Engineer's Report
Eden Prairie Lakes Water Quality Improvement Project

(Birch Island, Bryant, Northwest Anderson, and Southwest Anderson Lakes)

Petitioned by the City of Eden Prairie

Prepared for the Nine Mile Creek Watershed District

July 2006

Engineer's Report
Eden Prairie Lakes Water Quality Improvement Project

(Birch Island, Bryant, Northwest Anderson, and Southwest Anderson Lakes)

Petitioned by the
City of Eden Prairie

Prepared for the
Nine Mile Creek Watershed District

July 2006

BARR

4700 West 77th Street
Minneapolis, MN 55435
Phone: (952) 832-2600
Fax: (952) 832-2601

Engineer's Report

Eden Prairie Lakes Water Quality Improvement Project (Birch Island, Bryant, Northwest Anderson, and Southwest Anderson Lakes)

Nine Mile Creek Watershed District: Basic Water Management Project

Table of Contents

1.0 Introduction 1
2.0 Background Information 2
3.0 Description of Project Lakes and Watersheds 4
3.1 Birch Island Lake 4
3.2 Bryant Lake 5
3.3 Southwest and Northwest Anderson Lakes 9
3.3.1 Southwest Anderson Lake 9
3.3.2 Northwest Anderson Lake 9
3.3.3 Three Rivers Park District and City of Eden Prairie Goals 10
4.0 Description of Recent Lake Water Quality 11
4.1 Birch Island Lake 11
4.2 Bryant Lake 15
4.3 Southwest and Northwest Anderson Lakes 20
4.3.1 Southwest Anderson Lake 20
4.3.2 Northwest Anderson Lake 22
4.0 Proposed Improvement Plan 30
4.1 Birch Island Lake 30
4.2 Bryant Lake 31
4.3 Anderson Lakes 33
4.4 Southwest and Northwest Anderson Lake Alternative Treatment 36
4.7 Cost Estimate 37
4.6 Permits 38
4.7 Affected Property Owners 38
5.0 Impacts Caused by the Project 39
6.0 Recommendation 40

List of Tables

Table 1 Lake Management—Water Quality, Recreational and Ecological Use Classifications of, and Management Philosophies for Lakes Referencing Carlson's' Trophic State Index (TSI) Values (Secchi Disc Transparency Basis) 6

Table 2 Bryant Lake Water Quality Benefits of Potential Improvement Options 18

Table 3 Benefits of Goal Achievement Alternative (Curlyleaf Pondweed Control and In-Lake Alum plus Lime Treatments) for Southwest and Northwest Anderson Lakes with the NWL of 837.5 37

Table 4 Predicted Lake Water Quality Conditions (TSI_{SD}) Following Project Implementation 39

List of Figures

Figure 1 Engineer's Report on the Eden Prairie Lakes Water Quality Improvement Project Location Map 3

Figure 2 Birch Island Lake: Estimated TSI_{SD} Secchi Disc Following BMP Implementation 13

Figure 3 Birch Island Lake UAA: Potential BMP Placement 14

Figure 4 Bryant Lake: 2005 Observed Water Quality Data 17

Figure 5 Potential Improvement Option Locations for Bryant Lake 19

Figure 6 Southwest Anderson Lake 2001 Observed Water Quality Data 21

Figure 7a Southwest Anderson Lake: Estimated TSI_{SD} Following BMP Implementation and BMP Cost with the NWL at Elevation 839.0 24

Figure 7b Southwest Anderson Lake: Estimated TSI_{SD} Following BMP Implementation and BMP Cost with the NWL at Elevation 837.5 25

Figure 8 Anderson Lakes UAA Watersheds, Existing Storm Sewers, and Potential BMPs—Nine Mile Creek Watershed District 26

Figure 9 Northwest Anderson Lake 2001 Observed Water Quality Data 27

Figure 10a Northwest Anderson Lake: Estimated TSI_{SD} Following BMP Implementation and BMP Cost with the NWL at Elevation 839.0 28

Figure 10b Northwest Anderson Lake: Estimated TSI_{SD} Following BMP Implementation and BMP Cost with the NWL at Elevation 837.5 29

Figure 11 Conceptual Layout for the Trail System around the Restored Wetland (Cardinal Creek Trail System) 32

Figure 12 Outlet Structure from Pond NW-AL-12 35

List of Appendices

Appendix A Birch Island Lake UAA Report (*Executive Summary only)*

Appendix B Bryant Lake UAA Report (*Executive Summary only)*

Appendix C Anderson Lakes UAA Report (*Executive Summary only)*

Appendix D Birch Island Lake Water Level Investigation Report

Appendix E	Affected Property Owners
Appendix F	Petition of the City of Eden Prairie to the NMCWD for a Basic Water Management Project, and Accompanying City Council Resolution

1.0 Introduction

This report summarizes the proposed actions for improving the water quality of four lakes in the City of Eden Prairie, including:

- Birch Island Lake
- Bryant Lake
- Northwest Anderson Lake
- Southwest Anderson Lake

It is prepared in accordance with Section 103D.711 of the Minnesota Watershed Act under the direction of the Board of Managers of the Nine Mile Creek Watershed District, upon petition by the City of Eden Prairie (see Section 6.0).

2.0 Background Information

The Nine Mile Creek Watershed District (NMCWD) was established by the Minnesota Water Resources Board in 1959 and consists of land that drains to Nine Mile Creek. The District encompasses approximately 50 square miles in southern Hennepin County and it includes portions of the cities of Bloomington, Eden Prairie, Edina, Hopkins, Minnetonka, and Richfield (see Figure 1). Nine Mile Creek flows approximately 15 miles from its headwater, where it crosses County Road No. 3 in Hopkins, to its mouth at the Minnesota River. The South Fork of Nine Mile Creek, joining the main creek in Bloomington just south of Interstate Highway 494, is approximately 8.5 miles long. Stormwater management within the urbanizing Nine Mile Creek watershed was guided initially by the District's *Overall Plan* dated March 1961. That plan was revised by the Watershed District in April 1973, as prescribed by the Minnesota Water Resources Board. The 1973 revised *Overall Plan* guided development in the District until it was further revised in May 1996 (*Water Management Plan)*, in accordance with the Metropolitan Surface Water Management Act and Watershed Law: Minnesota Statutes Chapters 103B and 103D, respectively.

The water quality improvement projects recommended in this Engineer's Report for Birch Island, Bryant, Northwest Anderson and Southwest Anderson Lakes (Figure 1) are the outcome of Use Attainability Analyses (UAAs) prescribed by the 1996 Nine Mile Creek Watershed District *Water Management Plan* (Plan), and conducted during 2000 and 2003-05.

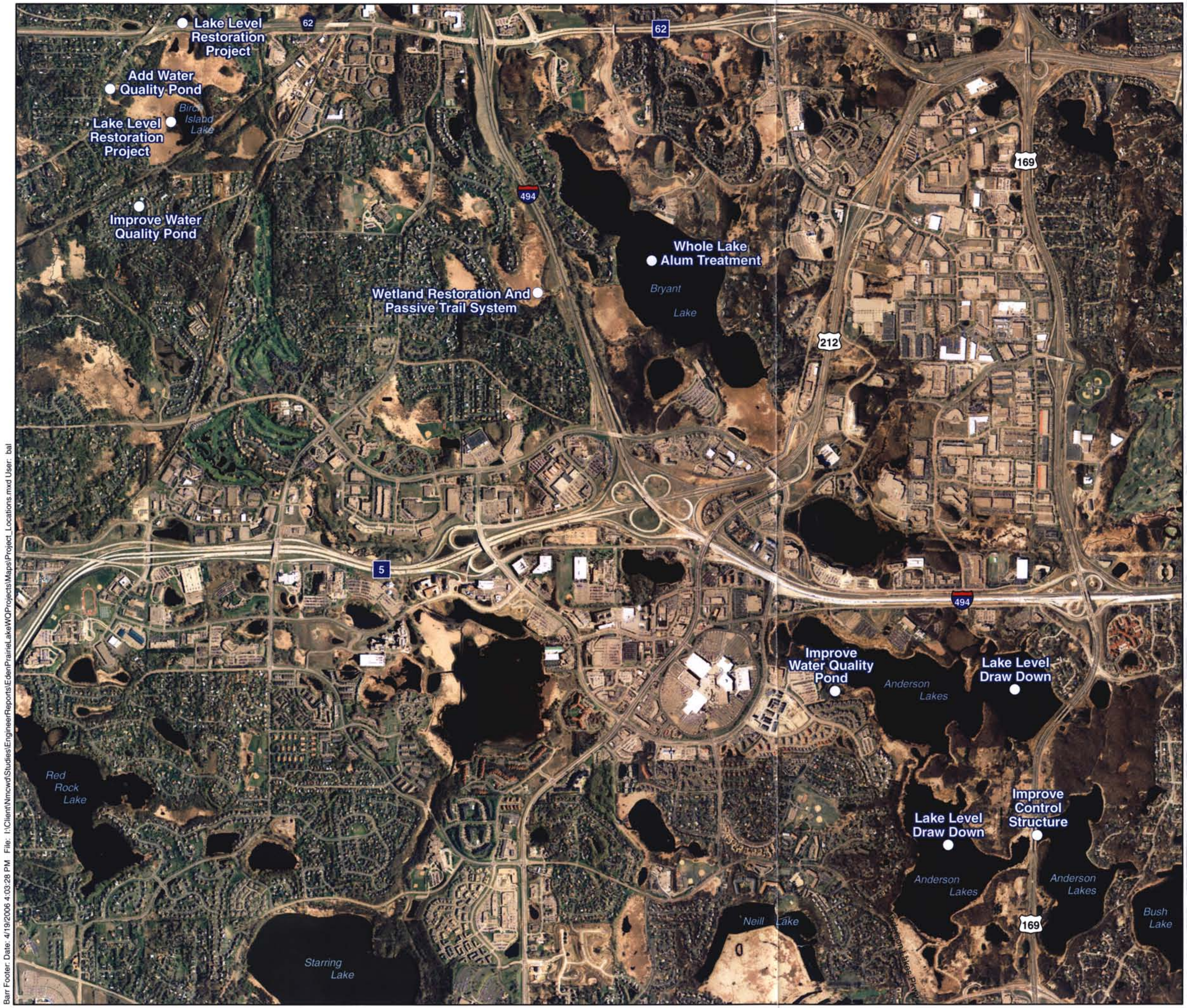


Figure 1

ENGINEER'S REPORT ON THE
EDEN PRAIRIE LAKES
WATER QUALITY INPROVEMENT
PROJECT LOCATION MAP
Nine Mile Creek Watershed District
Eden Pairie, Minnesota

3.0 Description of Project Lakes and Watersheds

The UAAs for the four Eden Prairie lakes considered were completed to provide the scientific foundations for lake-specific management plans that will preserve existing- or achieve potential- beneficial uses for the lakes. The UAAs are structured, scientific assessments of the factors affecting attainment of a beneficial use for both current and ultimate watershed development conditions. "Use Attainment" refers to achievement of water conditions suitable to support lake-specific beneficial uses such as swimming, fishing, aesthetic viewing, and wildlife habitat, among others, as designated in the 1996 *Water Management Plan.*

3.1 Birch Island Lake

The Birch Island Lake system watershed lies west of Interstate 494 between Excelsior Boulevard and Edenvale Boulevard in the south central portion of Minnetonka and the north central portion of Eden Prairie. The entire Birch Island Lake watershed is approximately 818 acres. However, a portion of it (275 acres) is tributary to Rose Lake prior to discharging to Birch Island Lake. Since Rose Lake seldom reaches an elevation high enough for outflow to occur, the 275 acres tributary to Rose Lake were considered landlocked for the UAA study. The portion of Birch Island Lake's watershed that is not landlocked is approximately 543 acres. The wetland to the north of the lake currently discharges to the lake on an infrequent basis. Therefore, the lake currently has a relatively small connected drainage area (169 acres). Birch Island Lake has a surface area of 25 acres at 880.6 mean sea level (MSL), an approximate maximum depth of 14 feet, and a mean depth of 3.4 feet. The lake currently discharges through a 24-inch clay tile located in the southeast corner of the wetland north of the lake at Elevation 888.1 to County Ditch 34.

The water quality goal for Birch Island Lake is a Level II classification as is specified in the approved *Nine Mile Creek District Water Management Plan* (Barr, 1996). This level fully supports water-based recreational activities, including sailboating, canoeing, hiking and picnicking, among others. The specific District goal is to achieve and maintain a Carlson's Trophic State Index (Secchi disc basis, TSI_{SD}) between 50 and 60. This index score is calculated from the interrelationships between summer Secchi disc transparencies and epilimnetic concentrations of chlorophyll *a* and total phosphorus. (The index results in scoring generally in the between zero and one hundred; lower score being indicative of better lake water quality.) This TSI_{SD} score corresponds to Secchi disc transparencies between 1.0

and 2.0 meters and total phosphorus concentrations between 45 and 75 μg/L. This and the corresponding chlorophyll *a* concentration and Secchi disc visibility goals are listed in Table 1 along with the water quality goals of other resource management agencies that have an interest in the conditions of these lakes.

The water surface elevation of Birch Island Lake has experienced a significant decline since the mid-1980s, diminishing the value of this water resource. The *Birch Island Lake, Shady Oak Lake, and Birch Island Lake Water Level Investigation*, (Barr, December 1992) concluded that the construction of CSAH 62 to the north of the lake was the likely cause of the lowering of the lake level. The *Birch Island Lake Water Level Investigation* (Barr, 2005) report similarly concluded that the hydraulic connection between Birch Island Lake and the drainage areas upstream of CSAH 62 is no longer functioning, thus significantly reducing the amount of surface and ground water reaching Birch Island Lake. The decreased lake level results in a smaller dilution potential for a given watershed phosphorus load. Therefore, the lake level decrease could account for a portion of the general water quality deterioration over the last 20 years.

3.2 Bryant Lake

The Bryant Lake watershed is located in the northeastern portion of the City of Eden Prairie and the southeastern portion of the City of Minnetonka. Interstate 494 nearly bisects the watershed from south to north, CSAH 62 crosses the northern half of the watershed from east to west, and the entire watershed lies just west of US Highway 212. The existing Bryant Lake watershed consists of approximately 3,250 acres. Bryant Lake is comprised of one central basin with a surface area of approximately 170 acres, an approximate maximum depth of 45 feet, and a mean depth of 15 feet. The South Fork of Nine Mile Creek flows through Bryant Lake with the outlet located in the southeast end of the lake.

Table 1 Lake Management—Water Quality, Recreational and Ecological Use Classifications of, and Management Philosophies for Lakes Referencing Carlson's' Trophic State Index (TSI) Values (Secchi Disc Transparency Basis)

Lake	Water Quality Condition (TSI_{SD})[1]			Lake Classification, by Regulatory Agency					District Management Strategy
	'Current" (Most recent NMCWD data)	Expected Ranges, Ultimate Watershed Land Use[2] With BMPs	Expected Ranges, Ultimate Watershed Land Use[2] Without BMPs	District Water Quality Goal[3]	MPCA* Swimmable Use Class	Metro Council Priority Waters Class	Municipal Use[4]	MDNR* Ecological Class[5]	
Northwest Anderson	Year of Record = 2001 [TP] = 99 µg/L [Chla] = 48.1 µg/L S.D. = 0.8 m **TSI_{SD} = 64**	[TP] = 87-184 µg/L [Chla] = 54-80 µg/L S.D. = 0.4-0.6 m **TSI_{SD} = 67-72**	[TP] = 98-235 µg/L [Chla] = 57-94 µg/L S.D. = 0.4-0.6 m **TSI_{SD} = 67-73**	III Wildlife habitat and aesthetic viewing 105≥ [TP] ≥75 µg/L 60≥ [Chla] ≥40 µg/L 0.6≤ S.D. ≤1.0 m **70≥ TSI_{SD} ≥60**	Shallow Lakes Criteria TP] ≤60 µg/L [Chla] ≤20 µg/L S.D. ≥1.0 m **TSI_{SD} ≤60**	Single-use Recreational Period of Record = Not Monitored	Wildlife habitat and aesthetic viewing	(Unspecified)	Protect
Southwest Anderson	Year of Record = 2001 [TP] = 60 µg/L [Chla] = 23.3 µg/L S.D. = 1.2 m **TSI_{SD} = 57**	[TP] = 45-435 µg/L [Chla] = 18-269 µg/L S.D. = 0.3-1.3 m **TSI_{SD} = 57-80**	[TP] = 47-482 µg/L [Chla] = 18-374 µg/L S.D. = 0.2-1.2 m **TSI_{SD} = 57-83**	II Wildlife habitat and aesthetic viewing 75≥ [TP] >45 µg/L 40≥ [Chla] >20 µg/L 1.0≤ S.D. <2.0 m **60≥TSI_{SD} ≥50**	Shallow Lakes Criteria TP] ≤60 µg/L [Chla] ≤20 µg/L S.D. ≥1.0 m **TSI_{SD} ≤60**	3 Single-use recreational Period of Record = Not Monitored	Wildlife habitat and aesthetic viewing	(Unspecified)	Protect
Birch Island	Year of Record = 1997 [TP] = 50 µg/L [Chla] = 25.3 µg/L S.D. = 1.0 m **TSI_{SD} = 60**	[TP] =31-71 µg/L [Chla] = 12-29 µg/L S.D. = 0.7-1.9 m **TSI_{SD} = 51-64**	[TP] = 40-103 µg/L [Chla] = 15-44 µg/L S.D. = 0.5-1.5 m **TSI_{SD} = 55-70**	II Partial body-contact recreational 75≥ [TP] >45 µg/L 40≥ [Chla] >20 µg/L 1.0≤ S.D. <2.0 m **60≥TSI_{SD} ≥50**	Full Support of Swimmable Use TP] ≤40 µg/L [Chla] ≤15 µg/L S.D. ≥1.2 m **TSI_{SD} ≤57**	3 Single-use recreational Period of Record = Not Monitored	Fish	30 Primary Fish Species: NP, BLB, BG **TSI_{SD} = 53**	Protect

Table 1 (cont.) Lake Management—Water Quality, Recreational and Ecological Use Classifications of, and Management Philosophies for Lakes Referencing Carlson's' Trophic State Index (TSI) Values (Secchi Disc Transparency Basis)

Lake	Water Quality Condition (*TSI_{SD}*)[1]			Lake Classification, by Regulatory Agency					District Management Strategy
	'Current" (Most recent NMCWD data)	Expected Ranges, Ultimate Watershed Land Use[2] With BMPs	Expected Ranges, Ultimate Watershed Land Use[2] Without BMPs	District Water Quality Goal[3]	MPCA* Swimmable Use Class	Metro Council Priority Waters Class	Municipal Use[4]	MDNR* Ecological Class[5]	
Bryant	Year of Record = 2005 [TP] = 38 µg/L [Chla] = 26 µg/L S.D. = 0.9 m **TSI_{SD} = 62**	[TP] = 29 µg/L [Chla] = 9 µg/L S.D. = 2.0 m **TSI_{SD} = 50**	[TP] = 42 µg/L [Chla] = 24 µg/L S.D. = 1.2 m **TSI_{SD} = 57**	I Whole body-contact recreational [TP] ≤45 µg/L [Chla] ≤20 µg/L S.D. ≥2.0 m **TSI_{SD} ≤50**	Full Support of Swimmable Use TP] ≤40 µg/L [Chla] ≤15 µg/L S.D. ≥1.2 m **TSI_{SD} ≤57**	2 Multi-use recreational Period of Record = 1989-1991:	Swim Fish	24 Primary Fish Species: NP, CA, BG **TSI_{SD} = 50**	Protect

TSI_{SD} Carlson's Trophic State Index score. This index was developed from the interrelationships between summer Secchi disc transparencies and epilimnetic concentrations of chlorophyll a and total phosphorus. The index results in scoring generally in the range between zero and one hundred. [District values calculated by Barr Engineering Company (from field data and water quality model predictions). MPCA values taken from the Guidance Manual for Assessing the Quality of Minnesota Surface Waters for Determination of Impairment 305(b) Report and 303 (d) List (2004); and MDNR values taken from Schupp (1992) Minnesota Department of Natural Resources Investigational Report No. 417. An ecological classification of Minnesota lakes with associated fish communities.]

2 No Best Management Practices (BMPs) assumed.

3 District
- I = Fully supports all water-based recreational activities including swimming, scuba diving and snorkeling.
- II = Appropriate for all recreational uses except full body contact activities: sailboating, water skiing, canoeing, wind surfing, jet skiing.
- III = Supports fishing, aesthetic viewing activities and wildlife observation
- IV = Generally intended for runoff management and have no significant recreational use values
- V = Wetlands suitable for aesthetic viewing activities, wildlife observation and other public uses.

4 Municipal Use
- SWIM = Public swimming beach
- FISH = Designated fishing resource

The approved *Nine Mile Creek District Water Management Plan* (Barr, 1996) preliminarily assessed Bryant Lake water quality for ultimate land use conditions. The Plan outlined five specific goals for Bryant Lake. These goals address water quality, recreational-use, aquatic communities, water quantity, and wildlife. Table 1 lists the water quality goals, recreational-use and ecological classifications for Bryant Lake. The table lists total phosphorus (TP) and chlorophyll *a* concentrations, Secchi disc (SD) transparencies, and Carlson's Trophic State Index (TSI) based on Secchi disc. The NMCWD's management strategy has been to "Protect" the resource. According to the Plan, "Protect" means "to avoid significant degradation from point and nonpoint sources and wetland alterations to maintain existing beneficial uses, aquatic and wetland habitats, and the level of water quality necessary to protect these uses in receiving waters."

Since the completion of the *NMCWD Water Management Plan,* the MPCA has developed assessment methodologies, conducted extensive sampling of lakes, and ultimately derived ecoregion-based lake eutrophication guidelines, beginning with guidelines for total phosphorus (MPCA, 2003). In turn, the total phosphorus guidelines have been used as the basis for assessing swimmable-use support for lakes. The MPCA has set a total phosphorus guideline of 40 μg/L, which serves as the upper threshold for full-support of swimmable use (or primary-contact recreation and aesthetics) for the North Central Hardwood Forests (NCHF) ecoregion (which includes the Bryant Lake watershed). This concentration corresponds to a Carlson's trophic state index (TSI) value of 57. Total phosphorus concentrations above full-support guideline levels would result in greater frequencies of nuisance algal blooms and increased frequencies of "impaired swimming." The upper threshold for partial-support of swimmable use is a 45 μg/L total phosphorus concentration for the NCHF ecoregion (which corresponds to 59 Carlson TSI units). A total phosphorus concentration above this level is associated with non-support of swimmable use in the NCHF ecoregion.

Byrant Lake is designated as a Level I "swimming lake" by the District (see Table 1) and, as such, its water quality condition should score 50, or less, on the Carlson's Trophic State Index (Secchi disc basis, TSI_{SD}) rating system. This level fully supports water-based recreational activities including swimming, scuba diving, and snorkeling. A TSI_{SD} score of 50 corresponds to a Secchi disc transparency of 2.0 meters, which exceeds the MPCA's transparency goal for swimmable use (>1.4 meters).

3.3 Southwest and Northwest Anderson Lakes

3.3.1 Southwest Anderson Lake

The overall watershed of Southwest Anderson Lake includes the areas that drain to it after passing through other upstream water bodies, such as Bush Lake and Southeast Anderson Lake. However, the lake's immediate watershed (the area that does not first drain to an upstream lake) is approximately 450 acres and is located entirely in Eden Prairie with its extended watershed encompassing portions of Bloomington. Based on 2000 Metropolitan Aerial photos, the 450-acre watershed includes roughly 100 acres for the lakes water surface. Therefore, the net immediate watershed, excluding lake water surface area, is approximately 350 acres. Southwest Anderson Lake has an open water surface area of approximately 100 acres (the open water area is variable, depending on the seasonally-varying coverage of the lake's cattail fringe), a maximum depth of approximately 8 feet, and a mean depth of approximately 4 feet. The lake volume is approximately 440 acre-feet. Southwest Anderson Lake is quite shallow, especially in comparison with its large surface area. Therefore Southwest Anderson Lake would be expected to be prone to frequent wind-driven mixing. This is supported by the data gathered from Southwest Anderson Lake indicating that the lake is polymictic. Because the lake is so shallow, aquatic plants can grow over the entire lake bed and a summer thermocline is not usually present.

The water quality goal for Southwest Anderson Lakes is specified by the NMCWD and presented in the *NMCWD Water Management Plan* as is a Category II classification. The specific NMCWD goal for Southwest Anderson Lakes is to achieve and maintain a TSI_{SD} between 50 and 60.

3.3.2 Northwest Anderson Lake

Northwest Anderson Lake's watershed in located primarily in Eden Prairie with the eastern portion in the City of Bloomington. The watershed is located just south of I-494 and US Highway 169 bisects the eastern portion of the watershed. Not accounting for the land area that drains to Northwest Anderson Lake indirectly, after the water passes through Southeast and Southwest Anderson Lakes, the "local" watershed of Northwest Anderson Lake is approximately 590 acres, including the lake's surface area.

Northwest Anderson Lake has an open water surface area of approximately 190 acres, a maximum depth of approximately 10 feet, and a mean depth of approximately 4 feet. The lake volume is approximately 730 acre-feet. Since Northwest Anderson Lake is quite shallow it would be expected to be prone to frequent wind-driven mixing, indicating that this lake is also polymictic.

The lake area, depth, and volume depend on the water level of the lake, which has been observed to vary between a high measurement of 841.8 feet MSL (1987) and a low measurement of 835.3 feet MSL (1978). The approximate water surface area, depth, and volume (given above) are as measured at the average water level of 839.0 feet MSL. The water level in the lake is controlled mainly by weather conditions (snowmelt, rainfall, and evaporation) and by the elevation of the outlet structure located at the northeast corner of Northwest Anderson Lake.

The *NMCWD Water Management Plan* specifies a water quality goal of a Category III classification for Northwest Anderson Lakes. The specific NMCWD goal is to achieve and maintain a TSI_{SD} between 60 and 70.

3.3.3 Three Rivers Park District and City of Eden Prairie Goals

Three Rivers Parks District and City of Eden Prairie have both expressed a desire to manage Southwest and Northwest Anderson Lakes to improve the waterfowl nesting habitat and the overall wildlife use of the area. Neither organization wishes to promote recreational use of these two resources. The specific water quality criteria listed in the Three Rivers Park District's 1999 Water Quality Management Plan is to maintain a TSI < 77. The City has not provide any specific water quality criteria but has indicated agreement with the Parks District's criteria. A TSI value of 77 translates into the following total phosphorus concentration, chlorophyll *a* concentration, and Secchi disc transparency.

- TSI < 77
- Total Phosphorus Concentration $\leq$ 156 µg/L
- Chlorophyll a concentration $\leq$ 113 µg/L
- Secchi disc transparency $\geq$ 0.3 meters

In addition to the water quality criteria listed above, the Parks District and City want to pursue lowering the normal water level (NWL) of Southwest and Northwest Anderson Lakes by 1.5 feet to Elevation 837.5 MSL.

4.0 Description of Recent Lake Water Quality

This section summarize observed and predicted in-lake water quality conditions for the four Eden Prairie lakes under various climatological conditions, ranging from wet to dry, with and without combinations of watershed runoff best management practices (BMPs). These predicted water quality conditions all assume ultimate watershed land use conditions. Details of the analyses conducted to prepare these summaries and graphic are contained in the executive summaries of the UAA reports for the individual lakes, which appear in appendices to this Engineer's Report:

- Appendix A—Birch Island Lake UAA Executive Summary
- Appendix B—Bryant Lake UAA Executive Summary
- Appendix C—Anderson Lakes UAA Executive Summary

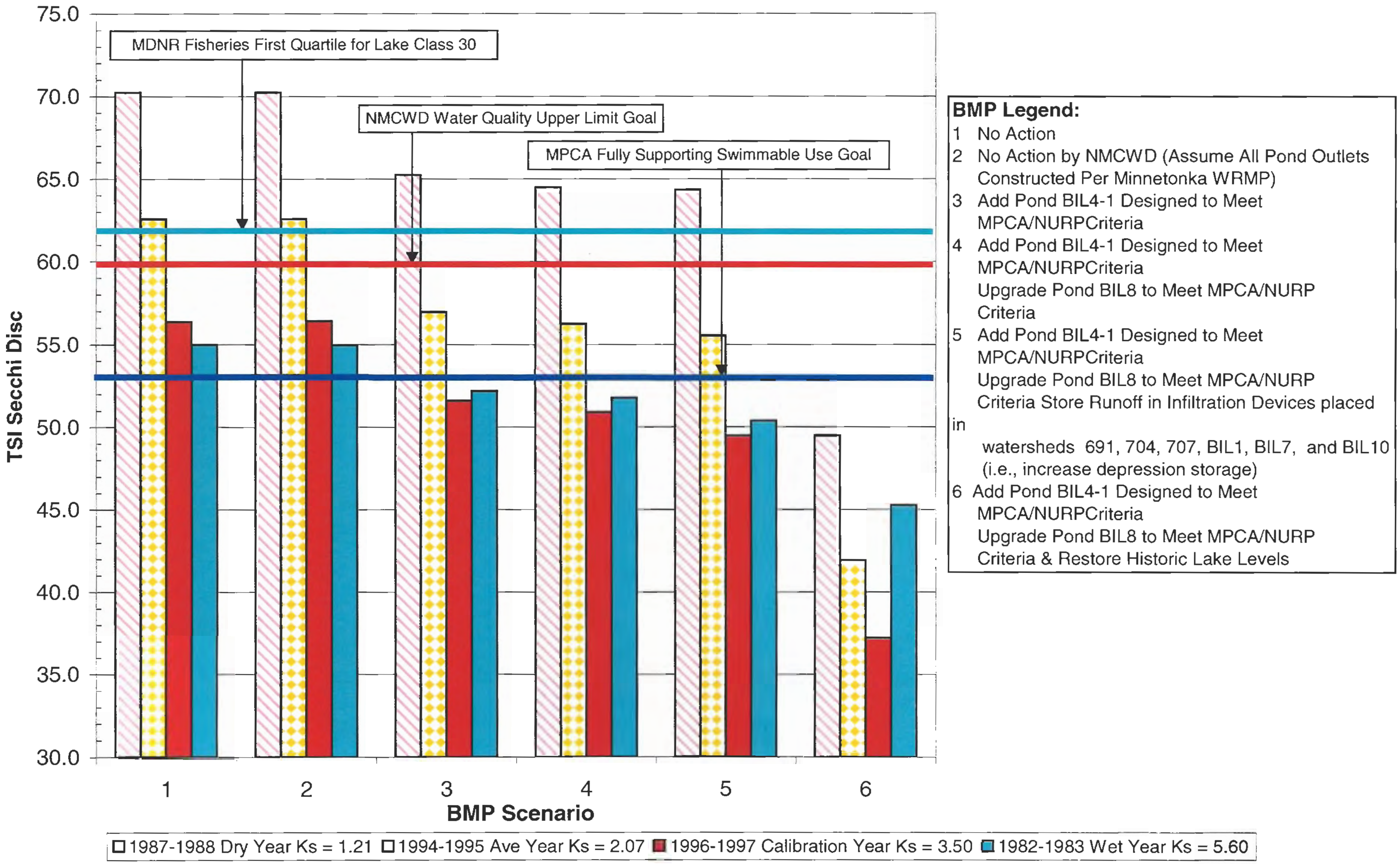
These UAA executive summaries also contain detailed descriptions of the project lakes and their watersheds.

4.1 Birch Island Lake

Birch Island Lake's 1997 summer average chlorophyll *a* (25.3 μg/L), Secchi disc transparency (1.0 m) and total phosphorus concentration (49.6 mg/L) would result in the lake being categorized as eutrophic, nutrient rich. The trophic status categories use the lake's total phosphorus concentration, chlorophyll *a* concentration, and Secchi disc transparency measurements to assign the lake to a water quality category that best describes its condition. Water quality categories include oligotrophic (i.e., excellent water quality, nutrient poor), mesotrophic (i.e., good water quality, moderate nutrient concentrations), eutrophic (i.e., poor water quality, nutrient rich), and hypereutrophic (i.e., very poor water quality, very high nutrients). Even though the 1997 water quality data would result in the lake being classified eutrophic, the average phosphorus concentrations, chlorophyll *a* concentrations, and Secchi disc transparencies were low enough to maintain the District's Level II water quality designation. Analysis of monitored lake total phosphorus, chlorophyll *a*, and Secchi disc transparency data for 1972, 1989, and 1997 indicate large variability from year to year, in terms of summer average conditions. This is consistent with the fact that the southern subwatersheds have been urbanized during that time period and that the lake level has also experienced a considerable decrease.

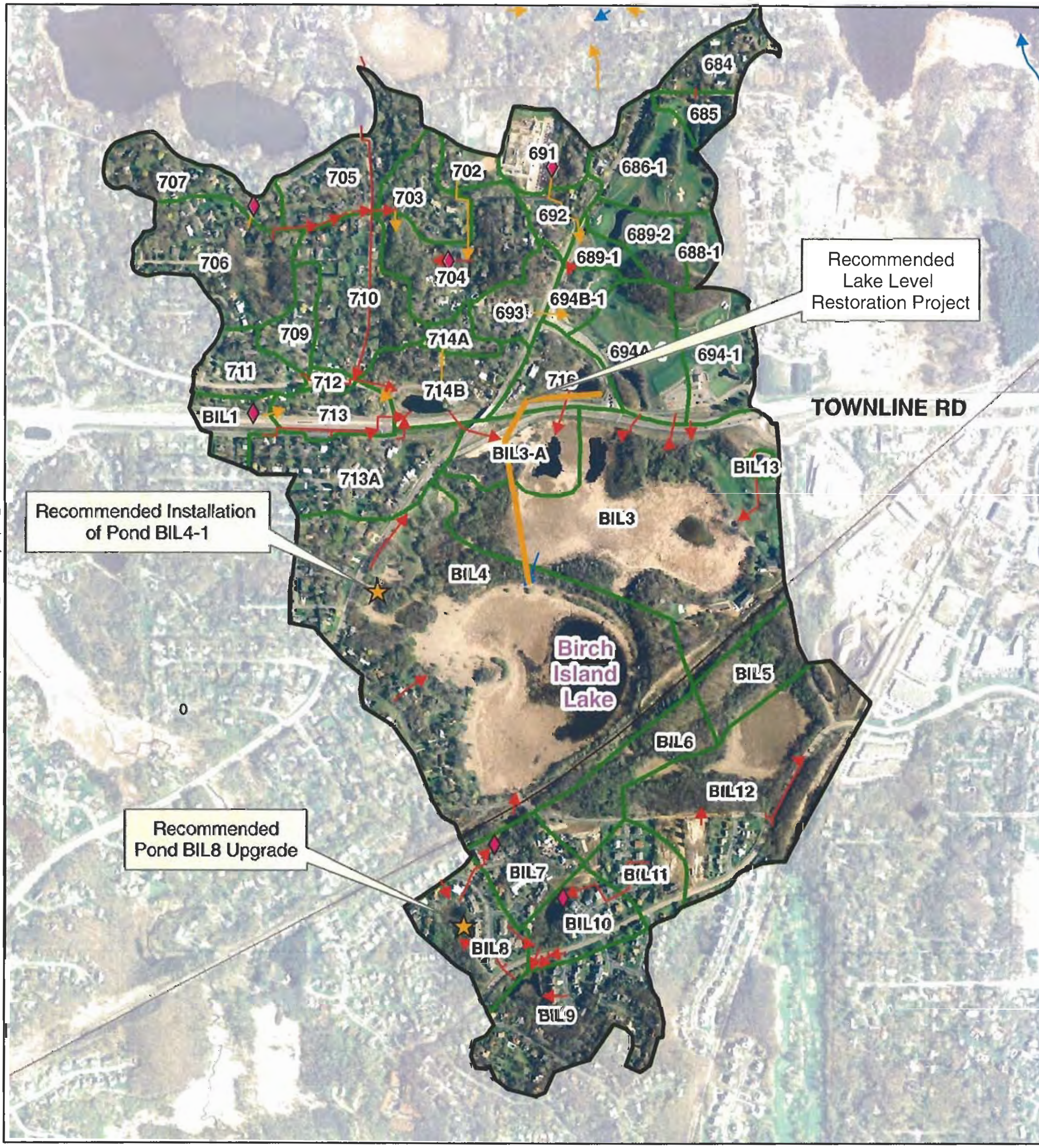
Water quality simulations using the P8 model indicated dry conditions produce the greatest impact on the water quality of Birch Island Lake because the low lake level during dry conditions results in less dilution of watershed phosphorus loading. Therefore, higher in-lake phosphorus concentrations result from phosphorus loading during dry climatic conditions. It was determined that dry conditions would reduce Birch Island Lake's water quality to levels outside the Level II classification limits. For wet-, and model-calibration-year precipitation totals, Birch Island Lake's water quality remains sufficiently good to support Level II recreational activities without additional BMPs. (See Figure 2, BMP Scenario 1, which involves no action by the District.) Figure 3 illustrates the various BMPs that were analyzed as part of the Birch Island Lake UAA. The impacts of these BMPs on lake water quality are summaries on Figure 2.

Birch Island Lake: Estimated TSI Secchi Disc Following BMP Implementation



P:\23\27\003\UAA\SAS\Birch Island\P8 Ultimate LU\BILSummaryNEW.xls

Figure 2



Legend

Major Watershed

Subwatershed Divides

Stormwater Conveyance System

Open Channel

Existing Storm Sewer

Proposed Storm Sewer

Potential BMPs

Addition of Infiltration Basin

Pond Upgrade to MPCA/NURP Criteria

Recommended Pond BMP

Recommended Lake Level Restoration Project

Figure 3

Birch Island Lake UAA
Potential BMP Options

N

Feet
1,000 0

4.2 Bryant Lake

Current Bryant Lake water quality data, 2005 data, were also evaluated according to trophic status categories. Figure 4 summarizes the seasonal changes in concentration of total phosphorus, chlorophyll *a*, and Secchi disc transparency for Bryant Lake in 2005. The data shown are compared to the trophic state categories.

Summer average water quality parameters for 2005 were within the range expected for eutrophic (high nutrient) and hypereutrophic (very high nutrient) systems. The summer average transparency of 0.9 meters fell near the threshold between a eutrophic and hypereutrophic system (Figure 4). Throughout the entire 2005 summer , Secchi disc transparencies observed were less than the upper limit of 1.6 meters established by the NMCWD for its Category I lakes. A comparison of past years of Secchi disc monitoring indicates that the lake's transparency is typically highest in the spring (May-June) and then consistently drops to its lowest levels at the end of the summer and fall (August-October).

The 2005 summer average concentration for chlorophyll *a* of 26.0 μg/L is indicative of a hypereutrophic (very high nutrient) system (Figure 4). Chlorophyll *a* concentrations during June and early-July were consistently in the eutrophic range (< 26 μg/L). the 2005 concentrations of chlorophyll *a* were frequently well above the established upper limit of 10 μg/L for Category I lakes.

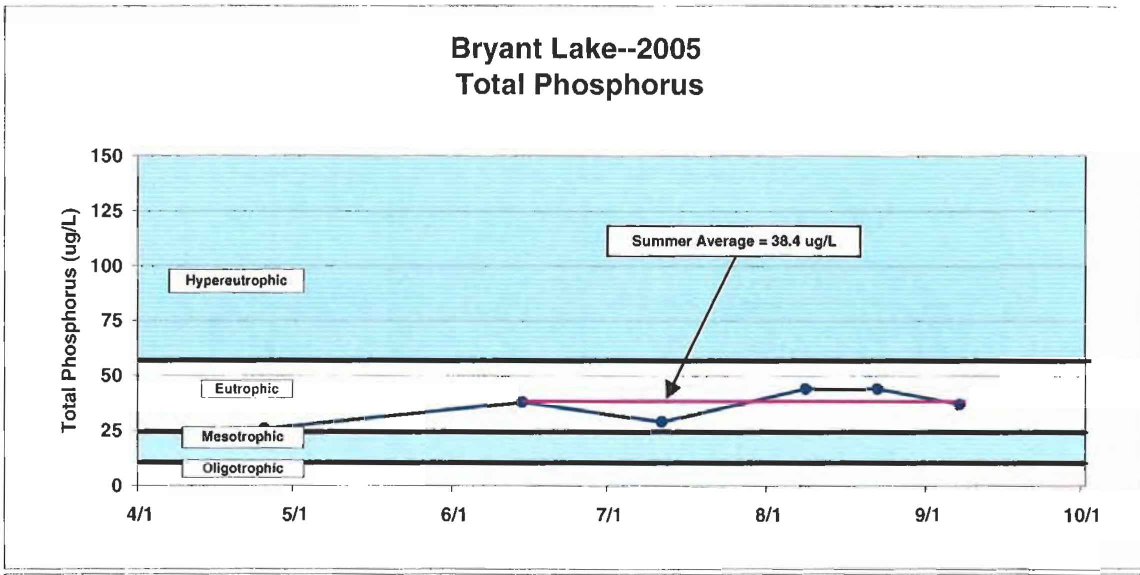
Summer total phosphorus concentrations in 2005 consistently remained within the range expected for eutrophic lake systems (Figure 4). Even though the 2005 total phosphorus levels were within the eutrophic range, the levels were all lower than the upper limit (45 μg/L) set by NMCWD for Category I lakes. This was unlike the 1998 levels in which many of the total phosphorus measurements were greater than the upper limit of 45 μg/L. An examination of past years of total phosphorus monitoring indicates that many years were consistent with 1998 levels. In general, the in-lake phosphorus concentrations are highest in the spring and decline slightly later in the summer.

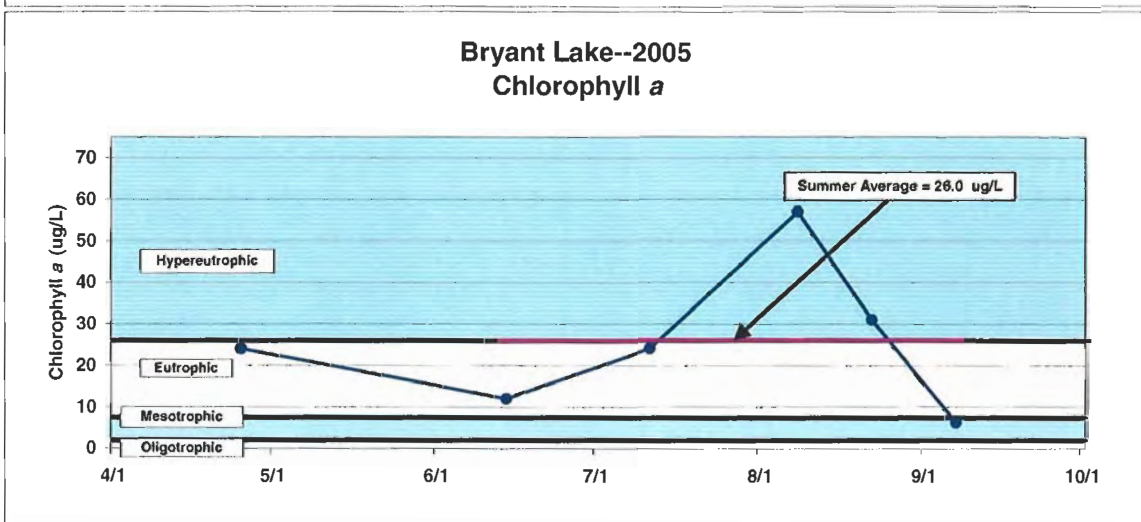
Current water quality in Bryant Lake is poor and based on 2005 data the lake would be classified as a eutrophic (high nutrient) water body. The current water quality falls short of goals established for the lake by the regulatory agencies. The P8 and in-lake models calibrated to measured 1997-98 water year concentrations, were subsequently used to estimate phosphorus loads and concentrations under various best management practice (BMP) options. The comparisons between the existing watershed and in-lake conditions and the future watershed conditions with implementation of BMPs were only made for the 1997-98 water year climatic conditions since:

- The detailed in-lake water quality data required for calibration of the phosphorus mass balance model equations does not exist for Bryant Lake during dry or wet years.
- Detailed in-lake water quality data need for calibration of the phosphorus mass balance model only exists for 1982, 1991 and 1995. The respective summer average (June-August) phosphorus concentrations for these years was 37, 36 and 46 µg/L, which is less than the 47 µg/L summer average for 1998, despite higher precipitation during each of the 3 water years (between 25.01 and 31.64 inches).
- The average of three Bryant Lake summer phosphorus concentrations (28 µg/L) during 1988, which represents a dry water year (with 18.67 inches of precipitation) was also lower than the 1998 summer average phosphorus concentration (47 µg/L). Therefore the 1997-98 water year climatic conditions represent a more critical water quality condition.

