2003 SUMMARY REPORT
of
HALF DAY PIT

Lake County, Illinois

Prepared by the

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LAKE IDENTIFICATION AND LOCATION

Lake Name: Half Day Pit

County: Lake

Nearest Municipality: Lincolnshire

Location: T43N, R11E, Section 14

Watershed: Des Plaines River

Sub-Basin: Lower Des Plaines River

Major Tributaries: None

Receiving Water Body: Des Plaines River

Surface Area: 14.1 acres

Shoreline Length: 0.9 miles

Maximum Depth: 14.1 feet

Mean Depth: 7.1 feet (estimated)

Volume: 99.4 acre-feet (estimated)

Lake Type: Borrow Pit

Elevation: Approximately 638 feet above mean sea level

EXECUTIVE SUMMARY

Half Day Pit's water quality is poor, compared to many lakes in Lake County. Most of the water quality parameters measured were above the medians of other lakes that we have monitored.

Water clarity, as measured by Secchi disk transparency readings, averaged 1.60 feet for the season, which is well below the county median of 3.41 feet. Secchi disk readings were deepest in May (2.33 feet), then decreased as the season progressed with a low of 1.02 feet in September. Correlated with the decrease in clarity during the season was the increase in total suspended solids (TSS). The 2003 TSS epilimnetic average (21.3 mg/L) was nearly three times the county median (7.5 mg/L). The source of these sediments could be from carp activity, which suspends sediment from the lake bottom, or from sediment from the Des Plaines River, which frequently floods the lake.

Total phosphorus (TP) concentrations in Half Day Pit were well above the county median. The 2003 average TP concentration was 0.169 mg/L in the epilimnion, which is nearly three times the county median for near surface samples (0.059 mg/L). Average total dissolved solid (TDS) concentration in the epilimnion (589 mg/L) was 31% above the county median of 451 mg/L. Similarly, the average conductivity reading in the epilimnion (1.069 milliSiemens/cm) was 42% higher than the county median of 0.7503 milliSiemens/cm. The possible causes for these high TDS concentrations and conductivity readings in Half Day Pit is input from dissolved solids washed into the lake from storm events in the watershed and from suspended sediment from the Des Plaines River. One of the most common dissolved solids is road salt used in winter road maintenance. Calculated chloride concentrations in the lake were at levels found to be detrimental to some aquatic species such as fish, zooplankton and benthic invertebrates.

Only three aquatic plant species (curlyleaf pondweed, sago pondweed, and Eurasian water milfoil (EWM)) were found in the lake. The most common aquatic plant in Half Day Pit was EWM which was found 21 times (31% of all sites). Poor water clarity, which limited light penetration, significantly reduced the potential plant growth in the lake.

A shoreline assessment was conducted in August 2003 to determine the condition of the lake shoreline. The most common shoreline type was shrub (84.9%), followed by riprap (9.1%) and woodland (6.0%). The riprap areas are poorly protecting the shoreline, since the riprap consisted of old concrete chunks being used in place of properly sized riprap. Approximately 42% or 2,564 feet of the shoreline of Half Day Pit was classified as slightly eroding. Moderate erosion was found along 827 feet or 15% of the shoreline and severe erosion was found on 965 feet or 17% of the shoreline around Half Day Pit. The moderately and severely eroded areas should be remediated immediately to prevent additional loss of shoreline and prevent continued degradation of the water quality. Several exotics were found growing along the shoreline, including buckthorn, common reed, honeysuckle, purple loosestrife, and reed canary grass. Buckthorn was the most common, particularly in the wooded and shrub habitats.

LIMNOLOGICAL DATA – WATER QUALITY

Half Day Pit is an old borrow pit created in the 1950's. See Figure 1 for an photograph of the area in 1939. Water samples were taken monthly from May - September at the deep-hole location (Figure 2). Water quality data was only collected in the main portion of the lake (i.e., western "pit"). Water from the eastern "pit," which is connected to the Des Plaines River, enters the western "pit" along the northeastern shoreline. See Appendix B for water sampling methods.

