2000 SUMMARY REPORT

of

GRASSY LAKE

Lake County, Illinois

Prepared by the

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LAKE IDENTIFICATION AND LOCATION

Lake Name: Grassy Lake

County: Lake

Nearest Municipality: North Barrington

Location: T43N, R9E, Section 14, E 1/2

Watershed: Fox River

Sub-Basin: Flint Creek

Major Tributaries: Honey Lake Drain

Receiving Water Body: Grassy Lake Drain and into Flint Lake

Surface Area: 39.3 acres

Shoreline Length: Approximately 1.5 miles

Maximum Depth: 8.5 feet

Mean Depth: 4.25 feet (estimated)

Volume: 167.0 acre-feet (estimated)

Lake Type: Glacial Slough

Elevation: Approximately 752 feet above mean sea level

LIMNOLOGICAL DATA – WATER QUALITY

Water samples were taken once a month, May through September, at the deep-hole location near the lake's center (Figure 1). See Appendix A for water sampling methods used.

Grassy Lake's water quality was poor (Table 1). Most of the water quality parameters measured were higher than the averages of other lakes in the county that the Health Department has monitored. Several important findings were noted.

Total phosphorus (TP) levels at both sample depths averaged approximately three times higher (0.195 mg/L and 0.203 mg/L in the near surface and deep samples, respectively) than the county average of 0.066 mg/L. These values are significantly higher than the average TP value of 0.04 mg/L found at the near surface samples on Honey Lake (which drains into Grassy Lake) in 1998. The high TP levels in Grassy Lake are likely due to the shallow nature of the lake coupled with the extensive carp population in the lake that resuspend nutrients from the sediment into the water column. Additional nutrients may be entering the lake from stormwater run-off from the surrounding area.

The ratio between nitrogen and phosphorus for Grassy Lake was 9:1, indicating a system that is nitrogen-limited. Most lakes in Lake County are phosphorus limited. 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. Grassy Lake is classified as nitrogen-limited due to the extremely high levels of phosphorus more than a lack of nitrogen. The three types of nitrogen measured showed average values. In fact, average Total Kjeldahl nitrogen (TKN) levels at both depths were actually higher than the county average of 1.3 mg/L.

Grassy Lake had high amounts of all types of solids measured. All values were significantly higher than county averages. For example, the seasonal averages for total suspended solids (TSS) in the near surface samples (27.1 mg/L) and the deep samples (33.3 mg/L) were greater than three times the county average of 8.6 mg/L. Most of the suspended solids were from sediment rather than algae or other biological sources. Evidence for this is seen in the non-volatile suspended solids (NVSS) value of 19.1 mg/L. NVSS measures the amount of inorganic solids in the sample. NVSS concentrations greater than 10 mg/L indicate inorganic solids such as sediment, rather than organic solids like algae, dominate the sample. Sediment suspended in the water column or run-off from the inlets are the likely sources. Correlated with these high TSS readings were the low Secchi disk transparency readings. Grassy Lake had an average Secchi disk reading of 1.44 feet, which is considerably lower than the county average (5.0 feet). The high level of total dissolved solids (TDS), which are salts and other minerals, are likely from state highway 59 that is less than 500 feet from the lake. The two inlets that enter Grassy Lake flow under the highway just before entering the lake.

Grassy Lake had high conductivity readings in 2000. High conductivity readings strongly correlate with the high total dissolved solids found. High conductivity readings in May and June are likely from winter road salt applied to the highway.

The high levels of nutrients, solids, and poor Secchi disk readings may come from the flocculent bottom and shallow nature of Grassy Lake. Disturbance of the bottom, from wind and wave action and carp activity, resuspends sediment and nutrients into the water column. Lake County Health Department staff experienced several windy days on Grassy Lake in 2000. In addition large numbers of carp were seen throughout the season.

Water levels on Grassy Lake fluctuated over the season. Highest levels were found in April, lowest levels in September. The total water level decrease from April to September was 2.27 feet. Fluctuating water levels may have influenced the lake's water quality. As water levels declined the negative influence of carp activities exacerbated Grassy Lake's problems.

