Willow Lake

Lake Status Report

Prepared for
Ramsey-Washington Metro Watershed District

April 2007

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Willow Lake
Lake Status Report

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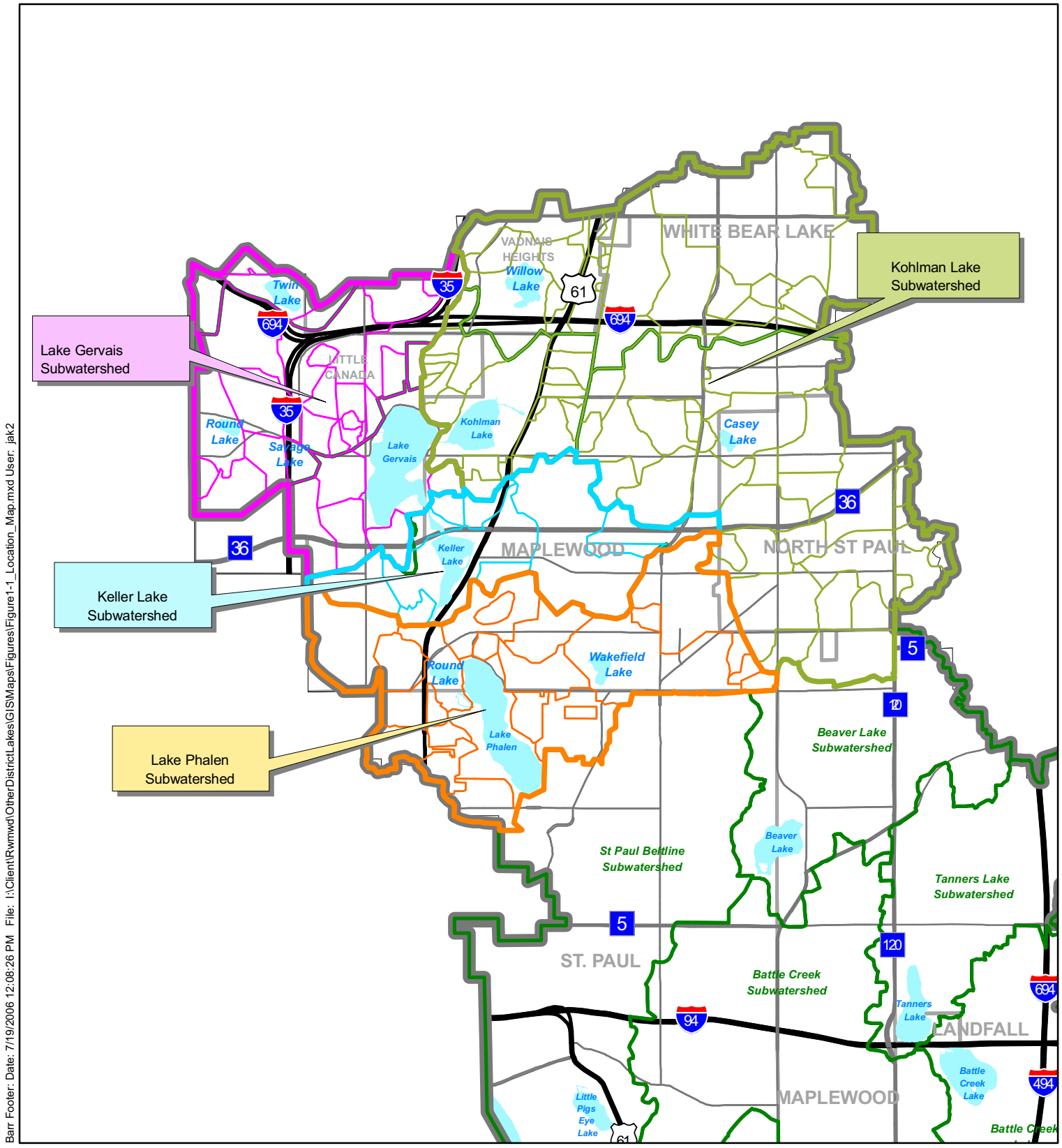
1.0 Introduction

One of the primary goals of the Ramsey-Washington Metro Watershed District (District) is to maintain or improve the quality of surface waters to meet or exceed the water quality necessary to support the District's designated beneficial uses. In 1997 the District established beneficial use categories based on desired recreational activities for a waterbody; and revisited again with the 2006 update as part of the development of the *Ramsey-Washington Metro Watershed District Watershed Management Plan* (Plan) (Barr, 1997; Barr, 2006 [draft]),. The recreational-use categories are ranked from Level 1 through Level 5, with Level 1 water bodies having the highest number of recreational uses and best water quality.

In order to help achieve desired water quality goals established in Plan, many of the lakes within the District have been studied in Strategic Lake Management Plans (SLMPs). However, for many of the smaller lakes within the District, SLMPs have not yet been completed and District water quality goals have not been re-evaluated. Because of limited lake information and water quality data, the development of a complete SLMP would not be possible for many of these small water bodies. Instead, a Lake Status Report (LSR) will be developed and recommendations will be made to outline future studies for these lakes.

The purpose of this LSR is to summarize and evaluate the available information for Willow Lake which has not been previously studied and to determine appropriate water quality goals based on the current and desired recreational uses, as outlined in the Plan, and through discussion with District staff. The watershed areas tributary to Willow Lake has already been modeled as part of the development of the larger Phalen Chain of Lakes SLMP (Barr, 2004 [Draft]). Figure 1-1 shows the location of Willow Lake.