Half Day Pit's water quality is poor, compared to many lakes in Lake County (Table 1 in Appendix A). Most of the water quality parameters measured were above the averages or medians (where 50% of the lakes are above and below this value) of other lakes that we have monitored. Several important findings were noted.

Water clarity, as measured by Secchi disk transparency readings, averaged 1.60 feet for the season, which is well below the county median of 3.41 feet. Secchi disk readings were deepest in May (2.33 feet), then decreased as the season progressed with a low of 1.02 feet in September. Correlated with the decrease in clarity during the season was the increase in total suspended solids (TSS), since solids suspended in the water reduce the depth at which the Secchi disk can be seen (Figure 3). The TSS concentrations increased each month during the sampling season. The 2003 epilimnetic average (21.3 mg/L) was nearly three times the county median (7.5 mg/L). To determine the likely source of the TSS concentrations we calculated the amount of non-volatile, or inorganic, suspended solids (NVSS) found in the samples. The majority (>70%) of the TSS in Half Day Pit mainly consisted of NVSS throughout the season, meaning that the TSS concentrations were mostly from sources such as sediment and not organic sources (i.e., algae). The source of these sediments could be carp activity, which suspend sediment from the lake bottom, the Des Plaines River, or fluctuating water levels. Although Half Day Pit flows into the river, during high water levels there is backflow from the river which floods the lake. In addition, this propensity for flooding causes fluctuating water levels, which may cause shoreline erosion. This erosion may also be a contributing factor in the high TSS concentrations.

Total phosphorus (TP) concentrations in Half Day Pit were well above the county median. The 2003 average TP concentration was 0.169 mg/L in the epilimnion, which is nearly three times the county median for near surface (0.059 mg/L). Values above 0.03 mg/L in the epilimnion are considered sufficient enough to cause algae blooms. Some planktonic algae was noted during the season. As mentioned above, sediment is dominant in the water column and is a likely source of the high TP concentrations, since phosphorus can attach to and be released from sediment particles. Additional evidence for this can be found in the concentrations of soluble reactive phosphorus (SRP), which averaged 0.009 mg/L in the epilimnion. In many county lakes, aquatic organisms quickly utilize SRP as it becomes available and it is usually found in concentrations below laboratory detection limits. In Half Day Pit, SPR concentrations were detectable in all samples.

Figure 1. 1939 photo.

Figure 2. Sample site

Figure 3. TSS and Secchi.

Half Day Pit had epilimnetic concentrations of total Kjeldahl nitrogen (TKN) that were 61% higher than the county median for near surface samples (1.970 mg/L and 1.220 mg/L, respectively). TKN is a measure of the organic nitrogen in the water. The higher concentrations are probably the result of the nitrogen that if from the Des Plaines River, which drains a very large watershed and receives millions of gallons of treated effluent each day.

High nutrient concentrations are usually indicative of water quality problems. Algae need light and nutrients, most importantly carbon, nitrogen (N) and phosphorus (P), to grow. Light and carbon are not normally in short supply (limiting). This means that nutrients (N&P) are usually the limiting factors in algal growth. Nitrogen, as well as carbon, naturally occur in high concentrations and come from a variety of sources (soil, air, etc.) that are more difficult to control than sources of phosphorus. To compare the availability of these nutrients, a ratio of total nitrogen to total phosphorus is used (TN: TP). Ratios < 10:1 indicate nitrogen is limiting. Ratios of >15:1 indicate phosphorus is limiting. Ratios >10:1, <15:1 indicate that there is enough of both nutrients for excessive algal growth. The average ratio between total nitrogen and total phosphorus for Half Day Pit in 2003 was 13:1, indicating a system that is neither nitrogen or phosphorus-limited. Most lakes in Lake County are phosphorus-limited. Lakes that are phosphorus-limited may be easier to manage, since controlling phosphorus is more feasible than controlling nitrogen or carbon.