The 1997-98 water year experienced near normal precipitation (24.26 inches) and temperature and is likely to be representative of a typical year for Bryant Lake. Also, watershed land use was near full planned development in 1998.

Each structural BMP was identified and analyzed for phosphorus reduction using the P8 model as part of the *Bryant Lake UAA*. Table 2 includes a summary of the effectiveness of watershed BMPs in terms of phosphorus removal and lake clarity improvement in Bryant Lake. In addition, the modeled BMP locations are shown on Figure 5. Appendix B includes the Executive Summary of the *Bryant Lake UAA* and summarizes the various BMP options.





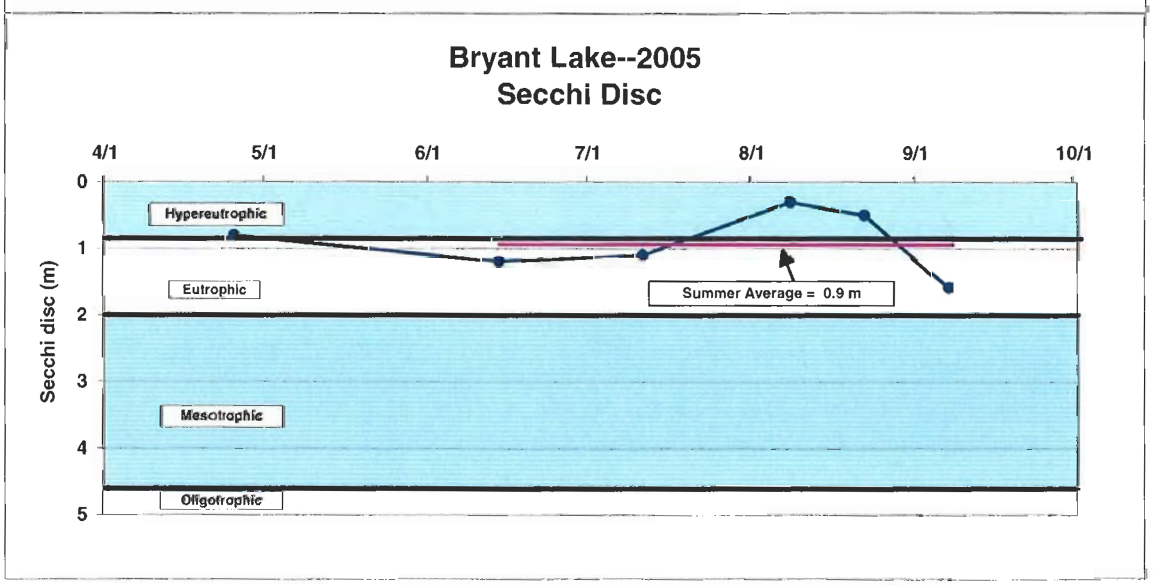


Figure 4

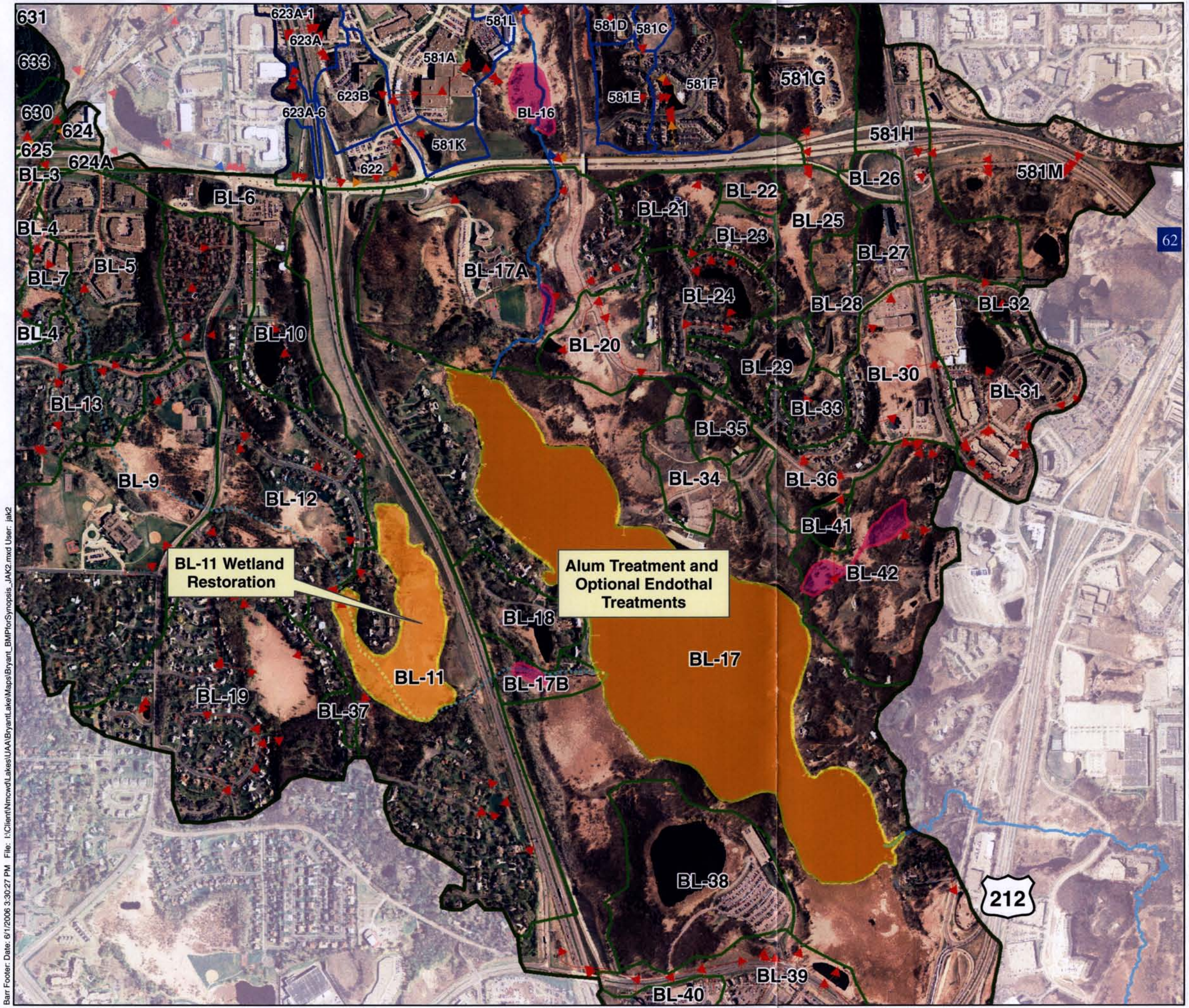
Bryant Lake 2005
Observed Water
Quaility Data

Table 2 Bryant Lake Water Quality Benefits of Potential Improvement Options

Improvement Option # Description of Potential Improvement	Model Calibration Year (1997-98; 24.3 inches of precipitation)			
	Average Summer TP Conc (May- Sept; µg/L)	Estimated Chl-a Conc (May-Sept; µg/L)	Estimated Secchi Disc Depth (May-Sept; meters)	Estimated Trophic State Index (TSI_{SD}) Value NMCWD Goal ≤ 50
Existing Conditions	42	24	1.2	57
1. Restore Wetland Within Subwatershed BL-11	39	20	1.4	56
2. Construct Pond Within Subwatershed BL-16	39	19	1.4	55
3. In-Lake Alum Treatment	34	15	1.6	53
4. Construct Pond Within Subwatershed BL-42	41	22	1.3	56
5. Combination of Improvement Options 1, 2 and 4	34	14	1.6	53
6. Combination of Improvement Options 1, 2, 3 and 4	27[1]	8	2.1	49
7. Combination of Improvement Options 1 and 3	32	12	1.8	52
8. Combination of Improvement Option 3 and County Ditch #34 and South Branch Nine Mile Creek Stormwater Alum Treatment Plants	26[1]	7	2.3	48
9. Curlyleaf Pondweed Management with Endothall	39	20	1.3	56
10. Combination of Improvement Options 1, 3 and 9	29[1]	9	2.0	50

NOTES:

[1] Estimated TP concentration corresponds well with 23-25 µg/L TP estimate of Pre-Settlement Conditions (from Vighi and Chiaudani, 1985) and low end range of 28-58 µg/L TP estimate from MPCA's MINLEAP Model.



Legend

- Major Watershed
- Subwatersheds
- South Branch Nine Mile Creek

Stormwater Conveyance System

- Existing Storm Sewer
- Proposed Storm Sewer
- Open Channel
- County Ditch 34

Potential BMPs

- Recommended BMPs
- Other Potential BMPs

N

Feet

1,000 0 1,000

Figure 5

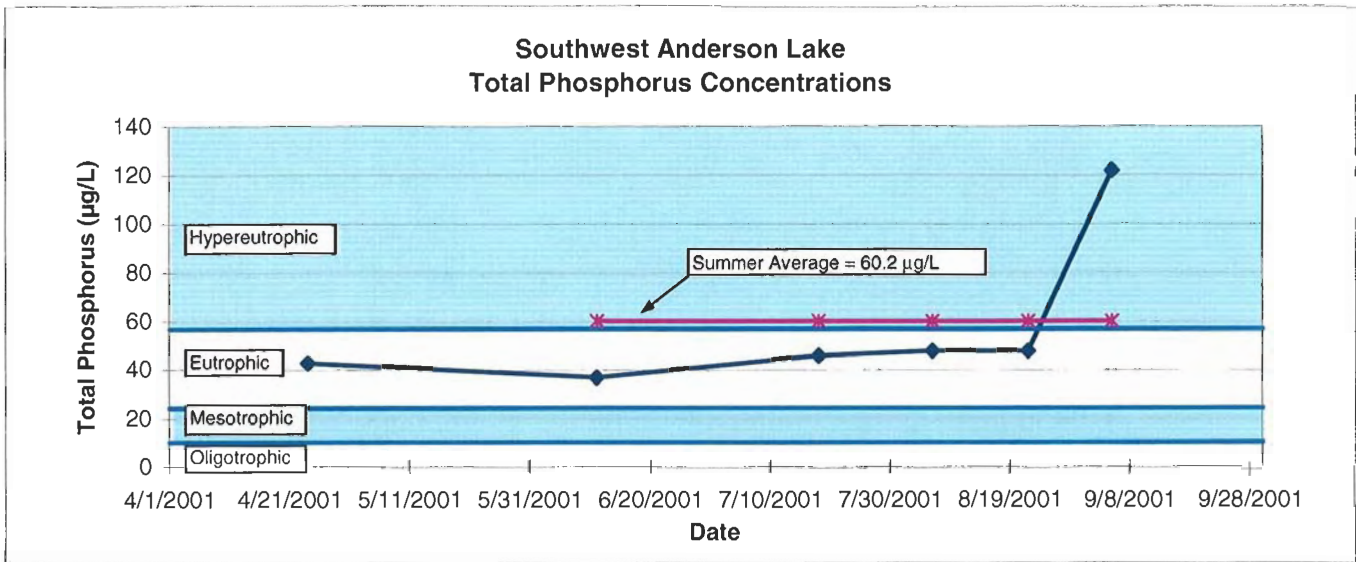
POTENTIAL IMPROVEMENT OPTIONS FOR BRYANT LAKE
Nine Mile Creek Watershed District

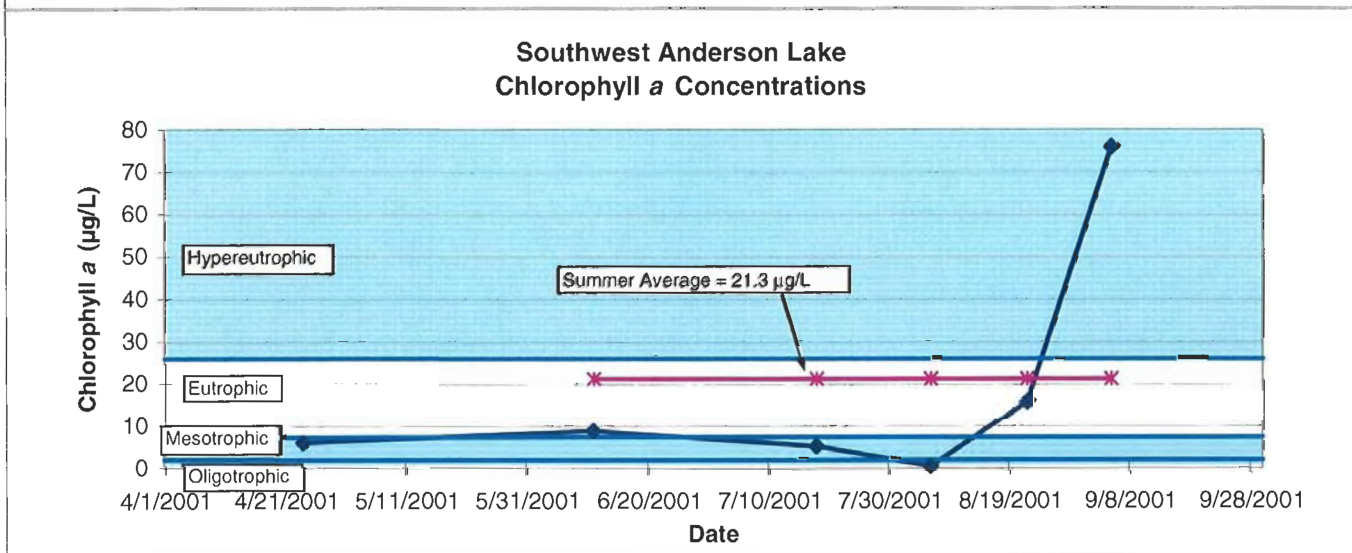
4.3 Southwest and Northwest Anderson Lakes

4.3.1 Southwest Anderson Lake

The baseline water quality (1973) of Southwest Anderson Lake was compared with current conditions (2001) to identify any significant changes. Summer average epilimnetic total phosphorus decreased 86 percent (from 426 µg/L in 1973 to 60 µg/L in 2001). Corresponding to the reduction in total phosphorus (nutrient) levels was a 95 percent decline in the average summer epilimnetic chlorophyll *a*. As a result of these reductions in nutrient and chlorophyll *a* concentrations, the lake's average Secchi disc transparency increased dramatically from 0.2 to 1.2 meters. Because of the limited number of samples collected in 1973, the current conditions were also compared to the 1988 data. While a significant decrease (76 percent) in summer average total phosphorus is still evident, the chlorophyll *a* and transparency data remained relatively unchanged between 1988 and 2001. In addition, all 6 years of data indicate the water quality in the lake is significantly worse than would by expected for a "minimally" impacted water body per the MnLEAP model, thus indicating there is room to improve the water quality in Southwest Anderson Lake.

Figure 6 summarizes the seasonal changes during 2001 in concentration of total phosphorus and chlorophyll *a*, and Secchi disc transparencies for Southwest Anderson Lake. The data shown are compared to the trophic status categories. Figure 6 illustrates, the epilimnetic (surface water, i.e., 0 to 2 meter depth) phosphorus concentration increased from the lake's steady-state spring concentration (~37 mg/L) to the lake's summer average concentration (60 mg/L). The increase was due to additional phosphorus inputs from a combination of stormwater runoff and internal sources. Chlorophyll *a* measurements (0 to 2 meters) during 2001 were in the mesotrophic to hypereutrophic categories. The 2001 summer average concentration (21 mg/L) indicates nuisance algal blooms (greater than 20 mg/L chlorophyll *a*) likely occurred and would have resulted in recreational use impairment. The 2001 Southwest Anderson Lake summer average Secchi disc transparency (1.2 m) is considered highly eutrophic. The average phosphorus concentration, chlorophyll *a* concentration and Secchi disc transparency were within the range to maintain the NMCWD's Category II water quality designation.





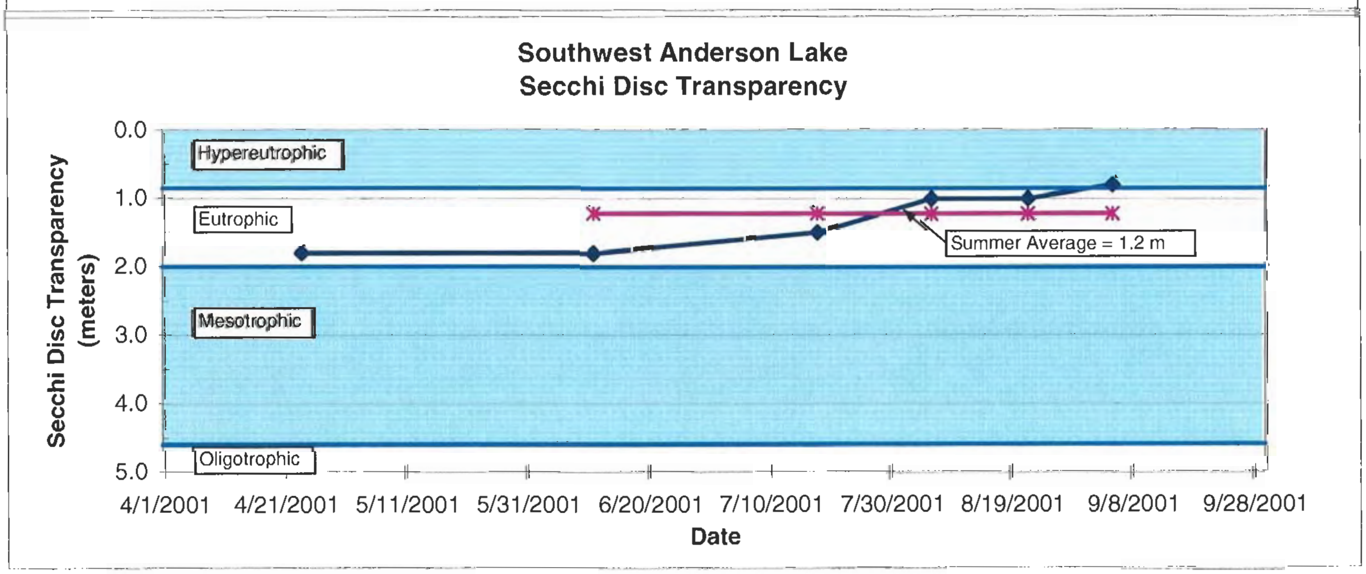


Figure 6

Southwest Anderson Lake 2001 Seasonal Changes in Concentration of Total Phosphorus and Chlorophyll *a* and Secchi Disc Transparencies

Water quality simulations using the P8 model indicated dry climatic conditions produce the greatest impact on the water quality in Southwest Anderson Lake. The increased internal phosphorus release from sediment, during relatively dry years, delivers a large phosphorus load to the lake. The internal release of phosphorus from curlyleaf pondweed die-back and lake sediments accounted for 33 percent of the lakes' annual loads. Curlyleaf pondweed was estimated to contribute 2 percent of the annual phosphorus loads in 2001 to Southwest Anderson Lakes during 2001. Dry conditions would increase Southwest Anderson Lake's water quality to levels outside the Level II classification limits. For wet-, and model-calibration-year precipitation totals, Southwest Anderson Lake's water quality remains sufficiently good to support Level II recreational activities without additional BMPs. (See Figures 7a and 7b, BMP Scenario 2, which involves no action by the District.) Figure 8 illustrates the various BMPs that were analyzed as part of the *Anderson Lake UAA*. The impacts of these BMPs on Southwest Anderson Lake's water quality are summaries on Figures 7a and 7b.

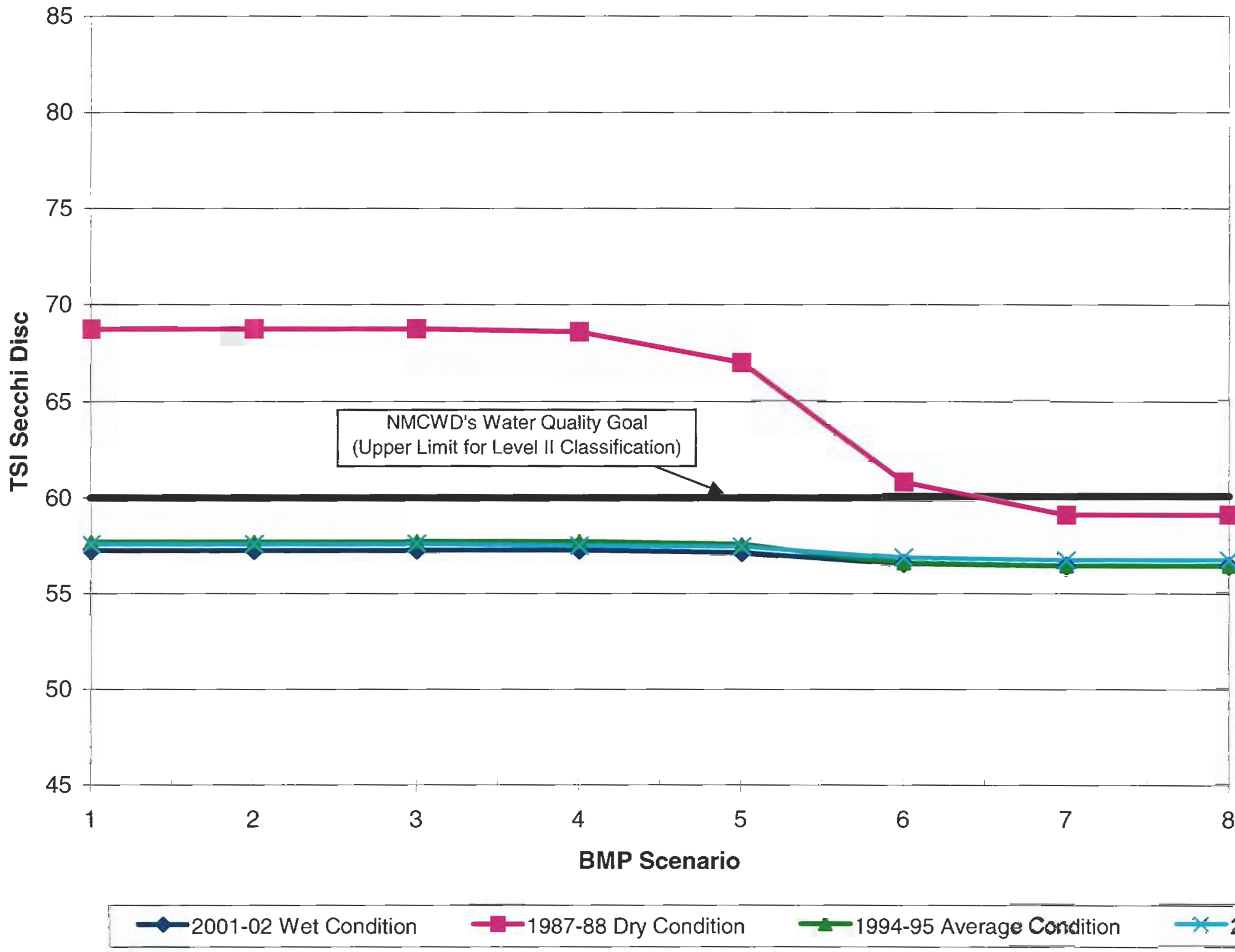
4.3.2 Northwest Anderson Lake

Comparing the recent year (2001) of water quality data to earlier data (1972), the chlorophyll *a* concentration (summer average) ranges between 53 μg/L in 1972 and 48 μg/L in 2001, indicating no significant improvement or decline. The mean summer total phosphorus concentration ranged between 165 μg/L in 1972 and 99 μg/L in 2001, with another high summer average TP concentration occurring in 2000 (164 μg/L). Like the chlorophyll *a* data, the Secchi disc transparency (summer average) between 1972 and 2001 did not change significantly (0.7 meters in 1972 versus 0.8 meters in 2001). The 6 years of available water quality data indicate significant variability from year-to-year, which could be the result of the developing watershed during this time period. In addition, all 6 years of data indicate the water quality in the lake is significantly worse than would by expected for a "minimally" impacted water body per the MnLEAP model.

Recent water quality data during 2001 in Northwest Anderson Lake was poor with the lake classified as a hypereutrophic (very high nutrient) water body for 2001. Summer total phosphorus concentrations were mostly within the range expected for hypereutrophic lake systems (Figure 9). The total phosphorus concentration increase steadily throughout the summer from the spring steady-state concentration (27 mg/L) to the early-fall concentration (147 mg/L). The increase was due to additional phosphorus inputs from a combination of stormwater runoff and internal sources. Chlorophyll *a* concentrations during 2001 ranged from 9 μg/L to 110 μg/L. The summer average concentration for chlorophyll *a* of 48 μg/L was indicative of a hypereutrophic (very high nutrient) system (Figure 9) while the summer average Secchi disc transparency (0.8 m) of the lake is considered highly eutrophic. The summer average phosphorus concentration, chlorophyll *a* concentration and Secchi disc transparency were within the range to maintain the NMCWD's Category III water quality designation.

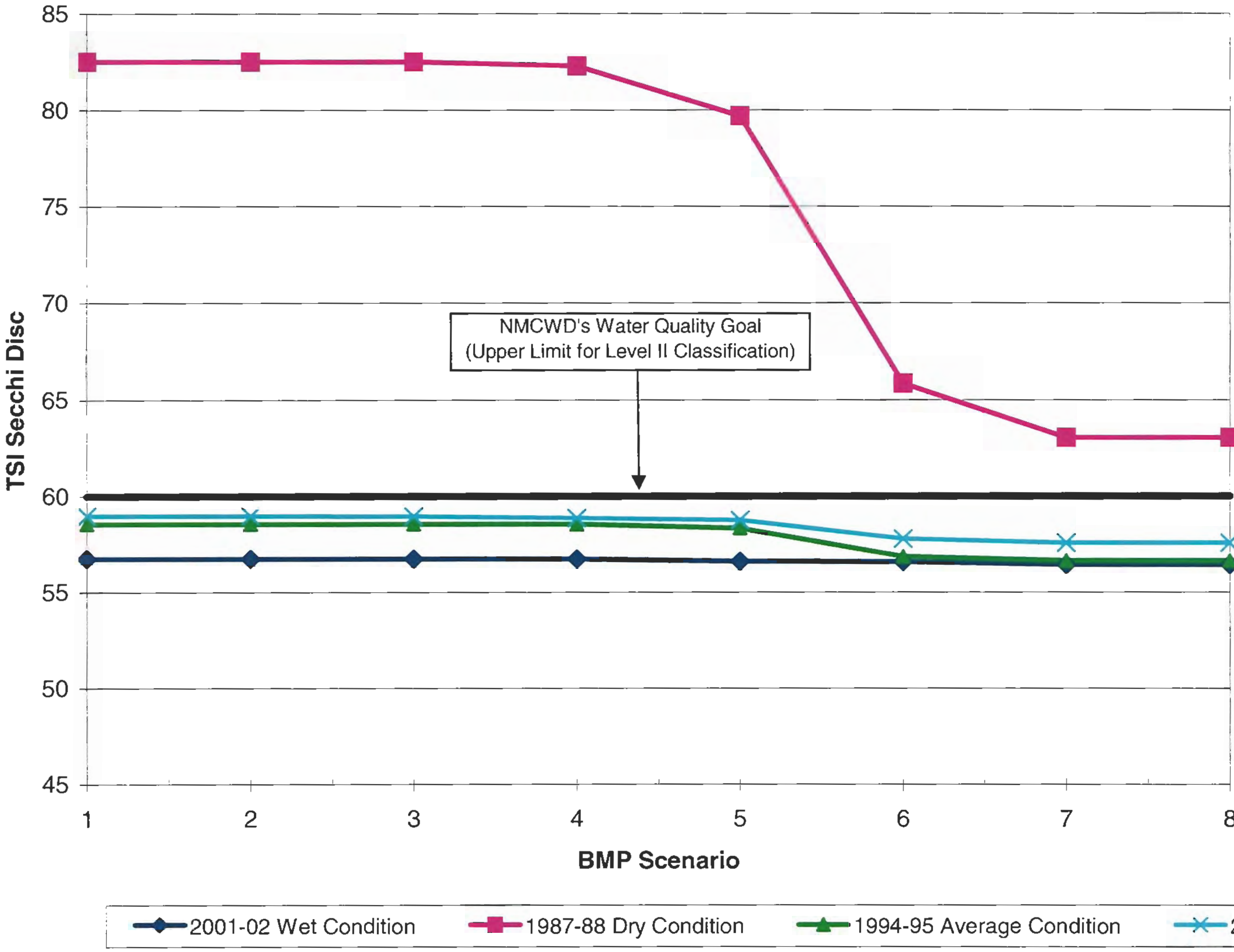
Unlike Southwest Anderson Lake, average climatic conditions produce the greatest impact on water quality in Northwest Anderson Lake. The increased internal phosphorus release from sediment, during relatively average years, delivers a large phosphorus load to the lake. The internal release of phosphorus from curlyleaf pondweed die-back and lake sediments accounted for 39 percent of the lakes' annual loads. Curlyleaf pondweed was estimated to contribute 9 percent of the annual phosphorus loads in 2001 to Northwest Anderson Lakes. Average climatic conditions would reduce Northwest Anderson Lake's water quality to levels outside the Level III classification limits (See Figures 10a and 10b BMP Scenario 1, which involves no action by the District.) Figure 8 illustrates the various BMPs that were analyzed as part of the Anderson Lake UAA. The impacts of these BMPs on the water quality in Northwest Anderson Lake are summaries on Figures 10a and 10b.

Figure EX-7a
Southwest Anderson Lake: Estimated TSI_{SD} Following BMP Implementation with the Normal Water Level at Elevation 839.0



BMP Legend:
1 Existing Land Use: No Action
2 Future Land Use: No Action by NMCWD
3 Future Land Use: Upgrade Selected Existings Ponds to Meet MPCA/NURP Criteria
4 Future Land Use: Upgrade Selected Existings Ponds to Meet MPCA/NURP Criteria and Add Ponds SW-AL-9 and NW-AL-19 Designed to Meet MPCA/NURP Criteria
5 Future Land Use: In-Lake Endothal Treatment to Southeast, Southwest, and Northwest Anderson Lakes
6 Future Land Use: In-Lake Alum plus Lime Treatment to Southeast, Southwest, and Northwest Anderson Lakes
7 Future Land Use: In-Lake Alum plus Lime Treatment and Endothal Treatments to Southeast, Southwest, and Northwest Anderson Lakes
8 Future Land Use: Winter Draw Down of Southwest & Northwest Anderson Lakes and In-Lake Alum plus Lime Treatment and Endothal Treatments to Southeast Anderson Lake

Figure EX-7b
Southwest Anderson Lake: Estimated TSI_{SD} Following BMP Implementation with the Normal Water Level at Elevation 837.5



BMP Legend:

1 Existing Land Use: No Action
2 Future Land Use: No Action by NMCWD
3 Future Land Use: Upgrade Selected Existings Ponds to Meet MPCA/NURP Criteria
4 Future Land Use: Upgrade Selected Existings Ponds to Meet MPCA/NURP Criteria and Add Ponds SW-AL-9 and NW-AL-19 Designed to Meet MPCA/NURP Criteria
5 Future Land Use: In-Lake Endothal Treatment to Southeast, Southwest, and Northwest Anderson Lakes
6 Future Land Use: In-Lake Alum plus Lime Treatment to Southeast, Southwest, and Northwest Anderson Lakes
7 Future Land Use: In-Lake Alum plus Lime Treatment and Endothal Treatments to Southeast, Southwest, and Northwest Anderson Lakes
8 Future Land Use: Winter Draw Down of Southwest & Northwest Anderson Lakes and In-Lake Alum plus Lime Treatment and Endothal Treatments to Southeast Anderson Lake

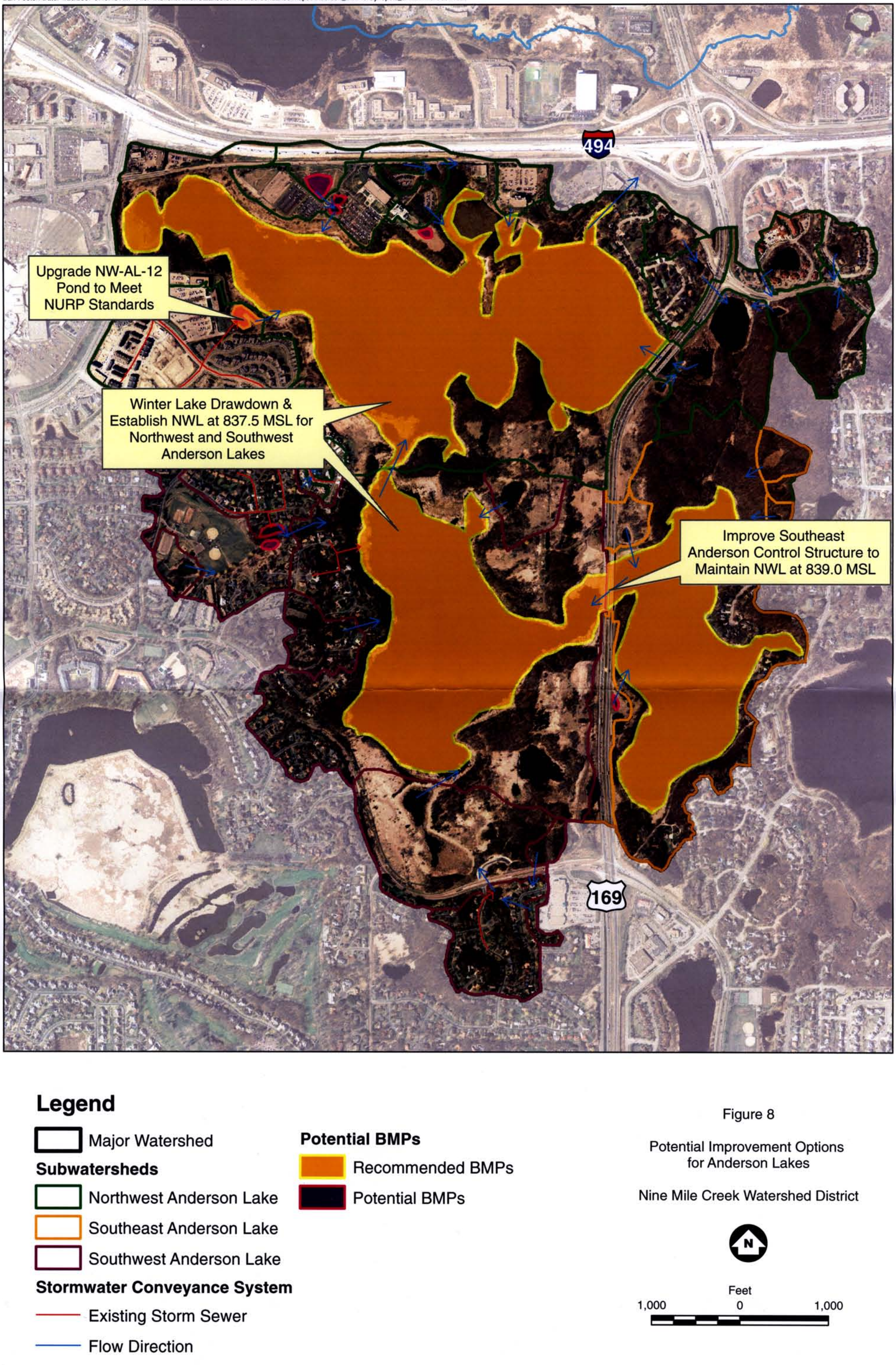
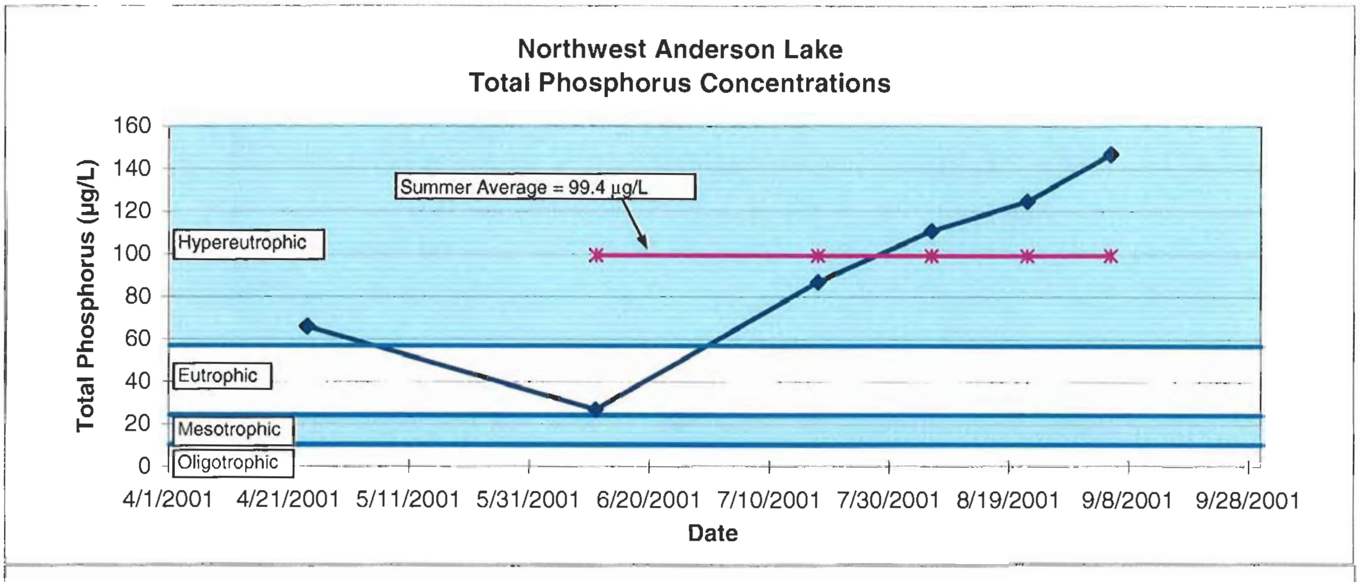
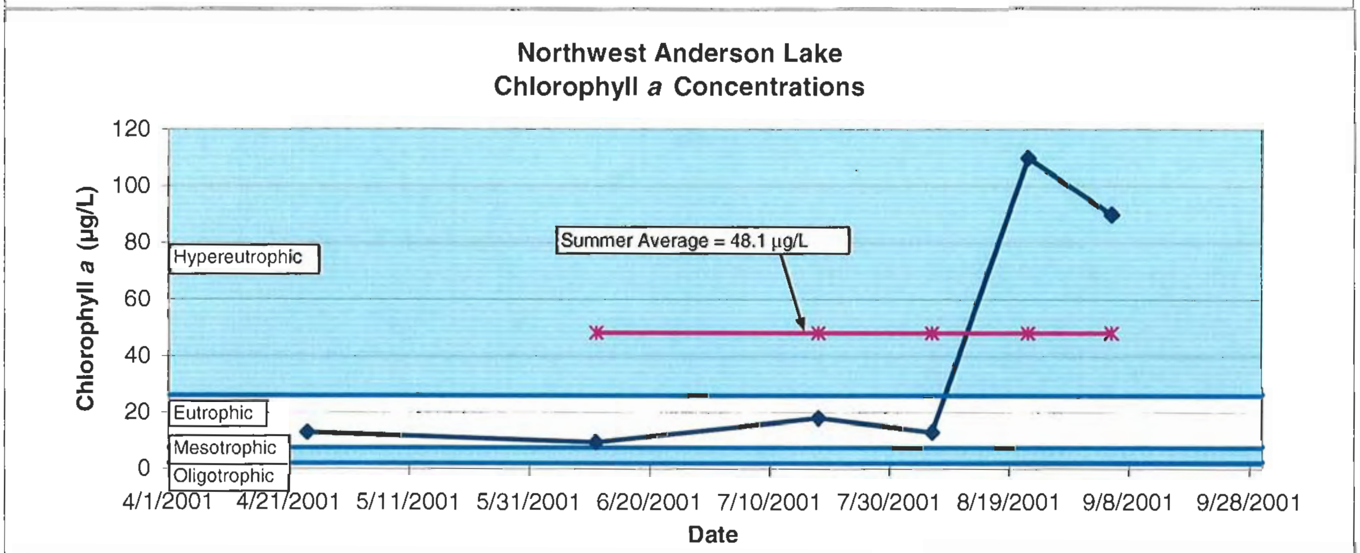


