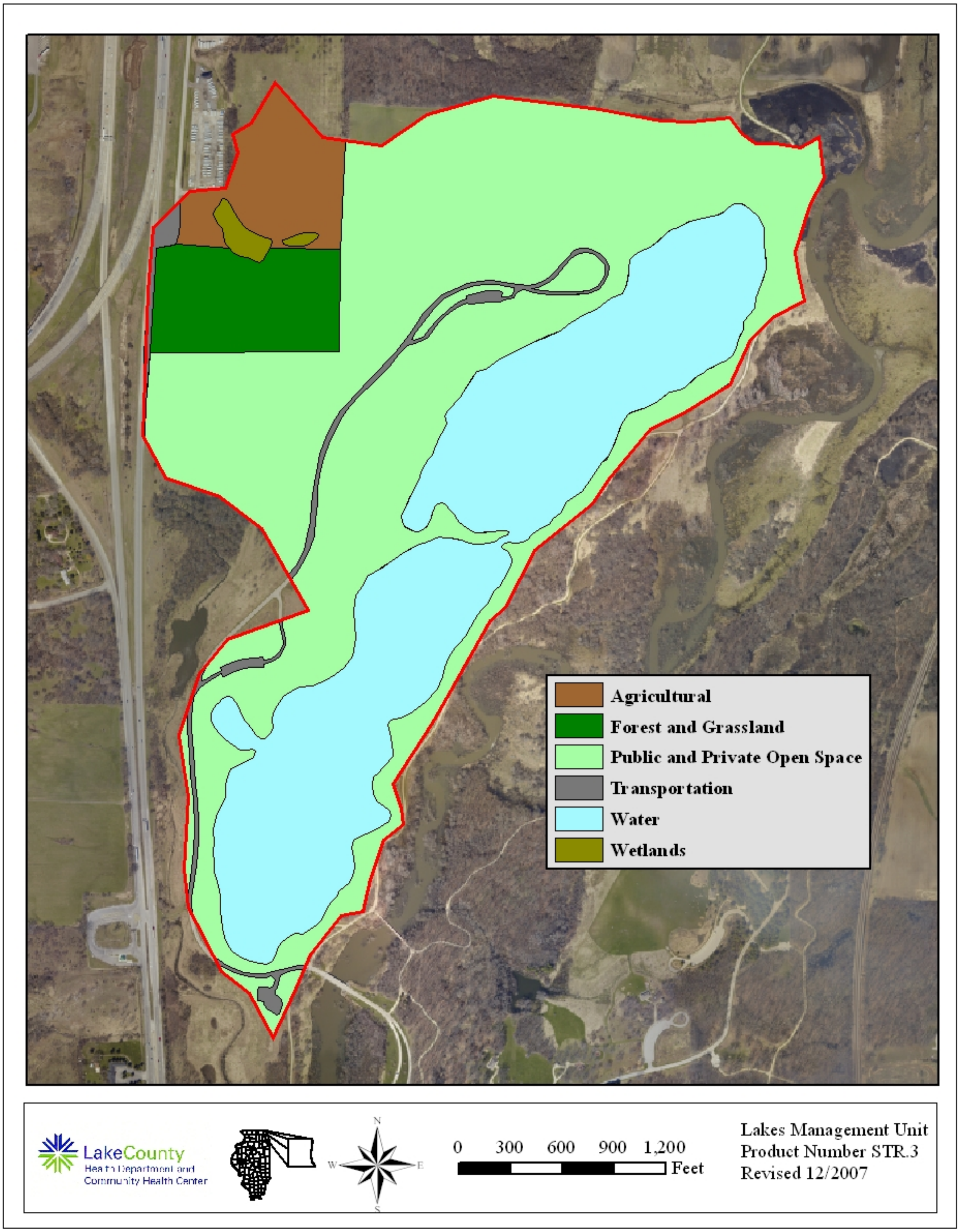

Table 3. Approximate land uses and retention time for Sterling Lake, 2007.

Land Use	Acreage	% of Total
Agricultural	12.41	4.9%
Forest and Grassland	14.88	5.9%
Public and Private Open Space	136.74	53.9%
Transportation	5.90	2.3%
Water	82.07	32.4%
Wetlands	1.54	0.6%
Total Acres	**253.55**	**100.0%**

Land Use	Acreage	Runoff Coeff.	Estimated Runoff, acft.	% Total of Estimated Runoff
Agricultural	12.41	0.05	1.7	2.3%
Forest and Grassland	14.88	0.05	2.0	2.8%
Public and Private Open Space	136.74	0.15	56.4	76.0%
Transportation	5.90	0.85	13.8	18.6%
Water	82.07	0.00	0.0	0.0%
Wetlands	1.54	0.05	0.2	0.3%
TOTAL	**253.55**		**74.2**	100.0%

Lake volume	**1132.80**	**acre-feet**
Retention Time (years)= lake volume/runoff	**15.27**	**years**
	5574.61	**days**

Figure 4. Aquatic plant sampling grid that illustrates plant density on Sterling Lake, July 2007.