Grassy Lake only weakly stratified during the 2000 season. A thermocline was beginning to form at the 5-foot depth in May, but weakened in June and dissipated by July. Dissolved oxygen (DO) concentrations fluctuated through the season. The entire water column of Grassy Lake was fully oxic (> 1 mg/L DO) throughout the season. DO levels low enough to cause stress in fish (< 5 mg/L) were present below 7 feet in May and below 5 feet in July. In the outlet channel on the northwestern end of the lake, carp were frequently seen at or near the surface, gasping for air. No DO readings were measured in this shallow (< 3 feet) channel. Unless the carp problem is addressed, poor water quality will likely continue.

Rain events probably contributed additional sediment, nutrients (i.e., phosphorus), or dissolved solids (i.e., road salt) to a lake, which may have influenced the water sample results. Rain occurred within 48 hours prior to water sampling in May (0.28 inches recorded at the Stormwater Management Commission rain gauge in Lake Zurich), June (0.38 inches), and July (0.56 inches).

Based on data collected in 2000, standard classification indices compiled by the Illinois Environmental Protection Agency were used to determine the current condition of Grassy Lake. A general overall index that is commonly used is called a trophic state index or TSI. The TSI index classifies the lake into one of four categories: oligotrophic (nutrient-poor, biologically unproductive), mesotrophic (intermediate nutrient availability and biological productivity), eutrophic (nutrient-rich, highly productive), or hypereutrophic (extremely nutrient-rich productive). This index is calculated using total phosphorus values obtained at or near the surface. The TSI for Grassy Lake classified it as a hypereutrophic lake. Eutrophic lakes are the most common types of lakes throughout the Midwest. In Grassy Lake, the aquatic life impairment index was low, indicating a full degree of support for all aquatic organisms in the lake. However, the swimming index showed a degree of partial support and the recreation use index showed a degree of nonsupport. The Health Department did not test for bacteria or other harmful pathogens on Grassy Lake in 2000.

LIMNOLOGICAL DATA – AQUATIC PLANT ASSESSMENT

Aquatic plant species presence and distribution in Grassy Lake were assessed monthly from May through September 2000 (see Appendix A for methods). Only three aquatic plant species, coontail (*Ceratophyllum demersum*), curlyleaf pondweed (*Potamogeton crispus*), and duckweed (*Lemna minor*) were found. None of the plants present were found in significant numbers. The average plant sample depth and the maximum depth at which a plant was found was 3.7 feet.

The 1 % light levels (the point at which photosynthesis ceases) on Grassy Lake help explain the lack of plant growth. The 1% light levels averaged 3.3 feet over the season and were deepest in July (4.2 feet) and most shallow in September (2.2 feet). This is significant since the estimated mean depth of Grassy Lake, calculated on the known depths and volumes of other lakes in Wisconsin, is 4.25 feet. Thus, a significant portion of the lake is receiving inadequate light to sustain plant growth. Improving the water clarity will help improve plant growth in Grassy Lake.

LIMNOLOGICAL DATA – SHORELINE ASSESSMENT

The entire shoreline of Grassy Lake is comprised mostly of cattails, although some wooded areas are located on the eastern side of the lake. No erosion problems were noted. However, three homeowners around the lake have altered the shoreline adjacent to their property. One has a landscaped lawn and shrubs up to the water's edge. Two others have mowed lawn to the edge.

Purple loosestrife (*Lythrum salicaria*) was seen around Grassy Lake. While loosestrife stands are not problematic yet, continual monitoring for this exotic is recommended. Cattails currently dominate the shorelines and may be problematic in the future if current stands expand. Some buckthorn (*Rhamnus sp.*) was noted in the wooded area on the eastern shoreline.

LIMNOLOGICAL DATA – WILDLIFE ASSESSMENT

See Appendix A for methods. No fish surveys were part of this study. However, Grassy Lake has a strong population of carp, which contribute significantly to its poor water quality. Numerous wildlife species were noted, primarily birds, including one state threatened species (sandhill crane) and one state endangered (common tern). No nest for either bird was found. Good wildlife habitat exists around the entire perimeter of Grassy Lake.