Figure 8

Potential Improvement Options for Anderson Lakes

Nine Mile Creek Watershed District





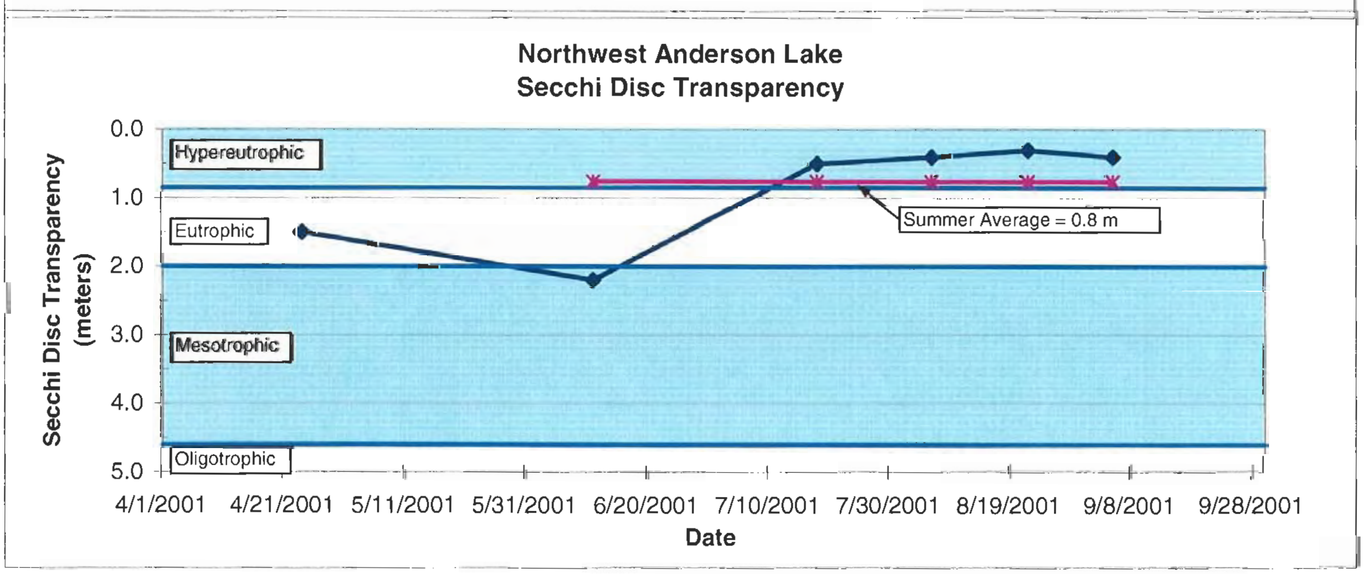
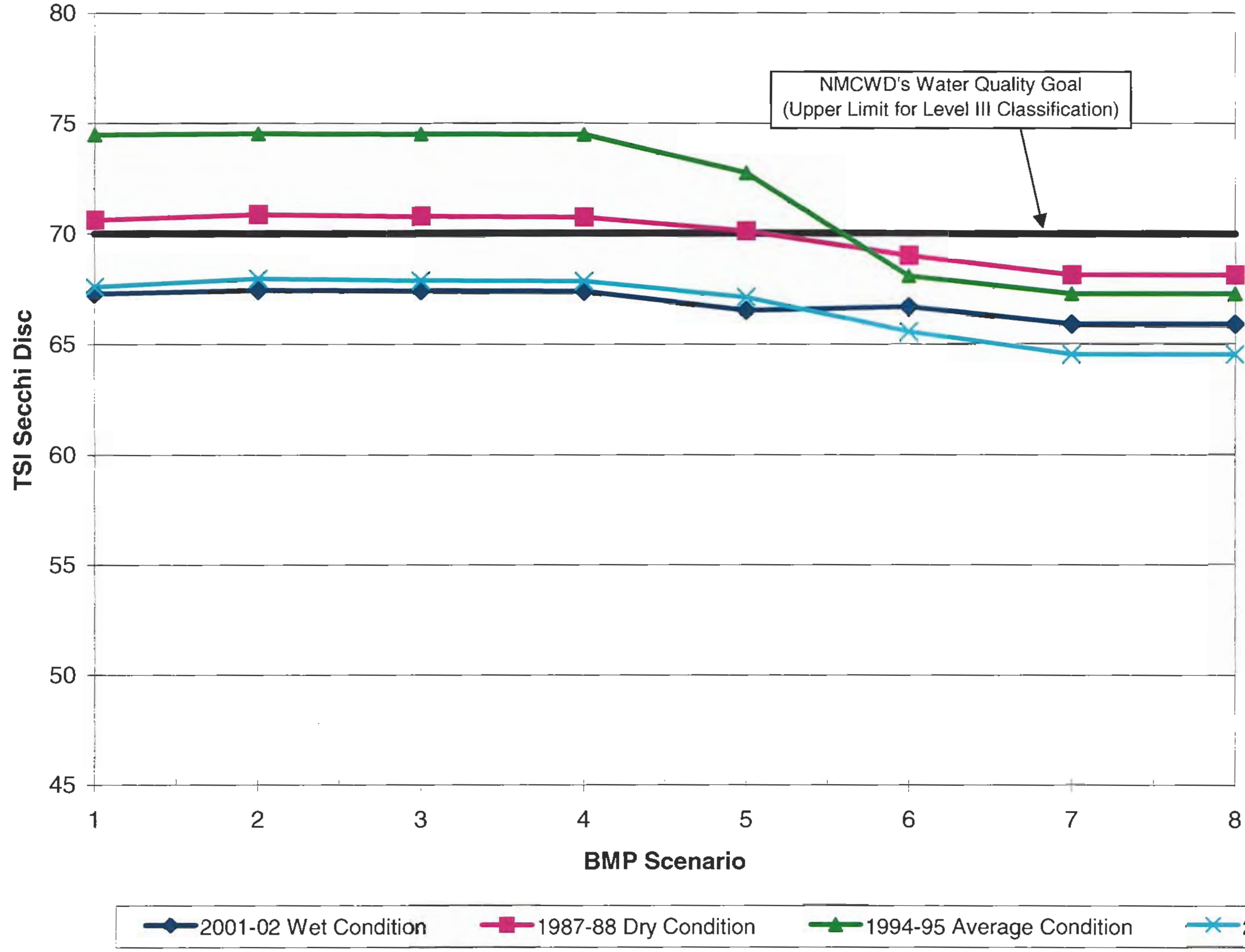


Figure 9

Northwest Anderson Lake 2001 Seasonal Changes in Concentration of Total Phosphorus and Chlorophyll *a* and Secchi Disc Transparencies

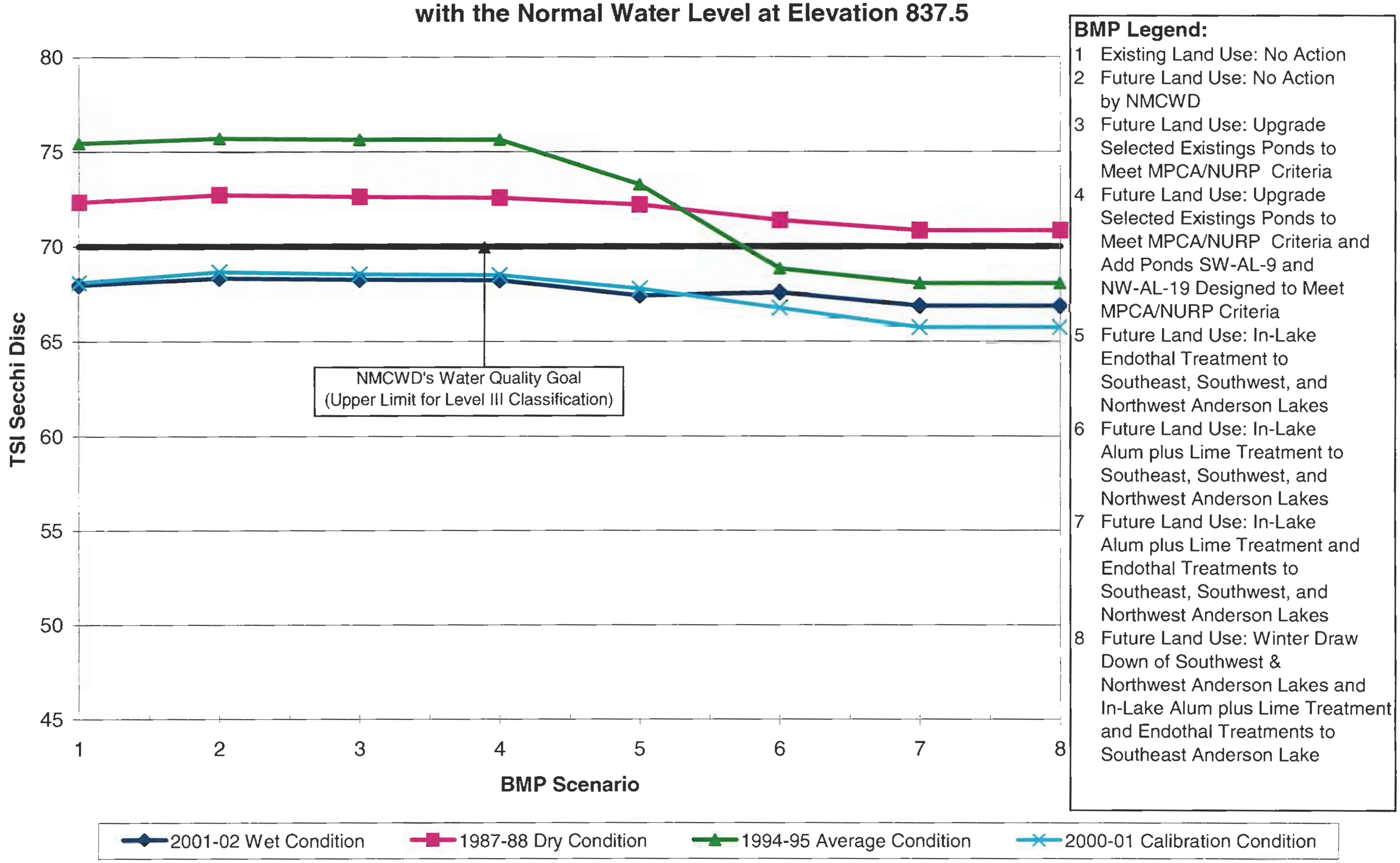
Figure EX-10a
Northwest Anderson Lake: Estimated TSI_{SD} Following BMP Implementation with the Normal Water Level at Elevation 839.0



BMP Legend:

1 Existing Land Use: No Action
2 Future Land Use: No Action by NMCWD
3 Future Land Use: Upgrade Selected Existings Ponds to Meet MPCA/NURP Criteria
4 Future Land Use: Upgrade Selected Existings Ponds to Meet MPCA/NURP Criteria and Add Ponds SW-AL-9 and NW-AL-19 Designed to Meet MPCA/NURP Criteria
5 Future Land Use: In-Lake Endothal Treatment to Southeast, Southwest, and Northwest Anderson Lakes
6 Future Land Use: In-Lake Alum plus Lime Treatment to Southeast, Southwest, and Northwest Anderson Lakes
7 Future Land Use: In-Lake Alum plus Lime Treatment and Endothal Treatments to Southeast, Southwest, and Northwest Anderson Lakes
8 Future Land Use: Winter Draw Down of Southwest & Northwest Anderson Lakes and In-Lake Alum plus Lime Treatment and Endothal Treatments to Southeast Anderson Lake

Figure EX-10b
Northwest Anderson Lake: Estimated TSI_{SD} Following BMP Implementation with the Normal Water Level at Elevation 837.5



P:\23\27\003\UAA\SAS\Anderson Lakes\InLakeModel\Ult_BMPAssess_NWL837-5\Updated\InLakeSummary_837-5.xls

6/2/2006
10:47 AM

4.0 Proposed Improvement Plan

The UAA executive summaries contained in the Appendices of this Engineer's Report include other management recommendations [e.g., exotic plant species (i.e., Eurasian watermilfoil and Purple loosestrife) control and fisheries management] that will also be undertaken separately, by either the City or the Watershed District, outside the bounds of the work covered by this report. The Eden Prairie Lakes Water Quality Improvement Project includes management actions, both watershed and in-lake, for the four lakes considered in this Engineer's Report. The following sections describe these management actions, by water body.

4.1 Birch Island Lake

Three improvements are recommended in the Birch Island Lake watershed, including:

- Construction of a runoff water quality treatment pond (BIL4-1) on the west side of Birch Island Lake, located in the southwest corner of Birch Island Lake Park adjacent to Eden Prairie Road (Co Rd 4). This basin is proposed to have a surface area of about 0.3 acres and a water quality storage volume below the normal water level of roughly 1.0 acre-feet.
- Improvement of an existing runoff detention pond (BIL8) south of Birch Island Lake, along Lesley Lane. This basin is proposed to have a surface area of about 0.28 acres and a water quality storage volume below the normal water level of roughly 1.15 acre-feet.
- Construction of a pipe bypass system to convey groundwater and surface water runoff from north of CSAH 62 directly to Birch Island Lake to restore the lake's historic hydrology. The recommended approach is to bypass the roadway embankment with both surface and groundwater flow. This would require a pipe, (cross culvert), 12-inch, be installed through the roadway embankment from the North Pond with an upstream invert elevation lower than the existing pipe. This new pipe would extend past the wetland and directly outlet to Birch Island Lake. The bypass would be installed by directional drilling through the roadway embankment and wetland. To provide a more efficient means to intercept flow, a drain tile system paralleling the roadway embankment to intercept groundwater flow is also recommended.

The two pond improvement options comprise BMP Scenario 4 in the *Birch Island Lake UAA Executive Summary* (Appendix A) and is depicted in the preceding Figures 2 and 3. The pipe bypass system is discussed further in the *Birch Island Lake Water Level Investigation* report (Appendix D). The combination of the two ponds and lake level restoration project comprise BMP Scenario 6 in Figure 2.

4.2 Bryant Lake

Two improvements are recommended in the Bryant Lake watershed:

- Restoration of the wetland in subwatershed BL-11 which is located along County Ditch 34 between I-494 and Cardinal Creek Road (see Figure 11). In addition to the phosphorus reduction measure as previously outlined, the city of Eden Prairie has petitioned the District to construct a passive trail system around the restored wetland. This trail system will connect to the existing city trails in the area (see Figure 11). The trial would be a clearing and cutting of the natural vegetation to provide access around the wetland complex

- Treat Bryant Lake sediments with aluminum sulfate (i.e., alum, $Al_2(SO_4)_3$ n H_2O) to immobilize potentially releasable phosphorus. Treatment is to be made at an areal dose rate (g/m^2) dependent on the results of sediment core analyses for levels of labile (i.e., loosely bound) and iron-bound phosphorus in surficial deposits (E. Rydin and E.B. Welch. 1998. Aluminum Dose Required to Inactive Phosphate in Lake Sediments. *Water Res.* 32(1):2969-2076). Sediment monitoring should occur 1 year before and for 3 years after alum treatment. Sediment monitoring should include an evaluation of the location of the treatment layer and collection of mobile phosphorus samples.

This improvement is discussed in detail as Option 7 in the *Bryant Lake UAA Executive Summary* (Appendix B), and is depicted in Figure 5. Based on the water quality analysis this BMP combination will provide a significant and more cost-effective water quality improvement for Bryant Lake. This option, which is a combination of Options 1 and 3, will provide water quality improvement that will meet the total phosphorus, chlorophyll *a,* and Secchi disc transparency water quality goals (set by the MPCA) for Bryant Lake. This option will meet the MPCA's goal for "Fully Supporting" swimmable use ($TSI_{SD} \leq 53$), however this option will not meet the NMCWD's more stringent goal for a trophic state index (TSI_{SD}) ≤ 50.

Legend

- Proposed Passive Trail System
- Parcels
- Wetland Restoration Area at Elev 858 MSL

Feet
300 0

Figure 11

CONCEPTUAL LAYOUT FOR THE WETLAND RESTORATION AND TRAIL SYSTEM IN SUBWATERSHED BL-11 (CARDINAL CREEK TRAIL SYSTEM)

Nine Mile Creek Watershed District

Removal of curlyleaf pondweed as describe below is not part of this plan but would be considered as an optional standalone project that would need to be considered in the future. To fully meet the NMCWD's goals for Bryant Lake the phosphorus load associated with the die-back of curlyleaf pondweed must be reduced. Removal of curlyleaf pondweed should have the added benefit of preserving native pondweed species adversely affected by algal blooms that follow curlyleaf pondweed die-off. Research has shown that the appropriate herbicide for curlyleaf pondweed control is endothall, and that this herbicide should be applied in the spring (when water is approximately 55-60°F) and at a dose of 1 mg/L (Poovey et al. 2002). Preliminary results from studies in Eagan, MN by John Skogerboe of the US Army Corps of Engineers have shown that four subsequent years of endothall treatment have essentially eliminated curlyleaf pondweed from two of the study lakes and that after the 4th year of treatment no viable turions (pondweed seeds) remained in the sediment. To remove curlyleaf pondweed, treatment will need to continue until no viable turions remain after treatment is completed. Treatment is expected to continue for 4 years. Sediment treatment (Option 3) should not be performed until curlyleaf pondweed is completely controlled. Sediment treatment prior to curlyleaf pondweed control could possibly increase the light availability to this plant and stimulate curlyleaf pondweed growth.

Assuming that four consecutive whole-lake, early-spring endothall treatments would be at least 80 percent effective in controlling curlyleaf pondweed, the annual phosphorus loads to Bryant Lake would be reduced by up to 6 percent. Table 2 summarizes the effectiveness of this improvement option (Option 9) in terms of phosphorus removal and lake clarity improvement during the summer months.

In addition to managing curlyleaf pondweed, spot herbicide treatments should be done in those areas where the macrophyte surveys indicate the presence of Eurasian watermilfoil. Three Rivers Parks District has indicated that the Parks District would continue the management of Eurasian watermilfoil. Therefore, the cost of manage of Eurasian watermilfoil is not included as part of this project.

4.3 Anderson Lakes

The city of Eden Prairie and Three Rivers Park District has indicated that the current water quality of Anderson Lakes is consistent with the proposed management goals for Northwest and Southwest Anderson Lakes. Therefore, no watershed BMPs were recommended as part of the UAA. However, field examination of one potential BMP site revealed that the embankment surrounding the control structure from pond NW-AL-12 had been breached (see Figure 12) and is reducing the ponds water quality treatment efficiency.

The city of Eden Prairie has also petitioned the District to perform a winter lake level draw down of Northwest and Southwest Anderson Lakes to reduce curlyleaf pondweed densities and consolidate the lake sediment, thus reducing the internal phosphorus load to the respective lakes.

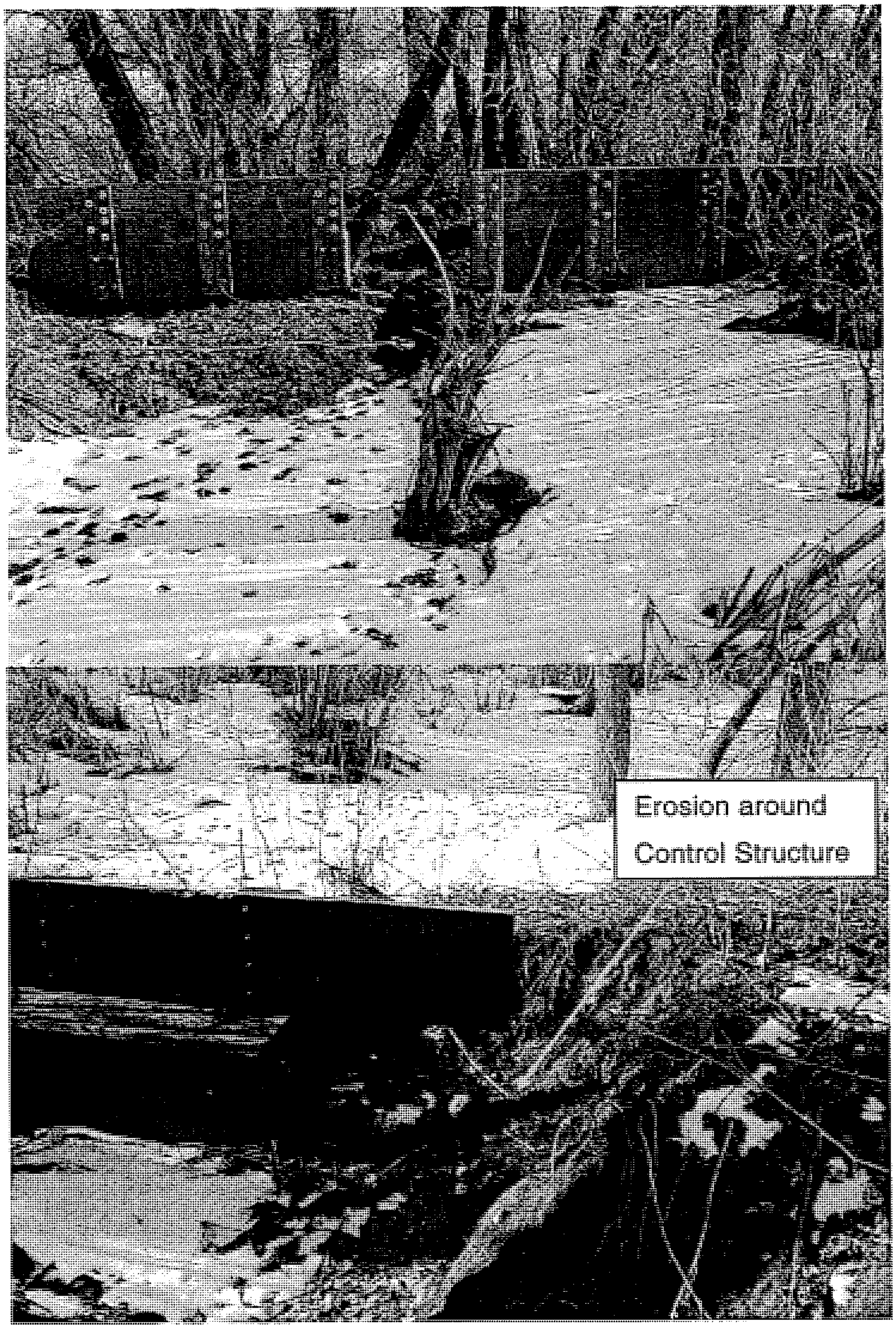
The City and Park District also plan to pursue a permanent lowering of the normal water level of Northwest and Southwest Anderson Lakes to Elevation 837.5 MSL. Comparing Figures 7a with 7b and 9a with 9b the impacts of lowering the NWL of Southwest and Northwest Anderson Lakes can be assessed. This comparison indicates that the lake water quality will generally be worse under the lower NWL scenarios. However, only the dry climatic conditions will likely result in TSI_{SD} values that fail to achieve the District's goals. To maintain the normal water level of Southeast Anderson Lake at 839 MSL once Northwest and Southwest Anderson Lakes are lowered, modifications to the exiting culvert connecting Southeast ans Southwest Anderson Lakes is required.

Three improvements are recommended in the Southwest and Northwest Anderson Lake watersheds, including:

- Improvement of the control structure between Southeast and Southwest Anderson Lakes.
- A drawing down of the water level in Southwest and Northwest Anderson Lakes to control non-native aquatic vegetation such as Curlyleaf pondweed.
- Improvement of the water quality and stormwater detention efficiency of a runoff detention pond (NW-AL-12) east of Prairie Lakes Drive. This will involve replacement of the control structure and excavation of additional water quality treatment storage.

Based on the city of Eden Prairie and Three Rivers Park Districts concerns a lake level draw down and winter freeze is the primary management approach that will be utilized to control non-native aquatic vegetation, such as Curlyleaf pondweed, and internal phosphorus release from the sediment. The effectiveness the draw down management approach will be assessed following full implementation. If the less costly winter drawdown fails to achieve the District's, City's, and Three River Park's water quality goals, the District should consider managing Curlyleaf pondweed and the internal release of phosphorus for the lake sediment with herbicide (endothal) and alum plus lime treatments. The herbicide and alum plus lime treatments discussed in Section 4.3.1 of this report are not proposed as part of this plan but would be considered as a standalone project that would need to be considered in the future.

Figure 12 Outlet Structure from Pond NW-AL-12



4.3.1 Southwest and Northwest Anderson Lake Alternative Treatment

BMP Scenario 7 involves herbicide (endothal) and alum plus lime treatments of Northwest and Southwest Anderson Lakes and should only be considered if the winter drawdown is ineffective. This BMP alternative is estimated to cost $2,500,000 or an annualized cost of $220,000 per year over a 20 year period. Below is the expected sequence of the lake management activities for the first 5 years.

- **Year 1 (2006)** Herbicide (endothal) treatment begins in the spring and summer water quality and macrophyte monitoring.
- **Year 2 (2007)** Endothal treatment and summer water quality and macrophyte monitoring.
- **Year 3 (2008)** Endothal treatment and summer water quality and macrophyte monitoring.
- **Year 4 (2009)** Final endothal treatment and summer water quality and macrophyte monitoring.
- **Year 5 (2010)** Alum plus lime treatment in the fall and summer water quality and macrophyte monitoring.

This alternative plan has been included because the overall productivity of all both Anderson Lakes needs to be significantly reduced to restore the lake to a more ecologically balanced condition. This means that both significant internal phosphorus sources, the aquatic plant curlyleaf pondweed and phosphorus release from sediments, need to be controlled. To remove curlyleaf pondweed, treatment will need to continue until no viable turions remain after treatment is completed. Treatment is expected to continue for 4 years. Sediment treatment should not be performed until curlyleaf pondweed is completely controlled. Sediment treatment prior to curlyleaf pondweed control could possibly increase the light availability to this plant and stimulate curlyleaf pondweed growth.

Water quality modeling indicates that if the normal water level of Southwest and Northwest Anderson Lakes is lowered to Elevation 837.5 MSL the summer average TSI_{SD} values for dry climatic conditions would fail to achieve the District's goals (see Table 3). However the District's TSI_{SD} goal would be achieved during the other climatic conditions analyzed.

Table 3 **Benefits of Goal Achievement Alternative (Curlyleaf Pondweed Control and In-Lake Alum plus Lime Treatments) for Southwest and Northwest Anderson Lakes with the NWL of 837.5 MSL**

Lake	Lake NWL	Trophic State Index (TSI_{SD}) Value				
		NMCWD Goal	Wet Year (1982-83)	Model Calibration Year (2000-01)	Average Year (1994-95)	Dry Year (1987-88)*
Southwest Anderson Lake	837.5	$50 < TSI_{SD} \leq 60$	56	58	57	63
Northwest Anderson Lake	837.5	$60 < TSI_{SD} \leq 70$	67	66	68	71

* The May 1, 1987 through April 30, 1988 precipitation total excludes the 10-inch 1987 superstorm because of the events rarity.

4.7 Cost Estimate

The aggregate cost of the recommended improvements described in this Engineer's Report and shown in Figure 1 is $1,928,000. This total is comprised of the following project subtotals which exclude land costs:

Birch Island Lake

Pond BIL4-1	$90,000
Pond BIL8	80,000
Lake Level Restoration	225,000
Subtotal	$395,000

Byrant Lake

Wetland Restoration (Pond BL-11)\Wetland Replacement	$375,000
Passive Trail System	473,000
Whole Lake Alum Treatment	142,000
Land Appraisals.	*
Subtotal	$990,000

Anderson Lakes

Pond NW-AL-12	$393,000
Improve SE Anderson Control Structure	25,000
NW & SW Anderson Lake Level Draw Down	125,000
Establish a NWL of 837.5 for NW & SW Anderson Lakes (City & Three Rivers Parks Responsibility)	0
Subtotal	$543,000
Construction Grand Total	$1,928,000

* Land appraisals will be performed prior to the public meeting to determine easement costs

4.6 Permits

Permits for the recommended improvements will be required by the City of Eden Prairie, the Minnesota Department of Natural Resources, the Minnesota Pollution Control Agency, the Nine Mile Creek Watershed District, and the St. Paul District of the U.S. Army Corps of Engineers.

4.7 Affected Property Owners

Owners of the properties potentially affected by the recommended improvements are listed in Appendix E.

5.0 Impacts Caused by the Project

No long-term adverse impacts to natural resources are expected to result from implementation of the recommended improvements. Some temporary construction-related impacts may occur to riparian wetlands, and mitigation may be required, but the extent of wetlands is generally expected to increase as a result of the project. Every effort possible will be made to minimize tree loss in connection with various aspects of the recommended projects. Trees that are unavoidably lost will be replaced, at the landowner's discretion.

Expected benefits of completing the petitioned projects are summarized, in terms of TSI_{SD} values, in the following table (Table 4), which presents summer average water quality condition estimates (from P8/In-Lake modeling). These predictions assume all elements of the recommended water quality improvement plan are implemented as described above.

Table 4 Predicted Lake Water Quality Conditions (TSI_{SD}) Following Project Implementation

Lake	Watershed Land Use	Trophic State Index (TSI_{SD}) Value				
		Recently Observed Conditions (Yr. of Record)	District Goal	Average Precipitation Year	Calibration Precipitation Year	Dry Precipition Year
Birch Island Lake	Ultimate	60 (1997)	$50 < TSI_{SD} \leq 60$	42	37	50
Bryant Lake	Ultimate	62 (2005)	≤ 50	--	52	--
Southwest Anderson Lake	Ultimate	57 (2001)	$50 < TSI_{SD} \leq 60$	57	58	63
Northwest Anderson Lake	Ultimate	64 (2001)	$60 < TSI_{SD} \leq 70$	68	66	71

The result of the petitioned project will be improved lake water quality to a point where it consistently meets its goal for wet, average and calibration climatic conditions.

6.0 Recommendation

The Eden Prairie Lakes Water Quality Improvement Project is a necessary and feasible part of the Overall Water Management Plan of the Nine Mile Creek Watershed District. The city of Eden Prairie has petitioned the Nine Mile Creek Watershed District to undertake this work on a cooperative basis with the City (see Appendix F). Because the project meets the water quality management goals of the District, it is recommended that the project be implemented as is generally described in this Engineer's Report.

Appendices

Appendix A

Birch Island Lake UAA Report (Executive Summary only)

Appendix A: Following is the Birch Island Lake UAA Executive Summary

Use Attainability Analysis
Final Report

Birch Island Lake

Prepared for
Nine Mile Creek Watershed District

June 2000

BARR

Use Attainability Analysis
Final Report

Birch Island Lake

Prepared for
Nine Mile Creek Watershed District

June 2000

BARR

4700 West 77th Street
Minneapolis, MN 55435
Phone: (612) 832-2600
Fax: (612) 832-2601

Executive Summary

Overview

This report describes the results of the Use Attainability Analysis (UAA) for Birch Island Lake in Eden Prairie. The UAA provides the scientific foundation for a lake-specific best management plan that will permit maintenance of existing or attainment of intended beneficial uses of Birch Island Lake. The UAA is a scientific assessment of a water body's physical, chemical, and biological condition. This study includes both a water quality assessment and a prescription of protective and/or remedial measures for Birch Island Lake and its watershed. The conclusions and recommendations are based on historical water quality data, the results of intensive lake water quality monitoring in 1997, and computer simulations of land use impacts on water quality in Birch Island Lake using watershed and lake models calibrated to the 1997 data set. In addition, best management practices (BMPs) were evaluated to compare their relative effect on total phosphorus concentrations and Secchi disc transparencies (i.e., water clarity). Management options were then assessed to determine attainment or non-attainment with the lake's beneficial uses.

Nine Mile Creek Watershed District Water Quality Goals

The approved *Nine Mile Creek Watershed District Water Management Plan* (Barr 1996) preliminarily assessed ultimate watershed water quality for Birch Island Lake and articulated five specific goals for Birch Island Lake. These goals address water quality, recreation, aquatic communities, water quantity, and wildlife. Where possible, the Nine Mile Creek Watershed District (NMCWD) goals were quantified by using the standardized lake rating system termed the Carlson's Trophic State Index (TSI). This index considers the lake's total phosphorus concentrations, chlorophyll *a* concentrations, and Secchi disc transparencies to assign a water quality index number reflecting the lake's general fertility level. The rating system results in index values between 0 and 100, with the index value increasing with increased lake fertility. Total phosphorus, chlorophyll *a*, and Secchi disc transparency are key water quality indicators for the following reasons.

- Phosphorus generally controls the growth of algae in lake systems. Of all the substances needed for biological growth, phosphorus is typically the limiting nutrient.

- Chlorophyll *a* is the main photosynthetic pigment in algae. Therefore, the amount of chlorophyll *a* in the water indicates the abundance of algae present in the lake.

- Secchi disc transparency is a measure of water clarity, and is inversely related to the abundance of algae. Water clarity typically determines recreational use impairment.

All three of the parameters can be used to determine a TSI. However, water transparency is typically used to develop the TSI_{SD} (trophic state index based on Secchi disc transparency) because people's perceptions of water clarity are often directly related to recreational use impairment. The TSI rating system results in the placement of a lake with medium fertility in the mesotrophic trophic status category. Water quality trophic status categories include oligotrophic (i.e., excellent water quality), mesotrophic (i.e., good water quality), eutrophic (i.e., poor water quality), and hypereutrophic (i.e., very poor water quality). Water quality characteristics of lakes in the various trophic status categories are listed below with their respective TSI ranges:

1. **Oligotrophic** – [$20 \leq TSI_{SD} \leq 38$] clear, low productive lakes, with total phosphorus concentrations less than or equal to 10 μg/L, chlorophyll *a* concentrations of less than or equal to 21 μg/L, and Secchi disc transparencies greater than or equal to 4.6 meters (15 feet).

2. **Mesotrophic** – [$38 \leq TSI_{SD} \leq 50$] intermediately productive lakes, with total phosphorus concentrations between 10 and 251 μg/L, chlorophyll *a* concentrations between 2 and 81 μg/L, and Secchi disc transparencies between 2 and 4.6 meters (6 to 15 feet).

3. **Eutrophic** – [$50 \leq TSI_{SD} \leq 62$] high productive lakes relative to a neutral level, with 25 to 57 μg/L total phosphorus, chlorophyll *a* concentrations between 8 and 261 μg/L, and Secchi disc measurements between 0.85 and 2 meters (2.7 to 6 feet).

4. **Hypereutrophic** – [$62 \leq TSI_{SD} \leq 80$] extremely productive lakes which are highly eutrophic and unstable (i.e., their water quality can fluctuate on daily and seasonal basis, experience periodic anoxia and fish kills, possibly produce toxic substances, etc.) with total phosphorus concentrations greater than 571 μg/L, chlorophyll *a* concentrations of greater than 26 μg/L, and Secchi disc transparencies less than 0.85 meters (2.7 feet).

The District's management strategy has been to "protect" the resource. According to the *NMCWD Water Management Plan*, "protect" means "to avoid significant degradation from point and nonpoint pollution sources, and from wetland alterations in order to maintain existing beneficial uses, aquatic and wetland habitats, and the level of water quality necessary to protect these uses in receiving waters." The NMCWD goals for Birch Island Lake include the following:

- The **Water Quality Goal** of Birch Island Lake is to achieve a Level II classification level. This level fully supports water-based recreational activities including sailboating, canoeing, hiking and picnicking, among others. Reasonable water quality goals for this activity level are total phosphorus concentrations between 45 and 75 μg/L, chlorophyll *a* concentrations of between 20 and 40 μg/L, and a Secchi disc transparency of 1.0 to 2.0 meters (3.3 to 6.6 feet), which corresponds to a trophic state index (TSI_{SD}) between 50 and 60. This goal is attainable for average, wet and model calibration climatic conditions, but only with the implementation of the watershed management practices described in this UAA.

- The **Recreation Goal** is to achieve water quality that fully supports swimming ($TSI_{SD} \leq 53$) as defined by the "MPCA Use Support Classification for Swimming Relative to Carlson's Trophic State Index by Ecoregion." This goal is attainable during wet and model calibration precipitation years but only with the implementation of the best management practices (BMPs) described in this UAA.

- The **Aquatic Communities Goal** is to achieve a water quality that fully supports the lake's fisheries use classification determined by the MDNR in accord with the *MDNR An Ecological Classification of Minnesota Lakes with Associated Fish Communities* and achieve a balanced ecosystem. Specifically, the goal is to maintain a lake classification of 30, with third and first quartile TSI_{SD} values of 48 and 62, respectively. Management of Birch Island Lake to achieve a balanced fishery includes achieving a balance of predator fish (e.g., northern pike, bass) and panfish (e.g., bluegills) of a desirable size for fishermen. This goal is not attainable in terms of water transparency level for dry climatic conditions, but with the implementation of the watershed management practices described in this UAA the goal is attainable for average, wet, and model calibration climatic conditions.

- The **Water Quantity Goal** is to provide sufficient water storage of surface runoff during a regional flood, the critical 100-year frequency storm event. This goal is attainable with no action.

- The **Wildlife Goal** for Birch Island Lake is to protect existing, beneficial wildlife uses. The wildlife goal can be maintained with no action, especially if the wetlands and park land surrounding the lake remain intact.

Water Quality Problem Assessment

Water Quality

Because only 1972, 1989, and 1997 water quality data were available for this study, a trend analysis could not be completed for Birch Island Lake. However, comparing data from 1972 to 1997, there was a threefold increase in chlorophyll *a* concentration (mean summer averages) from 8.1 μg/L in 1972 to

25.3 µg/L in 1997. The mean summer total phosphorus concentrations range between 27 µg/L in 1972 and 49.6 µg/L in 1997. Secchi disc transparency (mean summer average) has substantially deteriorated from 2.9 meters in 1972 to 1.9 meters in 1989 and 1.0 meters in 1997 (a 64 percent decrease). Comparing the 3 years of available data, it becomes evident that the lake's water quality has generally deteriorated over the last 25 years as the watershed approached complete urbanization and the water level decreased.

Figure EX-1 summarizes the seasonal changes in the concentrations of total phosphorus and chlorophyll *a*, and Secchi disc transparencies for Birch Island Lake during 1997. The data are shown compared the trophic status categories. Based on summer average chlorophyll *a* (25.3 µg/L), Secchi disc transparency (1.0 m) and total phosphorus concentration (49.6 mg/L), the lake is considered eutrophic. However, the average phosphorus concentrations, chlorophyll *a* concentrations, and Secchi disc transparencies were low enough to maintain the District's Level II water quality designation. Birch Island Lake's water quality does exhibit temporal variation, seasonally. This is evident by the variability in Secchi disc transparencies, chlorophyll *a* concentrations, and total phosphorus concentrations throughout the monitoring period. Analysis of monitored lake total phosphorus, chlorophyll *a*, and Secchi disc transparency data for 1972, 1989, and 1997 indicate large variability from year to year, in terms of average summer conditions. This is consistent with the fact that the southern subwatersheds have been urbanized during that time and that the lake level has experienced a considerable decrease. Monitored water quality conditions for 1972 and 1997 meet the District's management goals for the lake.

Major Hydrologic Characteristics

The water surface elevation of Birch Island Lake has experienced approximately a 7-foot decline since the mid-1980s, diminishing the value of this water resource. The *Glen Lake, Shady Oak Lake, and Birch Island Lake Water Level Investigation*, (Barr, December 1992) stated that the construction of CSAH 62 to the north of the lake was potentially the cause of the lowering of the lake level. However, the report also stated that due to conflicting information, no conclusions could be made without further investigation. The decreased lake level results in a smaller dilution potential for a given watershed phosphorus load. Therefore, the lake level decrease could account for a portion of the general water quality deterioration over the last 20 years.

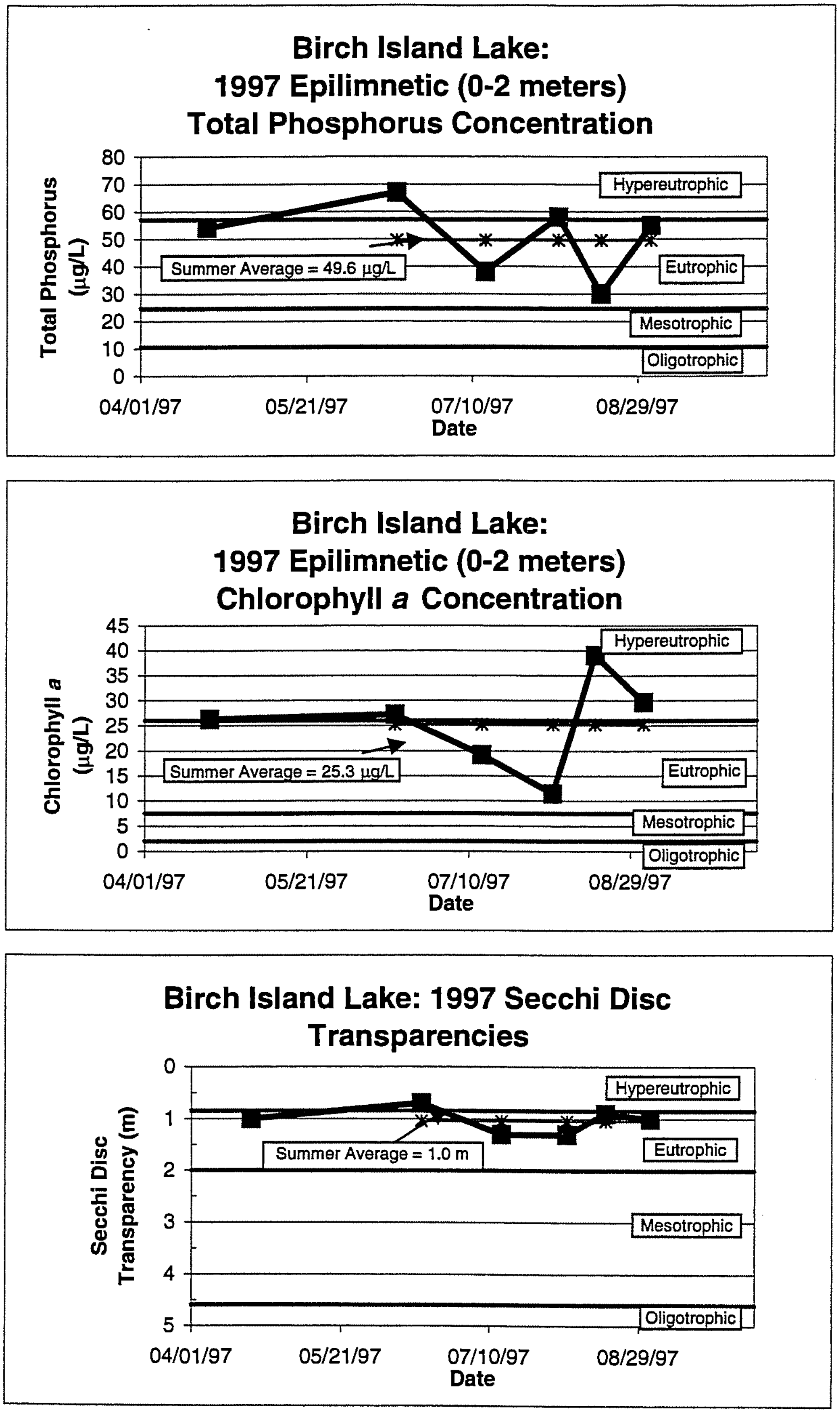


Figure EX-1 Seasonal Changes in Concentration of Total Phosphorus and Chlorophyll *a* and Secchi Disc Transparencies

Watershed Runoff Pollution

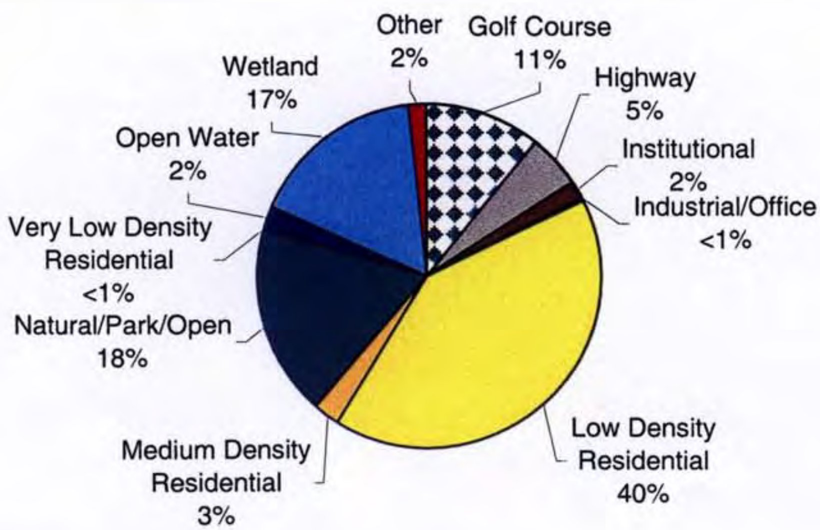
The entire Birch Island Lake watershed (543 acres, including 12 acres for the lake surface area) is urbanized. The urbanized watershed consists predominantly of low-density residential land use (40 percent as indicated on Figure EX-2). A small industrial area is located in the southeastern portion of the watershed. An area of medium-density residential land use is located to the southwest of the lake. There is a large wetland directly north of Birch Island Lake and smaller wetlands are sporadically spaced throughout the watershed that only periodically discharge to the lake. There are several other large wetlands directly to the southeast of the lake that do not discharge to the lake. These areas were disconnected from the lake by the construction of the Chicago, Milwaukee, St. Paul and Pacific Railroad in the 1800s. The main area where the watershed land use is expected to change is south of the lake, between Edenvale Boulevard and just north of Birch Island Road. In this area the land use is projected to change from natural/open to low density residential (See Figure EX-3). Future redevelopment within the watershed could result in density increases and increased phosphorus loading to the lake. Increased density of both residential and commercial land use development is possible in the future.