The Plan (Barr, 2006 [draft]) includes preliminary water quality goals and management classes for each of the District-managed lakes. The water quality goals are defined in terms of total phosphorus (TP), chlorophyll *a* (Chl *a*), and Secchi disc (SD). The goals outlined in the Plan will remain preliminary until an SLMP or other similar study, such as this LSR, is completed and appropriate goals are determined. The preliminary goals are consistent with either the Minnesota Pollution Control Agency's (MPCA) proposed draft criteria for shallow lakes in the North Central Hardwood Forests (CHF) ecoregion (MPCA, 2005), or the goals listed in the 1997 Plan.



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Feet
6,000 0 6,000

Figure 1-1

Location Map

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For lakes, the District management classes are identified as either "Improvement" or "Prevent further degradation." An "Improvement" class is warranted if the public perceives a need for water quality improvement and there are feasible management options that will accomplish water quality improvement. A "Prevent further degradation" class is assigned when current water quality meets the goals set for the lake. A "Prevent further degradation" class does not, however, imply inaction. Rather, development requirements, fisheries, shoreline, and macrophyte management; as well as additional water quality improvement projects; are pursued for the lake as opportunities and budgets allow.

For wetlands, the District has developed management Classes A, B, and C, based on a recent inventory and assessment of wetlands within the District. The wetland classification is based on the estimated quality of the wetland, with management Class A being the highest quality wetlands. Water bodies classified as "Water Quality Pond" are constructed treatment ponds only.

Additional classifications of the water bodies based on water quality include the Impaired Waters List under Section 303(d) of the *Federal Clean Water Act* (CWA). Those water bodies that do not meet the water quality standards established under the CWA are included on this list and future development of total maximum daily loads (TMDL) is required. The Minnesota Department of Natural Resources (MDNR) has developed another ecological management classification system for Minnesota lakes (Schupp, 1992) that is based on parameters such as lake size, depth, chemical fertility, and growing season length.

Table 1-1 summarizes the goals and classifications of Willow Lake. Note that for District-managed wetlands there are no water quality goals established. Additionally, note that the 2006 Preliminary RWMWD Water Quality Goals are those listed in the Plan (Barr, 2006 [draft]). The 2006 Proposed RWMWD Water Quality Goals are the result of this LSR and evaluation of the information available for Willow Lake.

Table 1-1 Summary of RWMWD Recreational-Use Level (2006 Draft Plan), Preliminary RWMWD Water Quality Goals (2006 Draft Plan), Proposed RWMWD Goals (Result of LSR), and Management Class (2006 Draft Plan) as well as 303(d) Impaired Waters and MDNR Ecological Management Class

Water Body	RWMWD Use Level	2006 Preliminary RWMWD Water Quality Goal	2006 Proposed RWMWD Water Quality Goal	RWMWD Management Class	303(d) Impaired Waters Pollutant	MDNR Ecological Class
Willow Lake	3	60 µg/L TP [1,2] 20 µg/L Chl*a* [1,2] 3.3 ft SD [1,2]	60 µg/L TP[1] 20 µg/L Chl*a*[1] 3.3 ft SD[1]	Prevent further degradation	N/A	40

1- Water quality goals are consistent with the MPCA's draft criteria for shallow lakes in the North Central Hardwood Forests (CHF) ecoregion (Minnesota Lake Water Quality Assessment Report: Developing Nutrient Criteria. Third Edition, September, 2005)

2- Goals remain preliminary until a SLMP or other similar study is completed and appropriate goals are determined

2.0 Lake Status Summary

2.1 Willow Lake

2.1.1 Lake and Watershed Characteristics

2.1.1.1 Description of Willow Lake

Willow Lake is located north of Interstate Highway 694 in Vadnais Heights (Township 30, Range 22, Section 33) and is a 75-acre District-managed lake. It is classified as Protected Public Water in the MDNR Public Waters Inventory (62-40P), and it meets the shallow lake criteria as outlined by MPCA (MPCA, 2005).

The maximum depth of Willow Lake is 6 feet. Approximate bathymetric contours have been created using lake survey data gathered by the District in 2002 and are seen in Figure 2-1. Historic lake level data is available for Willow Lake from 1986 to 2006 (See Figure 2-2).

Discharge from the lake flows into Willow Creek (formerly County Ditch 16) which is located just to the east of the lake. A dike was constructed in the early 1980s that diverted the flow of Willow Creek around Willow Lake. During this project, a new outlet was created on the east side of Willow Lake and is a 42-inch CMP including a flap gate for the prevention of backflow into the lake. In addition to the outlet from Willow Lake to Willow Creek, there is also an adjustable weir structure located on Willow Creek just east of where the creek flows under Highway 61, downstream of the lake's primary outlet (See Figure 2-3). This structure is managed by Ramsey County, as the H.B. Fuller Company leases a portion of this land from the County. The NWL of the lake outlet is 880.5 feet MSL and the critical 100-year flood elevation for Willow Lake is 886.2 feet MSL (Barr, 2006 [Draft]). The extent of the 100-year critical flood level can be seen in Figure 2-4.