Total dissolved solid (TDS) concentrations and conductivity readings were higher than the county medians. The average TDS concentration in the epilimnion (589 mg/L) was 31% above the county median of 451 mg/L. Similarly, the average conductivity reading in the epilimnion (1.069 milliSiemens/cm) was 42% higher than the county median of 0.7503 milliSiemens/cm. The possible causes for these high TDS concentrations and conductivity readings in Half Day Pit are water level fluctuations or input from dissolved solids washed into the lake during storm events. Bank erosion from the Des Plaines River and the shoreline around Half Day Pit may also be a source. One of the most common dissolved solids is road salt used in winter road maintenance. Because of the high conductivity readings, one additional parameter, chlorides, was calculated using a regression formula created with known chloride, TDS concentrations and conductivity. Chloride concentrations help determine if this was the case since most road salt is sodium chloride, calcium chloride, potassium chloride, magnesium chloride or ferrocyanide salts. The seasonal average for calculated chlorides in Half Day Pit in 2003 was 213 mg/L in the epilimnion and 242 mg/L in the hypolimnion. The IEPA standard for chloride is 500 mg/L. Once values exceed this standard the water body is deemed to be impaired, thus impacting aquatic life. It appears that the TDS is compounding in many lakes in the county. Some lakes in the county have seen a doubling of conductivity readings in the past 5-10 years. In a study by Environment Canada (equivalent to our USEPA), it was estimated that 5% of aquatic species such as fish, zooplankton and benthic invertebrates would be affected at chloride concentrations of about 210 mg/l. Additionally, shifts in algae populations in lakes were associated with chloride concentrations as low as 12 mg/l.

The lake was not stratified during the May sampling date. A weak thermocline was established in June at 9 feet. A stronger thermocline was established at 10 feet in July and 8 feet in August. By September the lake had completely turned over. Dissolved oxygen (DO) concentrations in Half Day Pit were at least 5 mg/L above 6.5 feet throughout the study. Generally concern arises when DO concentrations fall below 5 mg/L in the epilimnion. In 2003, all DO concentrations at the surface were >5mg/L. Anoxic conditions (where DO concentrations drop below 1 mg/L) did exist below approximately 12.5 feet in May, 7.5 feet in June and August, and 6.5 feet in July. Conditions in the lake (i.e., shallow morphology, water temperature, and algae prevalence) may cause DO concentrations to fluctuate widely, which may result in low DO concentrations at various times. In order to determine if these DO conditions are a problem, the percent of water volume at specific depths (preferably in one foot increments) is needed. Since no bathymetric map of Half Day Pit exists, an accurate assessment of the DO conditions in the lake cannot be made.

Water levels in Half Day Pit fluctuated throughout the season. The maximum one-month change in water level occurred from May to June (30.5 inch decrease), with a maximum seasonal change of 39.0 inches (decrease) during the study. Significant changes in water levels may have a negative impact on water quality. We observed minimal or no amount of water flowing from the eastern "pit" to the western "pit", except in May when the passage between the two "pits" was navigable in a canoe. Thus, the western "pit" was essentially isolated from the eastern "pit" for the remaining sampling months (June – September). This may explain why certain parameters (i.e., TP, TSS) increased as the season progressed due to the loss of volume in the western "pit", which concentrated the nutrients and solids. In addition, the fluctuating water levels on Half Day Pit potentially caused the shoreline erosion problems we observed (see **Shoreline Assessment** section). Water levels on Half Day Pit may be particularly susceptible to large fluctuations due to the influence of water from the Des Plaines River.

Rain events and resultant runoff can contribute additional sediment or nutrients (like phosphorus) to a lake, which may influence water sample results. Rain occurred within 48 hours prior to water sampling in each month, except August. July had the heaviest accumulation (0.93 inches) as recorded at the Lake County Stormwater Management Commission rain gage in Vernon Hills. Rain events probably did not influence water sample results during most of the season since minimal water exchange occurred between the two "pits", with the exception of May.

Based on data collected in 2003, standard classification indices compiled by the Illinois Environmental Protection Agency (IEPA) were used to determine the current condition of Half Day Pit. 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 can be calculated using total phosphorus values obtained at or near the surface. The TSIp for Half Day Pit in 2003 classified it as a hypereutrophic lake (TSIp = 78.2). Eutrophic lakes are the most

common types of lakes throughout the lower Midwest, and they are particularly common among manmade lakes. See Table 2 in Appendix A for a ranking of average TSIp values for Lake County lakes (Half Day Pit is currently #114 of 130). This ranking is only a relative assessment of the lakes in the county. The current rank of a lake is dependent upon many factors including lake origin, water source, nutrient loads, and morphometric features (volume, depth, substrate, etc.). Thus, a small, shallow, manmade lake with high nutrient loads may not achieve a high ranking even with intensive management.