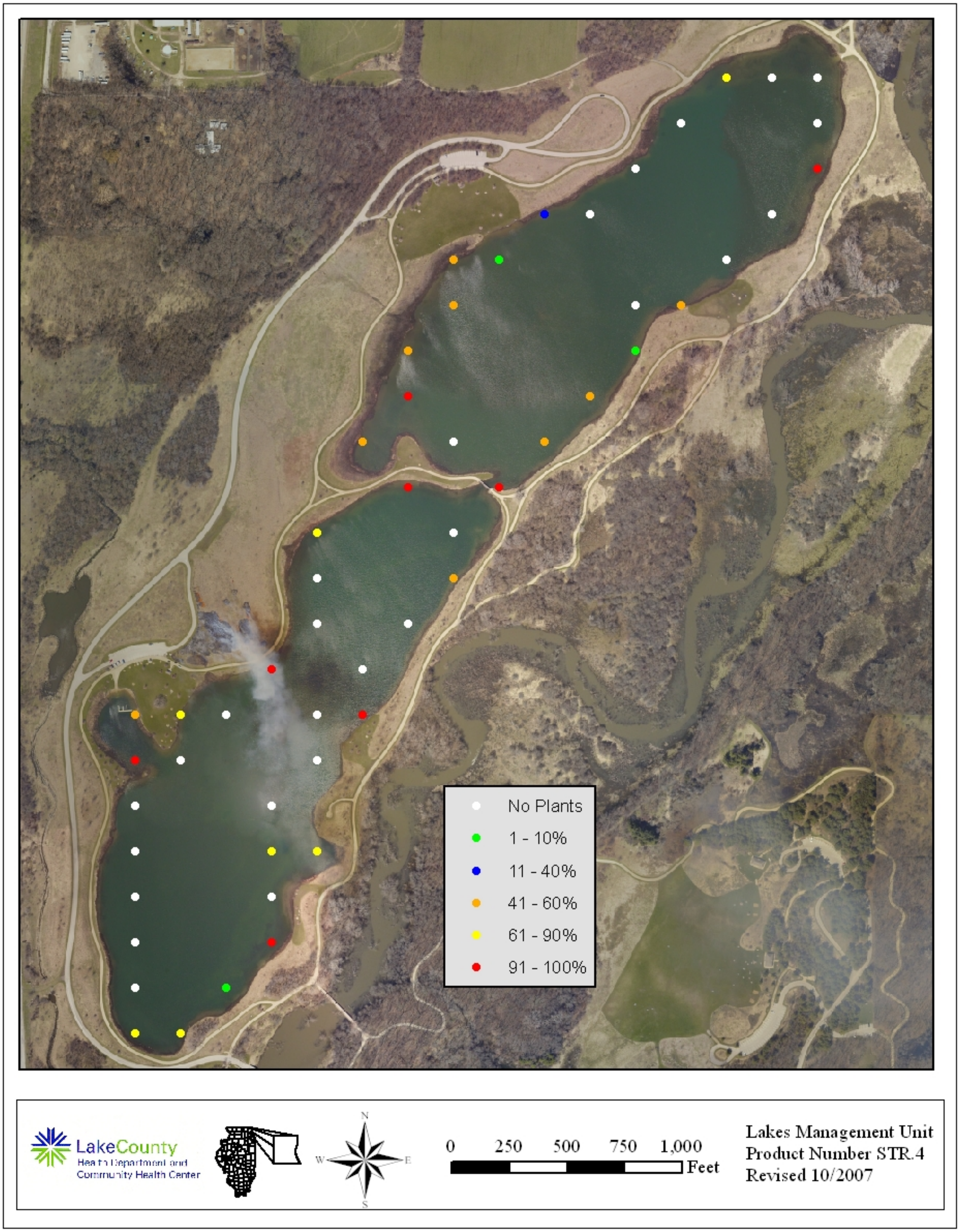

Table 4a. Aquatic plant species found at the 28 sampling sites on Sterling Lake, July 2007. Maximum depth that plants were found was 11.2 feet.

Plant Density	American Pondweed	Chara	Coontail	Curlyleaf Pondweed	Elodea	Eurasian Watermilfoil	Flatstem Pondweed	Floating Leaf Pondweed	Illinois Pondweed	Largeleaf Pondweed
Absent	39	37	53	52	49	46	52	47	53	53
Present	9	6	1	2	2	7	2	3	1	1
Common	5	1	0	0	1	0	0	1	0	0
Abundant	0	5	0	0	0	1	0	3	0	0
Dominant	1	5	0	0	2	0	0	0	0	0
% Plant Occurrence	27.8%	31.5%	1.9%	3.7%	9.3%	14.8%	3.7%	13.0%	1.9%	1.9%

Plant Density	Leafy Pondweed	Sago Pondweed	Slender Naiad	Small Pondweed	Spiny Naiad	Vallisneria	Whitewater Crowfoot	Water Stargrass	White Water Lily
Absent	48	36	40	53	53	50	52	52	46
Present	3	10	8	1	1	4	2	1	7
Common	0	4	5	0	0	0	0	0	0
Abundant	3	2	1	0	0	0	0	1	1
Dominant	0	2	0	0	0	0	0	0	0
% Plant Occurrence	11.1%	33.3%	25.9%	1.9%	1.9%	7.4%	3.7%	3.7%	14.8%

Table 4b. Distribution of rake density across all sampled sites.

Rake Density (Coverage)	# of Sites	%
No plants	26	48.1
>0 to 10%	3	5.6
>10 to 40%	1	1.9
>40 to 60%	9	16.7
>60 to 90%	7	13.0
>90%	8	14.8
Total Sites with Plants	28	51.9
Total # of Sites	54	100.0

Table 5. Aquatic plant species found in Sterling Lake in 2007.