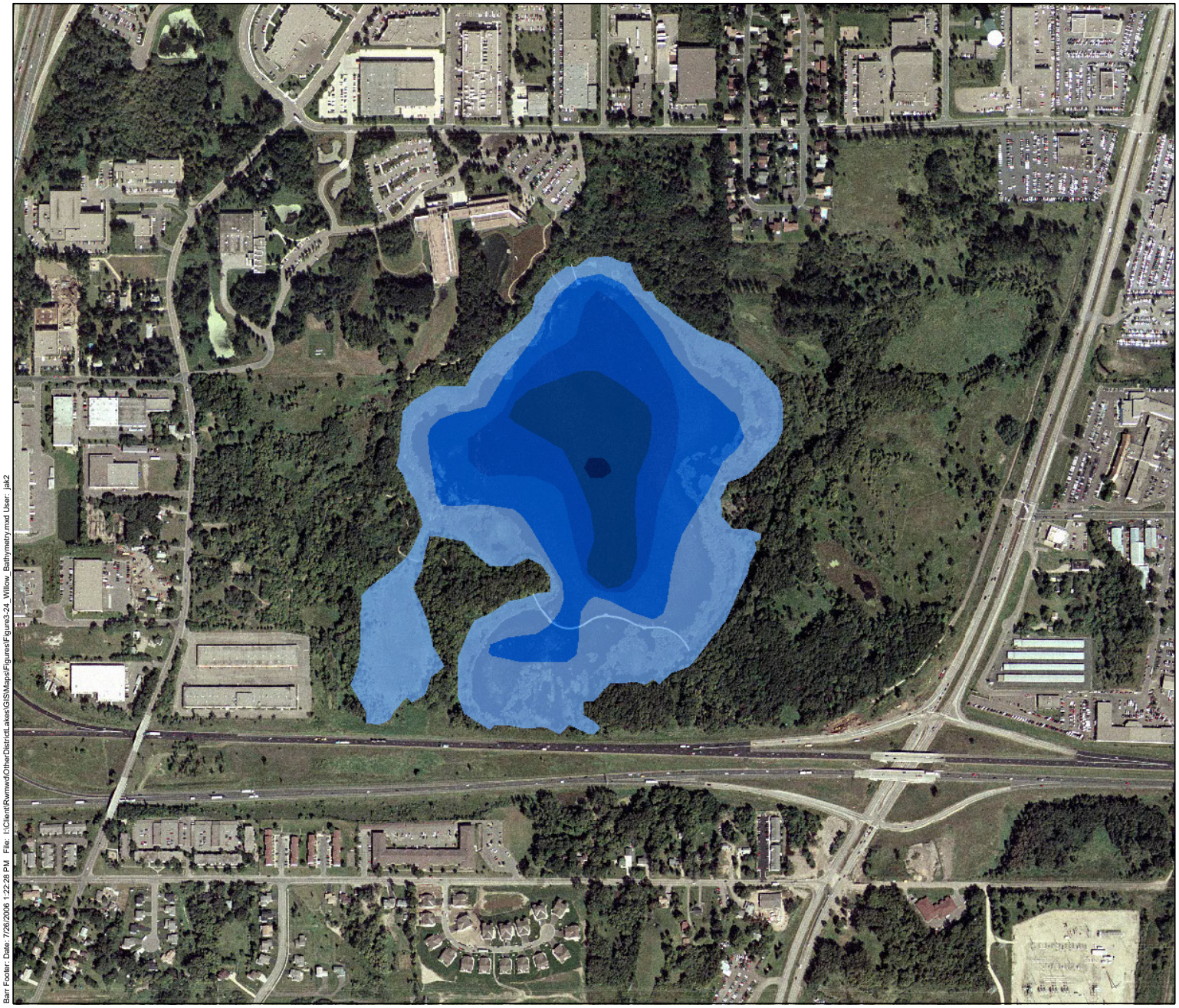
2.1.1.2 Watershed Characteristics

The Willow Lake watershed covers a 518.8-acre area (including lake surface area) north of I-694 in between I-35E and Highway 61, and it is part of the larger Kohlman Lake watershed. The breakdown of land use within the watershed is as follows: Commercial (8.9%), Highway (7.9%), High-density residential (3.2%), Institutional (0.6%), Industrial/office (21.6%), Low-density residential (10.8%), Medium-density residential (0.3%), Natural/park/open (20.9%), Open water (5.9%), and Wetland (19.9%). Willow Lake is included in both the Open water and wetland land use categories. Land use in the Willow Lake watershed is mapped in Figure 2-5.

Drainage from the watershed flows generally from the northwest into Willow Lake and two outfalls into the lake have been identified (per the District survey, 2002). There are a few stormwater treatment ponds located in the watershed upstream of Willow Lake. Willow Lake discharges to Willow Creek, and the drainage pattern of the Willow Lake watershed can be seen in Figure 2-6.

2.1.1.3 Recreational Uses

Willow Lake is completely surrounded by private land owned by the H.B. Fuller Company and has no public access locations. The entire preserve is surrounded by a locked, chain link fence. The Willow Lake Preserve has hiking trails as well as a pier that extends across the southern portion of the lake. It has been assigned a District recreational-use Level of 3, with current uses including canoeing, fishing, wildlife habitat, aesthetic viewing, and picnicking limited to H.B. Fuller employees and their families. Additionally, the Willow Lake Nature Preserve occasionally hosts school groups to provide hands-on educational opportunities.