Computer simulations and observed water quality data indicate that phosphorus inputs to the lake originate from watershed and atmospheric loads (external sources). Internal phosphorus loading (i.e., release from anoxic bottom sediments) is only a minor component of the lake's phosphorus budget and does not significantly impact Birch Island Lake's water quality.

Birch Island Lake's phosphorus budget for 1997 indicates approximately 59 percent of the lake's annual phosphorus load was from the lake's direct watershed (See Figure EX-4). Figure EX-4 also shows that <1 percent of the annual load was from natural conveyance systems and 12 percent was from the stormwater conveyance system. An annual total phosphorus load from atmospheric deposition of 29 percent was estimated for Birch Island Lake during 1997.

Computer simulations of runoff water quality, based on 1997 precipitation, indicate that the phosphorus yield from Birch Island Lake's watershed average 0.15 lb/ac/year, based on the 169-acre connected watershed (the portion of Birch Island Lake's watershed that contributes phosphorus during 1996-97). The estimated unit runoff for these same conditions is approximately 3.1 inches.

Birch Island Lake Use Attainability Analysis Existing Land Uses



Birch Island Lake Use Attainability Analysis Ultimate Land Uses

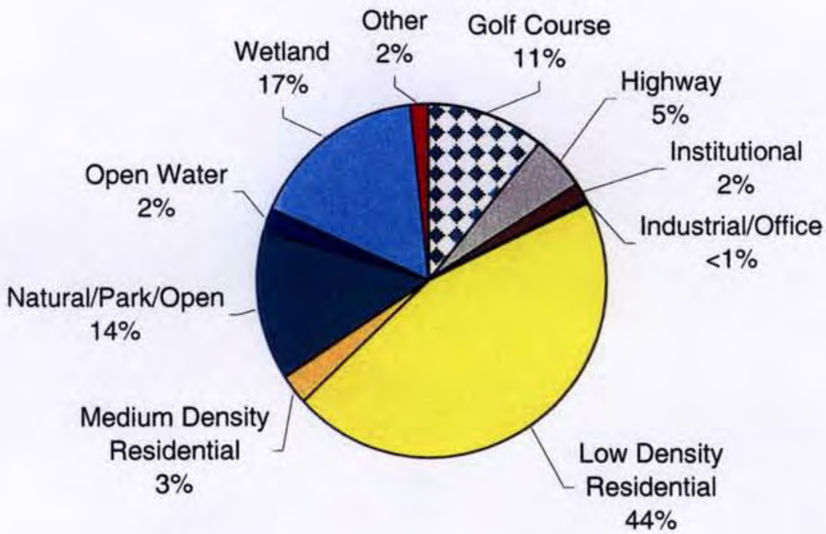


Figure EX-2
Birch Island Lake
Use Attainability Land Uses

P:\23\27\003\UAA\SAS\Birch Island\Report\BIL_ex_lu.xls

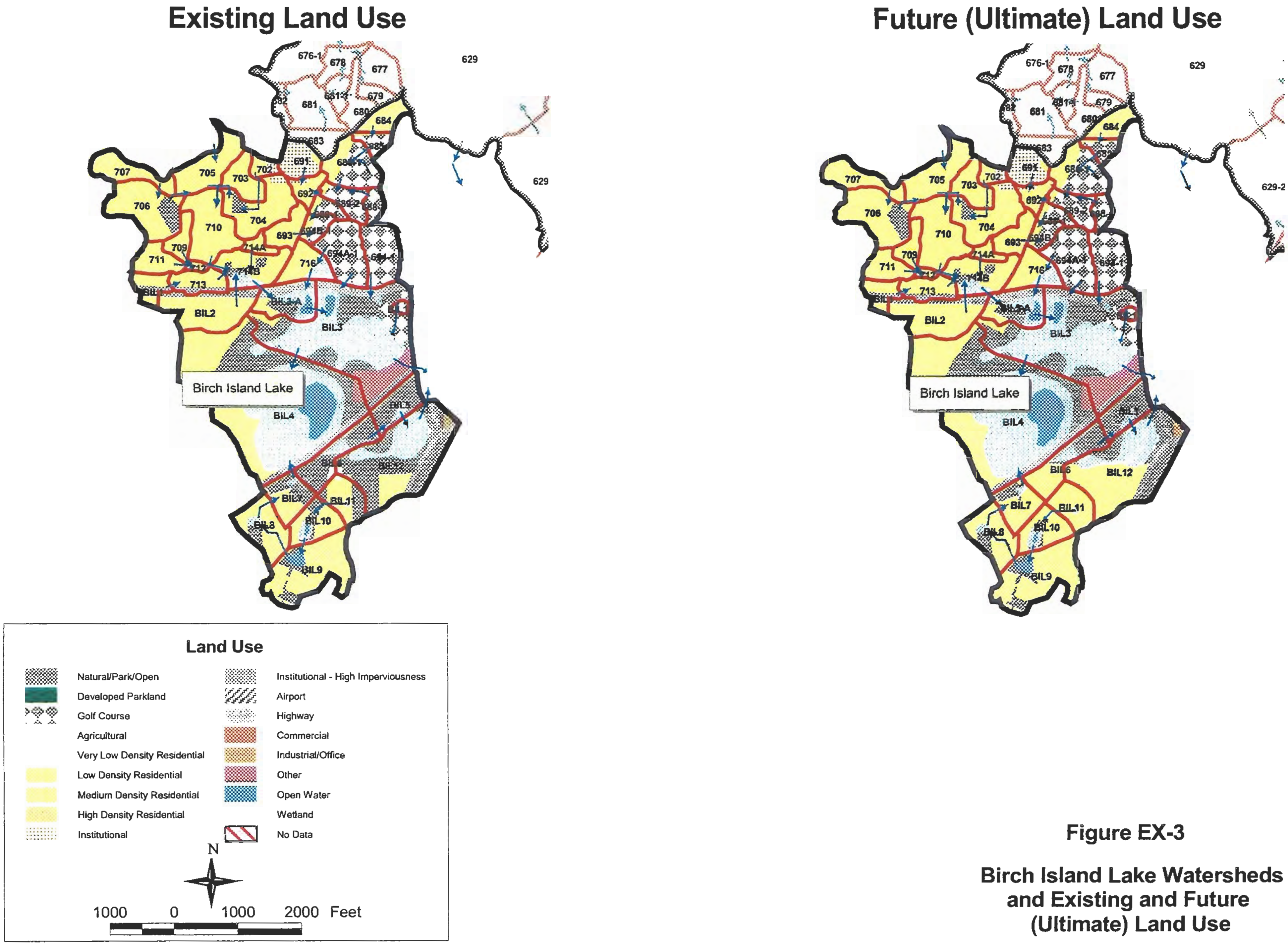
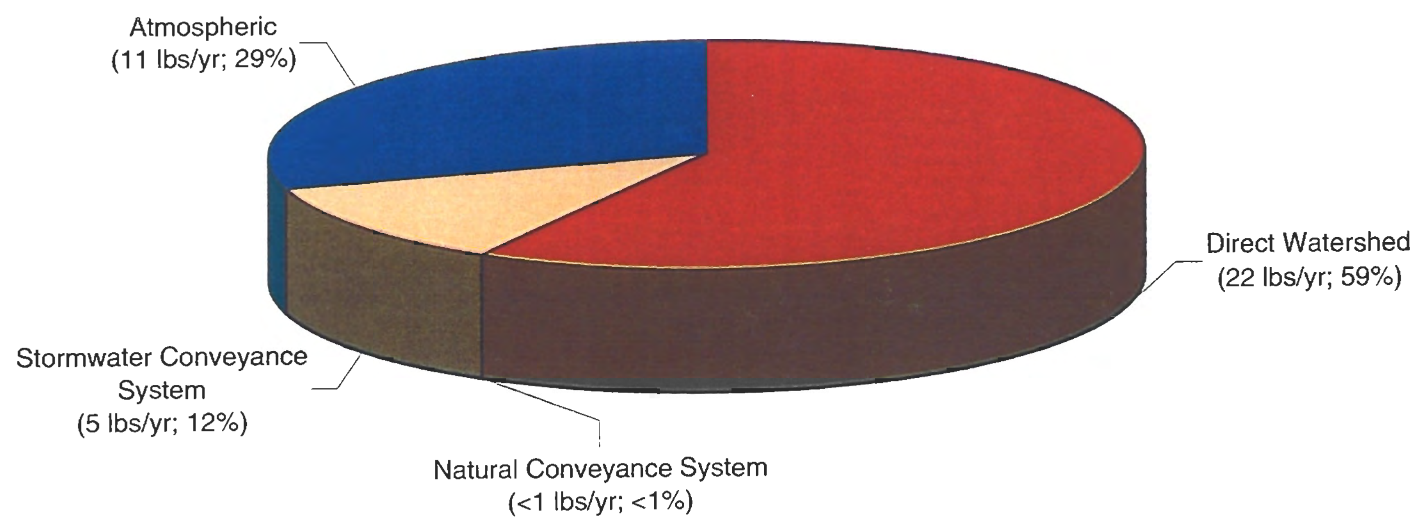


Figure EX-3

Birch Island Lake Watersheds and Existing and Future (Ultimate) Land Use

Birch Island Lake Annual Phosphorus Budget
Model Calibration Year ('97)



P:\23\27\003\UAA\SAS\Birch Island\P8 Ultimate LU\BILSummaryNEW.xls

Figure EX-4

Aquatic Weeds

Aquatic macrophyte (i.e., lake weed) surveys were conducted during June and August 1997. The current macrophyte communities in Birch Island Lake are diverse and healthy. However, by August a growth of purple loosestrife (*Lythrum salicaria*), a non-native noxious weed species, developed along the eastern and western shorelines of Birch Island Lake. Purple loosestrife is an undesirable non-native species. It out-competes native plants, such as cattail, and can eventually replace the native species, thereby interfering with the wildlife use of the lake. The 1981 Minnesota Department of Natural Resources (MDNR) lake survey for Birch Island Lake did not indicate the presence of purple loosestrife. However, by the 1992 MDNR lake survey, purple loosestrife was noted with a relatively common abundance, thus indicating that the purple loosestrife growth is not a recent development.

Ecosystem and Fisheries

The most recent fisheries report, conducted in 1992, indicates the absence of a fishery. The report also mentioned that the dissolved oxygen levels during the winter of 1990-91 were very low, thus indicating the lake winterkilled. The absence of fish in the 1992 lake survey could be a direct result of the recent winterkill. Therefore, stocking may improve the lake's fisheries. Winter aeration may be required to sustain a fishery in Birch Island Lake.

Recently collected phytoplankton and zooplankton data (1989 and 1997) suggests the communities are out of balance with each other. During 1997 an algal bloom was indicated by the phytoplankton data. There was not a corresponding increase in zooplankton levels. However, the limited amount of data makes it difficult to develop any trends. A balance between the algal, zooplankton, and fish communities is an important aspect of the lake's management. Balance of the lake's ecosystem may be enhanced under ultimate watershed land use conditions if phosphorus loads to the lake are reduced and management of the lake's fisheries is undertaken.

Recommended Lake and Watershed Management Practices

Aquatic Weed Management

Macrophyte surveys should continue on this lake to monitor the growths of undesirable non-native species. If purple loosestrife (*Lythrum salicaria*) starts dominating the emergent macrophyte community, some mitigation measures may be needed. Decline in native species reduces available habitat for wildlife, invertebrates and other food organisms for small fish. A typical macrophyte survey costs approximately $1,200 per lake.

Fisheries Management

Because there is no public access on Birch Island Lake, the MDNR cannot stock the lake. Since the MDNR does not stock the lake and the lake frequently winterkills, largemouth bass could be stocked at an estimated cost of $3,000 per stocking event to enhance Birch Island Lake's fisheries. Winter aeration of the lake would likely be required to maintain a fishery in Birch Island Lake.

A fishing pier located on Birch Island Lake would allow the community to better utilize this resource, especially community children. Piers cost about $18,000 for an 84-foot length and $25,000 for a 104-foot walkway (out to the cross or "T") according to the MDNR.

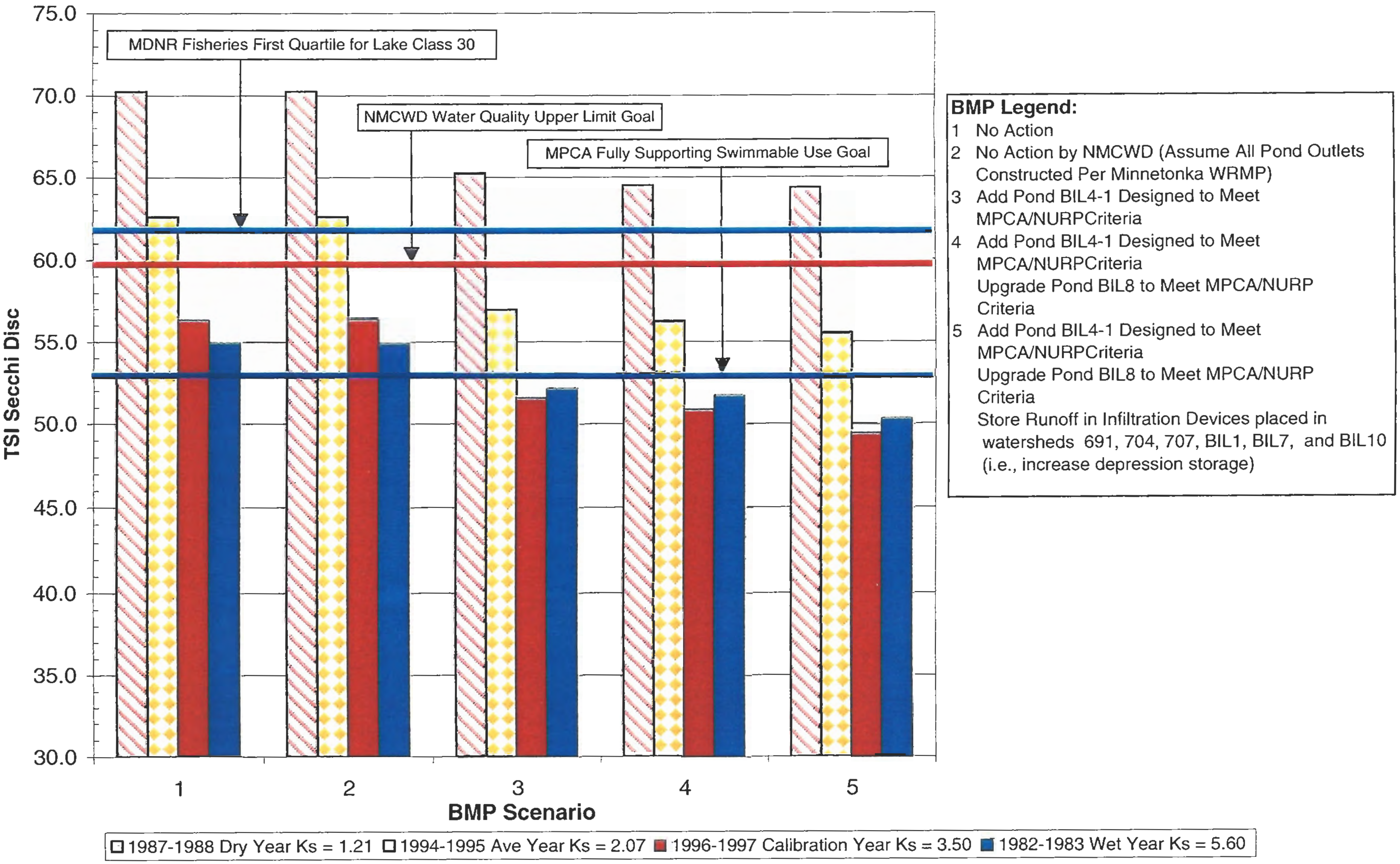
Watershed Management

Water quality simulations using the P8 model indicated dry conditions produce the greatest strain upon water quality in Birch Island Lake because the low lake level during dry conditions results in less dilution of watershed phosphorus loading. Therefore, higher in-lake phosphorus concentrations result from phosphorus loading during dry climatic conditions. It was determined that dry conditions would reduce Birch Island Lake's water quality to levels outside the Level II classification limits. For wet-, and model-calibration-year precipitation totals, Birch Island Lake's water quality remains sufficiently good to support Level II recreational activities without additional BMPs. (See Figure EX-5, BMP Scenario 1, which involves no action by the District.)

This UAA assumed, for ultimate watershed development, that planned elements of the *City of Minnetonka Water Resources Management Plan* (WRMP) (Barr 1999) would be completely implemented by the City of Minnetonka. Additional stormwater BMPs that have been recommended above and beyond those specified in the City of Minnetonka WRMP are discussed in this report. The following BMPs should be considered for implementation by the District to maintain the Level II classification level for Birch Island Lake under average, wet and model calibration climatic conditions. Most of their impacts are illustrated by Figure EX-5, which illustrates all the BMP combinations analyzed and their water quality benefits.

- A detention basin (Pond BIL4-1) added to treat runoff from a portion of subwatershed BIL4-1, Birch Island Lake's direct watershed (See Figure EX-6) would reduce phosphorus loads entering the lake by 7 to 13 pounds annually under varying climatic conditions. The addition of Pond BIL4-1 would likely require some wetland mitigation at a ratio of 2 to 1 because the proposed pond placement is located in an existing wetland. Because the pond would disturb approximately 2.4 acres of wetland, as much as 4.8 acres of wetland could be required to be created elsewhere. Construction of treatment Pond BIL4-1, including 4.8 acres of wetland mitigation and 30 percent for engineering design, is estimated to cost approximately $401,000, plus maintenance.

Birch Island Lake: Estimated TSI Secchi Disc Following BMP Implementation



P:\23\27\003\UAA\SAS\Birch Island\P8 Ultimate LU\BILSummaryNEW.xls

Figure EX-5

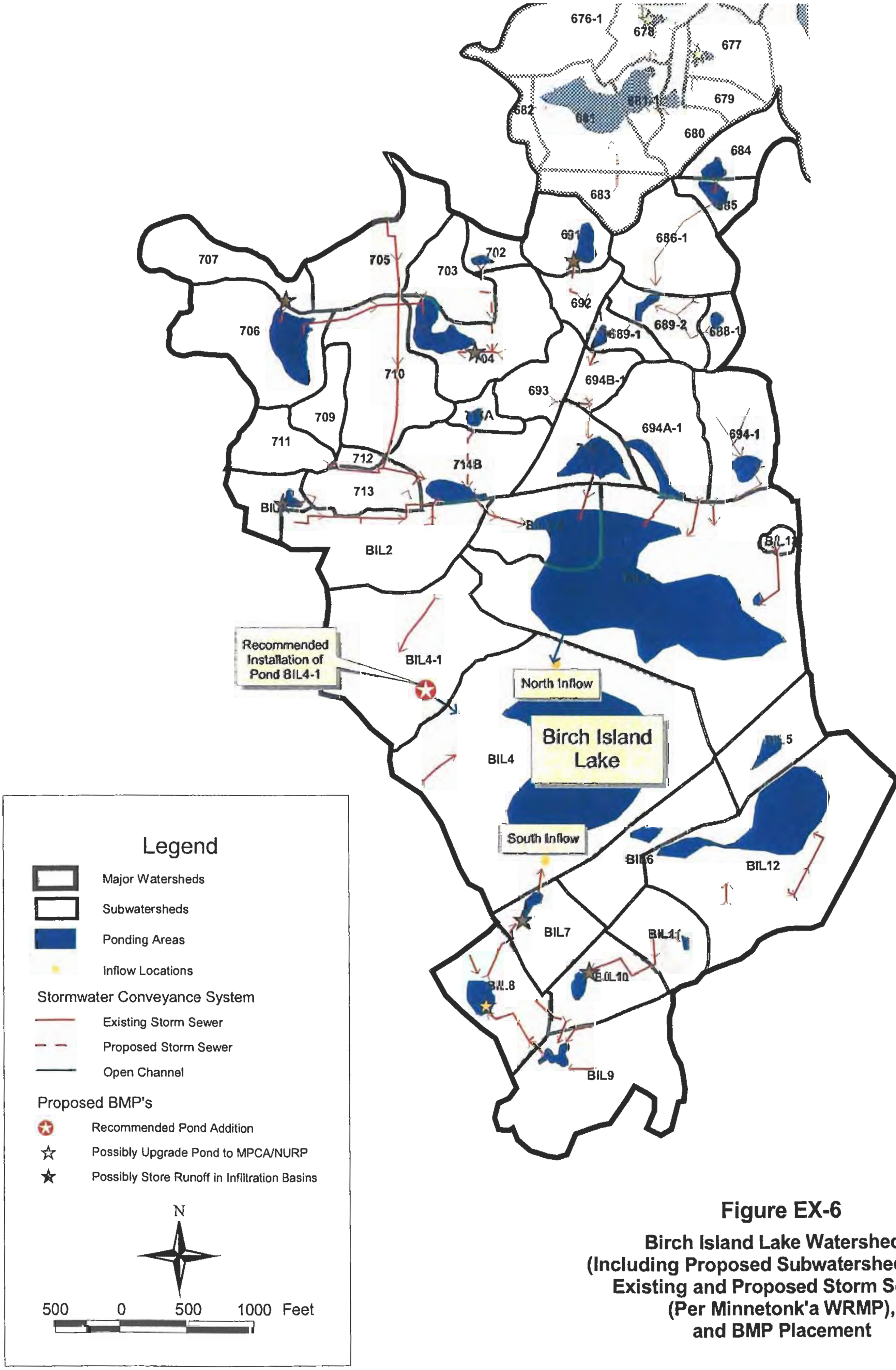
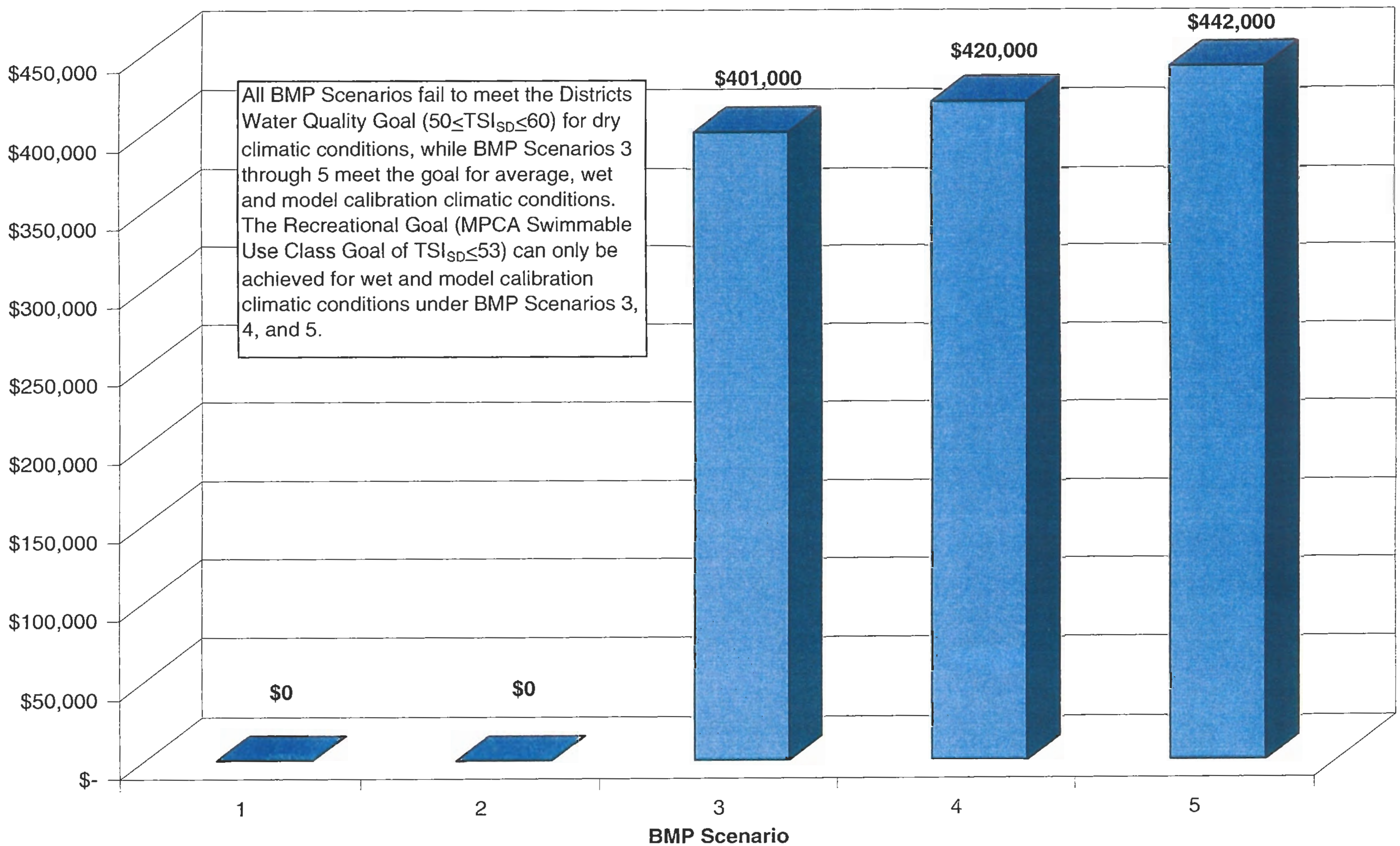


Figure EX-6

Birch Island Lake Watersheds (Including Proposed Subwatershed BIL4-1) Existing and Proposed Storm Sewers (Per Minnetonk'a WRMP), and BMP Placement

Figure EX-7 illustrates the cost of each BMP Scenario analyzed for this UAA while Figure EX-8 shows the minimum and maximum costs of the respective goal achieving alternative. No BMP Scenario will achieve the Recreational Goal set by the MPCA ($TSI_{SD} \leq 53$) for dry or average climatic conditions. However, during average-, wet-, and model calibration precipitation conditions, BMP Scenarios 3, 4, and 5 will achieve the NMCWD's Water Quality of attaining or maintaining a Level II classification level. Benefits of implementing any BMP Scenario will likely be visible within three flushing periods for the lake. Since BIL is a landlocked lake and water is only lost due to seepage and evaporation, the benefits may take several years to become evident.

Cost of Birch Island Lake BMP Scenarios



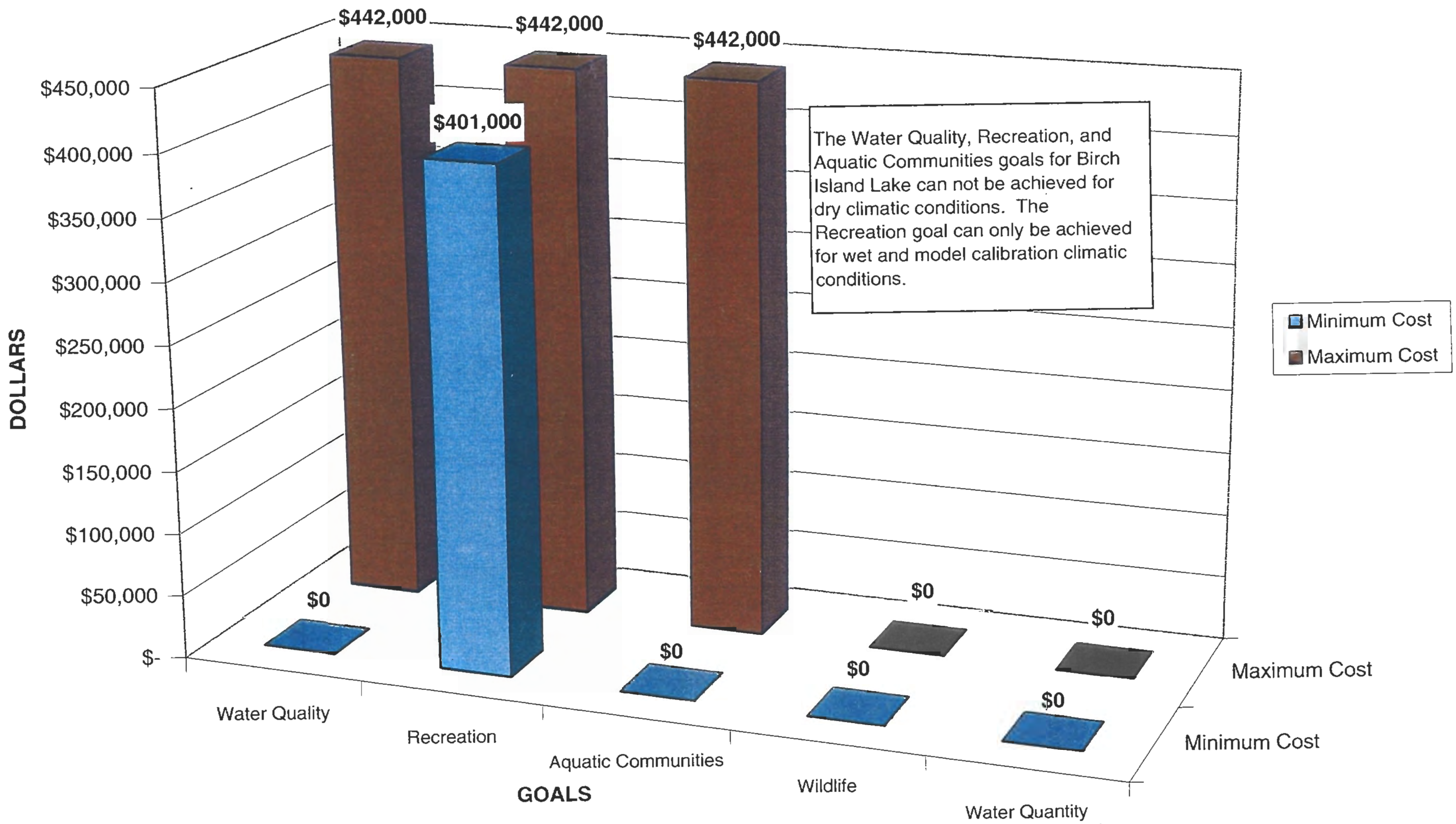
<u>**It is important to note that all of the costs for the BMP Scenarios DO NOT include the cost of implementing the City of Minnetonka Water Management Plan. It is assumed that the City of Minnetonka will cover those costs.**</u>

<u>**It is also important to note that the costs presented for the BMP Scenarios DO NOT include the cost the cost of land acquisition, if it were required to implement the BMP's. However, the above costs do include 30% for engineering and design.**</u>

P:\23\27\003\UAA\SAS\Birch Island\P8 Ultimate LU\BIL4-1cost esti.xls

Figure EX-7

Birch Island Lake
Costs to Meet or Exceed Goals for All Climatic Conditions



"Minimum Cost" is the cost of the option that just meets each of the goals set for Birch Island Lake for any one of the four climatic conditions analyzed.
"Maximum Cost" is the cost of the most expensive option analyzed in this study that exceeds each of the goals set for Birch Island Lake for any one of the four climatic conditions analyzed.
Between these options are others that offer different degrees of success in meeting or exceeding the goals set for Birch Island Lake.
It is important to note that all of the costs for meeting the Water Quality, Recreation, and Aquatic Communities goals DO NOT include the cost of implementing the City of Minnetonka Water Management Plan. It is assumed that the City of Minnetonka will cover those costs.
It is also important to note that the costs for meeting the Water Quality, Recreation, and Aquatic Communities goals DO NOT include the cost the cost of land acquisition. However, the above costs do include 30% for engineering and design.

Figure EX-8

P:\23\27\003\UAA\SAS\Birch Island\P8 Ultimate LU\BIL4-1cost esti.xls

Appendix B

Bryant Lake UAA Report
(Executive Summary only)

Appendix B: Following is the Byrant Lake UAA Executive Summary

Executive Summary

Overview

This report describes the results of the Use Attainability Analysis (UAA) for Bryant Lake in Eden Prairie, MN. The UAA provides the scientific foundation for a lake-specific best management plan that will permit maintenance of or attainment of intended beneficial uses of Bryant Lake. The UAA is a scientific assessment of a water body's physical, chemical, and biological condition. This study includes both a water quality assessment and prescription of protective and/or remedial measures for Bryant Lake and its watershed. The conclusions and recommendations are based on historical water quality data, the results of an intensive lake water quality monitoring in 1998, and computer simulations of land use impacts on water quality in Bryant Lake using watershed and lake models calibrated to the 1998 data set. In addition, best management practices (BMPs) were evaluated to compare their relative effect on total phosphorus concentrations and Secchi disc transparencies (i.e., water clarity). Management options were then assessed to determine attainment or non-attainment with the lake's beneficial uses.

Nine Mile Creek Watershed District Water Quality Goals

The approved *Nine Mile Creek Watershed District Water Management Plan* (Barr, 1996) preliminarily assessed ultimate watershed water quality for Bryant Lake and articulated five specific goals for the lake. These goals address water quality, recreational-use, aquatic communities, water quantity, and wildlife. Where possible, the Nine Mile Creek Watershed District (NMCWD) goals were quantified by using the standardized lake rating system termed the Carlson's Trophic State Index (TSI) (Carlson, 1977). This index considers the lake's total phosphorus, chlorophyll *a*, and Secchi disc transparencies to assign a water quality index number reflecting the lake's general fertility level. The rating system results in index values between 0 and 100, with the index value increasing with increased lake fertility. Total phosphorus, chlorophyll *a*, and Secchi disc transparency are key water quality indicators for the following reasons.

- Phosphorus generally controls the growth of algae in lake systems. Of all the substances needed for biological growth, phosphorus is typically the limiting nutrient.
- Chlorophyll *a* is the main photosynthetic pigment in algae. Therefore, the amount of chlorophyll *a* in the water indicates the abundance of algae present in the lake.
- Secchi disc transparency is a measure of water clarity, and is inversely related to the abundance of algae. Water clarity typically determines recreational-use impairment.

All three of the parameters can be used to determine a TSI. However, water transparency is typically used to develop the TSI_{SD} (trophic state index based on Secchi disc transparency) because people's perceptions of water clarity are often directly related to recreational-use impairment. The TSI rating system results in the placement of a lake with medium fertility in the mesotrophic trophic status category. Water quality trophic status categories include oligotrophic (i.e., excellent water quality), mesotrophic (i.e., good water quality), eutrophic (i.e., poor water quality), and hypereutrophic (i.e., very poor water quality). Water quality characteristics of lakes in the various trophic status categories are listed below with their respective TSI ranges:

1. **Oligotrophic** – [$20 \leq TSI_{SD} \leq 38$] clear, low productive lakes, with total phosphorus concentrations less than or equal to 10 µg/L, chlorophyll *a* concentrations of less than or equal to 2 µg/L, and Secchi disc transparencies greater than or equal to 4.6 meters (15 feet).
2. **Mesotrophic** – [$38 \leq TSI_{SD} \leq 50$] intermediately productive lakes, with total phosphorus concentrations between 10 and 25 µg/L, chlorophyll *a* concentrations between 2 and 8 µg/L, and Secchi disc transparencies between 2 and 4.6 meters (6 to 15 feet).
3. **Eutrophic** – [$50 \leq TSI_{SD} \leq 62$] highly productive lakes relative to a neutral level, with 25 to 57 µg/L total phosphorus, chlorophyll *a* concentrations between 8 and 26 µg/L, and Secchi disc measurements between 0.85 and 2 meters (2.7 to 6 feet).
4. **Hypereutrophic** – [$62 \leq TSI_{SD} \leq 80$] extremely productive lakes which are highly eutrophic and unstable (i.e., their water quality can fluctuate on daily and seasonal basis, experience periodic anoxia and fish kills, possibly produce toxic substances, etc.) with total phosphorus concentrations greater than 57 µg/L, chlorophyll *a* concentrations of greater than 26 µg/L, and Secchi disc transparencies less than 0.85 meters (2.7 feet).

The NMCWD's management strategy has been to "protect" the resource. According to the *NMCWD Water Management Plan*, "protect" means "to avoid significant degradation from point and nonpoint pollution sources and from wetland alterations, in order to maintain existing beneficial uses, aquatic and wetland habitats, and the level of water quality necessary to protect these uses in receiving waters." The NMCWD goals for Bryant Lake include the following:

- The **Water Quality Goal** of Bryant Lake is to achieve a Level I classification level. This level fully supports water-based recreational activities including swimming, scuba diving, and snorkeling, among others. Reasonable water quality goals for this classification level are total phosphorus concentrations of less than 45 µg/L, chlorophyll *a* concentrations of less than 20 µg/L, and Secchi disc transparencies of greater than 2.0 meters (6.6 feet), which correspond to a trophic state index (TSI_{SD}) of 50. The TSI_{SD} goal, as established by and presented in the *NMCWD Water Management Plan*, is probably not attainable, but the total phosphorus and chlorophyll *a* goals appear to be attainable with the implementation of the watershed management practices described in this UAA.

- The **Recreational-Use Goal** is to achieve water quality that fully supports swimming ($TSI_{SD} \leq 53$) as defined by the *MPCA Use Support Classification for Swimming Relative to Carlson's Trophic State Index by Ecoregion* (Hesikary, 1997). This goal, as established by the MPCA, is attainable, but only with the implementation of the watershed management practices described in this UAA.
- The **Aquatic Communities Goal** is to achieve a water quality that fully supports the lake's fisheries-use classification determined by the MDNR in accord with *An Ecological Classification of Minnesota Lakes with Associated Fish Communities* (Schupp, 1992) and achieve a balanced ecosystem. Specifically, the goal is to maintain a lake classification of 24, with a TSI_{SD} value of approximately 50. Management of Bryant Lake to achieve a balanced fishery includes achieving a balance of predator fish (e.g., northern pike, bass) and panfish (e.g., bluegills) of a desirable size for fishermen. The aquatic communities goal is likely to be attainable under most climatic conditions with little or no action beyond the recommended BMP implementation.
- The **Water Quantity Goal** is to provide sufficient water storage of surface runoff during a regional flood, the critical 100-year frequency storm event. This goal is attainable with no action.
- The **Wildlife Goal** for Bryant Lake is to protect existing, beneficial wildlife uses. The wildlife goal can be maintained with no action, especially if the wetlands and park land surrounding the lake remain intact.

Minnesota Pollution Control Agency Water Quality Guidelines

Since the completion of the *NMCWD Water Management Plan,* the MPCA has developed assessment methodologies, conducted extensive sampling of lakes, and ultimately derived ecoregion-based lake eutrophication guidelines, beginning with guidelines for total phosphorus (MPCA, 2003). In turn, the total phosphorus guidelines have been used as the basis for assessing swimmable use support for lakes. The MPCA has set a total phosphorus guideline of 40 μg/L, which serves as the upper threshold for full-support of swimmable use (or primary-contact recreation and aesthetics) for the North Central Hardwood Forests (NCHF) ecoregion (which includes the Bryant Lake watershed). This concentration corresponds to a Carlson's trophic state index (TSI) values of 57. Total phosphorus concentrations above full-support guideline levels would result in greater frequencies of nuisance algal blooms and increased frequencies of "impaired swimming." The upper threshold for partial-support of swimmable use is a 45 μg/L total phosphorus concentration for the NCHF ecoregion (which corresponds to 59 Carlson TSI units). A total phosphorus concentration above this level is associated with non-support of swimmable use in the NCHF ecoregion.

The MPCA has used the ecoregion-based total phosphorus guidelines in conjunction with Carlson's Trophic State Index (TSI) (Carlson 1977) as a means to classify lakes relative to support of swimmable use in 305(b) assessments. Separate indices are calculated from measurements of total phosphorus, chlorophyll *a* or Secchi disc depth using formulas that normalize the measurements such that each computed TSI value translates to comparable use support. Using these formulas, the chlorophyll *a* concentration and Secchi disc depth that corresponds to a Carlson's trophic state index (TSI) value of 57 (that serves as the upper threshold for full-support of swimmable use) is 15 μg/L and 1.2 meters, respectively.

The MPCA has also reconstructed water quality from analysis of fossil diatoms contained in sediment cores obtained from some Minnesota lakes (Heiskary and Swain, 2002). As part of this study, the MPCA found that there was good agreement between the phosphorus contained in diatom fossils and the Vighi and Chiaudani (MEI) model (1985) for lakes with background phosphorus concentrations of 30 μg/L or less. The Vighi and Chiaudani MEI model provides reasonable accurate estimates of pre-European settlement total phosphorus concentrations for lakes, based on current alkalinity or conductivity water quality measurements. Vighi and Chiaudani (1985) recommend using current measurements of alkalinity over conductivity measurements from lakes that are affected by anthropogenic (human) sources of phosphorus. As a result, current measurements of alkalinity taken from the surface waters of Bryant Lake were used to estimate the pre-European settlement total phosphorus concentration, based on the formulas provided by Vighi and Chiaudani (1985). The average total alkalinity in Bryant Lake was 152 mg/L, based on 38 current measurements. This average alkalinity value corresponds to an estimated pre-European settlement total phosphorus concentration in the range of 23 to 25 μg/L. As a result, this total phosphorus range would likely represent the best concentrations that could be attained if there were minimal impacts from anthropogenic sources of phosphorus. This also indicates that, given the existing level of development within the Bryant Lake watershed, there will be a limit to how far the in-lake phosphorus concentrations can be reduced with watershed and in-lake best management practices (BMPs).

The MPCA's MINLEAP model was used as a basis for evaluating the Bryant Lake conditions in an ecoregion-based context and as another element in the goal-setting process. This model does not provide a reliable estimate of background condition but can be used to assess the range of water quality that can typically be expected for lakes within each ecoregion, based on their watershed area and morphologic characteristics. The MINLEAP Model predicted a total phosphorus range of 28-58 μg/L for Bryant Lake.

Water Quality Problem Assessment

Water Quality

Current Bryant Lake water quality data (1998 data) were evaluated according to trophic status categories. The trophic status categories use the lake's total phosphorus concentration, chlorophyll *a* concentration, and Secchi disc transparency measurements to assign the lake to a water quality category that best describes its condition. Water quality categories include oligotrophic (i.e., excellent water quality, nutrient poor), mesotrophic (i.e., good water quality, moderate nutrient concentrations), eutrophic (i.e., poor water quality, nutrient rich), and hypereutrophic (i.e., very poor water quality, very high nutrients). Total phosphorus, chlorophyll *a*, and Secchi disc depth are key water quality indicators as explained earlier in the report.

Figure EX-1 summarizes the seasonal changes in concentration of total phosphorus, chlorophyll *a*, and Secchi disc transparency for Bryant Lake in 1998. The data are shown compared to the trophic state categories.

Summer average water quality parameters collected during 1998 fell within the range expected for eutrophic (high nutrient) and hypereutrophic (very high nutrient) systems. Secchi disc depth during April and May ranged from 2.6 meters to 1.1 meters. The summer average transparency of 0.83 meters fell on the threshold between a eutrophic and hypereutrophic system (Figure EX-1). During the months of September and October, Secchi disc depth remained close to the summer average. Throughout the summer and early-fall, Secchi disc transparencies observed in 1998 were less than the upper limit of 1.6 meters established by the NMCWD for its Category I lakes. An examination of past years of Secchi disc monitoring indicates a pattern consistent with the 1998 data. Secchi disc transparency is typically highest in the spring (May-June) and then consistently drops to its lowest levels at the end of the summer and fall (August-October).