Coontail	*Ceratophyllum demersum*
Chara (Macro algae)	*Chara* spp.
American Elodea	*Elodea Canadensis*
Water Stargrass	*Heteranthera dubia*
Eurasian Watermilfoil^	*Myriophyllum spicatum*
Slender Naiad	*Najas flexilis*
Spiny Naiad	*Najas marina*
White Water Lily	*Nymphaea tuberosa*
Largeleaf Pondweed	*Potamogeton amplifolius*
Curlyleaf Pondweed^	*Potamogeton crispus*
Leafy Pondweed	*Potamogeton foliosus*
Illinois Pondweed	*Potamogeton illinoensis*
Floatingleaf Pondweed	*Potamogeton natans*
American Pondweed	*Potamogeton nodosus*
Sago Pondweed	*Potamogeton pectinatus*
Small Pondweed	*Potamogeton pusillus*
Flatstem Pondweed	*Potamogeton zosteriformis*
White Water Crowfoot (rigid)	*Ranunculus longirostris*
Vallisneria (eel grass)	*Vallisneria americana*

^ Exotic plant

optimal plant coverage is 30% to 40% across the lake bottom. It was calculated that approximately 29% of the lake bottom was covered by plants.

Water clarity and depth are the major limiting factors in determining the maximum depth at which aquatic plants will grow in a specific lake. Aquatic plants will not photosynthesize in water depths with less than 1% of the available sunlight. During 2007, the 1% light level was available down to the bottom (24 feet) all season. Even though the 1% light level was to the bottom, plants were only found at 12.0 feet in July. This could be due to other factors limiting plant growth in Sterling Lake, such as substrate type and the rapid depth changes.

The 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. 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 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 2001-2007 Lake County lakes was 13.6 (Table 6). Sterling Lake had a FQI of 24.5 in 2007. This was an increase from 2001 when the FQI was 21.8. The change in the

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

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

Table 6. Continued.

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

Table 6. Continued.

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

Table 6. Continued.

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

aquatic plant sampling procedure could be a potential reason for this increase. Also, the aquatic plant species composition varied from year to year.

SUMARY OF SHORELINE CONDITION

Lakes with stable water levels potentially have less shoreline erosion problems. The water level in Sterling Lake fluctuated in 2007. A stake was pounded along the west shore near the LMU access point in June and used to measure the water level each month. The water level dropped 6.6 inches from June to July. From July to August the level rose 1.1 inches and another 10.1 inches from August to September. There was an overall seasonal increase in water level of 4.6 inches. This rise in water level was a result of large rains that fell across Lake County during the summer, particularly in August. The LMU recorded 17.35 inches of rain from June to September at the Illinois Beach State Park SwimCast station along the Lake Michigan shore at Illinois Beach State Park South Beach.

In 2003 an assessment was conducted to determine the condition of the shoreline at the water/land interface. Most of the shoreline was classified as developed (84%). The types of shoreline included buffer (75%), lawn (12%), beach (8%), and rip rap (5%). There were some nonnative aggressive plants growing within the buffer strips and other locations along the shoreline. These included Purple Loosestrife and Common Buckthorn. In 2003 the shoreline was also assessed for the degree of erosion. Approximately 3% was classified as moderately eroding and 3% was classified as slightly eroding. None of the shoreline was severely eroding. The eroding shoreline was either lawn or beach near the picnic areas. The shoreline was reassessed in 2007 for significant changes in erosion since 2003. Based on the 2007 assessment, there was an increase in shoreline erosion with approximately 22% of the shoreline having some degree of erosion (Figure 5). Overall, 78% of the shoreline had no erosion, 8% had slight erosion, 5% had moderate, and 9% had severe erosion. The area of severe erosion should be addressed soon. Most of the erosion appeared to be where fishermen access the lake. Some type of control should be employed in these areas to allow access for fishing, but also protect the shoreline from further erosion. It is much easier and less costly to mitigate slightly eroding shorelines than those with more severe erosion. If these shorelines are repaired by the installation of a buffer strip with native plants, the benefits can be three-fold. First, the erosion is repaired and the new native plants can stabilize the shoreline to prevent future erosion. Second, the addition of native plants adds habitat for wildlife to a shoreline that is otherwise limited in habitat. Thirdly, buffer habitat can help filter pollutants and nutrients from the near shore areas and keep geese and gulls from congregating, as it is not desirable habitat for them.

SUMMARY OF WILDLIFE AND HABITAT

Visual wildlife observations were made on a monthly basis during water quality and plant sampling activities. Sterling Lake is located in a rural setting with some buffered shoreline. This provides excellent habitat for a variety of birds, mammals, and other wildlife. Good numbers of wildlife, particularly birds, were noted on and around Sterling Lake (Table 7).

Sterling Lake's sport-fishing regulations include two pole and line fishing only; a limit of three Channel Catfish per day; a 15 inch minimum length limit on Largemouth and Smallmouth Bass

Figure 5. Shoreline erosion on Sterling Lake, 2007.