Table 2. Wildlife species observed at and around Grassy Lake, May – September 2000.

Birds	
Double-crested Cormorant	*Phalacrocorax auritus*
Canada Goose	*Branta canadensis*
Mallard	*Anas platyrhnchos*
Common Tern*	*Sterna hirundo*
Great Egret	*Casmerodius albus*
Great Blue Heron	*Ardea herodias*
Green Heron	*Butorides striatus*
Sandhill Crane+	*Grus canadensis*
Red-tailed Hawk	*Buteo jamaicensis*
American Kestrel	*Falco sparverius*
Mourning Dove	*Zenaida macroura*
Belted Kingfisher	*Megaceryle alcyon*
Downy Woodpecker	*Picoides pubescens*
Common Flicker	*Colaptes auratus*
Eastern Kingbird	*Tyrannus tyrannus*
Eastern Phoebe	*Sayornis phoebe*
Willow Flycatcher	*Empidonax traillii*
Barn Swallow	*Hirundo rustica*
Tree Swallow	*Iridoprocne bicolor*
American Crow	*Corvus brachyrhynchos*
Blue Jay	*Cyanocitta cristata*
Black-capped Chickadee	*Poecile atricapillus*
Marsh Wren	*Cistothorus palustris*
American Robin	*Turdus migratorius*
Catbird	*Dumetella carolinensis*
Cedar Waxwing	*Bombycilla cedrorum*
Wilson's Warbler	*Wilsonia pusilla*
Yellow Warbler	*Dendroica petechia*
Common Yellowthroat	*Geothlypis trichas*
Red-winged Blackbird	*Agelaius phoeniceus*
Common Grackle	*Quiscalus quiscula*
Starling	*Sturnus vulgaris*
Northern Cardinal	*Cardinalis cardinalis*
House Finch	*Carpodacus mexicanus*
American Goldfinch	*Carduelis tristis*
Chipping Sparrow	*Spizella passerina*
Song Sparrow	*Melospiza melodia*
Mammals	
Muskrat	*Ondatra zibethicu*s

Amphibians

Western Chorus Frog	*Pseudacris triseriata triseriata*
Green Frog	*Rana clamitans melanota*
Bull Frog	*Rana catesbeiana*
American Toad	*Bufo americanus*

Reptiles

Snapping Turtle	*Chelydra serpentina*

Insects

Cicadas
Dragonfly
Damselfly
Tiger Swallowtail Butterfly
Sulfur Butterfly

*Endangered in Illinois
+Threatened in Illinois

EXISTING LAKE QUALITY PROBLEMS

- *Excess nutrients (particularly phosphorus)*

  Grassy Lake had high levels of phosphorus (nearly three times the county average). Resuspension of nutrients from wind and wave action and carp activity likely contributes to these results. Eradication of carp and subsequent revegetation of the lake may help reduce nutrient levels in the water column.

- *High levels of solids*

  All solid parameters measured (total solids, total suspended solids, total dissolved solids, and total volatile solids) were high. The shallow, floculant nature of Grassy Lake likely enables wind and wave action and carp activity to resuspend sediment into the water column. In addition, run-off from state highway 59 likely contributes salts and other minerals to the lake. As with the nutrient problem eradication of carp and subsequent revegetation of the lake may help reduce solid levels in the water column.

- *Lack of aquatic vegetation*

  Little aquatic vegetation was found in Grassy Lake. Poor water clarity, due mostly to the high sediment (solid) levels which limited adequate light penetration, is likely responsible. Eradication of carp may help improve water clarity and light penetration and promote vegetation growth.

- *Excessive numbers of carp*

  While no fish surveys were completed by the Health Department in 2000, numerous carp were seen throughout the lake. Carp activity is likely one of the reasons for the poor water quality and lack of aquatic vegetation in Grassy Lake. To rotenone the entire lake would cost $17,000-25,000 (based on $50-75 per gallon of rotenone). Application, removal of dead fish, and restocking would add to the cost. However, due to the position of Grassy Lake within its watershed, a rotenone treatment may only be effective for 3-5 years or less. Because Grassy Lake is a flow-through system (i.e., it receives water from the Honey Lake Drain and drains to Flint Lake), total eradication of carp will be difficult since Honey Lake also has a healthy carp population.