In Half Day Pit, the IEPA aquatic life impairment index was low, indicating a full degree of support for all aquatic organisms in the lake. However, due to the poor water clarity the swimming and recreation indices indicated a degree of partial support. The degree of overall use of the lake was classified as a partial impairment. We did not test for bacteria or other harmful pathogens in Half Day Pit in 2003.

LIMNOLOGICAL DATA – AQUATIC PLANT ASSESSMENT

Aquatic plant species presence and distribution in Half Day Pit were assessed monthly from May through September 2003 (see Appendix B for methods). Both "pits" were sampled each month. Only three aquatic plant species (curlyleaf pondweed, sago pondweed, and Eurasian water milfoil (EWM)) were found (Table 3). Terrestrial shoreline plants were also noted, but not quantified.

The most common aquatic plant in Half Day Pit was EWM, which was found 21 times (31% of all samples; Table 4, Appendix A). Curlyleaf pondweed was found five times (7%) and sago pondweed was found three times (4%). Both EWM and curlyleaf pondweed are invasive exotics and are problematic in many lakes in the county. However, unless the water clarity in the lake is improved, the aquatic plant populations in the lake will remain depressed.

The 1% light levels (the point where plant photosynthesis ceases) were found at approximately 4.5 feet in June and July and only to a depth of 3.5 feet in August and September. This parallels the Secchi disk readings found in the lake. Due to the steep slopes in the lake, the majority of the lake bottom was not receiving adequate light for plant growth. It was estimated that approximately 1% of the lake bottom was covered with aquatic plants.

During the plant sampling we searched for the milfoil weevil (*Euhrychiopsis lecontei*) on EWM plants. This weevil attacks the tip and stem of the plant and is currently being used as a biological control for EWM in some lakes in the Midwest. The weevils are found naturally in many lakes. Unfortunately, no weevils were found in Half Day Pit in 2003. Due to the poor water clarity and the minimal amounts of EWM, the stocking of weevils for EWM management is not necessary at this time.

Floristic quality index (FQI; Swink and Wilhelm 1994) is an assessment tool designed to evaluate the closeness that the flora of an area is 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 aquatic plant in a lake is assigned a number between 1 and 10 (10 indicating the plant species most sensitive to disturbance). This is done for every floating and submersed plant species found in the lake. These numbers are averaged and multiplied by the square root of the number of species present to calculate an FQI. A high FQI number indicates that there are a large number of sensitive, high quality plant species present in the lake. Non-native species were counted in the FQI calculations for Lake County lakes. In 2003, Half Day Pit had a FQI of 2.9. The median FQI of lakes that we have studied from 2000-2003 is 14.0.

Table 3. Aquatic and shoreline plants on Half Day Pit, May - September 2003.

Aquatic Plants	
Eurasian Water Milfoil[#]	*Myriophyllum spicatum*
Curlyleaf Pondweed[#]	*Potamogeton crispus*
Sago Pondweed	*Stuckenia pectinatus*
Shoreline Plants	
Box Elder	*Acer negundo*
Silver maple	*Acer saccharinum*
Foxtail	*Alopecurus* sp.
Prairie Dogbane	*Apocynum cannabinum*
Swamp Milkweed	*Asclepias incarnata*
Sedges	*Carex spp.*
Oxeye Daisy	*Chrysanthemum leucanthemum*
Chicory[#]	*Cichorium intybus*
Dogwood	*Cornus sp.*
Queen Anne's Lace[#]	*Daucus carota*
Spikerush	*Eleocharis* sp.
Horsetail	*Equisetum* arvense
Ash	*Fraxinus* sp.
St. John's Wort	*Hypericum* sp.
Blue Flag Iris	*Iris hexagona*
White Sweet Clover[#]	*Melilotus alba*
Red Mulberry	*Morus rubra*
Honeysuckle[#]	*Lonicera* sp.
Purple Loosestrife[#]	*Lythrum salicaria*
Virginia Creeper	*Parthenocissus quinquefolia*
Reed Canary Grass[#]	*Phalaris arundinacea*
Timothy[#]	*Phleum pratense*
Common Reed[#]	*Phragmites australis*
Buckthorn[#]	*Rhamnus cathartica*
Poison Ivy	*Rhus radicans*
Elderberry	*Sambucus* sp.
Willow	*Salix sp.*