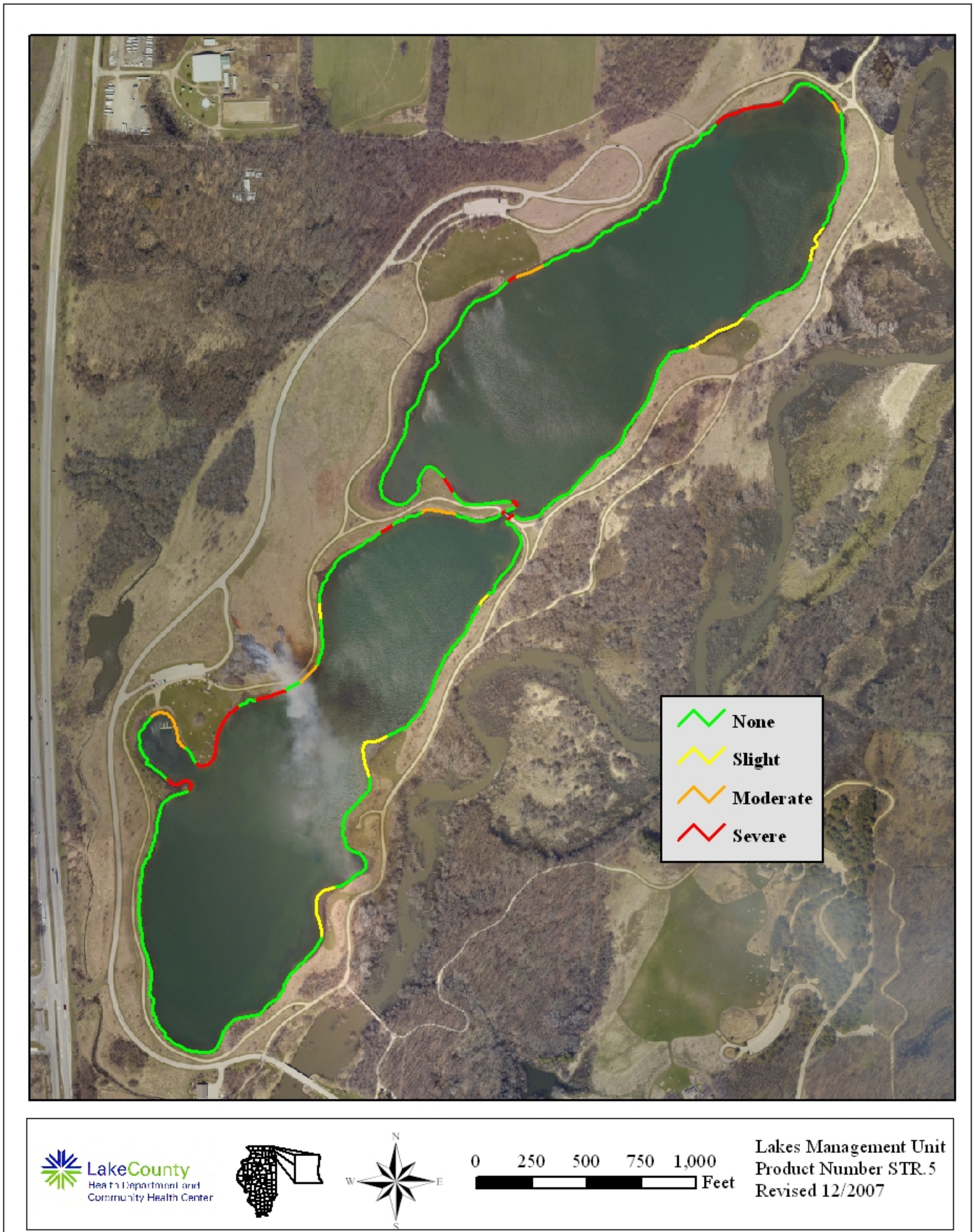

Table 7. Wildlife species observed on and around Sterling Lake, May – September 2007.

Birds	
Canada Goose	*Branta canadensis*
Mallard	*Anas platyrhnchos*
Ring-billed Gull	*Larus delawarensis*
Great Blue Heron	*Ardea herodias*
Turkey Vulture	*Cathartes aura*
Barn Swallow	*Hirundo rustica*
Tree Swallow	*Iridoprocne bicolor*
Red-winged Blackbird	*Agelaius phoeniceus*
Mammals	
Beaver	*Castor Canadensis*
Reptiles	
Painted Turtle	*Chrysemys picta*
Mussels	
Zebra Mussel^	*Dreissena polymorpha*

^ Exotic

with a one fish per day limit; a 16 inch minimum length limit on Walleye with a six per day limit; a 48 inch minimum length limit on Musky with a one per day limit; and a 24 inch minimum length limit on Northern Pike with a three fish per day limit.

Sterling Lake has been stocked with game fish since 1985 (Table 8). The Walleye fingerlings ranged in size from 1.5 to 4.1 inches. The Channel Catfish were introduced at a non-vulnerable size (approximately 8 inches). The Smallmouth Bass were 5.0 inches and the Musky ranged from 8 to 20 inches when they were stocked.

Several fishery assessments have been conducted by the IDNR from 1984 to 2006. The most recent survey was conducted on May 3rd and 4th of 2006. The survey was done early in the year targeting Walleye and Musky. The north and south pools of the lake were each shocked for 30 minutes and a trap and gill net were placed in each for 24 hours. A total of 586 fish, consisting of 15 species, were captured. The most common species caught were Yellow Bass (31%), Bluegill (24%), and Largemouth Bass (17%). There were eight Walleye ranging in length from 6.3 to 17.0 inches and seven Musky ranging in length from 12.9 to 39.0 inches caught. Black Crappie, Warmouth, Yellow Perch, Pumpkinseed, Channel Catfish, Spotted Sucker, and Common Carp were also caught. The forage species collected include Bluntnose Minnow, Brooksilverside, and Gizzard Shad.

The IDNR suggested fishermen be encouraged to keep and dispose of any Yellow Bass caught and to grate the connection leading to the Des Plaines River to make movement between the lake and river more difficult. They also suggest more enforcement of the sport fishing ordinances by the LCFPD law enforcement staff. In addition, the IDNR would like to see the LCFPD install more fish cribs "to provide cover for the smaller fish since the majority of the lake lacks cover beyond the weedline."