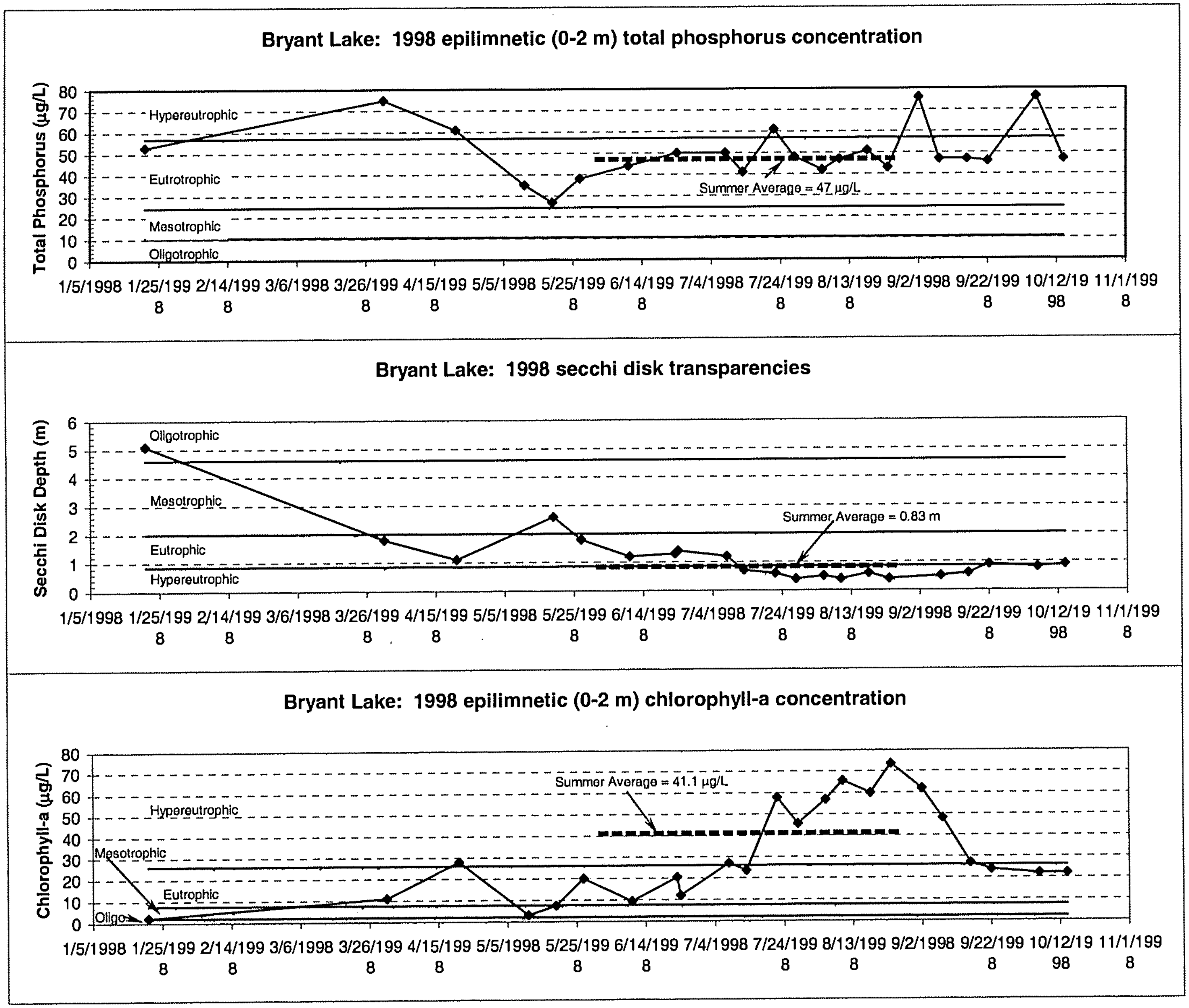


Figure EX-1. Seasonal Changes in Concentration of Total Phosphorus, Chlorophyll-a, and Secchi Disk Transparencies

Chlorophyll *a* concentrations during 1998 ranged from 2.1 µg/L to 73.6 µg/L. The summer average concentration for chlorophyll *a* of 41.1 µg/L was indicative of a hypereutrophic (very high nutrient) system (Figure EX-1). Chlorophyll *a* concentrations during June and early-July were consistently in the eutrophic range (< 26 µg/L), with an expected increase in chlorophyll *a* during July and August. Concentrations of chlorophyll *a* during 1998 were frequently well above the established upper limit of 10 µg/L for Category I lakes. An examination of past years of chlorophyll *a* monitoring indicates a pattern consistent with the 1998 data. Chlorophyll *a* concentrations are typically lowest in spring (May-June) and then consistently increase to their highest levels at the end of summer (August). The chlorophyll *a* concentrations typically decline going into the fall.

Summer total phosphorus concentrations consistently remained within the range expected for eutrophic lake systems (Figure EX-1). The higher total phosphorus concentrations (hypereutrophic range) seen in the early-spring and a few times in the fall, were likely due to phosphorus carried by runoff from the spring runoff and storm events, respectively. Many of the total phosphorus measurements taken in 1998 were greater than the upper limit of 45 µg/L set by the NMCWD for Category I lakes. An examination of past years of total phosphorus monitoring indicates that many years were consistent with the 1998 data. In general, the in-lake phosphorus concentrations are highest in the spring and decline slightly later in the summer.

Current water quality in Bryant Lake is poor. The lake would be classified as a eutrophic (high nutrient) water body, based on the 1998 data. The current water quality falls short of goals established for the lake by all regulatory agencies and organizations concerned with Bryant Lake.

Historical lake water quality monitoring data was examined for trends using all of the surface water total phosphorus, chlorophyll *a*, and Secchi disc transparency data collected from Bryant Lake. Multiple linear regression was used to distinguish the seasonal variation of each monitoring parameter from a statistically significant trend since monitoring began in 1974. A real trend in lake water quality would require a statistically significant trend (at the 95 percent confidence level) in all of the total phosphorus, chlorophyll *a*, and Secchi disc transparency data. For example, a real improving trend in Bryant Lake water quality would require a statistically significant increasing trend in Secchi disc transparency along with statistically significant decreasing trend in the total phosphorus and chlorophyll *a* data. None of the three lake water quality monitoring parameters had a statistically significant trend (at the 95 percent confidence level), so there does not appear to be any real improving or degrading trends in the historical water quality for Bryant Lake.

Watershed Runoff Pollution

The entire Bryant Lake watershed (3,246 acres including a lake surface area of 176 acres) is primarily urbanized. The urbanized watershed consists of low-density residential land use (32 percent) (see Figure EX-2) with park and open space (34 percent). There are large, channelized wetlands tributary to Bryant Lake, along with smaller ponds and wetlands sporadically spaced throughout the watershed. The proposed storm sewers in the City of Minnetonka will connect the Shady Oak Lake and Lone Lake watersheds to Bryant Lake. This will significantly increase the land area contributing to the Bryant Lake watershed (see Figure EX-3). Excluding these future contributing areas, the primary expected changes in watershed land use are increases in industrial/office land use (from 181.2 to 220.4 acres), low-density residential (from 1042.9 to 1151.8 acres), commercial (from 161.7 to 223.4 acres), institutional (from 125.7 to 176.9 acres) and high-density residential (from 143.2 to 170.4 acres). These increases will correspond to a decrease in natural/open land use, decreasing from 1092.1 to 812.9 acres. Implementation of the *City of Minnetonka Water Resource Management Plan* (Barr, 1999) will cause a significant increase in the land area contributing to Bryant Lake. Coupled with land use changes, phosphorus loads to the lake may be impacted. In addition, future construction intended to increase the capacity of Interstate 494 may increase phosphorus loading, especially during construction.

Computer simulations and observed water quality data indicate that phosphorus inputs to the lake are primarily from watershed, atmospheric loads (external sources) and internal phosphorus loading (i.e., release from anoxic bottom sediments), which is a major component of the lake's phosphorus budget when seasonally anoxic lake sediments contribute significant total phosphorus loadings in early-spring and during the late-summer and fall of the year.

Bryant Lake's phosphorus budget for 1997-98 indicates approximately 19 and 20 percent of the lake's annual phosphorus load was coming from each of two tributaries entering the lake at Subwatersheds BL-17A and BL-17B respectively (see Figure EX-4). Figure EX-4 also shows that 10 percent of the annual phosphorus load was from the lake's direct watershed, while the internal phosphorus load recycling from the curlyleaf pondweed die-back and sediment phosphorus release accounted for 33 percent of the annual total phosphorus budget. An annual total phosphorus load from atmospheric deposition of 9 percent was estimated for Bryant Lake.

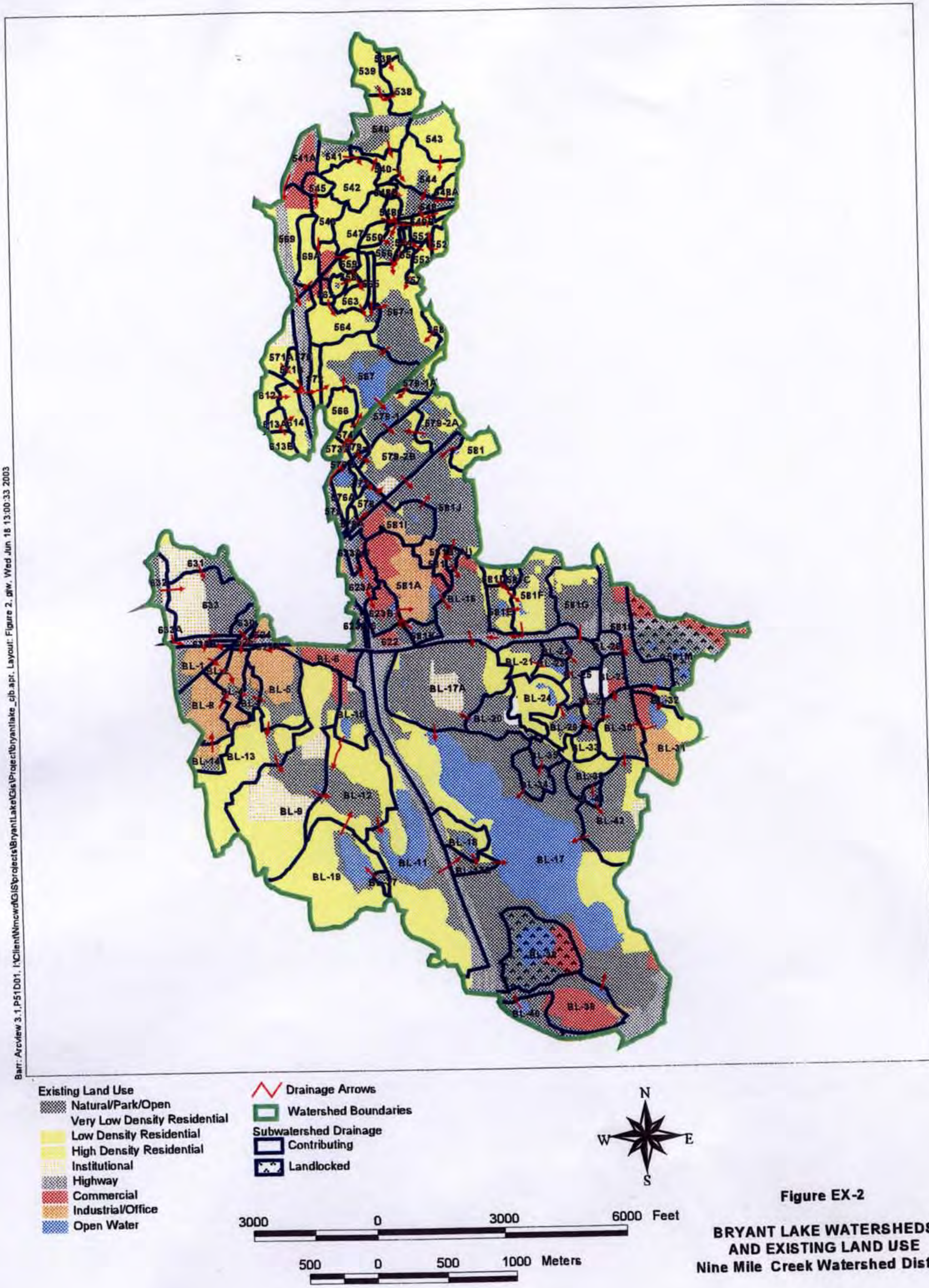
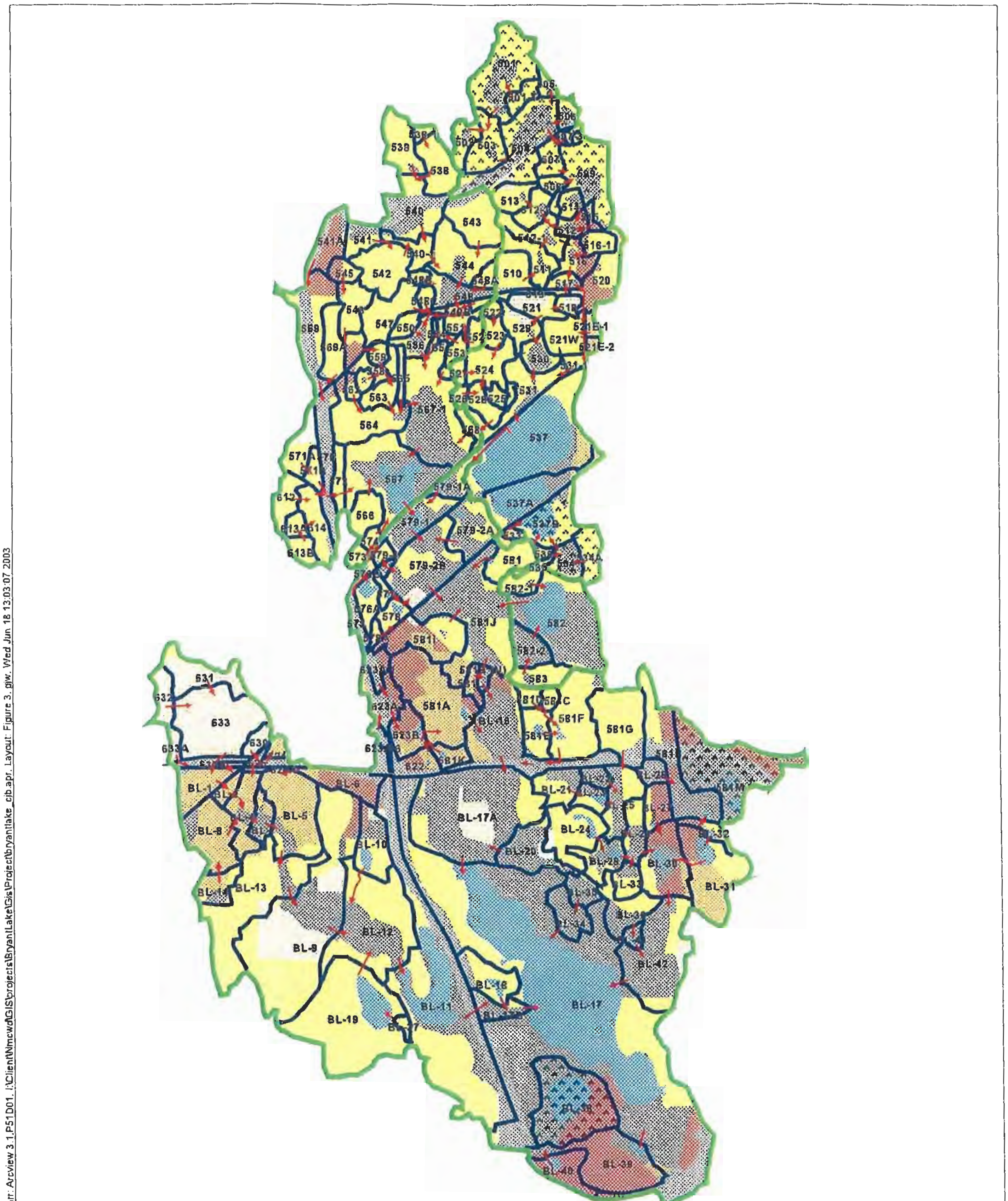


Figure EX-2

BRYANT LAKE WATERSHEDS AND EXISTING LAND USE
Nine Mile Creek Watershed District



Ultimate Land Use
- Natural/Park/Open
- Very Low Density Residential
- Low Density Residential
- Medium Density Residential
- High Density Residential
- Institutional
- Highway
- Commercial
- Industrial/Office
- Open Water

Drainage Arrows
Watershed Boundaries
Subwatershed Drainage
- Contributing
- Landlocked

N W E S

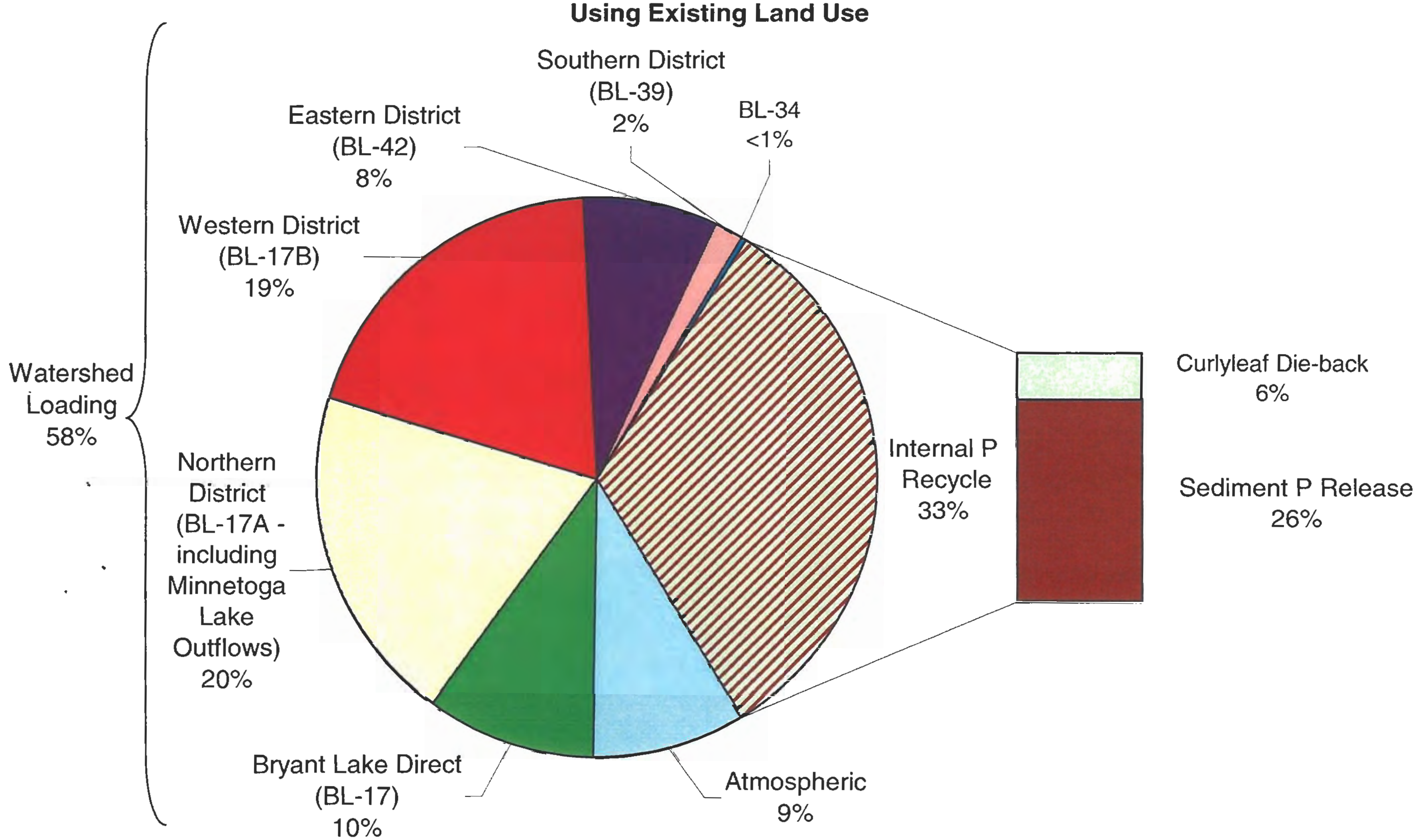
3000 0 3000 6000 Feet

600 0 600 1200 Meters

Figure EX-3

BRYANT LAKE WATERSHEDS AND FUTURE (ULTIMATE) LAND USE
Nine Mile Creek Watershed District

Figure EX-4
Bryant Lake Annual Phosphorus Budget (629 lbs)
Model Calibration Year (October 1997 to September 1998)
Using Existing Land Use



Aquatic Weeds

Dense growths of Eurasian watermilfoil were observed in Bryant Lake during the 1995 and 1998 macrophyte surveys. Eurasian watermilfoil is a particularly problematic exotic aquatic plant in North America due to its ability to reproduce from fragments and spread rapidly, its high-growth rate in a range of temperatures and environmental conditions, and its tendency to reach the surface and form extensive mats of plant at the surface, which can allow it to shade and outcompete native vegetation (Madsen et al. 1994; Valley and Newman 1998).

Curlyleaf pondweed (*Potamogeton crispus*) is another non-native submerged aquatic species. Light-density growths were observed in the Bryant Lake during the June 1998 survey. By the August surveys the curlyleaf pondweed had undergone its natural mid-season die-off. This mid-season die-back contributes (through plant matter decay) to the lake's summer surface water total phosphorus concentration and, therefore, supplies nutrients for algal growth. Curlyleaf pondweed can also replace native submerged macrophyte species and interfere with recreational use of the lake.

Ecosystem and Fisheries

Bryant Lake's fishery is composed of a balance of fish species, but is dominated by small fish. Fishing pressure is believed to be the primary mechanism causing the size structure of the lake's fishery (Pulomis, 2001). However, fishing pressure has not been evaluated since 1980.

Good spawning habitat conditions in Bryant Lake promote the natural reproduction of panfish, bass, and northern pike. Hence, only Hybrid Muskellunge are stocked, and stocking has occurred since 1985. The lake's management plan indicates Hybrid Muskellunge will be stocked once every 3 years. Stocking records, however, indicate stocking has occurred annually during the 1996 through 1999 period. Other management of Bryant Lake has been limited to the scheduled netting surveys.

The MDNR has determined a fisheries-use classification for Bryant Lake in accord with the MDNR *An Ecological Classification of Minnesota Lakes with Associated Fish Communities*. Bryant Lake is classified as a Class 24 lake. A Class 24 lake is a good, permanent fish lake (Schupp, 1992). Fish species in a Class 24 lake include northern pike and bluegill (primary species), largemouth bass, black crappie, and yellow perch (secondary species). The average Secchi disc transparency for this ecological class is 6.4 feet.(Schupp, 1992). Poorer water transparencies will result in less than ideal water quality conditions for the lake's fishery. The data indicate water quality improvement is needed to support the lake's fisheries-use classification.

Recommended Lake and Watershed Management Practices

Aquatic Weed Management

Macrophyte surveys should continue on this lake to monitor the growth of undesirable non-native species. Three species that are of special concern are purple loosestrife (*Lythrum salicaria*) to manage its proliferation, curlyleaf pondweed (*Potamogeton crispus*) and Eurasian watermilfoil (*Myriophyllum spicatum*) to prevent its introduction and proliferation. A decline in native aquatic plant species reduces available habitat for wildlife, invertebrates, and other food organisms for small fish. A typical macrophyte survey costs approximately $2,000 per lake.

The first step in the restoration of Bryant Lake is the management of curlyleaf pondweed. This should involve not just the management of curlyleaf pondweed such that the phosphorus inputs are reduced, but rather to remove it from Bryant Lake such that native plants can replace curlyleaf pondweed. Removal of curlyleaf pondweed should have the added benefit of preserving native pondweed species adversely affected by algal blooms that follow curlyleaf pondweed die-off. Research has shown that the appropriate herbicide for curlyleaf pondweed control is endothall, and that this herbicide should be applied in the spring (when water is approximately 55-60°F) and at a dose of 1 mg/L (Poovey et al. 2002). Preliminary results from studies in Eagan, MN by John Skogerboe of the US Army Corps of Engineers have shown that four subsequent years of endothall treatment have essentially eliminated curlyleaf pondweed from two of the study lakes and that after the 4th year of treatment no viable turions (pondweed seeds) remained in the sediment. To remove curlyleaf pondweed, treatment will need to continue until no viable turions remain after treatment is completed. Treatment is expected to continue for 4 years. Sediment treatment should not be performed until curlyleaf pondweed is completely controlled. Sediment treatment prior to curlyleaf pondweed control could possibly increase the light availability to this plant and stimulate curlyleaf pondweed growth.

Assuming that four consecutive whole-lake, early-spring endothall treatments would be a least 80 percent effective in controlling curlyleaf pondweed the annual phosphorus loads to Bryant Lake would be reduced by up to 6 percent. The predicted load reductions would have a measurable impact on the in-lake water quality of Bryant Lake. Table EX-1 summarizes the effectiveness of this improvement option (Option 9) in terms of phosphorus removal and lake clarity improvement during the summer months. The estimated cost to treat the entire surface area of Bryant Lake with Endothall for 4 consecutive years is $255,000 ($85,000/year).

In addition to managing curlyleaf pondweed, spot herbicide treatments should be done in those areas where the macrophyte surveys indicate the presence of Eurasian watermilfoil. John Barten of Three Rivers Parks District has indicated that the parks district would like to continue the management of Eurasian watermilfoil. Therefore the cost of managing Eurasian watermilfoil is not included in this UAA.

Fisheries Management

Bryant Lake's fishery is comprised of a balance of fish species, but is dominated by small fish. The large numbers of small fish are not appealing to fishermen, nor are they appropriate to maintain a healthy balance of predator fish species such as largemouth bass and northern pike. Research results indicate that improvement in the lake's water clarity would result in an improved panfish fishery. The data indicate that Secchi disc values less than 3 feet result in a poor panfish fishery. Bryant Lake Secchi disc transparencies during October of 1997 and during July through October of 1998 were less than 3 feet. Improvement in the lake's water transparency, particularly during the summer and fall periods, is expected to result in improvements to the panfish fishery (i.e., increased pounds per net and increased proportion per net).

In-Lake Management

Bryant Lake receives approximately 26 percent of its annual phosphorus load due to sediment phosphorus release and recycling from its bottom waters. Extensive monitoring conducted throughout the lake's water column during 1998 indicates that phosphorus released by the bottom sediments builds up in the hypolimnion and is: (1) slowly released into the epilimnion during the course of the summer, and (2) delivered to the epilimnion due to diffusion and direct entrainment following the downward migration of the thermocline, as well as mixing during fall turnover. Phosphorus released by the sediments is present in a form that can be quickly utilized by algae, leading to intense algal blooms. Areal application of aluminum sulfate (alum) has proven to be a highly effective and long-lasting control of phosphorus release from lake sediments, especially where an adequate dose has been given to the sediments and where sufficient diversion of nutrient incomes has occurred (Moore and Thornton, 1988). Table EX-1 summarizes the effectiveness of this improvement option (Option 3) in terms of phosphorus removal and lake clarity improvement during the summer months. As shown in Table EX-1, approximately 119 additional pounds of phosphorus, in the form of an internal load, would be removed during the summer. Table EX-1 shows that the estimated capital cost for this option is $142,000, depending on the required dose of alum. This in-lake treatment technique will likely be effective for approximately 10 years, depending upon how well watershed nutrient sources have been reduced. Surficial sediment core samples should be taken from Bryant Lake and analyzed for mobile phosphorus to better determine the alum dose required for this treatment option.

Watershed Management

Figure EX-5 shows the locations of the proposed lake improvement options. Table EX-1 includes a summary of the effectiveness of watershed Best Management Practices (BMPs) in terms of phosphorus removal and lake clarity improvement. In addition, the estimated costs of each of the following options were updated in Tables E-1 through E-6, and summarized in Table EX-1.

- **Option 1: Restore Wetland Within Subwatershed BL-11—** Bryant Lake receives approximately 19 percent of its annual phosphorus load from the County Ditch #34 watershed, which enters the lake from Subwatershed BL-17B. Restoration of the wetland within Subwatershed BL-11 will provide significant treatment of the runoff from the County Ditch #34 watershed by adding permanent pool storage volume and longer flow paths to the wetland discharge. Wetland restoration would involve the construction of permeable weirs and/or diversion structures, along with additional permanent pool storage areas.

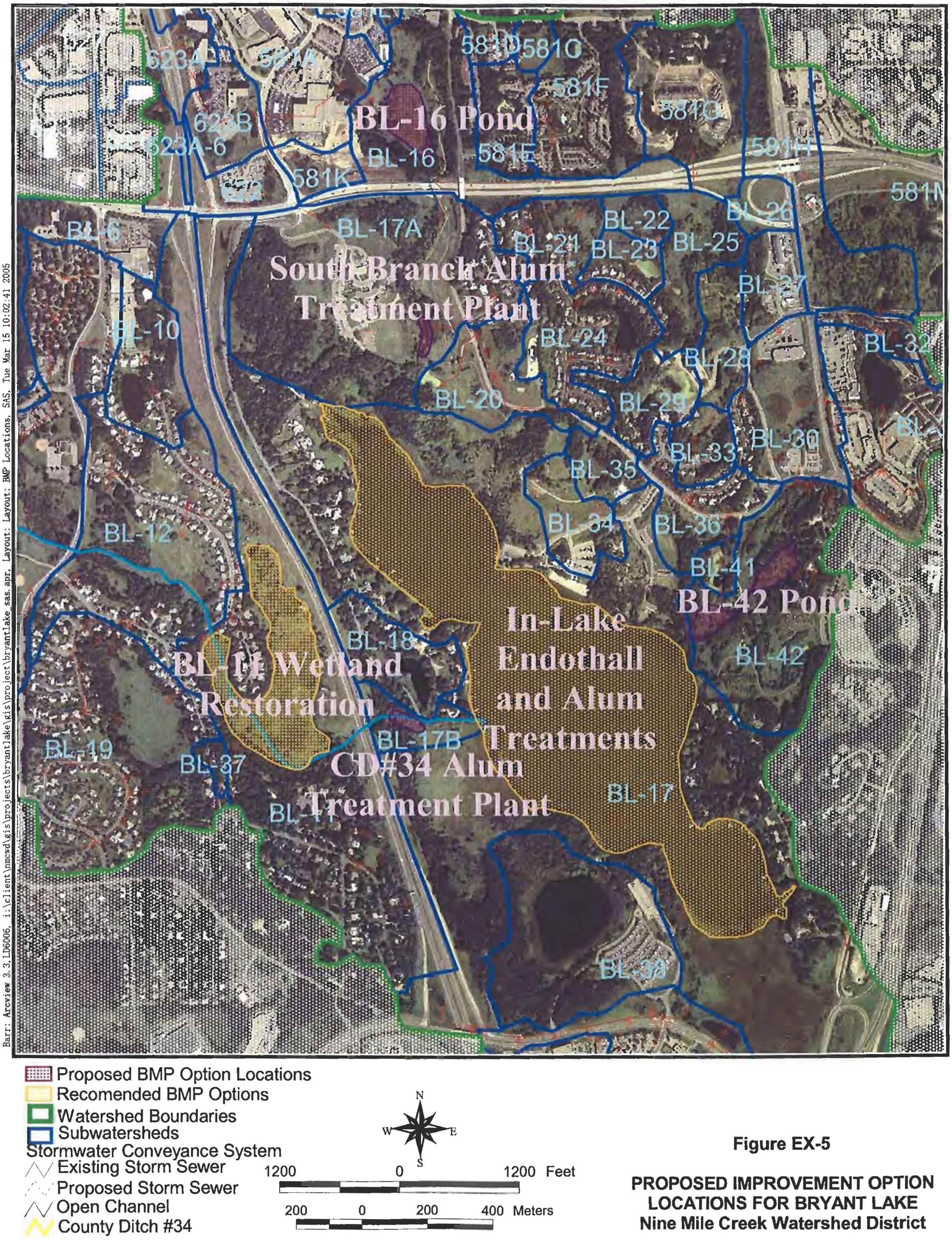
- **Option 2: Construct Pond Within Subwatershed BL-16—** Bryant Lake receives approximately 20 percent of its annual phosphorus load from the watershed ditch which enters the lake after draining through Subwatershed BL-17A from BL-16. Construction of a deeper pond area within the shallow Subwatershed BL-16 wetland will provide significant treatment of the runoff from this watershed by adding permanent pool storage volume and increasing the detention for the pond discharge. Pond construction would involve the excavation of a five-acre permanent pool storage area with an 18-inch diameter outlet for increased detention time.

- **Option 4: Construct Pond Within Subwatershed BL-42—** Bryant Lake receives approximately 8 percent of its annual phosphorus load from the watershed ditch, which enters the lake from Subwatershed BL-42. Construction of a deeper pond within Subwatershed BL-42 will provide significant treatment of the runoff from this watershed by adding permanent pool storage volume and increasing the detention for the pond discharge. Pond construction would involve the excavation of a five-acre, two-cell permanent pool storage area with a 15-inch diameter outlet for increased detention time. This project may requirement mitigation in accordance with the Wetland Conservation Act.

- **Option 8: In-Lake Alum Treatment (Option #3) and County Ditch #34 and South Branch Nine Mile Creek Stormwater Alum Treatment Plants (Design Flow=5 cfs for Each Plant)—** This option consists of the combination of an in-lake alum treatment (Option #3) and construction of two stormwater alum treatment plants: one for the flow from County Ditch #34 and one for the flow from the South Branch of Nine Mile Creek before it enters Bryant Lake (as shown in Figure EX-5). Each alum treatment plant would be designed to treat all of the flows up to 5 cfs, with the additional flows bypassing the system untreated. A building with an alum injection system would be constructed alongside a floc pond at each site. This option will provide additional treatment of the higher soluble phosphorus concentrations in the storm water runoff from each of the watershed areas. For this analysis, an 85% treatment efficiency was assumed for the design flow rate of each alum treatment plant. Based on the water quality analysis of these BMP Options, this combination will provide significant water quality improvement that will result in all of the total phosphorus, chlorophyll *a*, and Secchi disc transparency water quality goals (set by the NMCWD and the MPCA) for Bryant Lake, which includes the MPCA's goal for "Fully Supporting" swimmable use ($TSI_{SD} \leq 53$) and the NMCWD's goal for a trophic state index (TSI_{SD}) ≤ 50 being met. Table EX-1 shows that the estimated capital cost for this option is $2,098,000, with an annual operation and maintenance cost of $100,000.

The estimated land acquisition costs shown in Tables E-1 through E-5A were estimated to be three times the market values of each of the affected parcels, obtained from the Hennepin County database. Most of the affected parcels had market values of zero. The combination of Improvement Options 1, 2 and 4 (BMP Option 5), Options 1, 2, 3 and 4 (BMP Option 6), Options 1 and 3 (BMP Option 7) and Options 1, 3 and 9 (BMP Option 10) were evaluated to estimate the cumulative effect on lake water quality. The estimated treatment effectiveness and cost of each combination are described below and summarized in Table EX-1 and Figure EX-6.

- **Option 5—** Based on the water quality analysis of BMP Options 1, 2 and 4, this combination will provide significant water quality improvement and will meet the total phosphorus and chlorophyll *a* water quality goals (set by the NMCWD and the MPCA) for Bryant Lake. This option will meet the MPCA's goal for "Fully Supporting" swimmable use ($TSI_{SD} \leq 53$), but will not meet the NMCWD's goal for a trophic state index (TSI_{SD}) ≤ 50.



Barr: Arcview 3.3, LD6006, i:\client\nmcwd\gis\projects\bryantlake\gis\project\bryantlake sas.apr, Layout: BMP Locations, SAS, Tue Mar 15 10:02:41 2005

Figure EX-5

PROPOSED IMPROVEMENT OPTION LOCATIONS FOR BRYANT LAKE
Nine Mile Creek Watershed District

- **Option 6—** Based on the water quality analysis of BMP Options 1, 2, 3 and 4, this combination will provide significant water quality improvement that will result in all of the total phosphorus, chlorophyll *a*, and Secchi disc transparency water quality goals (set by the NMCWD and the MPCA) for Bryant Lake, which includes the MPCA's goal for "Fully Supporting" swimmable use ($TSI_{SD} \leq 53$) and the NMCWD's goal for a trophic state index (TSI_{SD}) ≤ 50 being met.

- **Option 7—** Based on the water quality analysis this BMP combination will provide significant and more cost-effective water quality improvement for Bryant Lake. This combination of Options 1 and 3 will provide significant water quality improvement that will meet the total phosphorus, chlorophyll *a*, and Secchi disc transparency water quality goals (set by the NMCWD and the MPCA) for Bryant Lake. This option will meet the MPCA's goal for "Fully Supporting" swimmable use ($TSI_{SD} \leq 53$), but will not meet the NMCWD's more stringent goal for a trophic state index (TSI_{SD}) ≤ 50.

- **Option 10—** Based on the water quality analysis of BMP Options 1, 3 and 9, this combination will provide significant water quality improvement that will result in meeting all of the total phosphorus, chlorophyll *a*, and Secchi disc transparency water quality goals (set by the NMCWD and the MPCA) for Bryant Lake. This includes the MPCA's goal for "Fully Supporting" swimmable use ($TSI_{SD} \leq 53$) and the more stringent NMCWD's goal for a trophic state index (TSI_{SD}) ≤ 50.

Table EX-1 Benefits and Costs of Potential Improvement Options

Improvement Option # Description of Potential Improvement	Model Calibration Year (1997-98; 24.3 inches of precipitation)					
		Average Summer TP Conc (May- Sept; µg/L)	Estimated Chl-a Conc (May-Sept; µg/L)	Estimated Secchi Disc Depth (May-Sept; meters)	Estimated Trophic State Index (TSI_{SD}) Value NMCWD Goal ≤ 50	Estimated Cost ($)
Existing Conditions		42	24	1.2	57	0
1. Restore Wetland Within Subwatershed BL-11		39	20	1.4	56	$282,000
2. Construct Pond Within Subwatershed BL-16		39	19	1.4	55	$712,000
3. In-Lake Alum Treatment		34	15	1.6	53	$142,000
4. Construct Pond Within Subwatershed BL-42		41	22	1.3	56	$941,000
5. Combination of Improvement Options 1, 2 and 4		34	14	1.6	53	$1,935,000
6. Combination of Improvement Options 1, 2, 3 and 4		27[1]	8	2.1	49	$2,077,000
7. Combination of Improvement Options 1 and 3		32	12	1.8	52	$424,000
8. Combination of Improvement Option 3 and County Ditch #34 and South Branch Nine Mile Creek Stormwater Alum Treatment Plants		26[1]	7	2.3	48	$2,098,000[2]
9. Curlyleaf Pondweed Management with Endothall		39	20	1.3	56	$340,000
10. Combination of Improvement Options 1, 3 and 9		29[1]	9	2.0	50	$764,000

NOTES:

[1] Estimated TP concentration corresponds well with 23-25 µg/L TP estimate of Pre-Settlement Conditions (from Vighi and Chiaudani, 1985) and low end range of 28-58 µg/L TP estimate from MPCA's MINLEAP Model.

[2] Estimate includes capital construction cost, only. Estimated annual operation and maintenance costs are an additional $100,000.

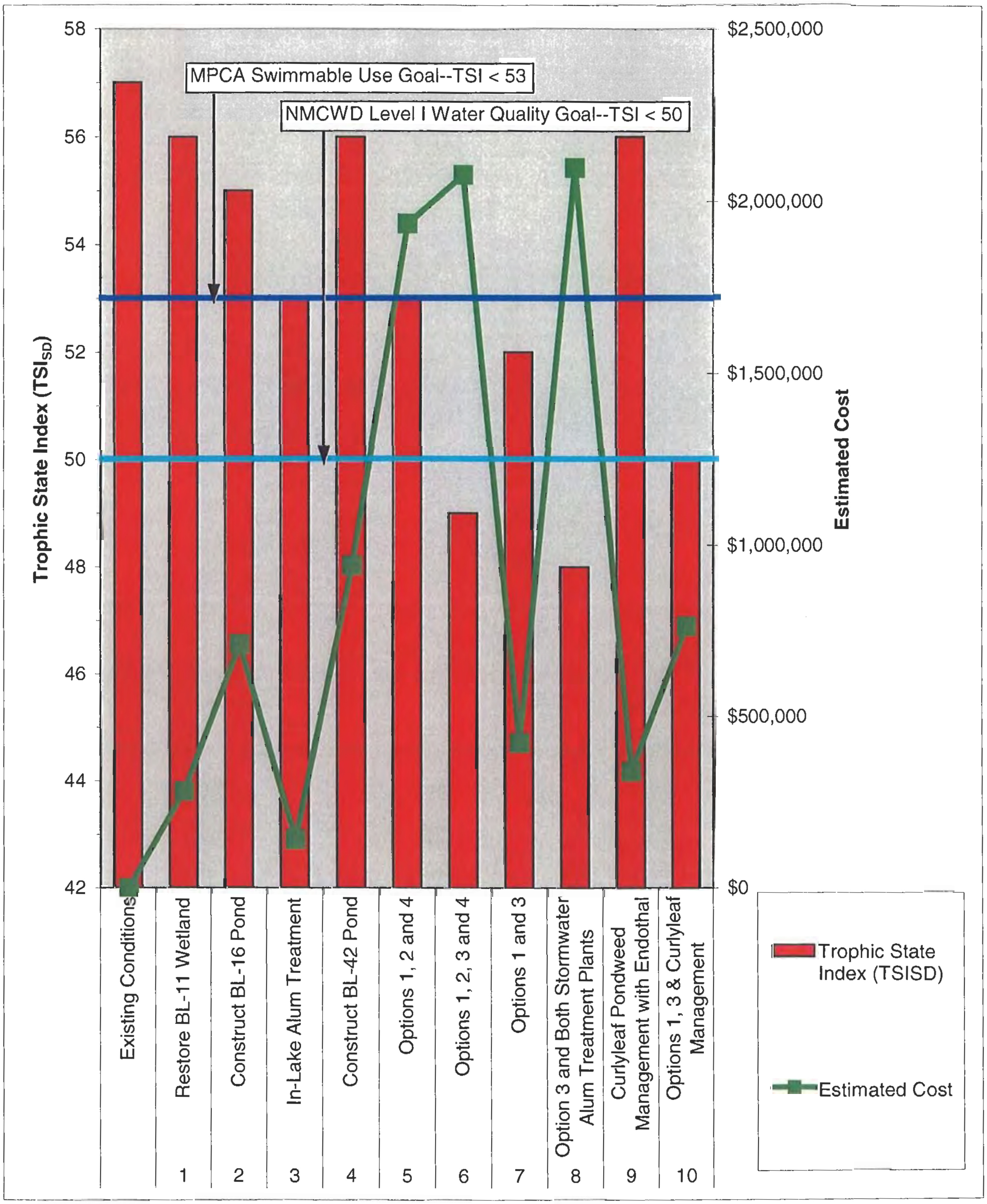


Figure EX-6
Cost and Benefits of Potential Improvement Options for Bryant Lake during 1997-1998 Climatic Condtions (Near Average Precipitation)

Recommended Goal Achievement Alternatives

No single BMP option will ensure that all of the NMCWD's and MPCA water quality and recreation goals can be met. In addition, none of the water quality goals are set at consistent levels with respect to the lake's trophic state (based on Carlson's Trophic State Index [TSI] standardized lake rating system). Table EX-1 and Figure EX-6 show that, based on the relationship between the water quality indicators for Bryant Lake, the TSI values associated with each goal ranges from 48 to 56. Some combinations of improvement options will meet some of the water quality goals and criteria, but only three combination of the improvement options (Options 5, 8 and 10) will meet all of them.

Based on the water quality analysis of the in-lake alum treatment and stormwater alum treatment plants option, this combination (Option 8) will provide the most significant water quality improvement and will meet all of the total phosphorus, chlorophyll *a*, and Secchi disc transparency water quality goals (set by the NMCWD and the MPCA) for Bryant Lake, which includes the MPCA's goal for "Fully Supporting" swimmable use ($TSI_{SD} \leq 53$) and the NMCWD's goal for a trophic state index ($TSI_{SD} \leq 50$). Table EX-1 and Figure EX-6 shows that the estimated capital cost for this option is $2,098,000, with an annual operation and maintenance cost of $100,000.