- *Exotic species present*

  Several purple loosestrife plants were noted, particularly in the outflow channel. It does not appear to be a problem at this time, but should be monitored. Buckthorn was noted in the wooded area on the eastern shoreline and should be removed.

Epilimnion

DATE	DEPTH	ALK	TKN	NH_3-N	NO_3-N	TP	SRP	TDS	TSS	TS	TVS	SECCHI	COND	pH	DO
5/3/00	1.5	197	1.97	<0.1	0.078	0.146	0.005	716	25	790	234	1.21	1.014	8.74	13.3
6/7/00	2	217	1.14	<0.1	0.095	0.112	0.026	608	26.9	695	236	1.44	1.023	8.21	11.1
7/5/00	2	189	1.05	0.103	0.507	0.173	0.069	522	16	537	167	2.03	0.7961	7.8	6
8/9/00	2	202	1.6	<0.1	0.115	0.303	0.054	534	24.6	553	147	1.54	0.8696	8.15	6.5
9/6/00	3*	221	1.98	<0.1	<0.05	0.242	0.096	558	43.2	651	173	0.98	0.9476	8.33	6.8
	Average	205	1.55	0.103[k]	0.199[k]	0.195	0.05	588	27.1	645	191	1.44	0.9301	8.25	8.7

Hypolimnion

DATE	DEPTH	ALK	TKN	NH_3-N	NO_3-N	TP	SRP	TDS	TSS	TS	TVS	SECCHI	COND	pH	DO
5/3/00	5.5	201	1.73	<0.1	0.067	0.168	0.005	666	52.8	739	199	NA	1.029	8.04	5.5
6/7/00	5	215	1.32	<0.1	0.146	0.126	0.021	600	31.2	702	196	NA	1.037	7.92	8.9
7/5/00	5	188	1.36	0.133	0.479	0.179	0.083	512	23.3	549	182	NA	0.7939	7.62	4.1
8/9/00	5	200	1.8	<0.1	0.115	0.337	0.061	514	25.8	557	201	NA	0.8687	8.12	6.2
	Average	201	1.553	0.133[k]	0.202	0.203	0.043	573	33.3	637	195	NA	0.9322	7.92	6.2

Glossary

ALK = Alkalinity, mg/L CaCO3
TKN = Total Kjeldahl nitrogen, mg/L
NH_3-N = Ammonia nitrogen, mg/L
NO_3-N = Nitrate nitrogen, mg/L
TP = Total phosphorus, mg/L
SRP = Soluble reactive phosphorus, mg/L
TDS = Total dissolved solids, mg/L
TSS = Total suspended solids, mg/L
TS = Total solids, mg/L
TVS = Total volatile solids, mg/L
SECCHI = Secchi Disk Depth, Ft.

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

Note: "k" denotes that the actual value is known to be less than the value presented
NA = Not Applicable
* = Only one sample was taken in September, due to low water level

Table 1. Vegetation Sampling Results for Grassy Lake, May - September, 2000.

Seasonal Summary 5/3/00-9/6/00	Coontail	Curlyleaf Pondweed	Duckweed
Num. of Sites	27	4	13
% Occurance	25%	4%	12%

Monthly Summary 5/3/00	Coontail	Curlyleaf Pondweed	Duckweed
Num. of Sites	1	2	0
% Occurance	20%	40%	0%

6/7/00	Coontail	Curlyleaf Pondweed	Duckweed
Num. of Sites	6	2	0
% Occurance	15%	5%	0%

7/5/00	Coontail	Curlyleaf Pondweed	Duckweed
Num. of Sites	12	0	13
% Occurance	30%	0%	33%

8/9/00	Coontail	Curlyleaf Pondweed	Duckweed
Num. of Sites	4	0	0
% Occurance	31%	0%	0%