Table 8. Game fish stocking records for Sterling Lake, 1985 – 2006.

Date	Walleye (fry)	Walleye (fingerlings)	Channel Catfish	Smallmouth Bass (fingerlings)	Musky (fingerlings)
1985		750			
1986		1000	1400		
1989	74000	5550	1850	3700	
1990		1850	3700		150
1991		1800	3700		150
1992		1850	3700		150
1993		4810	1850		150
1994	74000	1850	1850		150
1995	74000	4590	1850		
1996	74000	4540	1850		155
1997	74000	5428	1233		
1998		3285	758		200
1999		3300	480		224
2000		3420	499		75
2001		6075	728		300
2002		6028	812		
2003		5808	789		250
2004		5061	682		
2005		7476	567		150
2006		9972	845		150
Total	**370,000**	**84,443**	**29,143**	**3700**	**2254**

LAKE MANAGEMENT RECOMMENDATIONS

Sterling Lake's water quality was better than other lakes in Lake County, due to the presence of Zebra Mussels and the lake's recent origin. Most of the water quality parameters were well below the averages of other lakes in the county that the LMU has monitored. The land surrounding Sterling Lake is owned by the LCFPD and is a good refuge for many wildlife species. To improve the quality of Sterling Lake the LMU has the following recommendations.

- **Creating a Bathymetric Map**

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

- **Lakes with Shoreline Erosion**

  On Sterling Lake, 22% of the shoreline had some type of erosion. Most of the erosion appeared to be where fishermen access the lake. Some type of control should be employed in these areas to allow access for fishing, but also protect the shoreline from further erosion. All of the eroded areas should be remediated to prevent additional loss of shoreline and prevent continued degradation of the water quality through sediment inputs. When possible, the shorelines should be repaired using natural vegetation instead of riprap or seawalls (Appendix D2).

- **Reduce Conductivity and Chloride Concentrations**

  The average conductivity reading in Sterling Lake has increased since 2001. Although the seasonal average chloride concentration was below the county median, it was still high enough to potentially have impacts on aquatic life. The use of road salts for winter road management is a major contributor to chloride concentrations and conductivity. Proper application procedures and alternative methods can be used to keep these concentrations to a minimum (Appendix D3).

- **Participate in the Volunteer Lake Monitoring Program (VLMP)**

  To track future water quality trends, it is recommended the lake become enrolled in the Volunteer Lake Monitoring Program (VMLP), which trains a volunteer to measure the Secchi disk readings on a bimonthly basis from April to October (Appendix D4). In addition to the VMLP, a staff gauge should be installed to monitor the lake level each month.

- **Lakes with high Canada Geese populations**

  Sterling Lake had a large goose population present during the 2007 season. The presence of geese can contribute to the nutrients in the lake. Methods should be taken to control and discourage the geese congregating around the lake. A possible reason for the geese residing could be people feeding them. Even though signs saying “No Feeding Waterfowl” were posted around the lake, LCFPD staff should enforce this ordinance. (Appendix D5).

Beaver management

A beaver lodge was observed on the southeast end of Sterling Lake. Although the lodge seems to be providing good habitat for many aquatic animals, it should be monitored. Beavers can damage trees along the shoreline and can also dam the outlet causing an increase in water level and increased shoreline erosion (Appendix D6).

Grant program opportunities

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

APPENDIX A. METHODS FOR FIELD DATA COLLECTION AND LABORATORY ANALYSES

Water Sampling and Laboratory Analyses

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

Plant Sampling

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

Shoreline Assessment

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

> None – Includes man-made erosion control such as beach, rip-rap and sea wall.
>
> Slight – Minimal or no observable erosion; generally considered stable; no erosion control practices will be recommended with the possible exception of small problem areas noted within an area otherwise designated as “slight”.

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

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

Wildlife Assessment

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

Table A1. Analytical methods used for water quality parameters.

Parameter	*Method*
Temperature	Hydrolab DataSonde® 4a or YSI 6600 Sonde®
Dissolved oxygen	Hydrolab DataSonde ®4a or YSI 6600 Sonde®
Nitrate and Nitrite nitrogen	USEPA 353.2 rev. 2.0 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

Sterling Lake 2007 Multiparameter data

Date MMDDYY	Text Depth feet	Dep25 feet	Temp øC	DO mg/l	DO% Sat	SpCond mS/cm	pH Units	PAR æE/s/mý	Depth of Light Meter feet	% Light Transmission Average	Extinction Coefficient 0.21
05/15/2007	0.5	0.502	18.05	8.36	88.6	0.936	8.24	2173.7	Surface		
05/15/2007	1	1.064	18.05	8.32	88.2	0.936	8.21	2310.9	Surface	100%	
05/15/2007	2	2.117	18.04	8.33	88.3	0.936	8.21	1011.6	0.447	44%	1.85
05/15/2007	3	3.023	18.02	8.29	87.8	0.937	8.22	568.9	1.353	25%	0.43
05/15/2007	4	3.897	18.01	8.27	87.6	0.937	8.22	427.2	2.227	18%	0.13
05/15/2007	6	6.012	18.00	8.24	87.3	0.937	8.22	283.0	4.342	12%	0.09
05/15/2007	8	8.053	17.99	8.23	87.1	0.937	8.22	201.7	6.383	9%	0.05
05/15/2007	10	10.043	17.97	8.22	87.0	0.937	8.22	153.0	8.373	7%	0.03
05/15/2007	12	12.011	17.96	8.20	86.8	0.937	8.22	120.2	10.341	5%	0.02
05/15/2007	14	13.971	17.91	8.19	86.6	0.937	8.22	99.7	12.301	4%	0.02
05/15/2007	16	16.008	17.82	8.15	86.0	0.937	8.22	85.8	14.338	4%	0.01
05/15/2007	18	18.070	17.65	8.08	85.0	0.937	8.21	73.5	16.400	3%	0.01
05/15/2007	20	19.990	17.50	8.02	84.1	0.937	8.20	57.7	18.320	2%	0.01
05/15/2007	22	22.015	16.77	7.67	79.1	0.937	8.16	45.2	20.345	2%	0.01
05/15/2007	24	24.060	13.50	6.23	59.9	0.929	7.96	32.6	22.390	1.4%	0.01