If the MPCA's criteria for water quality impairment is of primary concern, the combination of Improvement Options 1, 3 and 9 (Option 10) will ensure that the Bryant Lake water quality will meet the total phosphorus and chlorophyll *a* water quality goals (set by the NMCWD and the MPCA) and will meet the MPCA's goal for "Fully Supporting" swimmable use ($TSI_{SD} \leq 53$), referenced in the NMCWD Water Management Plan. Table EX-1 and Figure EX-6 show that the estimated capital cost for this option is $764,000. The annual operation and maintenance costs for this option would be small and would primarily depend on the longevity of the in-lake alum treatment. Since the cost of this combination of options is significantly less than Options 5, 6 and 8, it is recommended that Improvement Options 1, 3 and 9 be implemented, initially, followed by a period of monitoring. If the subsequent monitoring indicates that the Bryant Lake water quality is not meeting the desired goals, then BMP Options 2 and 4 should be considered for future implementation.

The 20-year management plan and associated costs are illustrated on Figure EX-7. Below is the expected sequence of the lake management activities for the first 5 years.

- **Year 1 (2006)** Restore the wetland within subwatershed BL-11, herbicide (endothall) treatment begins in the spring and summer water quality and macrophyte monitoring.

- **Year 2 (2007)** Endothall treatment and summer water quality and macrophyte monitoring.
- **Year 3 (2008)** Endothall treatment and summer water quality and macrophyte monitoring.
- **Year 4 (2009)** Final endothall treatment and summer water quality and macrophyte monitoring.
- **Year 5 (2010)** Alum treatment in the fall and summer water quality and macrophyte monitoring.

The recommended implementation plan is BMP Option 10: restoration of the wetland in subwatershed BL-11, multiple herbicide (endothall) treatments and whole lake alum treatment. Alum treatment should not be performed until curlyleaf pondweed is completely controlled. Alum treatment prior to curlyleaf pondweed control could possibly increase the light availability to this plant and stimulate curlyleaf pondweed growth. The 20 year cost of this management option is estimated to cost $1,166,000 or an annualized cost of $102,000 per year over a 20 year period. This implementation plan has been selected because both the significant internal, the aquatic plant curlyleaf pondweed die-back and phosphorus release from sediments, and external phosphorus sources need to be controlled.

Post-Implementation Water Quality Monitoring Program

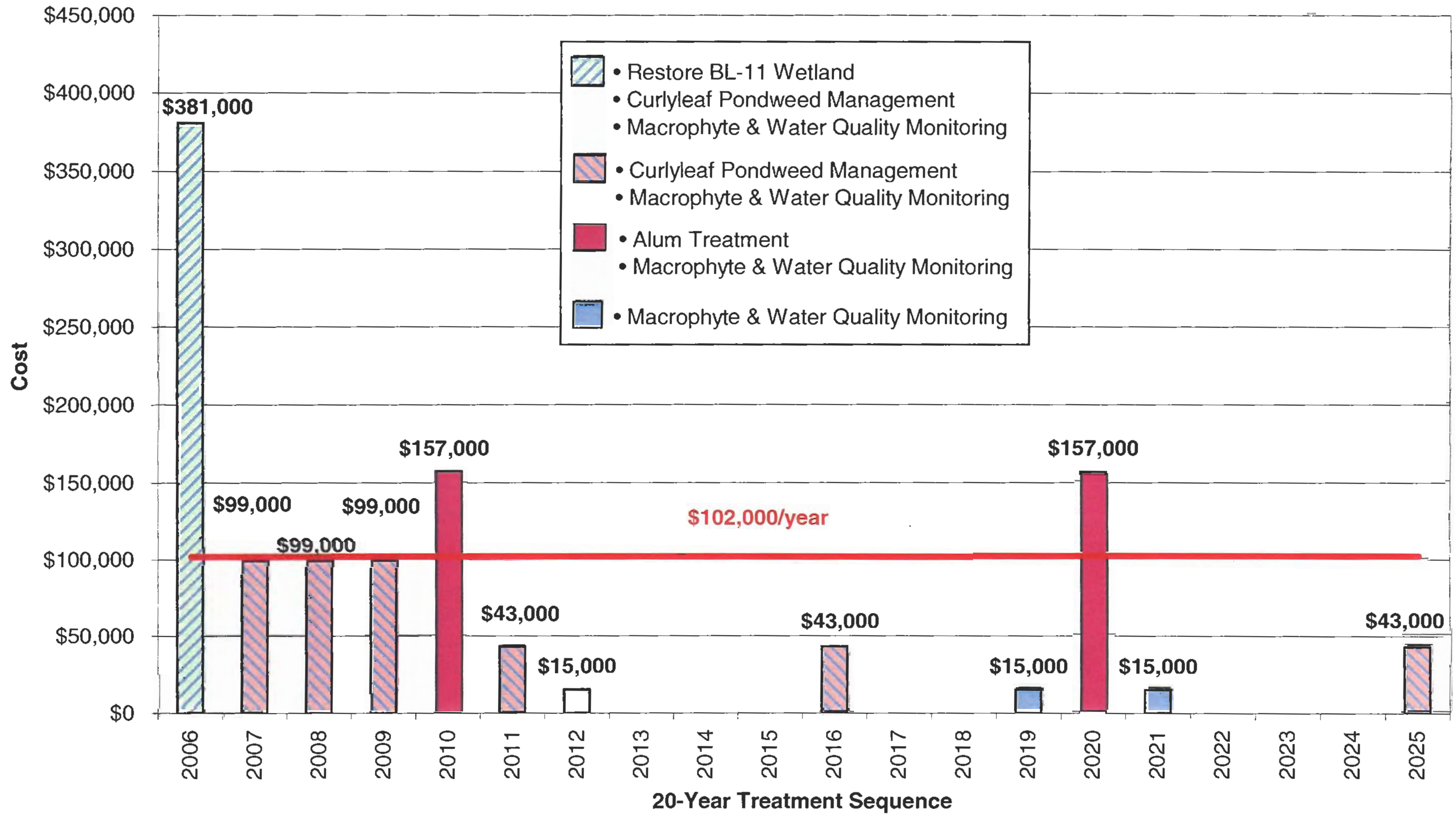
This plan will require monitoring during the various stages of the restoration effort to evaluate effectiveness and determine whether the prescribed components and sequence of management efforts remains appropriate. Aquatic plants and lake water quality should be monitored during the 5 years of treatment and for 3 years following treatment. Water quality monitoring should include total phosphorus, chlorophyll *a*, and Secchi disc monitoring from May through September each year. Sediment monitoring should occur 1 year before and for 3 years after alum plus lime treatment. Sediment monitoring should include an evaluation of the location of the treatment layer and collection of mobile phosphorus samples.

As previously discussed, a water quality monitoring program is recommended for Bryant Lake following implementation of Improvement Options 1, 3 and 9. This water quality monitoring program should consist of in-lake monitoring consistent with the program completed for NMCWD during 1998. The monitoring should include bi-weekly monitoring of the deep-hole location of the lake, during the open water period, for total phosphorus, pH, specific conductance, dissolved oxygen and temperature at 1-meter intervals. In addition, surface and bottom water samples should be collected and analyzed for soluble reactive phosphorus, nitrogen species, particulate and dissolved labile and refractory detritus. Chlorophyll-a and Secchi disc transparency measurements should also be collected, along with macrophyte, phytoplankton and zooplankton analyses. As previously discussed, if this monitoring program indicates that the Bryant Lake water quality is not meeting the desired goals, then BMP Options 2 and 4 should be considered for future implementation.

Coordination with the City of Eden Prairie and Three Rivers Park District

Bryant Lake is entirely within the borders of the City of Eden Prairie and is bordered on the east by a significant area of land managed by the Three Rivers Park District. The management alternatives discussed in this study have been developed with consideration of the Three Rivers Park District's 1999 Water Quality Management Plan and the intended efforts by the City of Eden Prairie and the Park District to improve the water quality and recreational use of Bryant Lake. Management recommendations provided in this report include additional efforts beyond those discussed with the City and Parks District. We have designed the management alternatives recommended in this study so that there will be time to evaluate the effectiveness of management efforts such as herbicide treatment and discuss the appropriate timing for additional management efforts such as an alum plus lime treatment.

Figure EX-7
Bryant Lake
20-Year Treatment Sequence and Estimated Project Costs



Appendix C

Anderson Lakes UAA Report (Executive Summary only)

Appendix C: Following is the Anderson Lakes UAA Executive Summary

Executive Summary

Overview

This report describes the results of the Use Attainability Analysis (UAA) for Southeast, Southwest, and Northwest Anderson Lakes in Bloomington and Eden Prairie, MN. The UAA provides the scientific foundation for a lake-specific best management plan that will permit maintenance of, or attainment of, intended beneficial uses of Southeast, Southwest, and Northwest Anderson Lakes. The UAA is a scientific assessment of a water body's physical, chemical, and biological condition. This study includes both a water quality assessment and prescription of protective and/or remedial measures for Southeast, Southwest, and Northwest Anderson Lakes and their watersheds. The conclusions and recommendations are based on historical water quality data, the results of an intensive lake water quality monitoring in 2000-01, and computer simulations of land use impacts on water quality in Southeast, Southwest, and Northwest Anderson Lake using watershed and lake models calibrated to the 2001 data set. In addition, best management practices (BMPs) were evaluated to compare their relative effect on total phosphorus concentrations and Secchi disc transparencies (i.e., water clarity). Management options were then assessed to determine attainment or non-attainment with the lake's beneficial uses.

Water Quality Goals

Nine Mile Creek Watershed District Water Quality Goals

The approved *Nine Mile Creek Watershed District Water Management Plan* (Barr, 1996) preliminarily assessed ultimate watershed water quality for Southeast, Southwest, and Northwest Anderson Lakes and articulated five specific goals for the lake. These goals address water quantity, water quality, aquatic communities, recreational-use, and wildlife. Where possible, the Nine Mile Creek Watershed District (NMCWD) goals were quantified by using the standardized lake rating system termed the Carlson's Trophic State Index (TSI). This index considers the lake's total phosphorus, chlorophyll *a*, and Secchi disc transparencies to assign a water quality index number reflecting the lake's general fertility level. The rating system results in index values between 0 and 100, with the index value increasing with increased lake fertility. Total phosphorus, chlorophyll *a*, and Secchi disc transparency are key water quality indicators for the following reasons.

- Phosphorus generally controls the growth of algae in lake systems. Of all the substances needed for biological growth, phosphorus is typically the limiting nutrient.

- Chlorophyll *a* is the main photosynthetic pigment in algae. Therefore, the amount of chlorophyll *a* in the water indicates the abundance of algae present in the lake.
- Secchi disc transparency is a measure of water clarity, and is inversely related to the abundance of algae. Water clarity typically determines recreational-use impairment.

All three of the parameters can be used to determine a TSI. However, water transparency is typically used to develop the TSI_{SD} (trophic state index based on Secchi disc transparency) because people's perceptions of water clarity are often directly related to recreational-use impairment. The TSI rating system results in the placement of a lake with medium fertility in the mesotrophic trophic status category. Water quality trophic status categories include oligotrophic (i.e., excellent water quality), mesotrophic (i.e., good water quality), eutrophic (i.e., poor water quality), and hypereutrophic (i.e., very poor water quality). Water quality characteristics of lakes in the various trophic status categories are listed below with their respective TSI ranges:

1. **Oligotrophic –** [$20 \leq TSI_{SD} \leq 38$] clear, low productive lakes, with total phosphorus concentrations less than or equal to 10 mg/L, chlorophyll *a* concentrations of less than or equal to 2 mg/L, and Secchi disc transparencies greater than or equal to 4.6 meters (15 feet).
2. **Mesotrophic –** [$38 \leq TSI_{SD} \leq 50$] intermediately productive lakes, with total phosphorus concentrations between 10 and 25 mg/L, chlorophyll *a* concentrations between 2 and 8 mg/L, and Secchi disc transparencies between 2 and 4.6 meters (6 to 15 feet).
3. **Eutrophic –** [$50 \leq TSI_{SD} \leq 62$] high productive lakes relative to a neutral level, with 25 to 57 mg/L total phosphorus, chlorophyll *a* concentrations between 8 and 26 mg/L, and Secchi disc measurements between 0.85 and 2 meters (2.7 to 6 feet).
4. **Hypereutrophic –** [$62 \leq TSI_{SD} \leq 80$] extremely productive lakes which are highly eutrophic and unstable (i.e., their water quality can fluctuate on daily and seasonal basis, experience periodic anoxia and fish kills, possibly produce toxic substances, etc.) with total phosphorus concentrations greater than 57 mg/L, chlorophyll *a* concentrations of greater than 26 mg/L, and Secchi disc transparencies less than 0.85 meters (2.7 feet).

The NMCWD's management strategy has been to "protect" the three Anderson Lakes. According to the *NMCWD Water Management Plan*, "protect" means "to avoid significant degradation from point and nonpoint pollution sources and from wetland alterations, in order to maintain existing beneficial uses, aquatic and wetland habitats, and the level of water quality necessary to protect these uses in receiving waters." The NMCWD goals for Southeast, Southwest, and Northwest Anderson Lake include the following:

The **Water Quantity Goal** for the three Anderson Lakes is to provide sufficient water storage of surface runoff during a regional flood, the critical 100-year frequency storm event. This goal is attainable with no action.

The **Water Quality Goal** for Southeast and Southwest Anderson Lakes is specified by the NMCWD and presented in the *NMCWD Water Management Plan*. The plan specifies a Category II classification Category. The specific NMCWD goal for Southeast and Southwest Anderson Lakes is to achieve and maintain a TSI_{SD} between 50 and 60. The plan specifies a Category III classification for Northwest Anderson Lakes. The specific NMCWD goal is to achieve and maintain a TSI_{SD} between 60 and 70. These goals, as established by and presented in the *NMCWD Water Management Plan*, are attainable, but only with the implementation of the BMPs described in this UAA.

The **Aquatic Communities Goal** for Southeast Anderson Lake is to achieve a water quality that fully supports the lake's fisheries-use classification determined by the MDNR as outlined in *An Ecological Classification of Minnesota Lakes with Associated Fish Communities* (Schupp, 1992) and achieve a balanced ecosystem. This includes a diverse growth of native aquatic macrophytes. Specifically, the goal for Southeast Anderson Lake is to achieve and maintain a $TSI_{SD} \simeq 61$ and a balanced fishery.

Since the MDNR did not specify the ecologic class for Northwest and Southwest Anderson Lakes there is no specific fisheries related TSI goal. However, like Southeast Anderson Lake, the NMCWD wants to achieve water quality that will result in a diverse native ecosystem.

The **Wildlife Goal** for each of the three Anderson Lakes is to protect existing beneficial wildlife uses. The wildlife goal can be achieved with no action, especially if the wetlands and natural land surrounding the lake remain intact.

Three Rivers Park District and City of Eden Prairie Goals

Both the Parks District and City of Eden Prairie have expressed a desire to manage Southwest and Northwest Anderson Lakes to improve the waterfowl nesting habitat and the overall wildlife use of the area. Neither organization wishes to promote recreational use of these two resources. The specific water quality criteria listed in the Three Rivers Park District's 1999 Water Quality Management Plan is to maintain a TSI < 77. The City did not provide any specific water quality criteria but have indicated that they agree with the Parks District's criteria. A TSI value of 77 translates into the following total phosphorus concentration, chlorophyll *a* concentration, and Secchi disc transparency.

- TSI < 77
- Total Phosphorus Concentration ≤ 156 μg/L
- Chlorophyll a concentration ≤ 113 μg/L
- Secchi disc transparency ≥ 0.3 meters

In addition to the water quality criteria listed above, the Parks District and City want to pursue lowering the normal water level (NWL) of Southwest and Northwest Anderson Lakes by 1.5 feet to Elevation 837.5. In order to lower the NWL in these water resources the Parks District or City would be required to get a permit from the MDNR.

City of Bloomington Goals

As part of the City of Bloomington's Surface Water Management Plan the City adopted the same management goals for Southeast Anderson Lake as outline to the NMCWD 1996 Water Management Plan.

Lake Characteristics

Historically the three Anderson Lakes were considered to be landlocked. In the early-1980's NMCWD installed an outlet structure at the northeast corner of Northwest Anderson Lake. This structure was designed to control the normal water Category (NWL) of the three lakes at Elevation 839.0. At this elevation the three lakes are interconnected. This original structure had a capacity of 2 cubic feet per second (cfs). Following the construction of US Highway 169, a new outlet structure with the same control elevation and a 10 cfs capacity was installed and became operational in the spring of 2000. With this structure installed the anticipated 100-year high water level (HWL) is estimated to be 841.0. In general, water is detained significantly by the lakes because of the limited outlet capacity. Therefore, the water levels in these lakes can fluctuate significantly and this fluctuation was incorporated into the lake water quality modeling process.

Southeast Anderson Lake receives runoff from its watershed and from the periodic pumping of water from Bush Lake (the pumped outlet from Bush Lake became operational in 2000 and starts pumping when the water surface elevation in Bush Lake exceeds 834.0). Water leaves the northwest corner of Southeast Anderson Lake by flowing through a 48-inch culvert under US Highway 169 to Southwest Anderson Lake. Southwest Anderson Lake is connected to Northwest Anderson Lake by a wetland area and small natural channel at the north end of the lake.

Southeast Anderson Lake

Southeast Anderson Lake is located in the western portion of Bloomington and has a water surface of approximately 81 acres, a maximum depth of approximately 9 feet, and a mean depth of 4.7 feet at a water surface elevation of 839.0. At this elevation the lake volume is approximately 470 acre-feet. Southeast Anderson Lake is relatively shallow and has a large littoral area, thus causing it to be prone to frequent wind-driven mixing of the lake's shallow and deep waters during the summer. One would therefore expect Southeast Anderson Lake to be polymictic (mixing many times per year) as opposed to lakes with deep, steep-sided basins that are usually dimictic (mixing only twice per year).

Southwest Anderson Lake

Southwest Anderson Lake has an open water surface area of approximately 110 acres (the open water area is variable, depending on the seasonally-varying coverage of the lake's cattail fringe), a maximum depth of approximately 8 feet, and a mean depth of approximately 4 feet. The lake volume is approximately 437 acre-feet. Southwest Anderson Lake is quite shallow, especially in comparison with its large surface area. Therefore, as is the case with Southeast Anderson Lake, Southwest Anderson Lake would be expected to be prone to frequent wind-driven mixing which is supported by the data gathered from Southwest Anderson Lake indicating that this lake is also polymictic. Because the lake is so shallow, aquatic plants can grow over the entire lake bed and a summer thermocline is not usually present.

Northwest Anderson Lake

Northwest Anderson Lake has an open water surface area of approximately 185 acres, a maximum depth of approximately 10 feet, and a mean depth of approximately 4 feet. The lake volume is approximately 732 acre-feet. Since Northwest Anderson Lake is quite shallow, especially in comparison with its large surface area, it would be expected to be prone to frequent wind-driven mixing, indicating that this lake is also polymictic.

The lake area, depth, and volume depend on the water level of the lake, which has been observed to vary between a high measurement of 840.7 feet MSL (1998) and a low measurement of 835.3 feet MSL (1978). The approximate water surface area, depth, and volume (given above) are as measured at the average water level of 839.0 feet MSL. The water level in the lake is controlled mainly by weather conditions (snowmelt, rainfall, and evaporation) and by the elevation of the outlet structure located at the northeast corner of Northwest Anderson Lake. Water balance modeling also indicates that the lake is influenced by groundwater inflows.

Water Quality Problem Assessment

Baseline Lake Water Quality Status

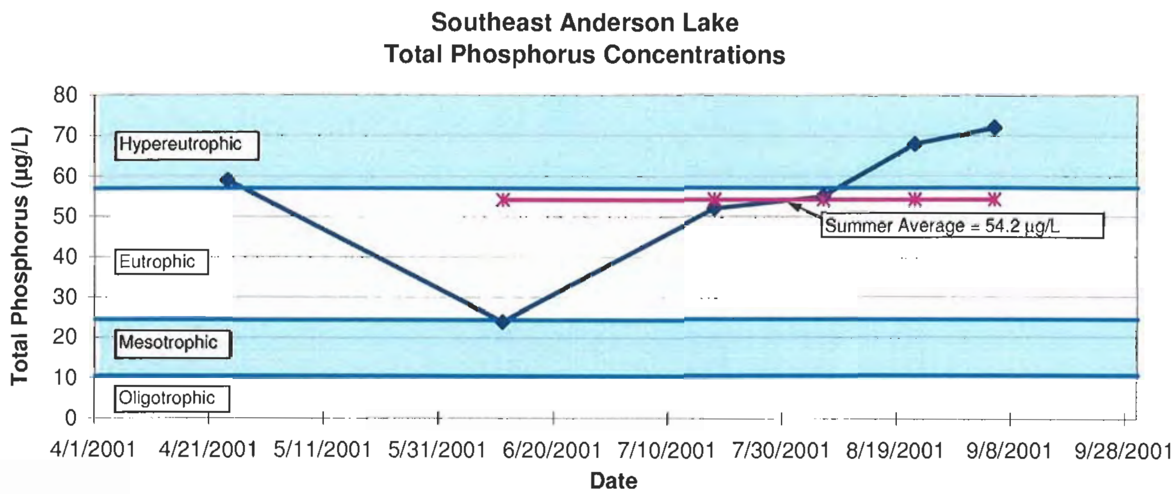
The Minnesota Lake Eutrophication Analysis Procedure (MnLEAP) is intended to be used as a screening tool for estimating lake conditions and for identifying "problem" lakes. In addition, MnLEAP modeling has been done in the past to identify Minnesota lakes which may be in better or worse condition than they "should be" based on their location, watershed area and lake basin morphometry (Heiskary and Wilson, 1990). MnLEAP predicts total phosphorus concentrations of approximately 39 μg/L, 59 μg/L, and 61 μg/L for Southeast, Southwest, and Northwest Anderson Lakes, respectively. The predicted phosphorus concentrations have a respective standard error of 15 μg/L, 19 μg/L, and 19 μg/L, which means that the NMCWD's water quality goals for total phosphorus are within the range of what is realistically attainable for each of the Anderson Lakes.

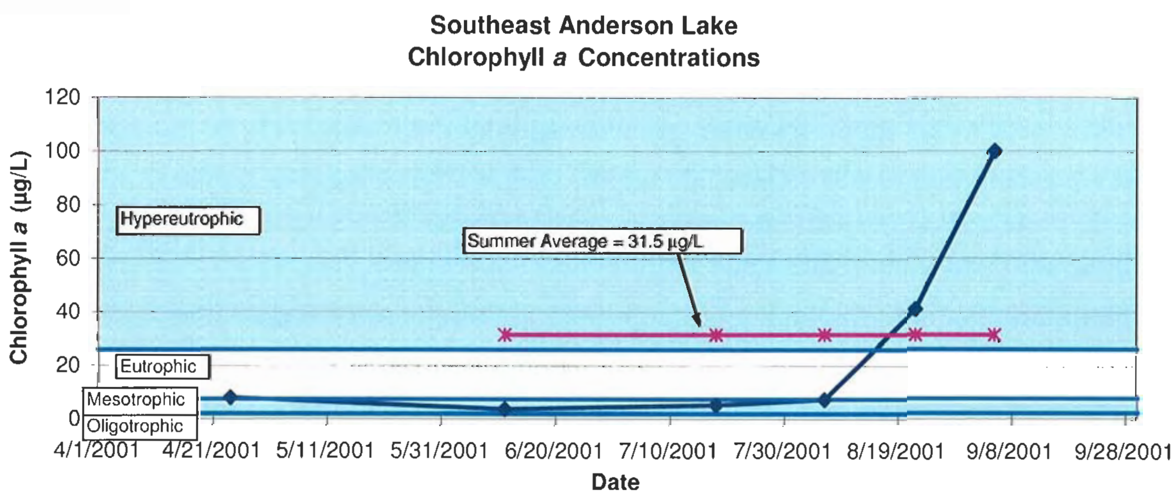
Vighi and Chiaudani (1985) developed another method to determine the phosphorus concentration in lakes that are not affected by anthropogenic (human) inputs. As a result, the phosphorus concentration in a lake resulting from natural, background phosphorus loadings can be calculated from information about the lake's mean depth and alkalinity or conductivity. Using the specific conductivity data or the long-term average alkalinity values for Southeast, Southwest, and Northwest Anderson Lakes (119, 104, and 117 mg/L as $CaCO_3$, respectively), the predicted phosphorus concentration from natural, background loadings should be 22-30 μg/L, 24-33 μg/L, and 25-34 μg/L, respectively. These predicted concentrations are significantly lower than the NMCWD's water quality goal for Southeast, Southwest, and Northwest Anderson Lakes total phosphorus concentrations and indicates that the NMCWD's goals are attainable, given the appropriate phosphorus loadings.

Southeast Anderson Lake Current (2001) Water Quality

Figure EX-1 summarizes the seasonal changes in concentration of total phosphorus and chlorophyll *a*, and Secchi disc transparencies for Southeast Anderson Lake during 2001. The data are shown compared to the trophic status categories. As Figure EX-1 illustrates, the epilimnetic (surface water, i.e., 0-2 meter depth) phosphorus concentration increased from the lake's steady-state spring concentration (24 mg/L) to the lake's summer average concentration (54 mg/L). The increase was due to additional phosphorus inputs from a combination of stormwater runoff, and internal sources. Chlorophyll *a* measurements (0 to 2 meters) during 2001, including the summer average concentration (31 mg/L), indicate nuisance algal blooms (greater than 20 mg/L chlorophyll *a*) likely occurred during 2001, resulting in recreational-use impairment. The 2001 Southeast Anderson Lake

Secchi disc measurements were primarily in the hypereutrophic (i.e., very poor water quality) category during the summer with June transparency placing the lake in the mesotrophic category. The summer average Secchi disc transparency (1.1 m) of the lake is considered highly eutrophic. The Secchi disc measurements ranged between 0.5 and 2.5 meters, with the best Secchi disc transparencies occurring during early-June, the same time periods when the total phosphorus and chlorophyll *a* concentrations were at their lowest. Therefore, the data indicate the lake's transparency is largely determined by algal abundance. During 2001, the average phosphorus concentration, chlorophyll *a* concentration, and Secchi disc transparency were low enough to maintain the NMCWD's Category II water quality designation.





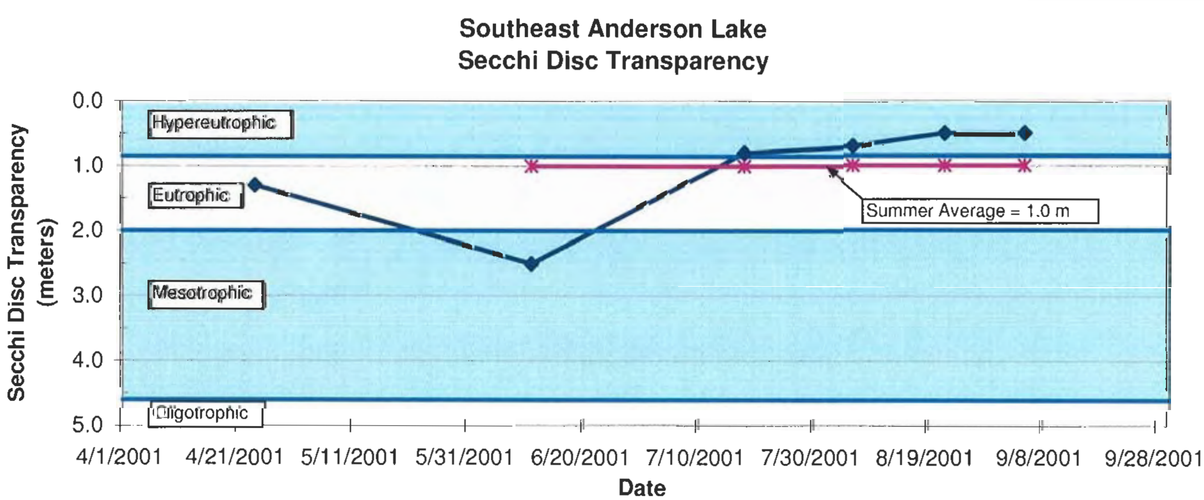


Figure EX-1

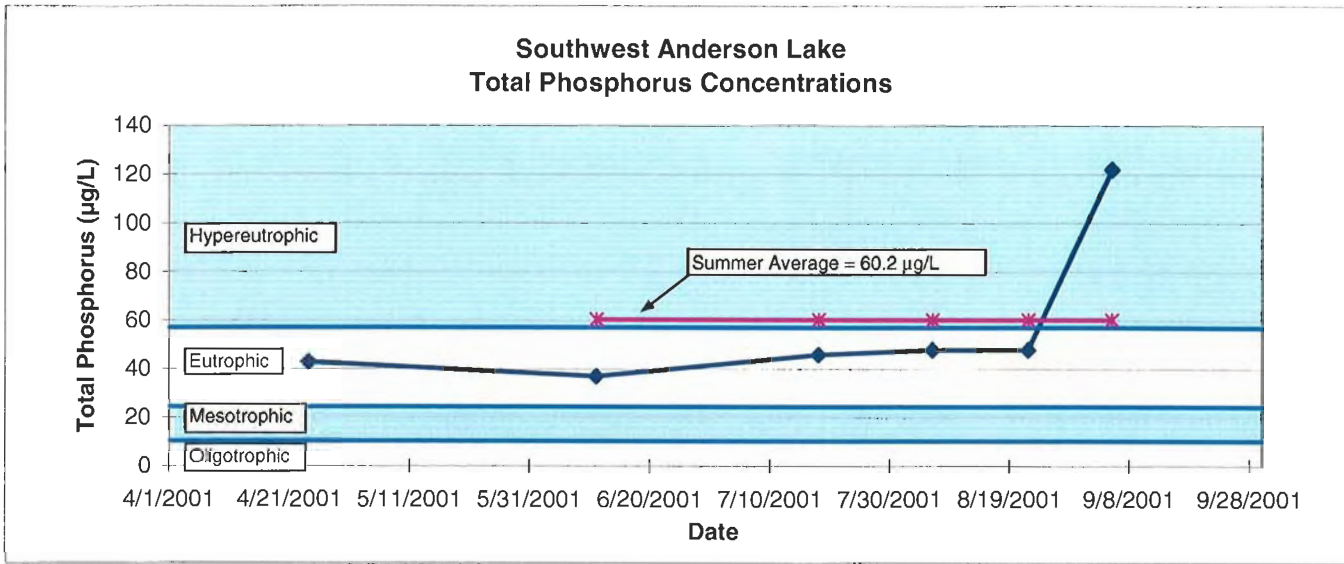
Southeast Anderson Lake 2001 Seasonal Changes in Concentration of Total Phosphorus and Chlorophyll *a* and Secchi Disc Transparencies

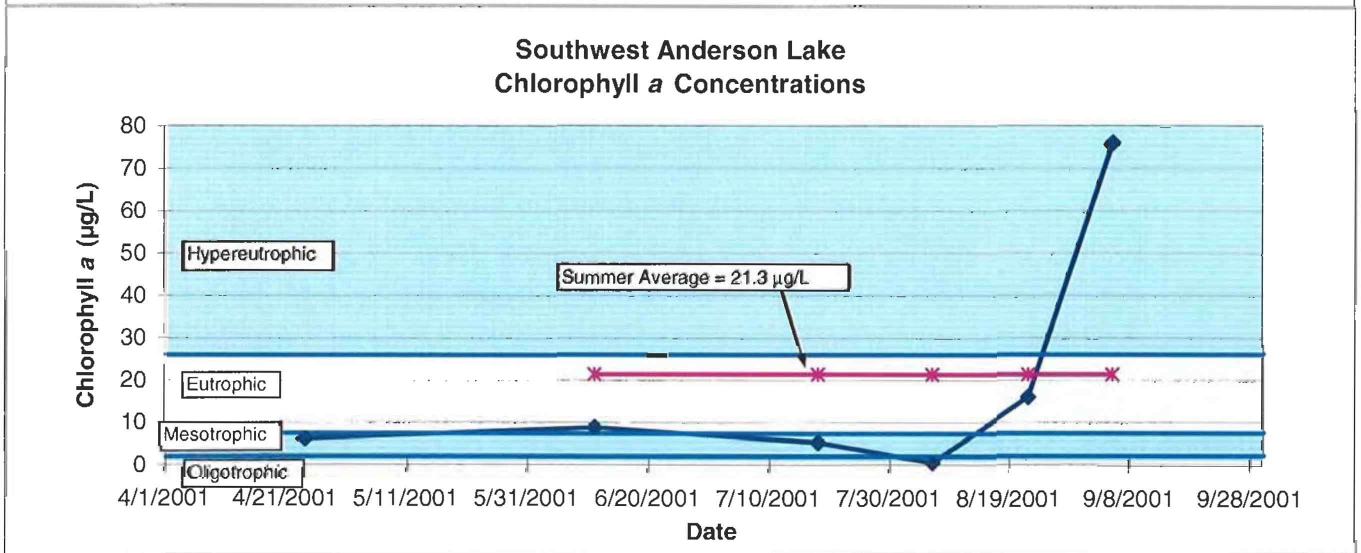
Southwest Anderson Lake Current (2001) Water Quality

Figure EX-2 summarizes the seasonal changes in concentration of total phosphorus and chlorophyll *a*, and Secchi disc transparencies for Southwest Anderson Lake during 2001. The data are shown compared to the trophic status categories. As Figure EX-2 illustrates, the epilimnetic (surface water, i.e., 0 to 2 meter depth) phosphorus concentration increased from the lake's steady-state spring concentration (~37 mg/L) to the lake's summer average concentration (60 mg/L). The increase was due to additional phosphorus inputs from a combination of stormwater runoff, and internal sources. Chlorophyll *a* measurements (0 to 2 meters) during 2001 were in the mesotrophic to hypereutrophic categories during the monitoring period. The summer average concentration (21 mg/L) indicates nuisance algal blooms (greater than 20 mg/L chlorophyll *a*) likely occurred during 2001 and would have resulted in recreational use impairment. The 2001 Southwest Anderson Lake Secchi disc measurements were primarily in the eutrophic category during the summer. Similar to Southeast Anderson Lake, Southwest Anderson Lake's summer average Secchi disc transparency (1.2 m) is considered highly eutrophic. The average phosphorus concentration, chlorophyll *a* concentration and Secchi disc transparency were low enough to maintain the NMCWD's Category II water quality designation.

Northwest Anderson Lake Current (2001) Water Quality

Current water quality in Northwest Anderson Lake is poor. The lake would be classified as a hypereutrophic (very high nutrient) water body for 2001. Summer total phosphorus concentrations were mostly within the range expected for hypereutrophic lake systems (Figure EX-3). The total phosphorus concentration increase steadily throughout the summer from the spring steady-state concentration (27 mg/L) to the early-fall concentration (147 mg/L). The increase was due to additional phosphorus inputs from a combination of stormwater runoff, and internal sources. Chlorophyll *a* concentrations during 2001 ranged from 9 µg/L to 110 µg/L. The summer average concentration for chlorophyll *a* of 48 µg/L was indicative of a hypereutrophic (very high nutrient) system (Figure EX-3) while the summer average Secchi disc transparency (0.8 m) of the lake is considered highly eutrophic. The summer average phosphorus concentration, chlorophyll *a* concentration and Secchi disc transparency were low enough to maintain the NMCWD's Category III water quality designation. However several individual samples fall short of goals established for a Category III lake.





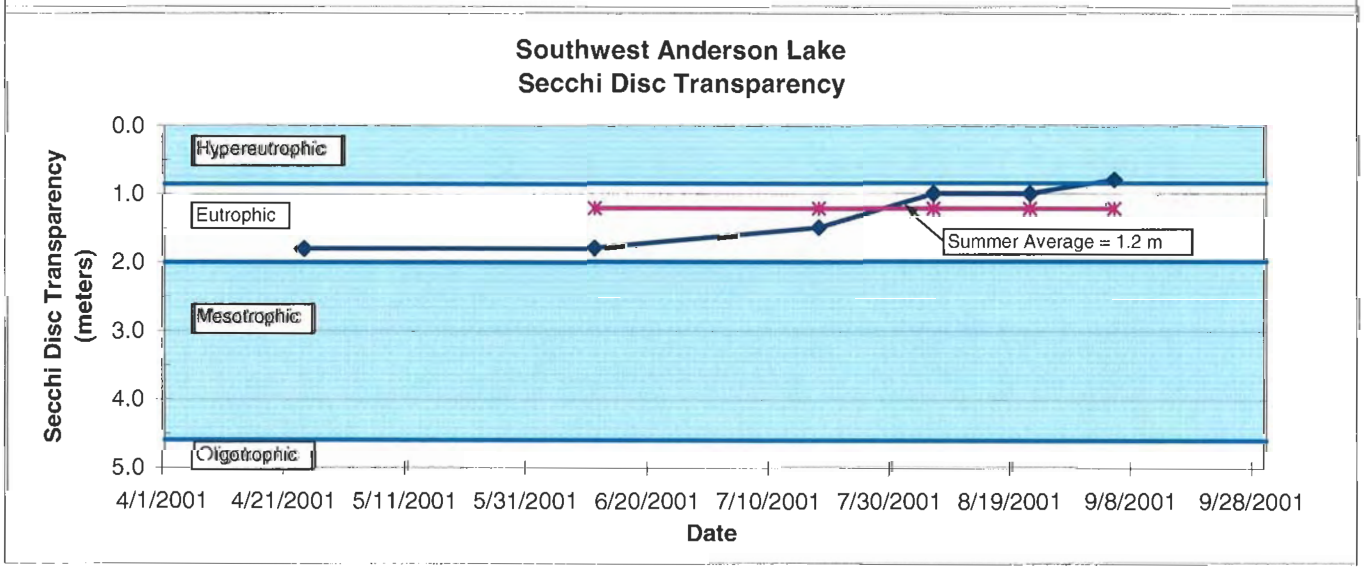


Figure EX-2

Southwest Anderson Lake 2001 Seasonal Changes in Concentration of Total Phosphorus and Chlorophyll *a* and Secchi Disc Transparencies

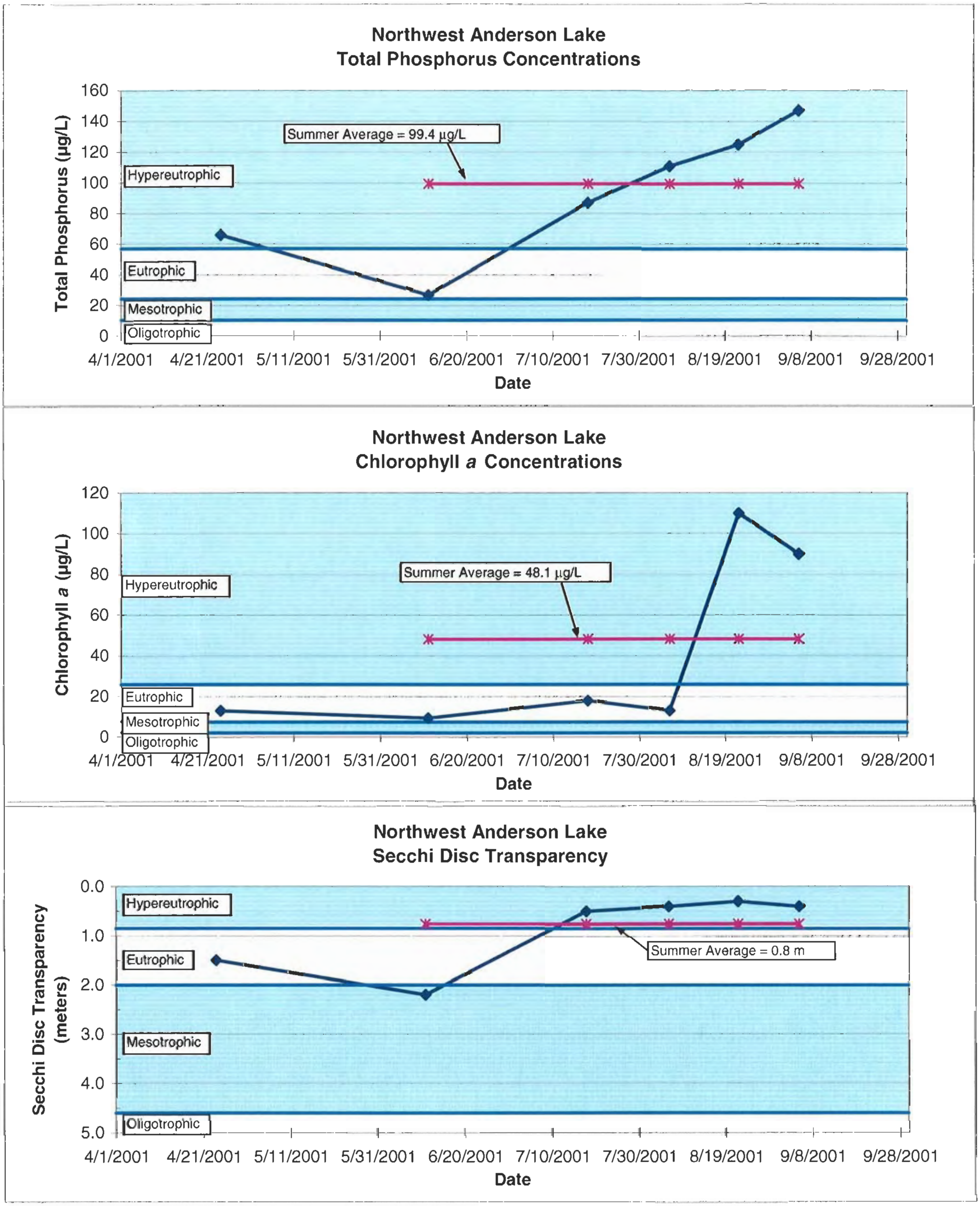


Figure EX-3

Northwest Anderson Lake 2001 Seasonal Changes in Concentration of Total Phosphorus and Chlorophyll *a* and Secchi Disc Transparencies

Trend Analyses

Trend analysis is a process by which changes in measured water quality indices can be evaluated as to their statistical significance; it is a way to determine whether apparent trends constitute a real decline or improvement in lake water quality. The trend analysis for Southeast, Southwest, and Northwest Anderson Lakes considers the historical trends for the three key water quality parameters: Total Phosphorus (TP), Chlorophyll a (Chl *a*), and Secchi disc transparency (SD). The analyses revealed that over the last 15 years there has been no statistically significant improvement or decline in the lakes' water quality.

Watershed Runoff Pollution

Historically, the three Anderson Lake watersheds were primarily comprised of basswood, sugar maple, and oak forests. There were also numerous wetlands located throughout the watershed. The terrain varies from gently to steeply rolling.

Southeast Anderson Lake

Southeast Anderson Lake's 194-acre watershed, including the lakes surface area of 81 acres, is primarily in the City of Bloomington. US Highway 169 is located along the western portion of the lake's watershed. Several types of land use exist within the immediate watershed of Southeast Anderson Lake. Based on analysis of 2000 aerial photographs, Southeast Anderson Lake's immediate watershed is dominated by three primary types of use (see Figure EX-4). Thirty-nine percent of the watershed is in a "natural" state, and vegetated with naturally-occurring or cultivated trees, shrubs, or grasses. Fourteen percent of the land is devoted to low-density residential-use while 6 percent of the watershed is considered to be highway use. The remaining 41 percent is open water (the lake's surface area). The relatively high proportion of land still in natural condition is significant. These "natural" lands include significant park areas.