9/6/00	Coontail	Curlyleaf Pondweed	Duckweed
Num. of Sites	4	0	0

% Occurance	40%	0%	0%

Plant Sampling Point Statistics

Average Sampling Depth	3.74 feet
Min. Sampling Depth	0.75 feet
Max Sampling Depth	8.4 feet
Max Plant Depth	8.4 feet
Total # of Samples	107

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 generally at the deepest point in the lake (see sample site map), three feet below the surface, and approximately two feet off the bottom. Samples were collected with a horizontal or vertical 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. TestAmerica Incorporated, an environmental services lab, analyzed samples collected for total Kjeldahl nitrogen (TKN). The Health Department lab analyzed all other samples. 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. Total Kjeldahl nitrogen was analyzed by method 351.2 from the Methods for Chemical Analyses of Water and Wastes (EPA 600 Series). 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 foot until reaching the bottom in lakes $\leq$ 15 feet deep, and every two feet in lakes >15 feet.

Plant Sampling

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 random locations in the littoral zone, 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, any plants on the rake were identified and recorded. Plants that were not found on the rake but were occularly 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. Approximate locations of each point were drawn on an aerial photo of the lake. Locations of the plant edge were also identified and marked on the aerial photo. The plant edge was defined as the area where aquatic plants presence dissipated, typically toward the deeper portions of the lake. The number of sample locations was contingent upon lake surface area, area of littoral zone, and presence and distribution of plants.

Shoreline Assessment

To assess the current condition of each lake's shoreline, a shoreline assessment was completed in 2000. This survey was conducted with the use of a boat, aerial photos, and county parcel maps. The shoreline along the land/water interface on each parcel was observed from a boat and various parameters were assessed (Table A2). Shorelines were first identified as developed or undeveloped. The type of shoreline was then determined and length of each type was recorded based on the parcel map or was occularly estimated. In addition, several other parameters were measured including: the extent of shoreline vegetation, the degree of slope and erosion, and the presence of inlets, recreational structures (including boats, canoes, jetskis, boat ramps, piers, boat lifts, swimming platforms, etc.), aerators, irrigation pumps, water control structures, invasive vegetation, beaver activity, and deadfall (trees or shrubs lying in the water).

Frequently a parcel consisted of several shoreline types. For example, a parcel may have a beach, a steel seawall, and rip-rap along the its shore. In this case, the parcel was subdivided into three separate sections.

Data was entered and analyzed in ArcView 3.2 © Geographic Information System (GIS) software. Total shoreline lengths and percentages for each category were determined using Excel software.

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
Dissolved oxygen	Hydrolab DataSonde ®4a
Nitrate nitrogen	Brucine method
Ammonia nitrogen	Electrode method, #4500F
Total Kjeldahl nitrogen	EPA 600 Series, Method 351.2
pH	Hydrolab DataSonde® 4a, Electrometric method
Total solids	Method #2540B
Total suspended solids	Method #2540D
Total dissolved solids	Method #2540C
Total volatile solids	Method #2540E, from total solids
Alkalinity	Method #2320B, titration method
Conductivity	Hydrolab DataSonde® 4a
Total phosphorus	Methods #4500-P B 5 and #4500-P E
Soluble reactive phosphorus	Methods #4500- P E and #4500-P B1
Clarity	Secchi disk
Color	Illinois EPA Volunteer Lake Monitoring Color Chart
Photosynthetic Active Radiation (PAR)	Hydrolab DataSonde® 4a, LI-COR® 192 Spherical Sensor

Table A2. Shoreline Type Categories and Assessment.

Category	*Assessment*
Developed	Yes, No
Inlets	None, Culvert, Creek, Farm Tiles, Storm Water Outlet, Swale, Sump
Shoreline Vegetation	None, Light, Moderate, Heavy
Type	Prairie, Shrub, Wetland, Woodland, Beach, Buffer, Canopy, Lawn, Rip-rap, Seawall, Vacant
Slope	Flat, Gentle, Steep
Erosion	None, Slight, Moderate, Severe
Water Control Structures	None, Culvert, Dam, Spillway
Recreational Structures	Yes, No
Irrigation Present	Yes, No
Aerator Present	Yes, No
Invasive Vegetation	Yes, No
Beaver Activity	Yes, No
Deadfall	Yes, No