Date MMDDYY	Text Depth feet	Dep25 feet	Temp øC	DO mg/l	DO% Sat	SpCond mS/cm	pH Units	PAR æE/s/mý	Depth of Light Meter feet	% Light Transmission Average	Extinction Coefficient 0.15
06/19/2007	0.5	0.504	25.83	3.62	44.6	0.916	8.37	3628.3	Surface		
06/19/2007	1	1.052	25.84	3.52	43.4	0.916	8.35	3571.6	Surface	100%	
06/19/2007	2	2.158	25.85	3.25	40.0	0.916	8.35	2057.6	0.488	58%	1.13
06/19/2007	3	3.116	25.85	2.93	36.1	0.916	8.35	454.9	1.446	13%	1.04
06/19/2007	4	3.959	25.84	2.55	31.4	0.916	8.35	1107.0	2.289	31%	-0.39
06/19/2007	6	6.054	25.84	2.38	29.3	0.916	8.35	1134.8	4.384	32%	-0.01
06/19/2007	8	7.964	25.83	2.24	27.7	0.916	8.35	950.9	6.294	27%	0.03
06/19/2007	10	9.968	25.82	2.09	25.8	0.916	8.35	566.0	8.298	16%	0.06
06/19/2007	12	12.054	25.81	1.97	24.3	0.916	8.35	554.9	10.384	16%	0.00
06/19/2007	14	14.099	25.80	1.90	23.4	0.916	8.35	458.9	12.429	13%	0.02
06/19/2007	16	15.865	24.23	1.53	18.2	0.921	8.11	357.5	14.195	10%	0.02
06/19/2007	18	18.121	22.83	1.24	14.4	0.922	7.97	264.0	16.451	7%	0.02
06/19/2007	20	19.918	21.85	0.81	9.3	0.925	7.84	195.8	18.248	5%	0.02
06/19/2007	22	22.098	20.76	0.40	4.5	0.927	7.74	103.4	20.428	3%	0.03
06/19/2007	24	23.907	19.59	0.10	1.1	0.931	7.68	70.9	22.237	2%	0.02

Date MMDDYY	Text Depth feet	Dep25 feet	Temp øC	DO mg/l	DO% Sat	SpCond mS/cm	pH Units	PAR æE/s/mý	Depth of Light Meter feet	% Light Transmission Average	Extinction Coefficient 0.31
07/17/2007	0.5	0.500	25.45	9.15	112.0	0.931	8.46	3093.8	Surface		
07/17/2007	1	1.011	25.44	9.16	112.1	0.931	8.43	2906.7	Surface	100%	
07/17/2007	2	2.007	25.42	9.16	112.0	0.930	8.43	820.5	0.337	28%	3.75
07/17/2007	3	3.009	25.37	9.15	111.8	0.930	8.43	791.1	1.339	27%	0.03
07/17/2007	4	3.995	25.30	9.16	111.7	0.930	8.43	900.6	2.325	31%	-0.06
07/17/2007	6	6.058	25.30	9.18	112.0	0.930	8.42	761.9	4.388	26%	0.04
07/17/2007	8	8.005	25.31	9.16	111.8	0.930	8.42	573.7	6.335	20%	0.04
07/17/2007	10	10.012	25.30	9.17	111.8	0.930	8.42	416.5	8.342	14%	0.04
07/17/2007	12	12.022	25.21	9.21	112.1	0.930	8.42	529.6	10.352	18%	-0.02
07/17/2007	14	14.032	25.17	9.25	112.6	0.930	8.42	323.3	12.362	11%	0.04
07/17/2007	16	15.981	24.62	7.47	90.0	0.932	8.32	159.4	14.311	5%	0.05
07/17/2007	18	18.052	24.58	6.94	83.5	0.933	8.27	206.8	16.382	7%	-0.02
07/17/2007	20	20.013	24.32	6.02	72.1	0.935	8.20	99.9	18.343	3%	0.04
07/17/2007	22	21.972	24.02	4.92	58.6	0.936	8.11	41.6	20.302	1.4%	0.04
07/17/2007	24	24.011	23.35	2.41	28.3	0.939	7.98	35.8	22.341	1.2%	0.01