Table 3. Aquatic and shoreline plants on Half Day Pit, May - September 2003 (cont'd).

Softstem Bulrush	*Scirpus validus*
Nightshade[#]	*Solanum dulcamara*
Canada Goldenrod	*Solidago candensis*
Sow Thistle[#]	*Sonchus* sp.
Cattail	*Typha* sp.
Elm	*Ulmus* sp.
Wild Grape	*Vitis sp.*

[#] **Exotic species**

LIMNOLOGICAL DATA – SHORELINE ASSESSMENT

A shoreline assessment was conducted in August 2003 to determine the condition of the lake shoreline (see Appendix B for methods). Of particular interest was the condition of the shoreline at the water/land interface.

The entire shoreline of Half Day Pit was classified as undeveloped, as it is part of the Lake County Forest Preserve District. The most common shoreline type was shrub (84.9%), followed by riprap (9.1%) and woodland (6.0%; Figure 4). The shrub type was dominated by willow species. The riprap areas were poorly protecting the shoreline, since the riprap consisted of old concrete chunks being used in place of properly sized riprap. These broken concrete chunks are ineffective at absorbing wave energy, due in part to the flat surfaces of the concrete that actually deflect wave energy into the spaces between the slabs, eventually eroding the bank behind the concrete. It also appears that no filter fabric exists below the concrete.

The shoreline was assessed for the degree and type of shoreline erosion. Approximately 42% or 2,564 feet of the shoreline of Half Day Pit was classified as slightly eroding (Figure 5). Moderate erosion was found along 827 feet or 15% of the shoreline and severe erosion was found on 965 feet or 17% of the shoreline around Half Day Pit. The moderately and severely eroded areas should be remediated immediately to prevent additional loss of shoreline and prevent continued degradation of the water quality through sediment inputs. When possible, the shorelines should be repaired by using native plantings. Riprap and seawalls are considered less preferable.

Several exotics were found growing along the shoreline, including buckthorn, common reed, honeysuckle, purple loosestrife, and reed canary grass. Buckthorn was the most common, particularly in the wooded and shrub habitats. Similar to aquatic exotics, these terrestrial exotics are detrimental to the native plant ecosystems around the lake. Removal or control of exotic species is recommended.

Figure 4.

Figure 5.

LIMNOLOGICAL DATA – WILDLIFE ASSESSMENT

Good numbers of wildlife, particularly birds, were noted on and around Half Day Pit. See Appendix B for methods. Several of the species listed in Table 5 (below) were seen during spring or fall migration and were assumed not to be nesting around the lake.

Habitat around Half Day Pit was fair, due mostly to the urban environment in proximity to the lake. Also, the dominance of exotic species precludes a more diverse abundance of species due to the aggressiveness of these exotics. The scattered trees around the lake provide good habitat for many insectivorous birds. In addition, the proximity of the lake to the Des Plaines River is an asset, since the river serves as a habitat corridor for many fish and wildlife species. The river is the likely reason for the numbers of turtles seen during the season. Numerous eastern spiny softshell and painted turtles were observed, particularly in the eastern "pit."

We did not conduct any fish assessments of Half Day Pit in 2003. In addition, no historical data (particularly from the Illinois Department of Natural Resources) was found.

Table 5. Wildlife species observed on Half Day Pit, April – September 2003.