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Legend

Depth

- 0 - 3.2 ft
- 3.2 - 5 ft
- 5 - 5.6 ft
- 5.6 - 6 ft
- 6+ ft

N

Feet

500 0 500

Figure 2-1

Willow Lake
Approximate Bathymetry

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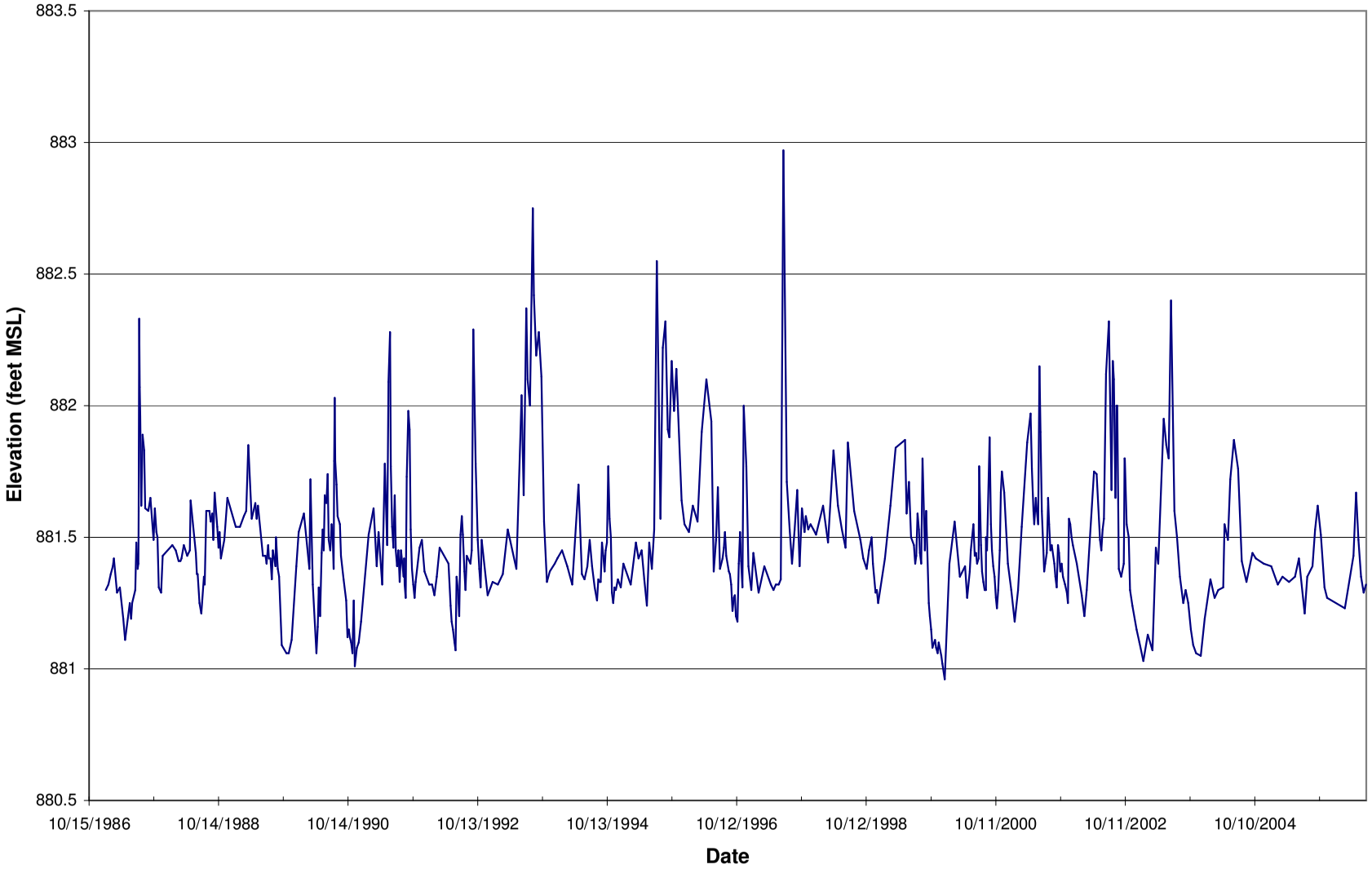


Figure 2-2
Willow Lake Historic Lake Levels
1986 - 2006

(a)

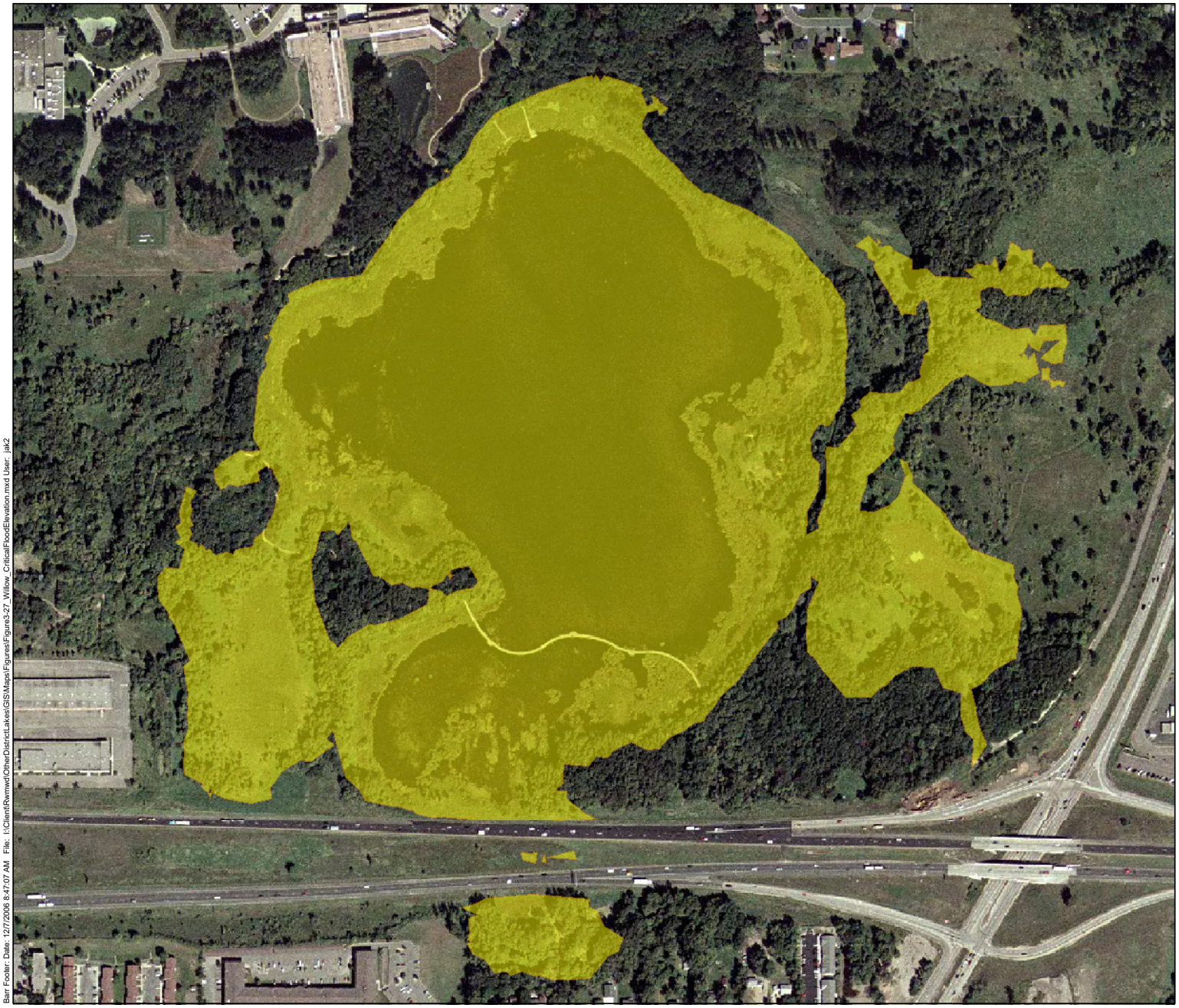
(b)