The immediate watershed of Southeast Anderson Lake was analyzed with respect to probable future land use patterns by examination of the City of Bloomington ultimate land use map. Future land use is not expected to vary from present use (see Figure EX-5). As a result the watershed would be considered fully-developed.

Barr: Arcview 3.3,OPT2601, I:\client\nmcwd\gis\users\rar2\anderson_lk_uaa_rar2.apr, Layout: Layout: Figure EX-4, sas, Fri Jun 02 12:27:24 2006

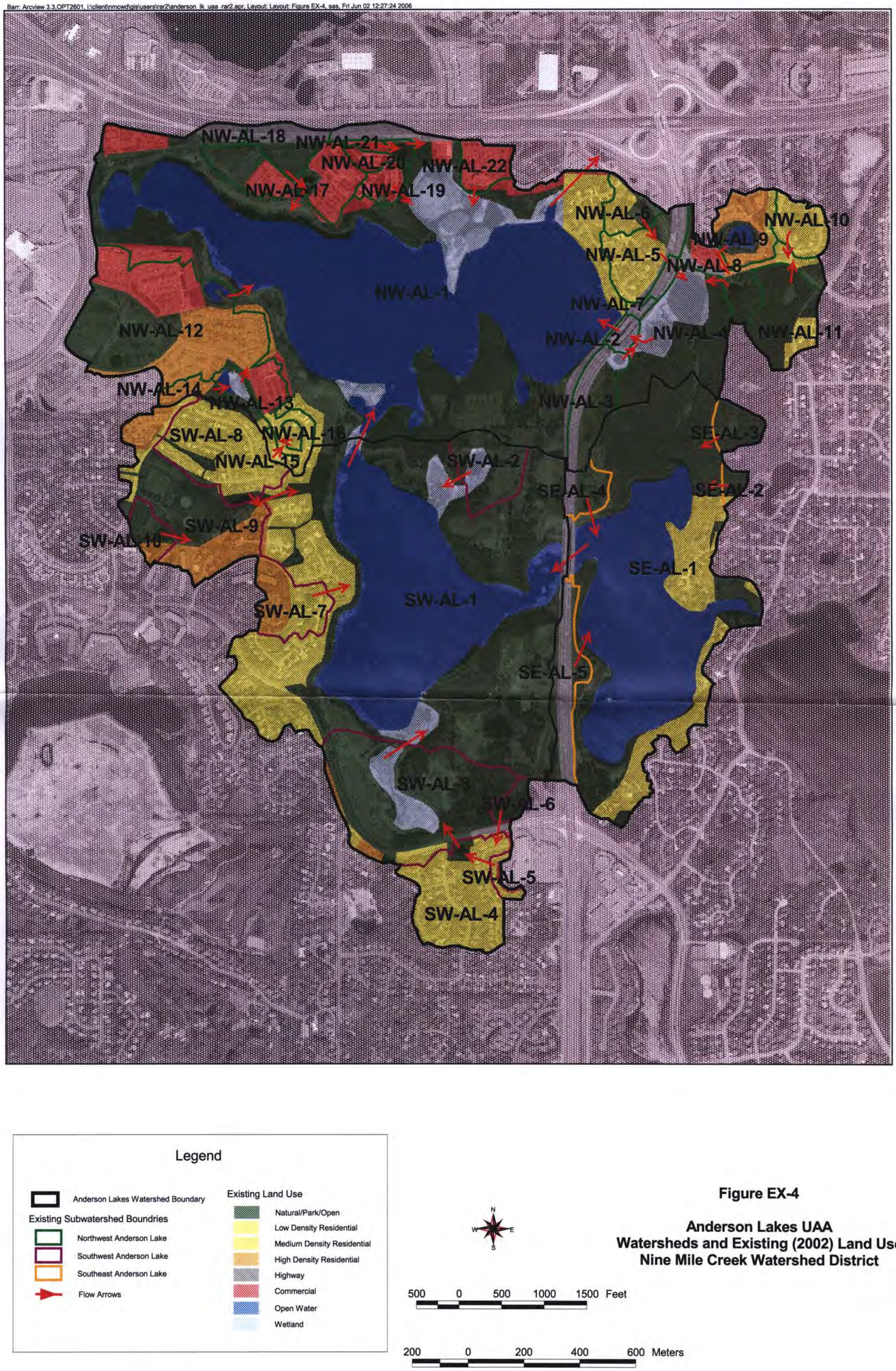
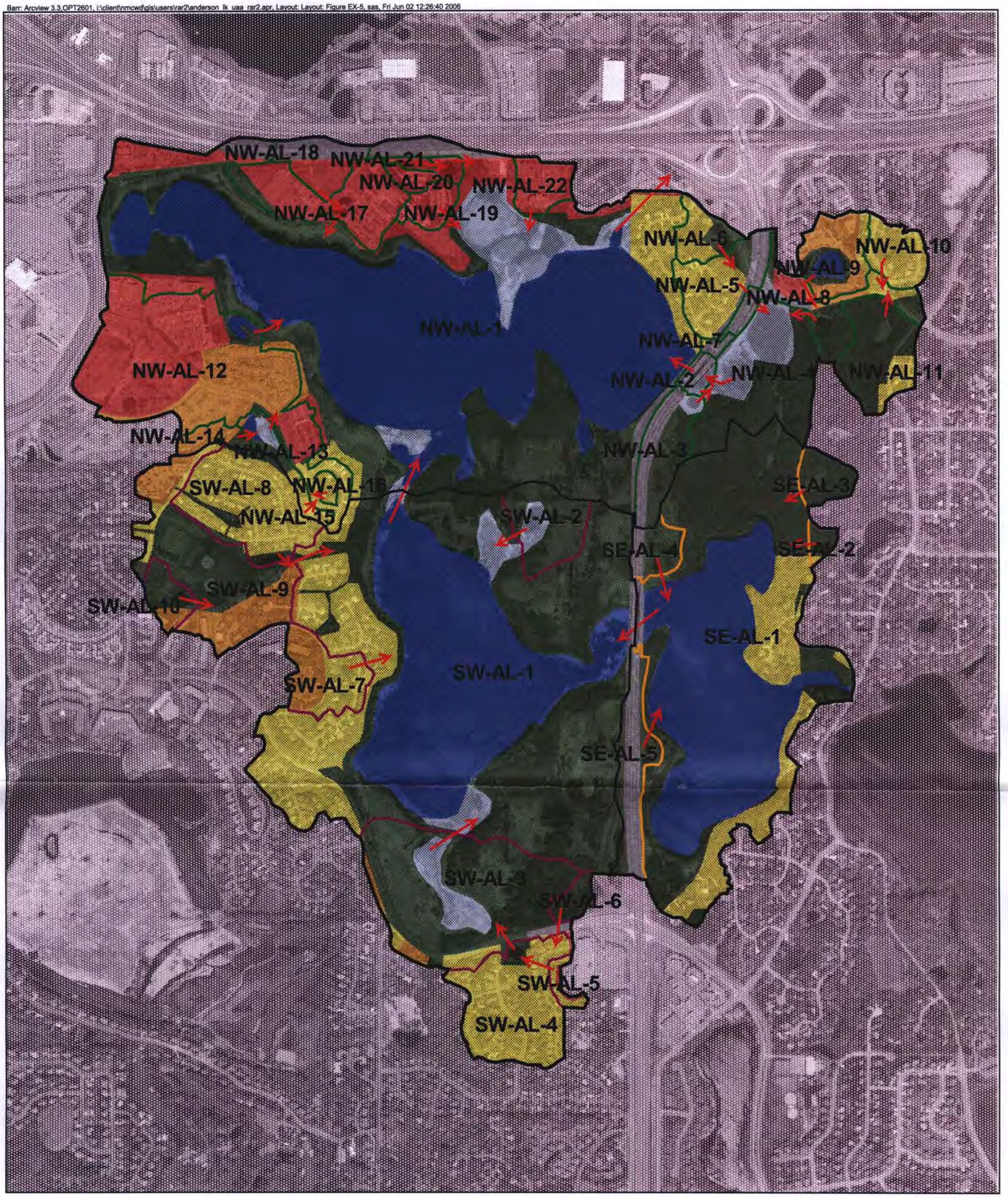


Figure EX-4

Anderson Lakes UAA
Watersheds and Existing (2002) Land Use
Nine Mile Creek Watershed District

Barr: Arcview 3.3,OPT2601, i:\client\nmcwd\gis\users\rar2\anderson_lk_uaa_rar2.apr, Layout: Layout: Figure EX-5, sas, Fri Jun 02 12:26:40 2006



Legend

Anderson Lakes Watershed Boundary

Ultimate Subwatershed Boundries
- Northwest Anderson Lake
- Southwest Anderson Lake
- Southeast Anderson Lake
- Flow Arrows

Ultimate Land Use
- Natural/Park/Open
- Low Density Residential
- Medium Density Residential
- High Density Residential
- Highway
- Commercial
- Open Water
- Wetland

N W E S

500 0 500 1000 1500 Feet

200 0 200 400 600 Meters

Figure EX-5

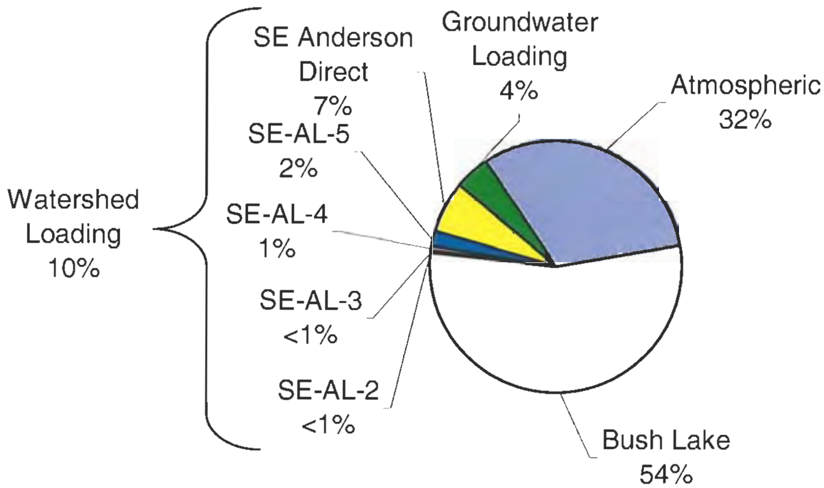
**Anderson Lakes UAA
Watersheds and Ultimate Land Use
Nine Mile Creek Watershed District**

For existing land use conditions on the Southeast Anderson Lake watershed, modeling simulations indicate a total phosphorus load from the watershed during 2001 of 32 lbs, and a watershed stormwater runoff volume of 59 acre-feet. The annual water and phosphorus loads are equivalent to 6.2 inches and 0.28 lb/acre, respectively (assuming a terrestrial area of 115 acres). The relatively large fraction of land remaining in natural condition in the Southeast Anderson Lake watershed helps to reduce average areal external phosphorus loads to the lake. Watershed analysis suggests that under existing conditions, the lake's direct watershed contributes the second largest amount, 21 percent, of the lake's annual phosphorus load while only contributing 7 percent of the annual water load (see Figure EX-6). Groundwater contributes roughly 4 percent of the lakes annual water budget while the internal release of phosphorus from the die-back of curlyleaf pondweed, a non-native aquatic plant, and bottom sediment contributed 42 percent of the annual phosphorus load in 2001.

Southwest Anderson Lake

The overall watershed of Southwest Anderson Lake includes the areas that drain to it after passing through other upstream water bodies, such as Bush Lake and Southeast Anderson Lake. However, the lake's immediate watershed (the area that does not first drain to an upstream lake) is approximately 453 acres. Based on 2000 Metropolitan Aerial photos, the 453-acre watershed includes about 98 acres for the lakes water surface. Therefore, the net immediate watershed, excluding lake water surface area, is approximately 355 acres. Since the Southwest Anderson Lake's immediate watershed is within the City of Eden Prairie, the City of Eden Prairie Guide Plan Map was consulted to verify land uses. The Southwest Anderson Lake watershed is nearing full-development. Figure EX-4 illustrates the urbanized watershed consists predominantly of natural/open space land use (43 percent). About 24 percent of the watershed is devoted to low-density residential-use. High-density residential, wetlands, and highway comprise 6, 4 and 1 percent of the watershed, respectively. There is a small percentage of the watershed (0.2 percent) that has been developed for commercial/office use near the intersection of US Highway 169 and Anderson Parkway. Future land use is not expected to vary from present use (see Figure EX-5).

Southeast Anderson Lake Annual Water Budget (603 ac-ft/yr)
Model Calibration Year (May 1, 2000 to April 30, 2001)
Using Existing Land Use



Southeast Anderson Lake Phosphorus Budget (129 lbs/yr)
Model Calibration Year (May 1, 2000 to April 30, 2001)
Using Existing Land Use

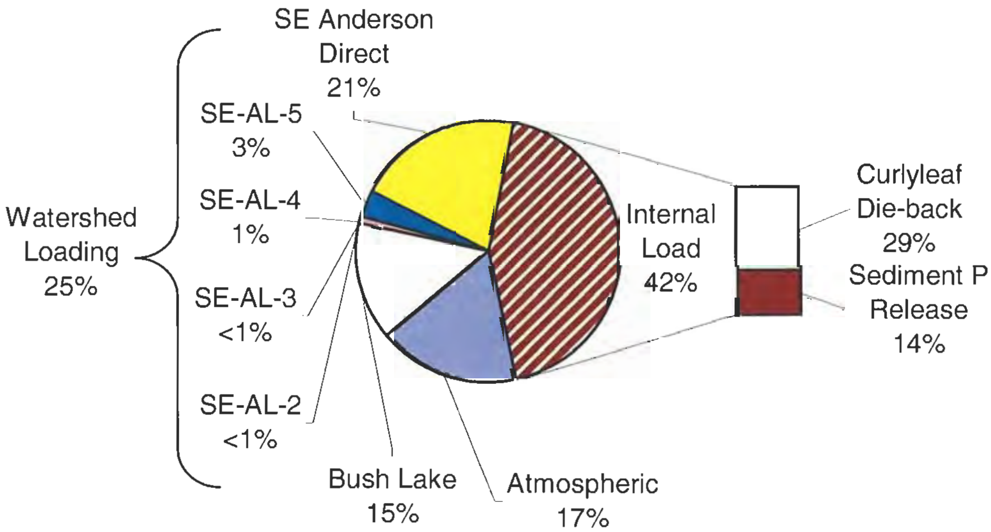


Figure EX-6
Southeast Anderson Lake Watershed Phosphorus and Water Budgets

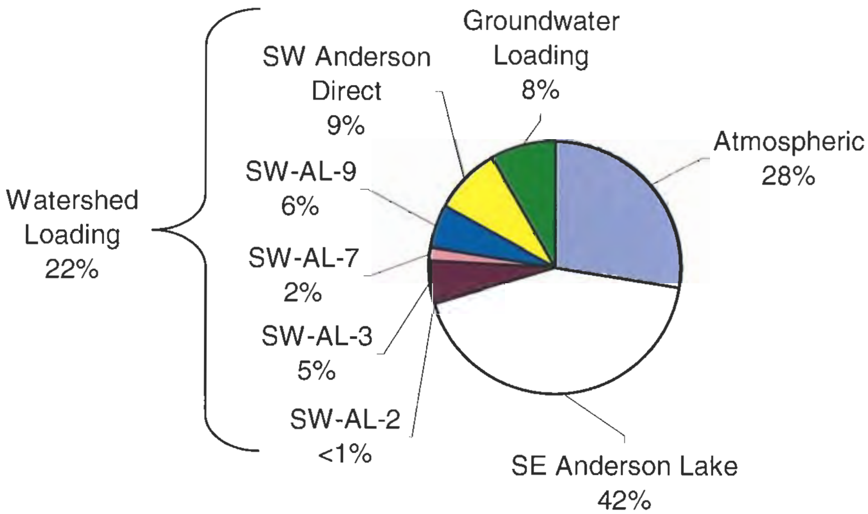
For existing land use conditions on the Southwest Anderson Lake watershed, modeling simulations indicate a total phosphorus load from the watershed during 2001 of 103 lbs, and a watershed stormwater runoff volume of 208 acre-feet. The water and phosphorus loads are equivalent to 7.1 inches and 0.29 lb/acre, respectively (assuming a immediate terrestrial area of 354 acres). Watershed analysis suggests that under existing conditions, the largest external loading source, 21 and 42 percent of the annual phosphorus and water budgets, respectively, to the lake appears to be from upstream Southeast Anderson Lake (see Figure EX-7). Atmospheric deposition directly on the lake surface and runoff from the lake's direct watershed contribute 10 and 17 percent of the lake's annual phosphorus budget. In addition to watershed and atmospheric loadings, model simulations indicate groundwater contributes roughly 8 percent of the lakes annual water budget. The internal release of phosphorus from the die-back of curlyleaf pondweed, a non-native aquatic plant, and bottom sediment contributed 33 percent of the annual phosphorus load in 2001.

Northwest Anderson Lake

Northwest Anderson Lake's watershed in located primarily in Eden Prairie with the eastern portion in the City of Bloomington. The watershed is located just south of where I-494 and US Highway 169 bisects the eastern portion of the watershed. Not counting the land area that drains to Northwest Anderson Lake indirectly, after the water passes through Southeast and Southwest Anderson Lakes; the watershed of Northwest Anderson Lake (its "immediate" watershed) is approximately 587 acres, including 179 acres for the lake surface area

Based on analysis of 2000 aerial photographs, Northwest Anderson Lake's immediate watershed is dominated by natural open space (see Figure EX-4). Thirty-three percent of the watershed is in a "natural" state, and vegetated with naturally-occurring or cultivated trees, shrubs, or grasses. Fifteen percent of the land is devoted to residential-use of various densities. Eleven percent is used for commercial uses. Future conversion of these natural areas to other highly impervious uses will place additional stress on Northwest Anderson Lake. Future land use is expected to vary from present use (see Figure EX-5). The three primary future land uses will be: Natural (26 percent); Residential (15 percent); and Commercial (18 percent).

Southwest Anderson Lake Annual Water Budget (978 ac-ft/yr)
Model Calibration Year (May 1, 2000 to April 30, 2001)
Using Existing Land Use



Southwest Anderson Lake Phosphorus Budget (288 lbs/yr)
Model Calibration Year (May 1, 2000 to April 30, 2001)
Using Existing Land Use

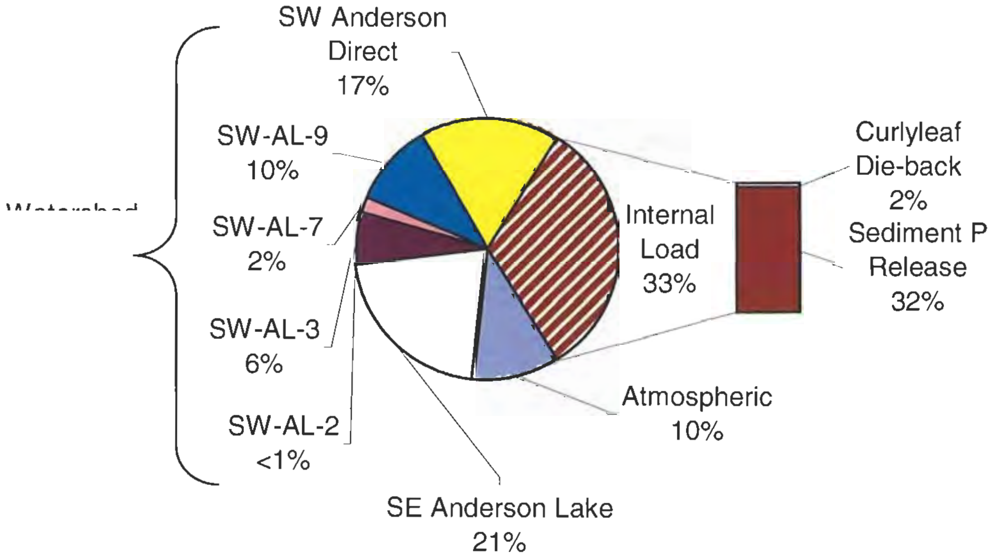
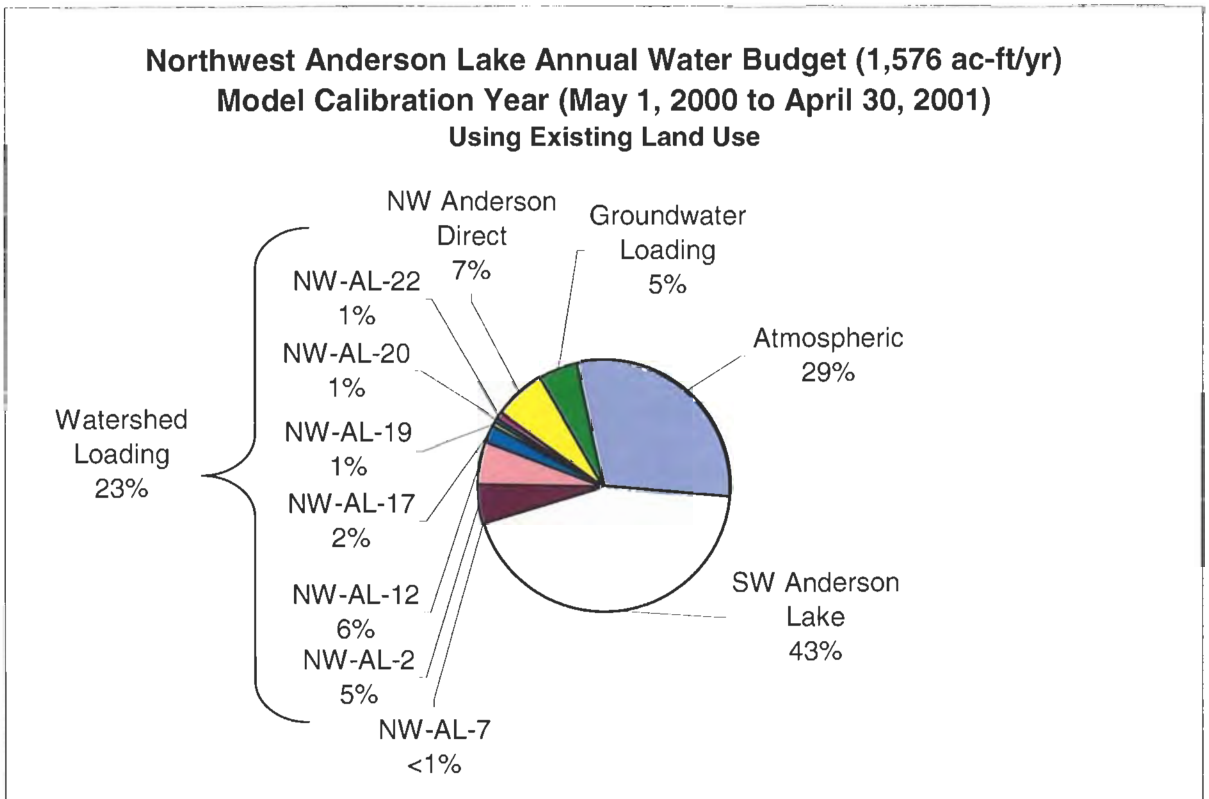


Figure EX-7
Southwest Anderson Lake Watershed
Phosphorus and Water Budgets

Computer simulations of runoff water quality, based on 2000-01 precipitation, indicate that the phosphorus yield from Northwest Anderson Lake's immediate watershed was about 0.37 lb/ac/year (157 pounds annually). The modeled water load from the lake's watershed during 2000-01 (338 acre-feet) is equivalent to 9.8 inches of runoff over the 415-acre watershed. Both the phosphorus and water areal yields are significantly higher than the other two Anderson Lakes because there is considerably more development with large areas of imperviousness in the Northwest Anderson Lake watershed. Northwest Anderson Lake's phosphorus budget for 2001 indicates approximately 22 percent of the lake's annual phosphorus load was from Southwest Anderson Lake (see Figure EX-8). Similar to Southwest Anderson Lake, the pumping from Bush Lake was the primary reason for the large loading from the upstream lake. Southwest Anderson Lake also contributes the largest portion of the annual water load 43 percent (see Figure EX-8). The fact that atmospheric deposition and direct precipitation comprise large percentages of the loading is the direct result of the lake's relatively large surface area in relation to the lake's immediate watershed size. Figure EX-8 also shows that 29 percent of the annual phosphorus and 23 percent of the annual water budget is associated with watershed runoff. In addition to watershed and atmospheric loadings, model simulations indicate groundwater contributes roughly 5 percent of the lakes annual water budget while internal phosphorus release contributes about 39 percent of the lakes annual phosphorus budget.



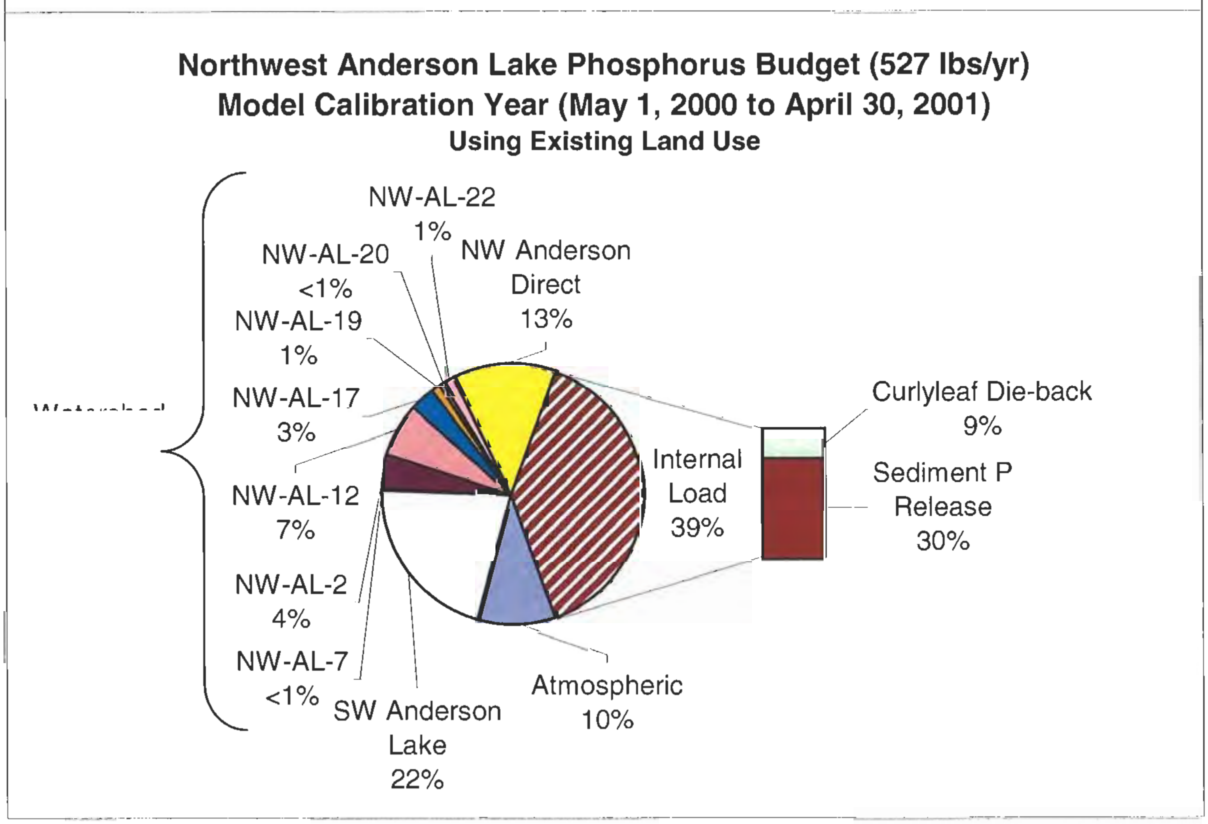


Figure EX-8
Northwest Anderson Lake Watershed
Phosphorus and Water Budgets

Aquatic Weeds

Macrophyte (i.e., lake weed) surveys were conducted during June and August 2000 and 2001. The current macrophyte communities in Southeast, Southwest, and Northwest Anderson Lake are diverse and healthy. However, a couple of non-native species (purple loosestrife and curlyleaf pondweed) were sampled during either the June or August surveys. Abundant growths of purple loosestrife (*Lythrum salicaria*), a non-native noxious emergent weed species which produces brilliant purple flowers and large quantities of persistent seeds, was identified sporadically spaced along the shorelines of Southeast and Northwest Anderson Lakes. It out-competes native plants, such as cattail, and can eventually replace the native species, thereby interfering with the wildlife use of the lake.

Curlyleaf pondweed (*Potamogeton crispus*) is a non-native submerged aquatic species. Light-to-heavy-density growths were observed in the Southeast and Northwest Anderson Lakes during the June 2001 survey. The June 2000 survey also identified curlyleaf pondweed in various densities in all three Anderson Lakes. By the August surveys the curlyleaf pondweed had undergone its natural mid-season die-off. This mid-season die-back contributes (through plant matter decay) to the lake's summer surface water total phosphorus concentration and, therefore, supplies nutrients for algal growth. Curlyleaf pondweed can also replace native submerged macrophyte species and interfere with recreational use of the lake.

Ecosystem and Fisheries

The most recent fisheries reports for Southeast, Southwest, and Northwest Anderson Lake, conducted in 1993, 1962, and 1962, respectively, indicates a low abundance of planktivorous fish species (sunfish, etc.). The reports also suggest the lakes may be subject to winterkills. Since there is no public access on any of the lakes the MDNR will not stock fish in the lakes.

Recently collected phytoplankton and zooplankton data (2000 and 2001) suggest the communities are healthy and in balance with each other. Continued balance of the lake's ecosystem may be enhanced under ultimate watershed land use conditions by reducing phosphorus loads to the lake.

Recommended Lake and Watershed Management Practices

Aquatic Weed Management

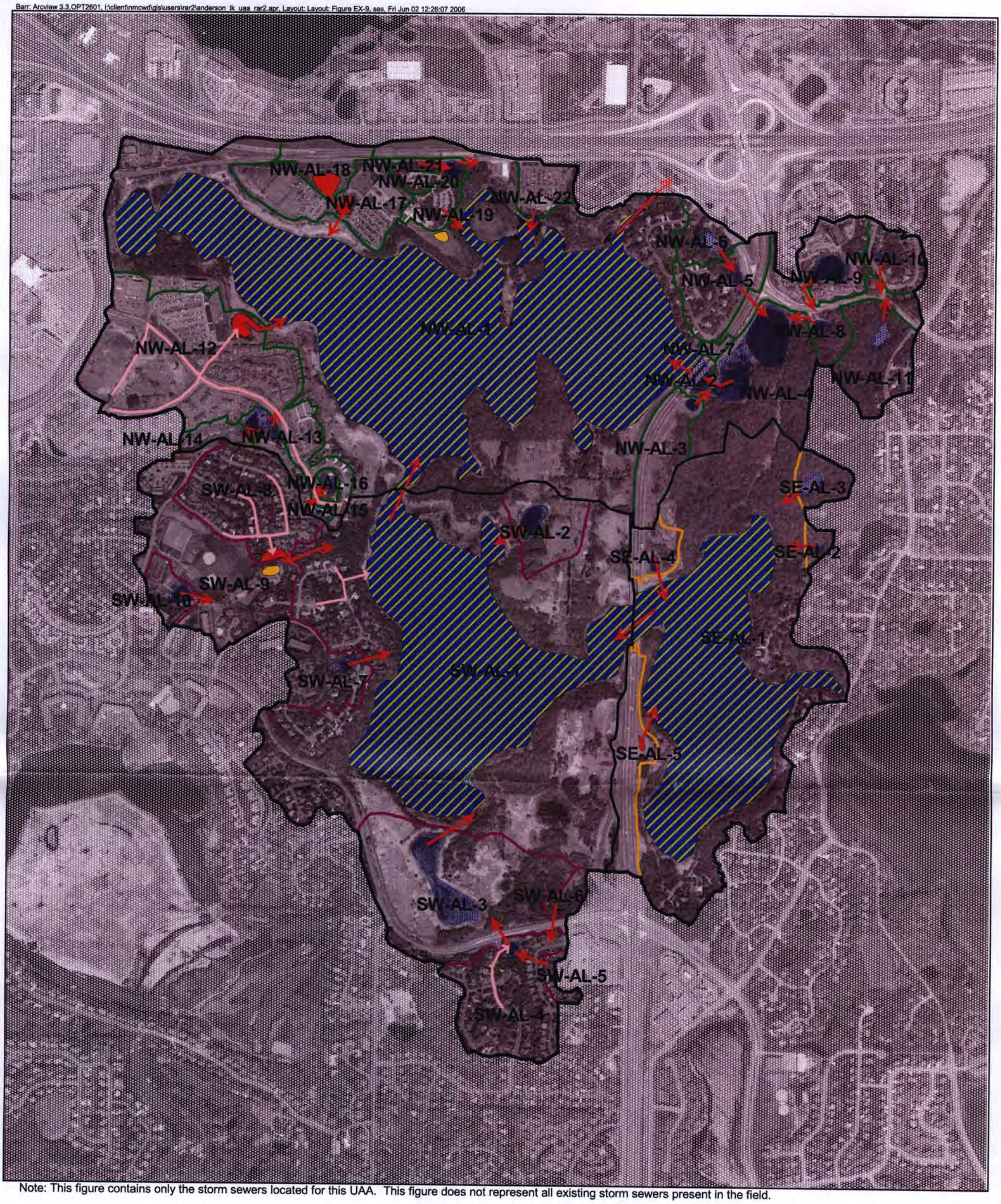
Macrophyte surveys should continue on these lakes to monitor the growths of undesirable non-native species. If purple loosestrife (Lythrum salicaria) starts dominating the emergent macrophyte community, some mitigation measures, such as chemical or biological treatment, may be needed. Chemical treatment of the curlyleaf pondweed (*Potamogeton crispus*) is needed to reduce the internal phosphorus load when it dies back in mid to late-June. The resultant decline in native species would reduce the available habitat for wildlife, invertebrates and other food organisms for small fish. A typical macrophyte survey costs approximately $2,000 per lake.

Watershed Management

Model simulations indicated that upgrading existing ponds to NURP criteria and adding two additional water quality ponds (see Figure EX-9) will not achieve the NMCWD's goals during the various climatic conditions examined for this UAA (see Figures EX-10, EX-11a & b, and EX-12a & b). Therefore, no watershed BMPs are recommended as part of this UAA. However, the NMCWD should still require developers to provide appropriately-sized (in accordance with existing NURP-criteria) detention ponds for urbanizing subwatersheds, and that the ponds are sized appropriately for the ultimate land-use conditions.

Comparing Figures EX-11a with EX-11b and EX-12a with EX-12b the impacts of lowering the NWL of Southwest and Northwest Anderson Lakes can be assessed. This comparison indicates that the lake water quality will generally be worse under the lower NWL scenarios. However, only the dry climatic conditions will likely result in TSI_{SD} values that fails to achieve the District's goals.

Barr: Arcview 3.3,OPT2601, I:\client\nmcwd\gis\users\rar2\anderson_lk_uaa_rar2.apr, Layout: Layout: Figure EX-9, sas, Fri Jun 02 12:26:07 2006



Note: This figure contains only the storm sewers located for this UAA. This figure does not represent all existing storm sewers present in the field.

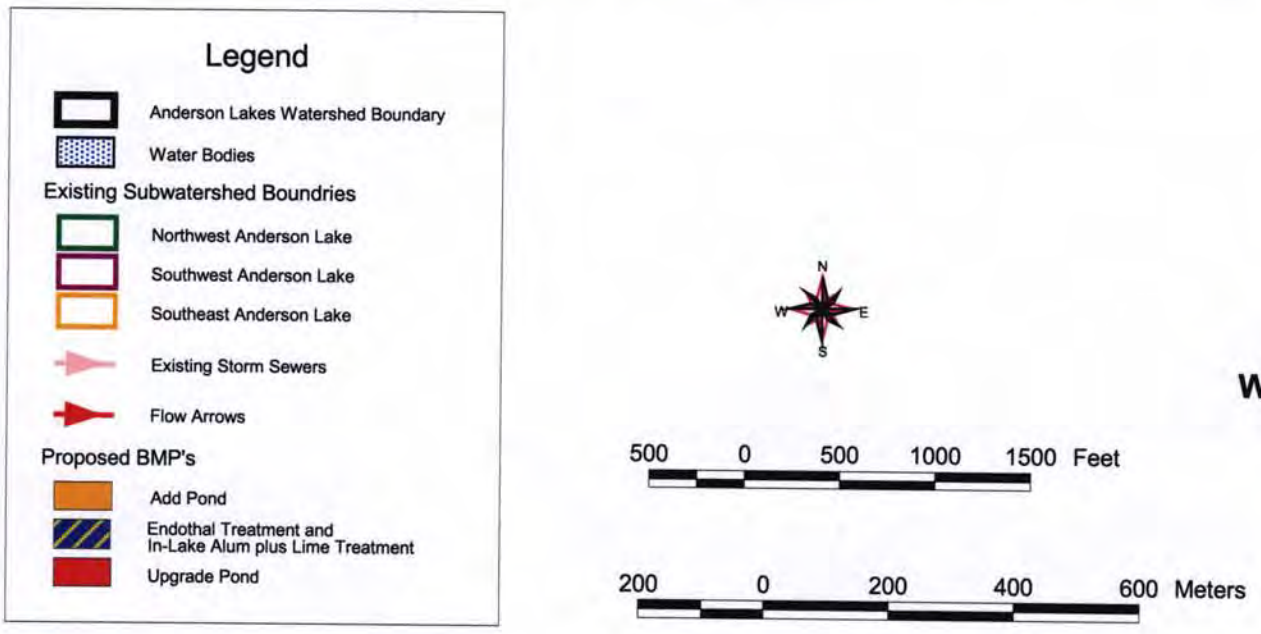
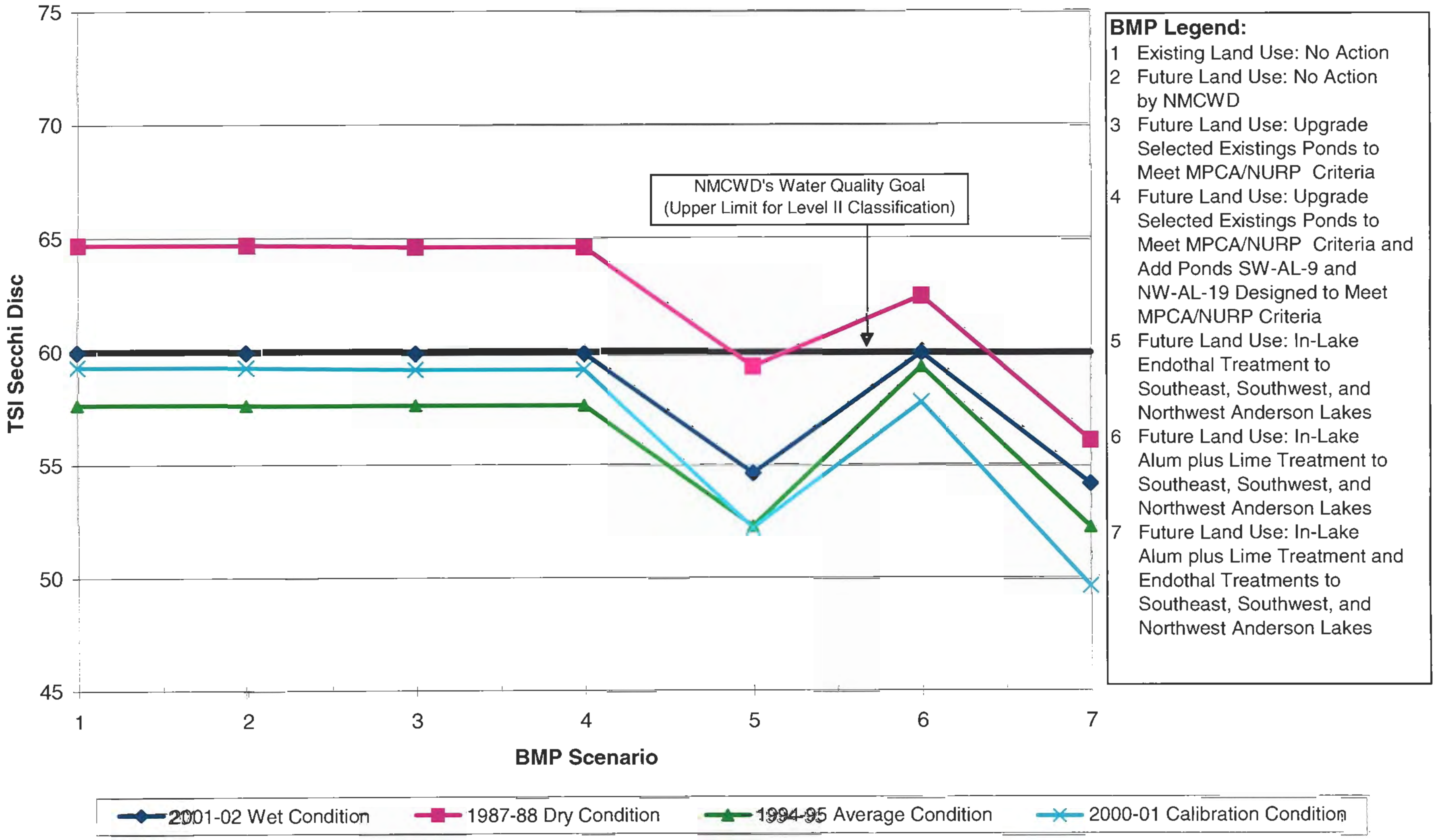


Figure EX-9

Anderson Lakes UAA
Watersheds and Existing Storm Sewers
Nine Mile Creek Watershed District