Birds	
Double-crested Cormorant	*Phalacrocorax auritus*
Canada Goose	*Branta canadensis*
Mallard	*Anas platyrhnchos*
Wood Duck	*Aix sponsa*
Blue-winged Teal	*Anas discors*
Great Egret	*Casmerodius albus*
Great Blue Heron	*Ardea herodias*
Green Heron	*Butorides striatus*
Killdeer	*Charadrius vociferus*
Spotted Sandpiper	*Actitis macularia*
Solitary Sandpiper	*Tringa solitaria*
Turkey Vulture	*Cathartes aura*
Belted Kingfisher	*Megaceryle alcyon*
Barn Swallow	*Hirundo rustica*
American Crow	*Corvus brachyrhynchos*
Blue Jay	*Cyanocitta cristata*
Black-capped Chickadee	*Poecile atricapillus*
Catbird	*Dumetella carolinensis*
Blue-gray Gnatcatcher	*Polioptila caerulea*
American Robin	*Turdus migratorius*
Red-eyed Vireo	*Vireo olivaceus*
Warbling Vireo	*Vireo gilvus*
Chestnut-sided Warbler	*Dendroica pensylvanica*

Table 5. Wildlife species observed on Half Day Pit, April – September 2003 (cont'd).

Palm Warbler	*Dendroica palmarum*
Yellow Warbler	*Dendroica petechia*
Ovenbird	*Seiurus aurocapillus*
Red-winged Blackbird	*Agelaius phoeniceus*
Common Grackle	*Quiscalus quiscula*
Starling	*Sturnus vulgaris*
Northern Oriole	*Icterus galbula*
Northern Cardinal	*Cardinalis cardinalis*
American Goldfinch	*Carduelis tristis*
Song Sparrow	*Melospiza melodia*
Mammals	
Eastern Chipmunk	*Tamias striatus*
Muskrat	*Ondatra zibethicu*s
Amphibians	
Western Chorus Frog	*Pseudacris triseriata triseriata*
Reptiles	
Painted Turtle	*Chrysemys picta*
Eastern Spiny Softshell Turtle	*Apalone spinifera*
Mussels	
Giant Floater	*Pyganodon grandis*
Insects	
Cicadas	
Dragonfly	
Damselfly	
Monarch Butterfly	

EXISTING LAKE QUALITY PROBLEMS AND MANAGEMENT SUGGESTIONS

Half Day Pit has very poor water quality compared to many of the other lakes in the county. Many of the water quality parameters measured were above county medians. The lake is used for public recreation (particularly fishing) and habitat for fish and wildlife.

- *Lack of a Quality Bathymetric Map*

  A bathymetric (depth contour) map is an essential tool for effective lake management since it provides critical information on the morphometric features of the lake (i.e., acreage, depth, 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. No such map for Half Day Pit exists.

- *High Concentrations of Nutrients and High Conductivity Readings*

  Half Day Pit had high average concentrations of total phosphorus, total Kjeldahl nitrogen, total suspended solids, and total dissolved solids (TDS). Many of these parameters were high due to the large amounts of dissolved ions and suspended sediment in the water column. Correlated with the high TDS concentrations were high conductivity readings, which is likely due to road salt used in winter road deicing. Calculated chloride concentrations were at levels found to be detrimental to some aquatic species such as fish, zooplankton and benthic invertebrates.

- *Shoreline Erosion*

  Moderate erosion occurred along 827 feet or 15% of the shoreline and severe erosion was found on 965 feet or 17% of the shoreline around Half Day Pit. The erosion is due to the steep shoreline slopes, improper riprap and the large water level fluctuations that occur in the lake. The riprap that is currently covering parts of the shoreline is inadequate and should be replaced or repaired.

- *Aquatic Exotic Plant Species*

  Very limited numbers of aquatic plants were found in the lake. Two of the three species, Eurasian water milfoil (EWM) and curlyleaf pondweed are exotic. EWM is the dominant aquatic plant and was found 31% of the sites. Due to the poor water clarity, and hence poor light penetration, only about 1% of the lake bottom was covered with plants.

- *Terrestrial Exotic Plant Species*

  Several other exotic species were found along Half Day Pit shoreline including buckthorn, common reed, honeysuckle, purple loosestrife, and reed canary grass Buckthorn was most common along the woodland and shrub habitat. These exotics have the potential to become a significant problem and should be removed or controlled to prevent their spread.