(c)

(d)

Figure 2-3

Channel from Willow Lake to Outlet Structure (a); Willow Lake Outlet Structure with Flap Gate (located along Willow Creek) (b); Entrance to Adjustable Weir Structure on Willow Creek (c); Looking down on Adjustable Weir Structure (located under Access/Hiking Path in H.B. Fuller Willow Lake Nature Preserve just west of Highway 61) (d)
(Photos Taken on 6/12/2006)



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Legend

Flood Elevation = 886.2 ft MSL

N

Feet

500 0 500

Figure 2-4

Willow Lake
Critical Flood Elevation

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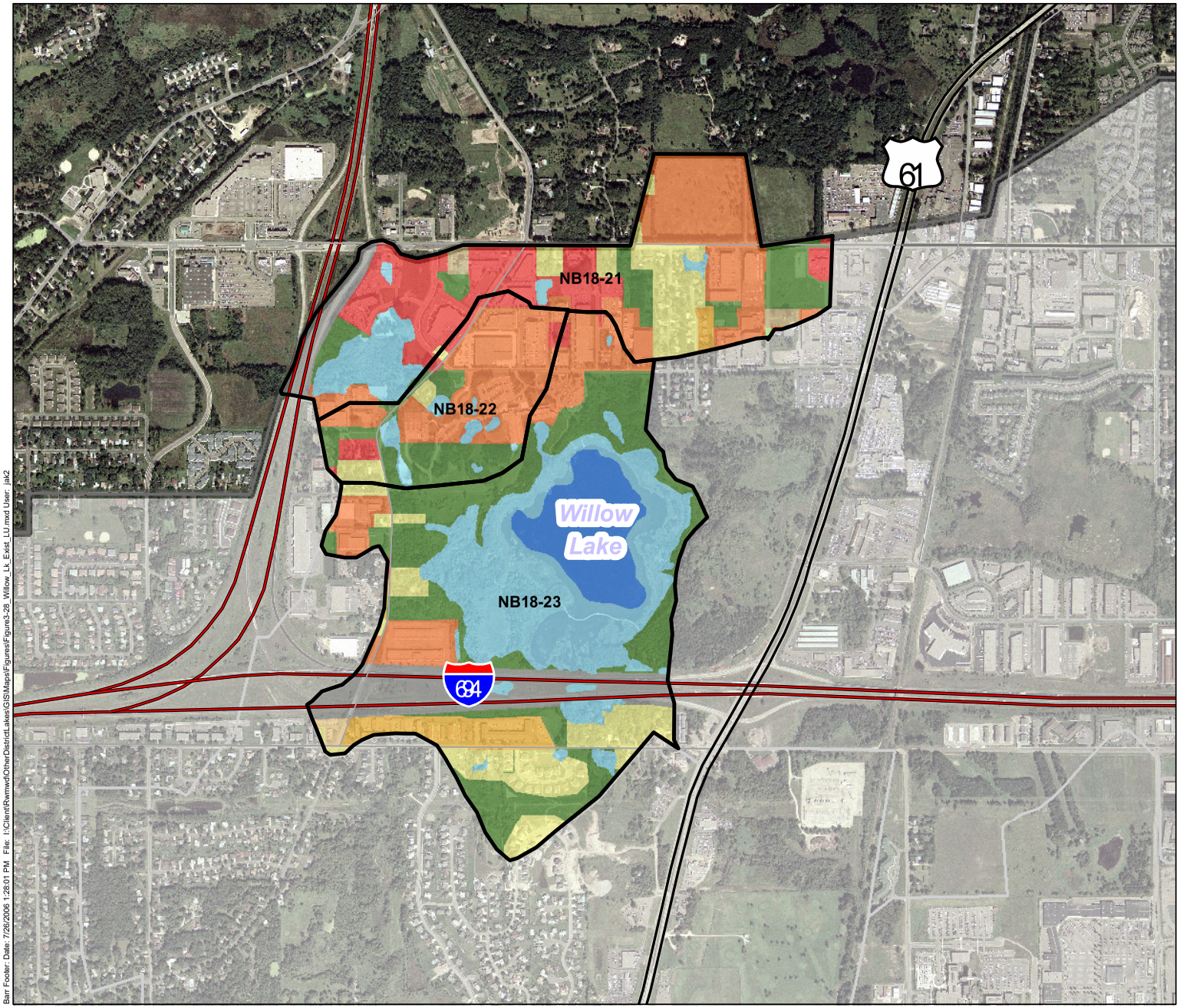