Sterling Lake 2007 Multiparameter data

Date MMDDYY	Text Depth feet	Dep25 feet	Temp øC	DO mg/l	DO% Sat	SpCond mS/cm	pH Units	PAR æE/s/mý	Depth of Light Meter feet	% Light Transmission	Extinction Coefficient
										Average	0.17
08/14/2007	0.5	0.502	27.40	9.27	117.4	0.896	8.61	3872.2	Surface		
08/14/2007	1	1.037	27.39	9.30	117.8	0.896	8.56	3747.6	Surface	100%	
08/14/2007	2	2.116	27.32	9.45	119.5	0.897	8.56	1890.3	0.446	50%	1.53
08/14/2007	3	2.951	27.26	9.25	116.9	0.897	8.55	1294.3	1.281	35%	0.30
08/14/2007	4	4.000	27.19	9.29	117.3	0.896	8.55	1003.4	2.330	27%	0.11
08/14/2007	6	5.992	27.14	9.20	116.1	0.896	8.55	913.3	4.322	24%	0.02
08/14/2007	8	8.028	27.11	9.09	114.5	0.896	8.55	486.7	6.358	13%	0.10
08/14/2007	10	10.021	27.10	9.15	115.3	0.896	8.55	471.3	8.351	13%	0.00
08/14/2007	12	12.076	27.09	9.01	113.5	0.897	8.54	321.5	10.406	9%	0.04
08/14/2007	14	14.142	27.08	8.82	111.2	0.897	8.54	243.5	12.472	6%	0.02
08/14/2007	16	16.101	27.05	8.76	110.3	0.897	8.53	182.7	14.431	5%	0.02
08/14/2007	18	18.035	26.87	8.16	102.5	0.900	8.50	136.0	16.365	4%	0.02
08/14/2007	20	19.993	26.06	4.70	58.1	0.916	8.21	103.3	18.323	3%	0.02
08/14/2007	22	21.973	25.16	0.81	9.9	0.929	8.00	64.7	20.303	2%	0.02
08/14/2007	24	24.028	23.05	0.14	1.7	0.944	7.86	28.4	22.358	0.8%	0.04

Date MMDDYY	Text Depth feet	Dep25 feet	Temp øC	DO mg/l	DO% Sat	SpCond mS/cm	pH Units	PAR æE/s/mý	Depth of Light Meter feet	% Light Transmission	Extinction Coefficient
										Average	0.25
09/18/2007	0.5	0.461	20.74	13.93	155.9	0.885	8.43	3545.4	Surface		
09/18/2007	1	0.923	20.76	13.93	155.9	0.904	8.38	3477.0	Surface	100%	
09/18/2007	2	2.005	20.74	13.88	155.3	0.904	8.37	1735.8	0.335	50%	2.07
09/18/2007	3	2.922	20.74	13.91	155.6	0.904	8.35	431.1	1.252	12%	1.11
09/18/2007	4	4.021	20.70	13.83	154.6	0.904	8.34	780.7	2.351	22%	-0.25
09/18/2007	6	6.037	20.40	13.68	152.1	0.903	8.33	741.0	4.367	21%	0.01
09/18/2007	8	7.971	20.39	13.62	151.3	0.903	8.32	502.0	6.301	14%	0.06
09/18/2007	10	10.019	20.37	13.56	150.6	0.903	8.31	377.2	8.349	11%	0.03
09/18/2007	12	11.998	20.34	13.54	150.3	0.903	8.31	262.0	10.328	8%	0.04
09/18/2007	14	13.939	20.34	13.52	150.1	0.904	8.30	192.6	12.269	6%	0.03
09/18/2007	16	15.963	20.32	13.47	149.5	0.904	8.30	140.5	14.293	4%	0.02
09/18/2007	18	18.012	20.29	13.43	149.0	0.903	8.30	101.2	16.342	3%	0.02
09/18/2007	20	20.077	20.29	13.32	147.7	0.904	8.30	68.2	18.407	2%	0.02
09/18/2007	22	22.038	20.29	13.31	147.6	0.904	8.29	47.2	20.368	1.4%	0.02
09/18/2007	24	24.000	20.29	13.34	148.0	0.904	8.29	34.0	22.330	1.0%	0.01

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. 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.

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

Option 2: Install Rock Rip-Rap or Gabions

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

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

Option 3: Create a Buffer Strip

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

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

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

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

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

Option 5: Install A-Jacks®

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

D3. Options to Reduce Conductivity and Chloride Concentrations

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

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

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

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

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

Option 1. Proper Use on Your Property

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

Option 2. Examples of Alternatives

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

Calcium, Magnesium or Potassium Chloride

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

Calcium Magnesium Acetate (CMA)

- Mixture of dolomic lime and acetic acid; can also be made from cheese whey and may have even better ice penetration.
- Benefits: low corrosion rates, safe for concrete, low toxicity and biodegradable, stays on surfaces longer (fewer applications necessary).
- Multi-Purpose: use straight, mix with sodium chloride, sand or as a liquid
- Negatives: slow action at low temperatures, higher cost.

Agricultural Byproducts

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

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

Option 3. Talk to Your Municipality About Using an Alternative

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

D4. Participate in the Volunteer Lake Monitoring Program

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

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

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

For information, please contact:

VLMP Regional Coordinator:
Holly Hudson
Chicago Metropolitan Agency for Planning
233 S. Wacker Drive, Suite 880
Chicago, IL 60606
(312) 386-8700

D5. Options for Lakes with High Canada Geese Populations

Option 1: Removal

Since Canada Geese are considered migratory waterfowl, both state and federal laws restrict taking or harassing geese. Under the federal Migratory Bird Treaty Act, it is illegal to kill or capture geese outside a legal hunting season or to harass their nests without a permit. If removal of problematic geese is warranted or if nest and egg destruction becomes an option, permits need to be obtained from the Illinois Department of Natural Resources (217- 782-6384) and the U.S. Fish and Wildlife Service (217-241-6700). Removing a significant portion of a problem goose population can have a positive effect on the overall health of a lake. However, if the habitat conditions still exist, more geese will likely replace any that were removed. Thus, money and time used removing geese may not be well spent unless there is a change in habitat conditions.