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Legend

Land Use

- Natural/Park/Open
- Developed Parkland
- Golf Course
- Agricultural
- Very Low Density Residential
- Low Density Residential
- Medium Density Residential
- High Density Residential
- Institutional
- Institutional - High Imperviousness
- Airport
- Highway
- Commercial
- Industrial/Office
- Other
- Open Water
- Wetland
- Willow Lake Subwatersheds
- RWMWD Boundary

N

Feet
1,000 0 1,000

Figure 2-5

Willow Lake Waterhsed
Land Use

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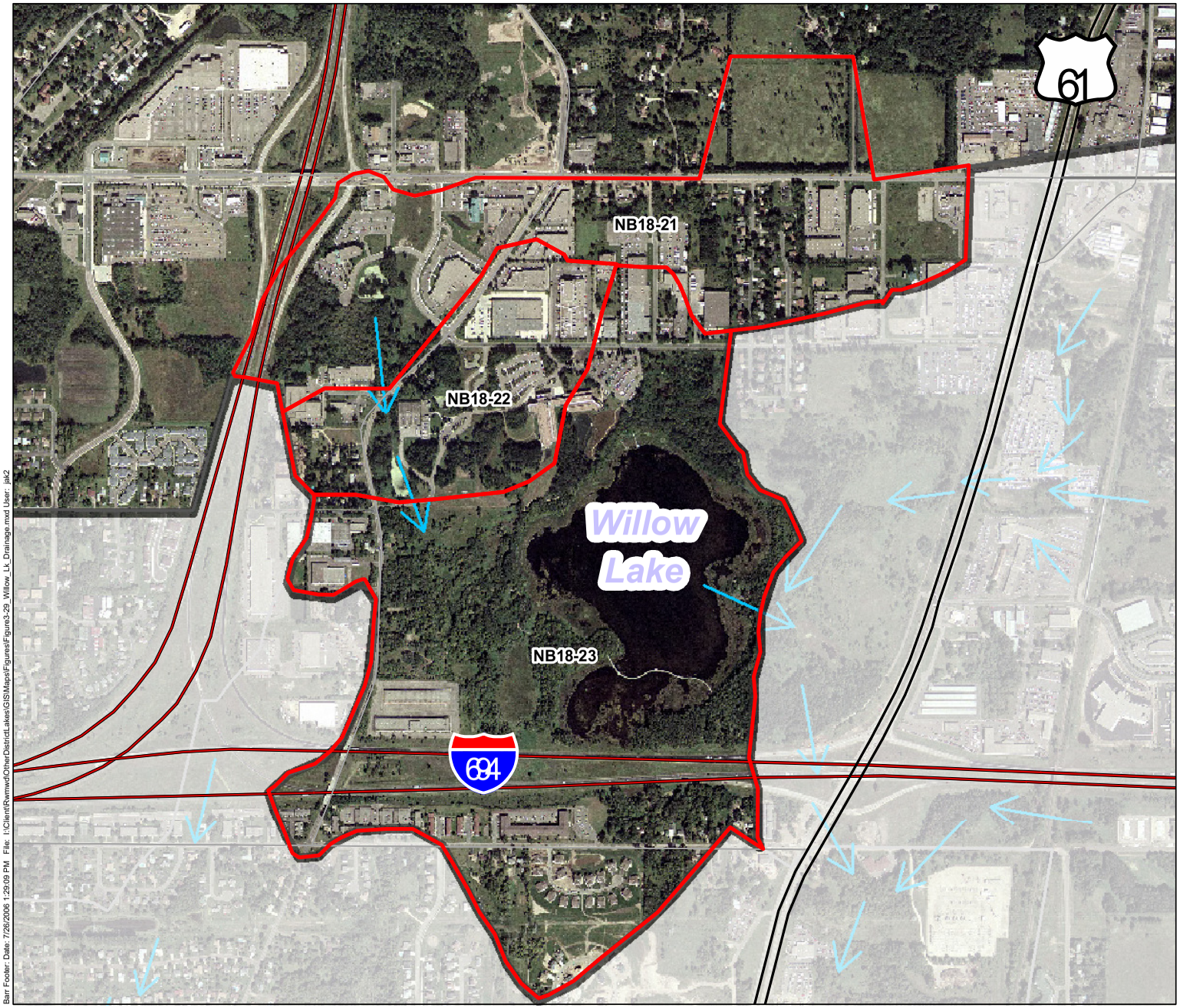

Legend

- Willow Lake Subwatersheds
- RWMWD Boundary
- Flow Direction

N

Feet

1,000 0 1,000

Figure 2-6

Willow Lake Watershed
Subwatersheds & Drainage

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2.1.2 Water Quality Data

2.1.2.1 Water Quality Analysis

Water quality data is available for Willow Lake from the early 1980's, including data for TP and Chl *a* concentrations as well as SD transparencies. More recent water quality data was collected (1996 to 2001) by the Willow Lake Nature Preserve (H.B. Fuller Company). The summer average TP and Chl *a* concentrations for the years of record in Willow Lake are 47 µg/L and 8 µg/L, respectively. The summer average SD transparency is 5.4 feet (1.65 meters). This data is summarized in Figure 2-7 below. Based on this data, the Carlson TSI for TP is 60. For Chl *a*, it is 51 while for average SD transparency, it is 53, suggesting that Willow Lake is a eutrophic lake. There was not sufficient data to run a trend analysis on the data available.

The most recent fishery survey was completed in 1987 by the MDNR. The survey suggests a lower quality fishery dominated by black bullhead, bluegill, and the hybrid sunfish. No macroinvertebrate, phytoplankton, or zooplankton surveys have been completed for Willow Lake.

2.1.2.2 P8 Modeling Results

The P8 model for Willow Lake watershed was run for wet, dry, and average climatic conditions. Water and total phosphorus loads to Willow Lake were determined for each climatic period. The results of this modeling are summarized in Table 2-1.