Option 2: Dispersal/Repellent Techniques

Several techniques and products are on the market that claim to disperse or deter geese from using an area. These techniques can be divided into two categories: harassment and chemical. With both types of techniques it is important to implement any action early in the season, before geese establish territories and begin nesting. Once established, the dispersal/repellant techniques may be less effective and geese more difficult to coerce into leaving. Harassment techniques include scaring off geese with noisemakers, or chasing them off using dogs or swans. Chemical repellents may also be used with some effectiveness. New products are continually coming out that claim to rid an area of nuisance geese.

With persistence, harassment and/or use of repellants can result reduced or minimal usage of an area by geese. Fewer geese may mean less feces and cleaner yards and parks, which may increase recreational uses along shorelines. However, the effectiveness of harassment techniques is reduced over time since geese will adapt to the devices.

Option 3: Exclusion

Erecting a barrier to exclude geese is another option. In addition to a traditional wood or wire fence, an effective exclusion control is to suspend netting over the area where geese are unwanted. Geese are reluctant to fly or walk into the area. A similar deterrent that is often used is a single string or wire suspended a foot or so above the ground along the length of the shoreline. This technique will not be effective if the geese are using a large area. The single string or wire method may be effective at first, but geese often learn to go around, over, or under the string after a short period of time. Excluding geese from one area will force them to another area on a different part of the same lake or another nearby lake. While this solves one property owner's problem, it creates one for another.

Option 4: Habitat Alteration

One of the best methods to deter geese from using an area is through habitat alteration. Habitats that consist of mowed turfgrass to the edge of the shoreline are ideal for geese. Create a buffer strip (approximately 10-20 feet wide) between the shoreline and any mowed lawn by planting natural shoreline vegetation (i.e., bulrushes, cattails, rushes, grasses, shrubs, and trees, etc.) or allowing the vegetation to establish naturally. Aeration systems that run into the fall and winter prevent the lake from freezing, thus not forcing geese to migrate elsewhere. To alleviate this problem, turn aerators off during fall and early winter. Once the lake freezes over and the geese have left, wait a few weeks before turning the aerators on again if needed.

Altering the habitat in an area can not only make the habitat less desirable for geese, but may be more desirable for many other species of wildlife. A buffer strip has additional benefits by filtering run-off of nutrients, sediments, and pollutants and protecting the shoreline from erosion from wind, wave, or ice action. The more area that has natural vegetation, the less turfgrass needs to be constantly manicured and maintained.

Option 5: Do Not Feed Waterfowl!

There are few "good things", if any, that come from feeding waterfowl. Birds become dependent on handouts, become semi-domesticated, and do not migrate. This causes populations to increase and concentrate, which may create additional problems such as diseases within waterfowl populations. The nutritional value in many of the "foods" (i.e., white bread) given to geese and other waterfowl are quite low. Since geese are physiologically adapted to eat a variety of foods, they can actually be harmed by filling-up on human food. Geese that are accustomed to hand feeding may become aggressive toward other geese or even the people feeding the geese.

D6. Options for Beaver management

Option 1: Exclusion

One of the most successful options in beaver management is using exclusion techniques to prevent damage to valued resources, like shrubs and trees. Excluding the beavers from damaging trees and shrubs is accomplished by erecting a fence either around an area or individual plant. A height of four feet is necessary to prevent beaver from breaching the fence in winters with significant snow depths.

Excluding beaver from certain areas or individual plants will prevent the damage of the plants selected for protection. Exclusion of beavers may also force them to move to another more suitable location since their main source of food has been made inaccessible. Preventing beaver from damaging certain areas or plants may force them to select other areas or plants that are not protected. This may lead to having to exclude more areas or plants from damage than previously planned.

Option 2: Removal

Removing beavers from an area is usually done by live or kill trapping or shooting. Live traps may look like a box or an open clamshell. These traps usually need to be set on dry land so the captured beaver does not drown. Kill traps are usually set underwater, along a run, or at the surface of the water. Licenses are required to trap or shoot beaver in Illinois. Many municipalities prohibit discharging a firearm within its boundaries.

Trapping beavers will remove the nuisance animals from the immediate area. If a commercial trapper is used, nothing else needs to be done by the landowner. Physically removing beavers is a time consuming, often is short-lived, and is sometimes an expensive technique. Hiring someone to trap beaver can be costly and seldom are all beavers trapped out of an area. Even if all members of a population are trapped, it is likely that other beavers will immigrate into the habitat vacated by the trapped individuals.

Option 3: Habitat Alteration

Altering the habitat around the dam or lodge can also avert beaver damage. Removing the preferred foods (i.e., maple, aspen, and willow) and replacing or replanting with less preferred foods (i.e., pine or spruce) may reduce the amount of damage. Physically removing the dam or lodge may encourage the beaver to move elsewhere, but significant time and effort would be needed to alter the habitats around a lake. However, permits from the Illinois Department of Natural Resources are needed for this. Beaver may still gnaw on non-preferred food items. Damaged or removed dams may be rebuilt.

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

2000 - 2007 Water Quality Parameters, Statistics Summary

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

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

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

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

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

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

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

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

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

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

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

LakeCounty
Health Department and
Community Health Center

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 F. GRANT PROGRAM OPPORTUNITES

Table F1. 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 F1. Continued

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

CW = Chicago Wilderness
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