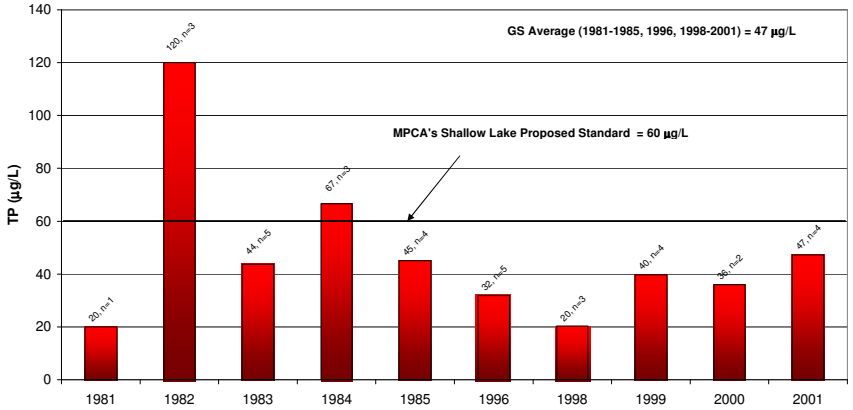
Table 2-1 P8 Estimated Watershed and TP Loads to Willow Lake under Wet, Dry, and Average Climatic Conditions

Climatic Condition (Water Year)	Parameter		Load
Wet (10/1/01-9/30/02)	Flow	ac-ft	603.6
	TP	lbs	688.93
Average (10/1/00-9/30/01)	Flow	ac-ft	676.71
	TP	lbs	637.09
Dry (10/1/88-9/30/89)	Flow	ac-ft	428.06
	TP	lbs	441.94

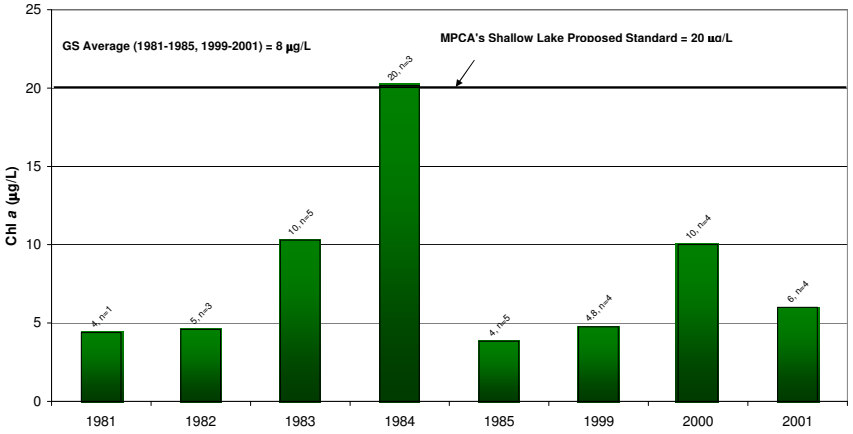
It is important to note that climatic condition periods were selected based on depths of precipitation over a 17-month period that included the summer before the water year of interest because it is assumed that the water and TP load to the lake during this period affects the following year's spring TP concentration. During the 12-month period from October through September (the water year), however, the water load to the lake was slightly higher during the average year than the wet year.

Conversely, the TP load was higher in the wet year than in the average year over this 12-month period due to the fact that higher TP loading is often associated with the smaller, more frequent storm events like the ones that occurred between October 2001 and September 2002.

WILLOW LAKE
Growing Season (June through September) Average
Total Phosphorus Concentrations
1981-1985, 1996, 1998-2001



WILLOW LAKE
Growing Season (June through September) Average
Total Chlorophyll *a* Concentrations
1981-1985, 1999-2001



WILLOW LAKE
Growing Season (June through September) Average
Secchi Disc Transparencies
1982,1984-1985, 1996, 1998-2001

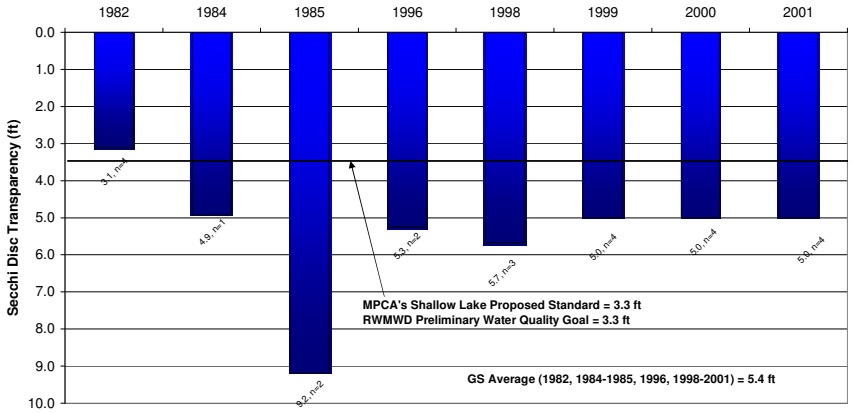


Figure 2-7
Willow Lake Growing Season Averages for Total Phosphorus, Chlorophyll *a*, and Secchi Disc Transparency

2.1.3 Recommendations

2.1.3.1 Water Quality Goals

Preliminary District water quality goals for TP, Chl *a*, and SD are listed in the updated 2006 draft *Watershed Management Plan* and are the same as those listed by the MPCA for shallow lakes in the North Central Hardwood Forest. The District management class is listed as "Prevent further degradation." Willow Lake is not listed on the CWA 303(d) Impaired Waters List and it has MDNR ecological class of 41 assigned, suggesting the presence of a lower quality fishery that has the potential to be upgraded with the implementation of specific management practices. See Table 1-1 for a summary of applicable classifications and goals established for Willow Lake. A comparison of the average values of TP, Chl *a*, and SD to the preliminary water quality goals established by the District shows that in all cases, Willow Lake meets the preliminary goal that has been set.

The Minnesota Lake Eutrophication Analysis Procedure (MINLEAP) is a screening tool for estimating lake conditions and for identifying "problem" lakes. In addition, MINLEAP modeling has been done in the past to identify Minnesota Lakes which may be better or worse than they "should be" based on their location, watershed area and lake basin morphometry.

Results from MINLEAP suggest that the expected water quality for a minimally impacted lake, similar to Willow Lake (based on its location within the Central Hardwood Forest ecoregion and with its basic basin and watershed characteristics), would be within the following ranges for TP, Chl *a*, and SD, respectively: 34 to 70 µg/L, 8 to 34 µg/L, and 0.8 to 1.8 meters. In each of these cases, the observed values fall within these ranges, suggesting that the water quality within Willow Lake is consistent with other similar lakes in the CHF ecoregion.

2.1.3.2 Further Studies

Because Willow Lake already has high water quality and meets and exceeds the 2006 District preliminary water quality standards, a prevention of further degradation management approach for this lake is appropriate.

A prevention of further degradation approach typically involves:

- Enforcement of rules to ensure that new developments do not increase the sediment and phosphorus leaving their sites.
- Monitoring of the fishery, specifically focusing on the presence of benthivorous fish such as carp.
- Monitoring of macrophytes.
- Evaluation of shoreline conditions.

3.0 Conclusions

In summary, Willow Lake has water quality data available as well as some fishery data. The Lake satisfies the proposed MPCA water quality criteria for shallow lakes.

Table 3-1 below summarizes the proposed District recreational-use levels, water quality goals, and management classes based on evaluation of the data available for Willow Lake.

Table 3-1 Summary of the Proposed RWMWD Recreational-Use Level, Water Quality Goals, and Management Class

Water Body	RWMWD Use Level	2006 RWMWD Water Quality Goal	RWMWD Management Class
Willow Lake	3	60 µg/L TP[1] 20 µg/L Chla[1] 3.3 ft SD[1]	Prevent further degradation

1- Water quality goals are consistent with the MPCA's draft criteria for shallow lakes in the North Central Hardwood Forests (CHF) ecoregion (Minnesota Lake Water Quality Assessment Report: Developing Nutrient Criteria. Third Edition, September, 2005)

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Appendix A

Fisheries and Biological Data

Name: WILLOW

Nearest Town: WHITE BEAR LAKE
Primary County: Ramsey

Survey Date: 09/10/1987
Inventory Number: 62-0040-00

Lake Characteristics

Lake Area (acres): N/A
Littoral Area (acres): N/A
Maximum Depth (ft): 5.00
Water Clarity (ft): N/A

Dominant Bottom Substrate: N/A
Abundance of Aquatic Plants: N/A
Maximum Depth of Plant Growth (ft): N/A

Fish Sampled for the 1987 Survey Year

Species	Gear Used	Number of fish per net Caught	Normal Range	Average Fish Weight (lbs)	Normal Range (lbs)
Muskellunge	Gill net	6.0	N/A - N/A	2.18	N/A - N/A
Largemouth Bass	Gill net	7.0	1.0 - 3.8	1.20	0.2 - 0.7
Hybrid Sunfish	Gill net	11.0	N/A - N/A	0.34	N/A - N/A
Green Sunfish	Gill net	1.0	0.8 - 13.0	0.10	N/A - N/A
Bluegill	Gill net	28.0	N/A - N/A	0.20	N/A - N/A
Black Bullhead	Gill net	43.0	8.0 - 90.0	0.88	0.1 - 0.4
Largemouth Bass	Trap net	0.7	0.2 - 1.1	0.45	0.3 - 1.0
Hybrid Sunfish	Trap net	2.7	N/A - N/A	0.41	N/A - N/A
Bluegill	Trap net	11.7	2.8 - 43.3	0.20	0.1 - 0.3
Black Bullhead	Trap net	1.0	2.5 - 70.2	0.73	0.1 - 0.5

Normal Ranges represent typical catches for lakes with similar physical and chemical characteristics.

Length of Selected Species Sampled for All Gear for the 1987 Survey Year

Species	Number of fish caught in each category (inches) *0-5*	*6-8*	*9-11*	*12-14*	*15-19*	*20-24*	*25-29*	*>29*	*Total*
Muskellunge	0	0	0	0	0	4	2	0	6
Largemouth Bass	0	1	3	4	1	0	0	0	9
Hybrid Sunfish	0	19	0	0	0	0	0	0	19
Green Sunfish	1	0	0	0	0	0	0	0	1
Bluegill	18	44	0	0	0	0	0	0	62
Black Bullhead	0	0	35	11	0	0	0	0	46

Fish Consumption Advisory

No fish consumption information is available for this lake. For more information, see the "Fish

Consumption Advice" pages at the Minnesota Department of Health.

For Additional Information

Area Fisheries Supervisor:

1200 WARNER ROAD
ST. PAUL, MN 55106
(651) 772-7950

Lake maps can be obtained from:

Minnesota Bookstore
660 Olive Street
St. Paul, MN 55155
(651) 297-3000 or (800) 657-3757
To order, use NOMAP for the map-id.

General DNR Information:

DNR Information Center
500 Lafayette Road
St. Paul, MN 55155-4040
(651) 296-6157 or (888) MINNDNR
TDD: (651) 296-5484 or (800) 657-3929
E-Mail: info@dnr.state.mn.us

Turn in Poachers (TIP):

Toll-free: (800) 652-9093