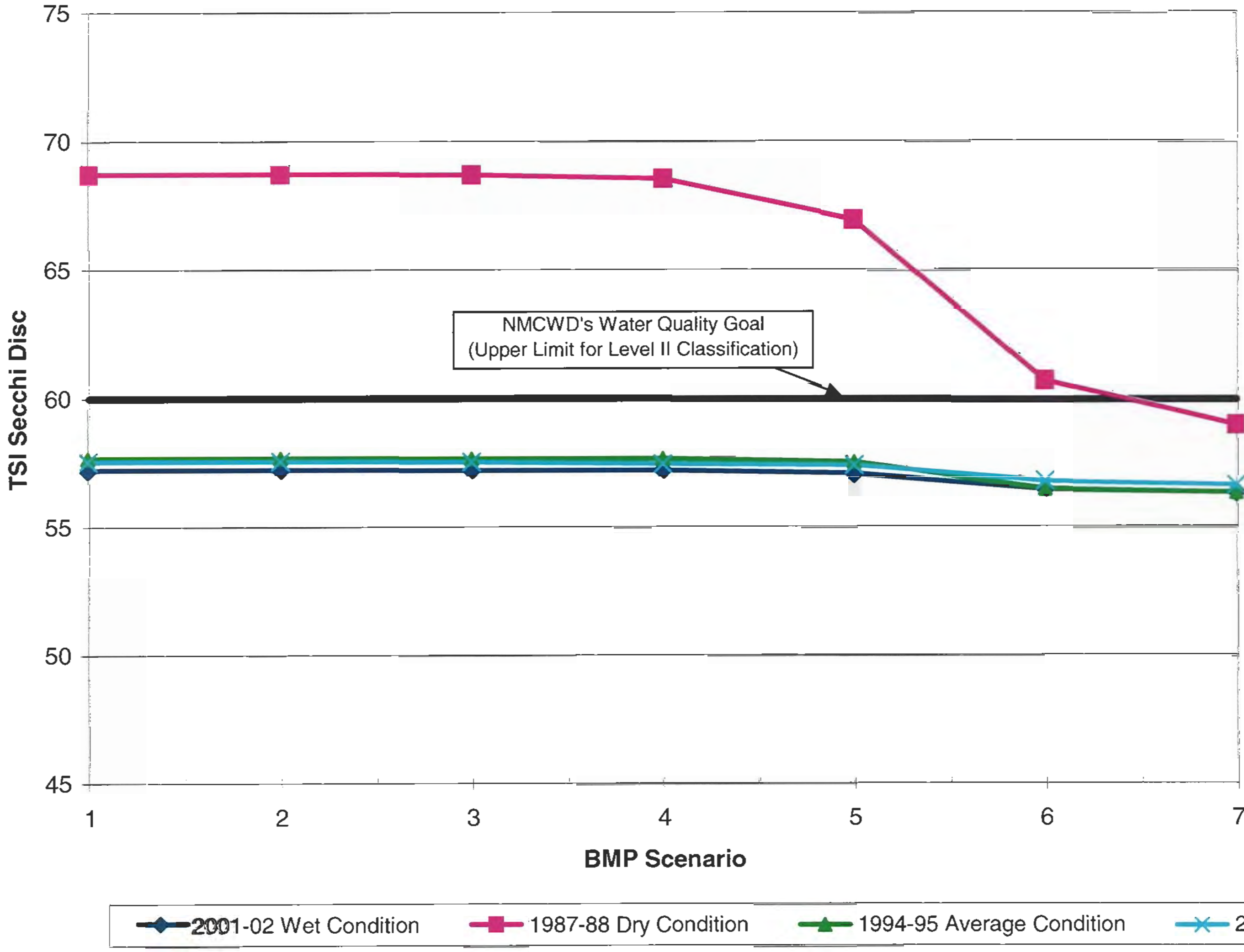
Figure EX-10
Southeast Anderson Lake: Estimated TSI_{SD} Following BMP Implementation with the Normal Water Level at Elevation 839.0



P:\23\27\003\UAA\SAS\Anderson Lakes\InLakeModel\Ult_BMPAssess\Updated\InLakeSummary.xls

6/2/2006
12:18 PM

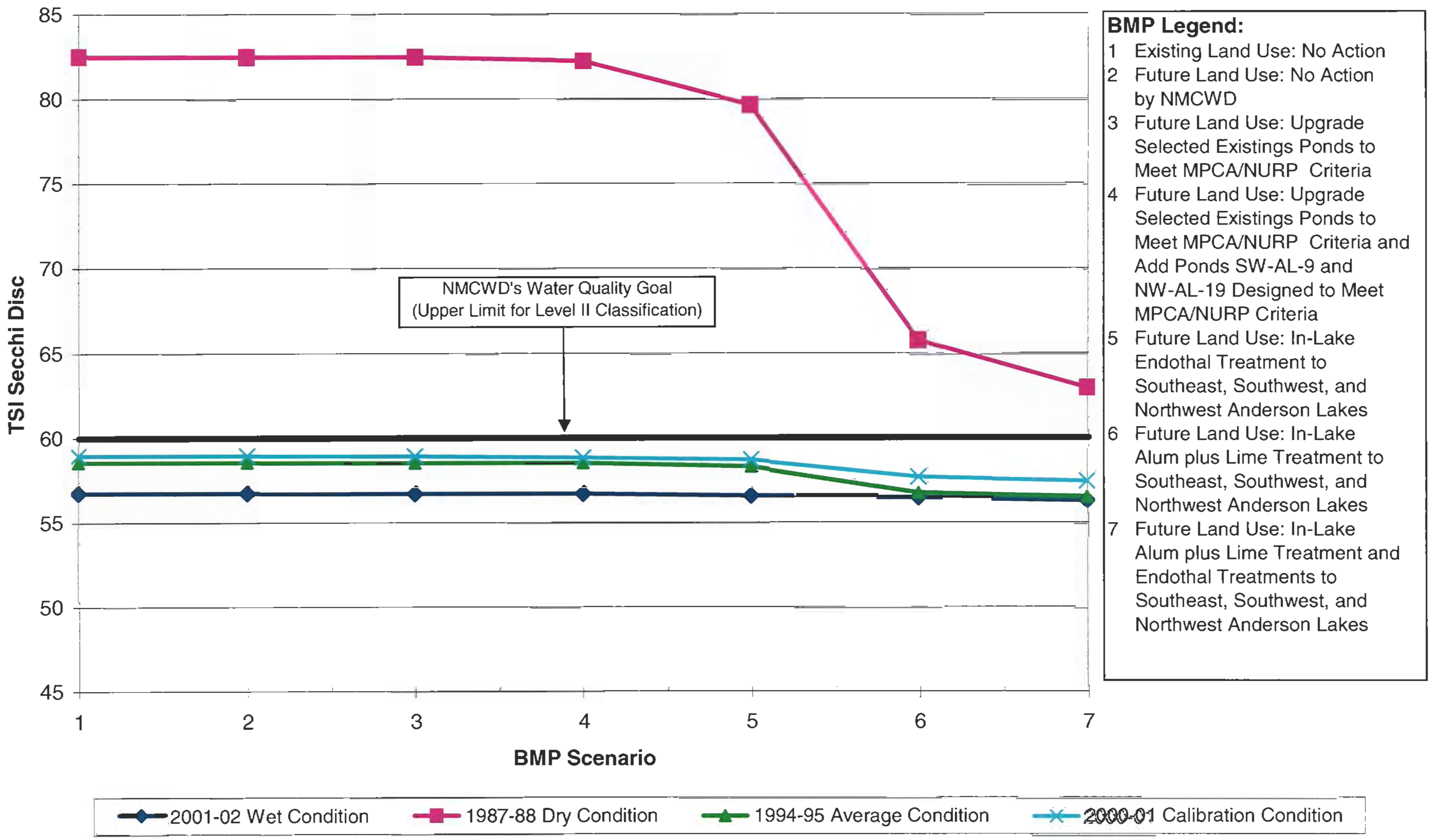
Figure EX-11a
Southwest Anderson Lake: Estimated TSI_{SD} Following BMP Implementation with the Normal Water Level at Elevation 839.0



BMP Legend:

1. Existing Land Use: No Action
2. Future Land Use: No Action by NMCWD
3. Future Land Use: Upgrade Selected Existings Ponds to Meet MPCA/NURP Criteria
4. Future Land Use: Upgrade Selected Existings Ponds to Meet MPCA/NURP Criteria and Add Ponds SW-AL-9 and NW-AL-19 Designed to Meet MPCA/NURP Criteria
5. Future Land Use: In-Lake Endothal Treatment to Southeast, Southwest, and Northwest Anderson Lakes
6. Future Land Use: In-Lake Alum plus Lime Treatment to Southeast, Southwest, and Northwest Anderson Lakes
7. Future Land Use: In-Lake Alum plus Lime Treatment and Endothal Treatments to Southeast, Southwest, and Northwest Anderson Lakes

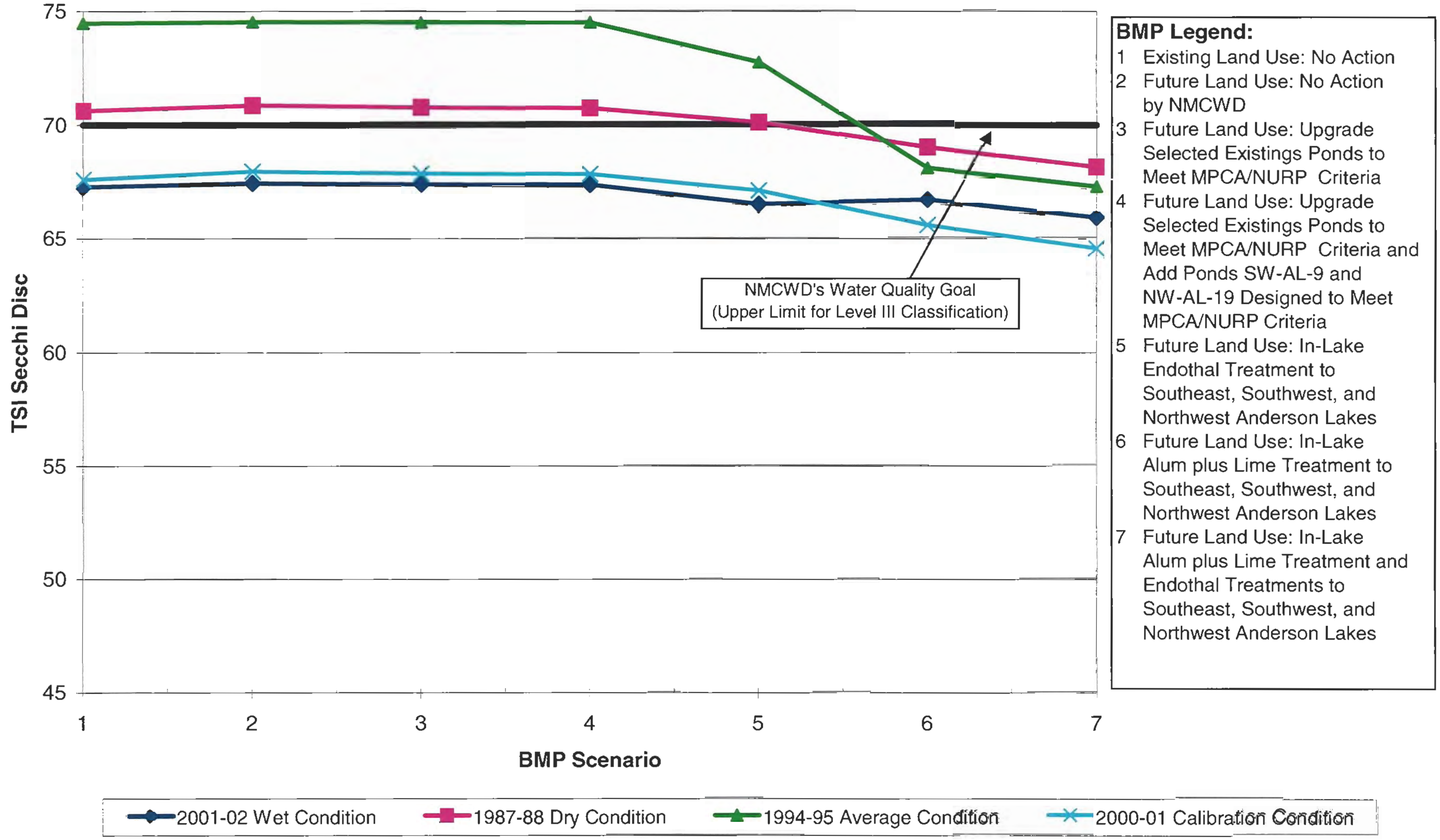
Figure EX-11b
Southwest Anderson Lake: Estimated TSI_{SD} Following BMP Implementation with the Normal Water Level at Elevation 837.5



P:\23\27\003\UAA\SAS\Anderson Lakes\InLakeModel\Ult_BMPAssess_NWL837-5\Updated\InLakeSummary_837-5.xls

6/2/2006
12:19 PM

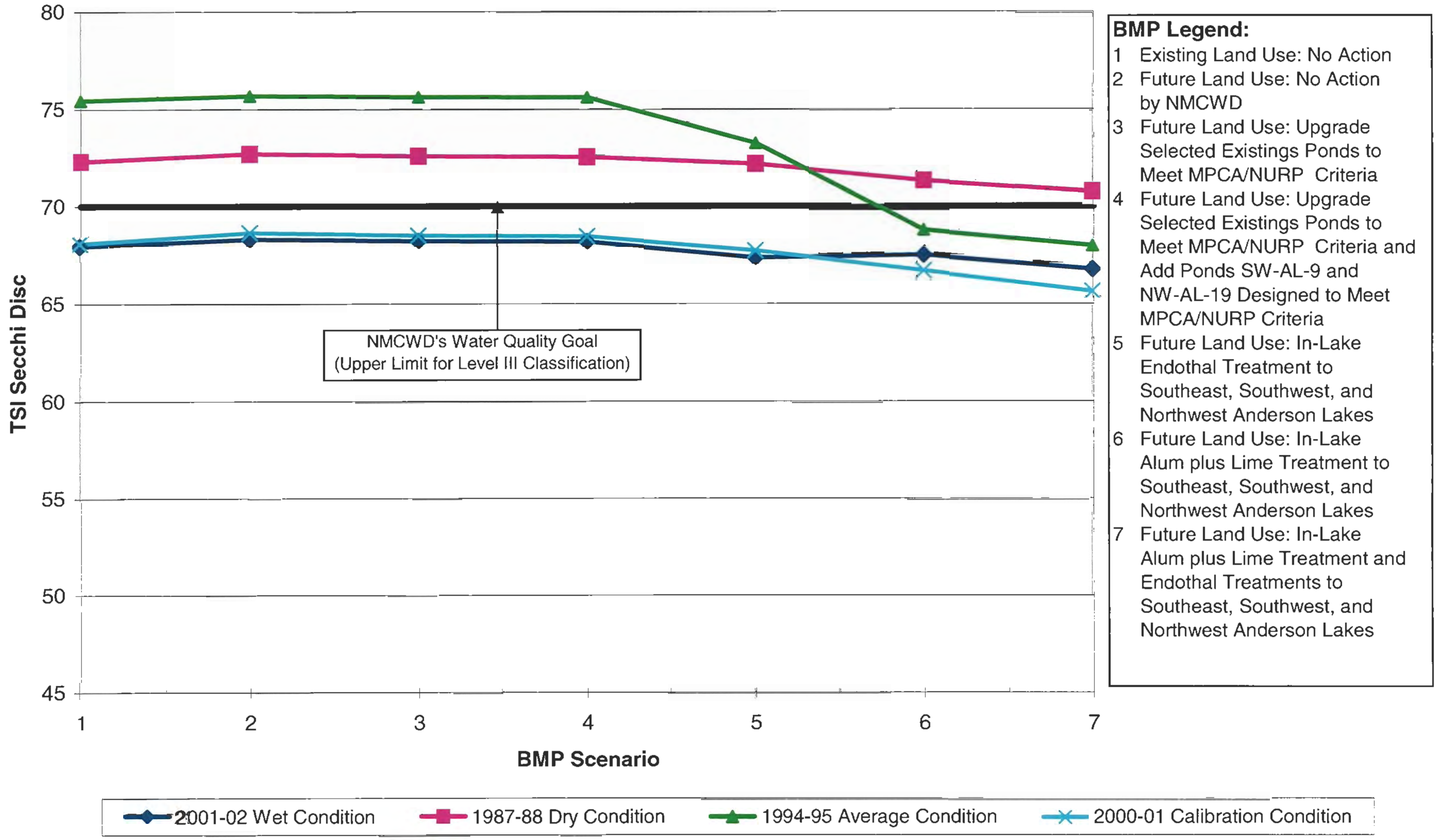
Figure EX-12a
Northwest Anderson Lake: Estimated TSI_{SD} Following BMP Implementation with the Normal Water Level at Elevation 839.0



P:\23\27\003\UAA\SAS\Anderson Lakes\InLakeModel\Ult_BMPAssess\Updated\InLakeSummary.xls

6/2/2006
12:18 PM

Figure EX-12b
Northwest Anderson Lake: Estimated TSI_{SD} Following BMP Implementation with the Normal Water Level at Elevation 837.5



P:\23\27\003\UAA\SAS\Anderson Lakes\InLakeModel\Ult_BMPAssess_NWL837-5\Updated\InLakeSummary_837-5.xls

6/2/2006
12:19 PM

In-Lake Management

Water quality simulations using the P8 model indicated dry climatic conditions produce the greatest strain upon water quality in Southeast, Southwest, and Northwest Anderson Lake. The increased internal phosphorus release from sediment, during relatively dry years, delivers a large phosphorus load to the lake. As previously stated, the internal release of phosphorus from curlyleaf pondweed die-back and lake sediments accounted for 33 to 42 percent of the lakes' annual loads. Curlyleaf pondweed was estimated to contribute 29, 5, and 9 percent of the annual phosphorus loads to Southeast, Southwest and Northwest Anderson Lakes during 2001.

The first step in the restoration of the Anderson Lakes is the management of curlyleaf pondweed. This should involve not just the management of curlyleaf pondweed such that the phosphorus inputs are reduced, but rather to remove it from the Anderson Lakes such that native plants can replace curlyleaf pondweed. Removal of curlyleaf pondweed should have the added benefit of preserving native pondweed species adversely affected by algal blooms that follow curlyleaf pondweed die-off. Research has shown that the appropriate herbicide for curlyleaf pondweed control is endothal, and that this herbicide should be applied in the spring (when water is approximately 55-60°F) and at a dose of 1 mg/L (Poovey et al. 2002). Preliminary results from studies in Eagan, MN by John Skogerboe of the US Army Corps of Engineers have shown that four subsequent years of endothal treatment have essentially eliminated curlyleaf pondweed from two of the study lakes and that after the 4th year of treatment no viable turions (pondweed seeds) remained in the sediment. To remove curlyleaf pondweed, treatment will need to continue until no viable turions remain after treatment is completed. Treatment is expected to continue for 4 years. Sediment treatment should not be performed until curlyleaf pondweed is completely controlled. Sediment treatment prior to curlyleaf pondweed control could possibly increase the light availability to this plant and stimulate curlyleaf pondweed growth.

In-lake application of alum plus lime (aluminum sulfate) to prevent sediment phosphorus release in the main lake basin during the summer and fall months is another BMP scenario analyzed. Following an alum plus lime treatment of all three Anderson Lakes, modeling simulations indicate the internal summer phosphorus load would be reduced by about 80 percent. This reduction in sediment phosphorus release would significantly reduce the total loadings to the three lakes, up to 14, 70, and 125 pounds for Southeast, Southwest, and Northwest Anderson Lakes, respectively.

The 20-year management plan and associated costs are illustrated on Figure EX-13. Below is the expected sequence of the lake management activities for the first 5 years.

- **Year 1 (2006)** Herbicide (endothal) treatment begins in the spring and summer water quality and macrophyte monitoring.
- **Year 2 (2007)** Endothal treatment and summer water quality and macrophyte monitoring.
- **Year 3 (2008)** Endothal treatment and summer water quality and macrophyte monitoring.
- **Year 4 (2009)** Final endothal treatment and summer water quality and macrophyte monitoring.
- **Year 5 (2010)** Alum plus lime treatment in the fall and summer water quality and macrophyte monitoring.

This BMP alternative is estimated to result in predicted TSI_{SD} in Southeast, Southwest, and Northwest Anderson Lakes of 56, 59, and 68, respectively for dry climatic conditions (the climatic condition estimated to produce the poorest water quality) with a NWL of 839.0, thus achieving the NMCWD's goals (see Table EX 1a).

Table EX-1a Benefits and Costs of Goal Achievement Alternative (Curlyleaf Pondweed Control and In-Lake Alum plus Lime Treatments) for Southeast, Southwest, and Northwest Anderson Lakes with the NWL of 839.0

Lake	Lake NWL	Trophic State Index (TSI_{SD}) Value				
		NMCWD Goal	Wet Year (1982-83)	Model Calibration Year (2000-01)	Average Year (1994-95)	Dry Year (1987-88)*
Southeast Anderson Lake	839.0	$50 < TSI_{SD} \leq 60$	50	48	49	52
Southwest Anderson Lake	839.0	$50 < TSI_{SD} \leq 60$	58	58	58	59
Northwest Anderson Lake	839.0	$60 < TSI_{SD} \leq 70$	64	64	64	65

* The May 1, 1987 through April 30, 1988 precipitation total excludes the 10-inch 1987 superstorm because of the events rarity.

Water quality modeling indicates that if the NWL of Southwest and Northwest Anderson Lakes is lowered to Elevation 837.5 the summer average TSI_{SD} values for dry climatic conditions would fail to achieve the District's goals (see Table EX-1b). However the District's TSI_{SD} goal would be achieved during the other climatic conditions analyzed.

Table EX-1b Benefits and Costs of Goal Achievement Alternative (Curlyleaf Pondweed Control and In-Lake Alum plus Lime Treatments) for Southeast, Southwest, and Northwest Anderson Lakes with the NWL of 837.5

Lake	Lake NWL	Trophic State Index (TSI_{SD}) Value				
		NMCWD Goal	Wet Year (1982-83)	Model Calibration Year (2000-01)	Average Year (1994-95)	Dry Year (1987-88)*
Southeast Anderson Lake	839.0	$50 < TSI_{SD} \leq 60$	50	48	49	52
Southwest Anderson Lake	837.5	$50 < TSI_{SD} \leq 60$	56	58	57	63
Northwest Anderson Lake	837.5	$60 < TSI_{SD} \leq 70$	67	66	68	71

* The May 1, 1987 through April 30, 1988 precipitation total excludes the 10-inch 1987 superstorm because of the events rarity.

The recommended implementation plan is BMP Scenario 7: herbicide (endothal) treatment and alum plus lime treatment. This BMP alternative is estimated to cost $3,102,000 or an annualized cost of $270,400 per year over a 20 year period. Below is the expected sequence of the lake management activities for the first 5 years. This implementation plan has been selected because the overall productivity of all three Anderson Lakes needs to be significantly reduced to restore the lake to a more ecologically balanced condition. This means that both significant internal phosphorus sources, the aquatic plant curlyleaf pondweed and phosphorus release from sediments, need to be controlled.

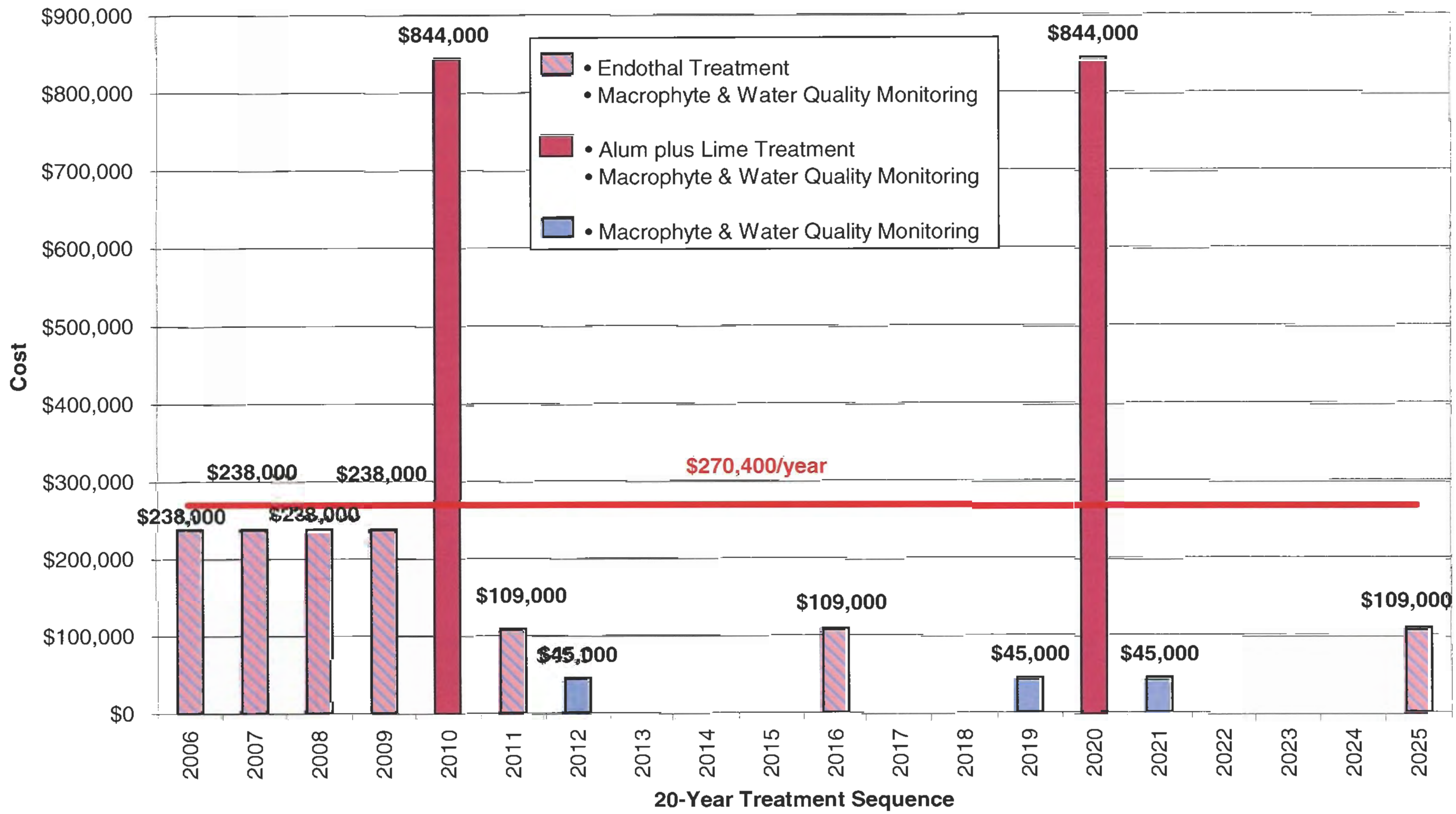
This plan will require monitoring during the various stages of the restoration effort to evaluate effectiveness and determine whether the prescribed components and sequence of management efforts remains appropriate. Aquatic plants and lake water quality should be monitored during the 5 years of treatment and for 3 years following treatment. Water quality monitoring should include total phosphorus, chlorophyll *a*, and Secchi disc monitoring from May through September each year. Sediment monitoring should occur 1 year before and for 3 years after alum plus lime treatment. Sediment monitoring should include an evaluation of the location of the treatment layer and collection of mobile phosphorus samples.

Coordination with the City of Eden Prairie and Three Rivers Park District

Southwest and Northwest Anderson Lakes lie predominately within the borders of the City of Eden Prairie and Three Rivers Park District. The City and Park District also plan to pursue a draw down of the lake such that the normal water level will be maintained at Elevation 837.5. The management alternatives discussed in this study have been developed with consideration of the Three Rivers Park District's 1999 Water Quality Management Plan and the intended efforts by the City of Eden Prairie and the Park District to improve the water quality and wildlife habitat of the Anderson Lakes.

Management recommendations provided in this report include additional efforts beyond those discussed with the City and Parks District. We have designed the management alternatives recommended in this study so that there will be time to evaluate the effectiveness of management efforts such as herbicide treatment and discuss the appropriate timing for additional management efforts such as an alum plus lime treatment.

Figure EX-13
Anderson Lakes
20-Year Treatment Sequence and Estimated Project Costs



Appendix D

Birch Island Lake Water Level Investigation Report

Appendix D: Following is the Birch Island Lake Water Level Investigation Report

Birch Island Lake Water Level Investigation

Prepared for
Nine Mile Creek Watershed District

July 2005

Birch Island Lake Water Level Investigation

Prepared for
Nine Mile Creek Watershed District

July 2005

BARR

4700 West 77th Street
Minneapolis, MN 55435
Phone: (952) 832-2600
Fax: (952) 832-2601

Birch Island Lake
Water Level Investigation

Table of Contents

1.0 Problem Description 1

2.0 Study of 1992 2

- 2.1 Lake Level Comparison 2
- 2.2 Water Balance 2
- 2.3 Highway 62 Construction 3
- 2.4 Sand Point Installation 3
- 2.5 Piezometer Installation 4
- 2.6 Installation of Data Level Recorders 5

3.0 Conclusions 6

- 3.1 Construction Options 6
  - Pipe Bypass System 6
  - Flow Path Seal 7

List of Figures

Figure 1 Location Map

Figure 2 Fill Area

Figure 3 Selected Water Surface Elevations

Figure 4 One-Minute Water Levels

1.0 Problem Description

Birch Island Lake is located in the northeast corner of the City of Eden Prairie. The lake location is shown on Figure 1. A decline in the lake level began in approximately 1987, and it has remained low up to the present time. Several adjacent lakes also experienced a decline and all were studied by the Nine Mile Creek Watershed District in the report Glen Lake, Shady Oak Lake, and Birch Island Lake water level investigation, December 1992. The report concluded the lake level declines were directly related to a lack of precipitation occurring in the preceding years.

Birch Island Lake was an exception as the lake levels did not match the expected water levels based on climatic conditions. The decline was larger than what the water balance analysis concluded.

Since 1992, the water levels of Shady Oak Lake, Glen Lake and Lone Lake have returned to more normal conditions. The water level of Birch Island Lake, however, has not returned to the pre-1987 levels. Since 1992, the Nine Mile Creek Watershed District has been collecting additional water level data on several ponds and wells in the area of Birch Island Lake to supplement the data collected and summarized in the 1996 report.

2.0 Study of 1992

The following is a summary of the 1992 report, Glen Lake, Shady Oak Lake, and Birch Island Lake water level investigation, December 1992.

The elevations of Glen Lake, Shady Oak Lake and Birch Island Lake have experienced a decline in recent years, which has diminished the value of these water resources. This report summarizes this investigation and its conclusions. The lakes have several similarities, which can result in significant fluctuations in water levels. Two most significant similarities are the small watershed drainage area in relation to the surface area of the lake, and the lack of low-level outlets establishing a normal elevation for the lake. Lakes of this type are referred to as landlocked. The analysis to determine the hydrologic system for lakes with these characteristics is referred to as a water balance. A water balance will show the relationship between precipitation, surface water runoff, overflow, groundwater flow, evaporation, and transpiration for each lake. This type of analysis will determine if the elevations are a result of climatic conditions or changes in the hydrologic system of the lake.

Several approaches were pursued in the investigation of water levels of the study lakes. These included: comparison of the lake levels with each other, comparison with other lakes within the general area, the computation of a water balance for each lake, and the potential impacts and urbanization and construction at two activities would have on the Birch Island Lake water levels.

2.1 Lake Level Comparison

The comparison of the water levels of the study lakes with other nearby lakes was intended to determine if the lakes were behaving in a similar manner. The lakes previously listed were used, as well as Lone Lake. Lone Lake, a landlocked lake; was used for additional comparison. The lakes should be expected to respond in a similar matter based on the characteristics of the watersheds. A review of the lake levels indicates that the lakes exhibit similar behavior for the available lake level record. The significant exception is the excessive drop of Birch Island Lake levels in the late-1980s.

2.2 Water Balance

In an attempt to determine changes in the hydrologic systems of the study lakes, a computer model was created to predict lake levels based on the weather records from 1965 to 1992. This model computes long-term watershed yield based on hydrologic watershed factors.

The results of the water balance for Glen Lake and Shady Oak Lake show the computed levels correlate with the measured levels well for the period of record. This indicates that the hydrology has not been significantly altered.

The results of the water balance for Birch Island Lake, however, are different. The computed and recorded levels compared fairly well until the late-1980s. At that time, the lake levels dropped significantly below predicted levels and have remained well below the predicted levels. This is an indication that changes have occurred in the watershed altering the hydrologic system of the lake.

2.3 Highway 62 Construction

In 1985, Hennepin County began placing fill in the wetland north of Birch Island Lake for the proposed T.H. 62 roadway alignment. Because of poor foundation material in the area, granular fill was placed along the proposed roadway alignment to surcharge the existing organic material. Surcharging compacts the organics and provides a stable subbase for the roadway. The construction information indicates that approximately 35 feet of granular surcharge was placed in this area. Soils information obtained from the County indicates the existing organic material is underlain by a sand layer. It is possible that with the placement of the granular material over the organic material, a connection was made with this sand layer. This connection could prevent, intercept, both surface and groundwater from reaching Birch Island Lake.

The current level of Birch Island Lake ranges from 6 to 8 feet below the levels computed using the water balance model. It was speculated that the construction of T.H. 62 had the potential to be the cause of the lowering of the lake level; however, additional investigation was performed to better define the groundwater conditions within the area.

2.4 Sand Point Installation

In order to determine groundwater characteristics along the T.H. 62 roadway embankment, four sand point wells were installed along the shoulder of the roadway. The location of these wells is shown on Figure 2. These wells have been monitored on a monthly basis from 1994 to the present. In addition to these wells, the ponding basins both upstream and downstream were also surveyed. The location of the ponding basins are also shown on Figure 2.

On two occasions, September 1996 and January 1999, the water levels in the roadway embankment, as represented by the sand points, were lower than the elevation of the South Pond. This indicates a groundwater flow through the roadway embankment flowing easterly to a sand lens, rather than toward South Pond prior to the roadway construction.

The data collected indicates that the North Pond and the piezometers generally correspond with each other. The levels of Birch Island Lake and the South Pond, however, do not seem to correspond with the piezometers. This indicates that the hydraulic connection between the piezometers and the South Pond is not strong, supporting the assumption that groundwater flow has been diverted likely easterly to an existing underlying sand lens.

2.5 Piezometer Installation

In August 2003, two additional piezometers were installed on the south side of T.H. 62 and on the eastern side of the wetland (referred to as B1 and B2). These piezometers were installed within 10 feet of each other, laterally. The upper piezometer (B1) has been installed to a depth of 13.5 feet. The well is screened in a saturated sand lense within peat deposits, that is connected to the existing roadway embankment. The lower piezometer (B2) is 15 feet deeper and is in a more extensive glacial outwash deposit on the east side of the wetland that trends north-south. Data has been collected from these piezometers on a monthly basis since they were installed.

In addition to the new piezometers, elevation data has been collected at the four shallow sand point piezometers installed in the roadway embankment in 1994, the ponds north and south of the road, and Birch Island Lake. Figure 3 shows selected data for the period of record of the piezometer.

A review of the water level data trends indicates three different groupings:

- Birch Island Lake and the South Pond, which have fairly steadily declined throughout the monitoring period.
- The new piezometers and three of the sand point piezometers (NE, NW and SW) which declined through March 2004 and thereafter rose.
- Sand point piezometer SE, which has gone up and down irregularly.

The water level in the lower piezometer (B2) closely parallels the water levels in the shallow sand points, the new shallow piezometer (B1),and the North Pond based on the monthly readings. The water levels in the lower piezometer (B2) are approximately 2 feet lower. This appears to indicate that the lower aquifer is connected with the aquifer within the roadway embankment.

The water levels in the South Pond and Birch Island Lake do not change in concert with the sand points in the embankment and the new piezometers installed in the natural sand lens and glacial outwash deposit on the eastern end of the roadway embankment. This indicates that the hydrologic factors affecting these ponds are not directly connected with the factors affecting the piezometers. Similarly, the SE sand point appears to be in an isolated system, which rises and falls dramatically during rainfall events.

2.6 Installation of Data Level Recorders

The data to date is based on monthly measurements, and shows only broad seasonal changes (dry fall in 2003, winter, and spring 2004 recharge). More detailed data may document the effects related to specific precipitation events. Such detail may provide more proof of the hydrologic groupings identified above.

The data recording devices were installed within the piezometers (B1 and B2) on June 24, 2004 and removed on August 16, 2004. These data recorders were installed to record water levels in each well at one-minute intervals. Plotting the water level in each of the piezometers shows that the aquifers are directly connected. The water level in the lower aquifer responds at the same time as the upper aquifer, but with a slightly smaller magnitude. The Nile Creek Watershed District maintained a rainfall gauge at the Mn/DOT maintenance facility in Eden Prairie. The data from this rainfall gauge was plotted for four rainfall events that occurred during the period of June 24, 2004 through August 16, 2004. Figure 4 shows the relationship between the rainfall and the piezometer elevations and that both piezometers (B1 and B2) react without delay to the rainfall.

A graph (Figure 3) of the water surface elevations in the North Pond the South Pond and the new piezometers (B1 and B2) shows the elevations of the South Pond and Birch Island Lake do not react to the rainfall events as the piezometers do. This indicates that the hydraulic connection between Birch Island Lake and the drainage area upstream of the roadway embankment is no longer functioning. The watershed area north of T.H. 62 is no longer contributing surface and groundwater to Birch Island Lake.

3.0 Conclusions

The results of the data collected indicate that the roadway embankment is directly connected to the lower aquifer and is providing a bypass conduit for the watershed runoff thus preventing it from reaching Birch Island Lake. This has resulted in the low lake levels since the construction of the roadway embankment.

3.1 Construction Options

During the conceptual design of the potential solutions, the location of the primary discharge point into the south pond was found to enter approximately 600 feet to the west. The overall conclusions of the report are still valid. The fill placed for the roadway embankment connected the ponds in the area to the lower aquifer.

There are two options considered to correct the problem. The first is to bypass the road embankment with both surface and groundwater flow, and the second is to seal the flow path that is removing the water from the watershed.

Pipe Bypass System

The first option is to bypass the roadway embankment with both surface and groundwater flow. This would require a pipe, (cross culvert), 12-inch, be installed through the roadway embankment from the North Pond with an upstream invert elevation lower than the existing pipe. This new pipe would extend past the wetland and directly outlet to Birch Island Lake. The bypass would be installed by directional drilling through the roadway embankment and wetland.

To provide a more efficient means to intercept flow, a drain tile system paralleling the roadway embankment to intercept groundwater flow is recommended. The cost of this option is estimated to be $225,000.

This option has the advantage of being straightforward. There is no attempt to pinpoint the exact location where the surface water is leaving the wetland/roadbed. The expectation of success is high.

Flow Path Seal

This second option is to block the current flow path of both surface and groundwater and restore the drainage to its original direction, this would be accomplished by either constructing a sheet pile cutoff paralleling the roadway embankment near the east end of the roadway fill section or sealing the permeable soils of the embankment with a silicate grout. The grout would be injected into the permeable roadway embankment. The cost of this option is estimated to be $230,000.

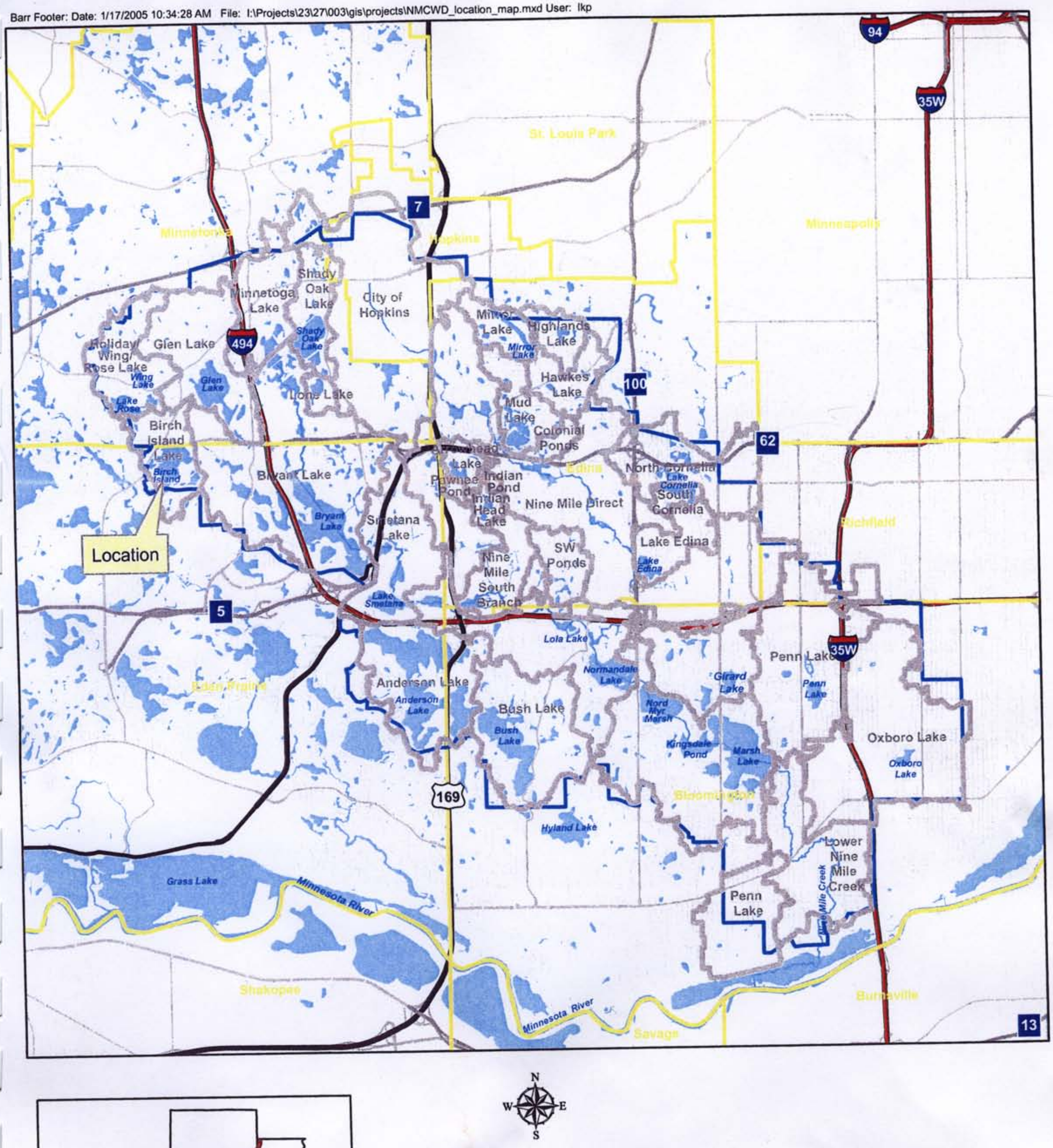
These options have the potential to be less effective than the pipe bypass system. The effectiveness of any geotechnical construction is more variable because the underground conditions can vary between borings.

Recommendation

It is recommended that the pipe/drain tile system be implemented to restore the level of Birch Island Lake to pre-roadway construction conditions. It is estimated that for normal climatic conditions, the lake level will rise between 0.5 and 1.0 feet per year.

Figures

Barr Footer: Date: 1/17/2005 10:34:28 AM File: I:\Projects\23\27\003\gis\projects\NMCWD_location_map.mxd User: lkp



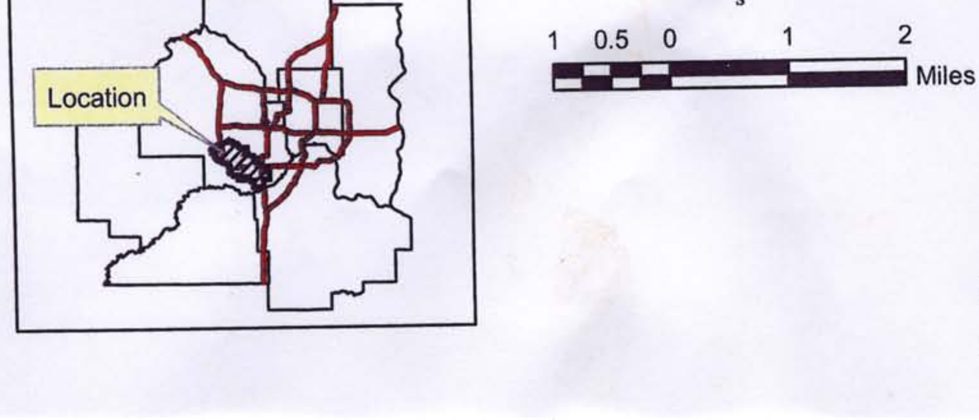


Figure 1

LOCATION MAP
BIRCH ISLAND LAKE
Nine Mile Creek Watershed District

Barr Footer: Date: 1/18/2005 2:49:55 PM File: I:\Projects\23\27\003\gis\projects\birch_island_lake.mxd User: lkp

Figure 2

FILL AREA
BIRCH ISLAND LAKE
Nine Mile Creek Watershed District

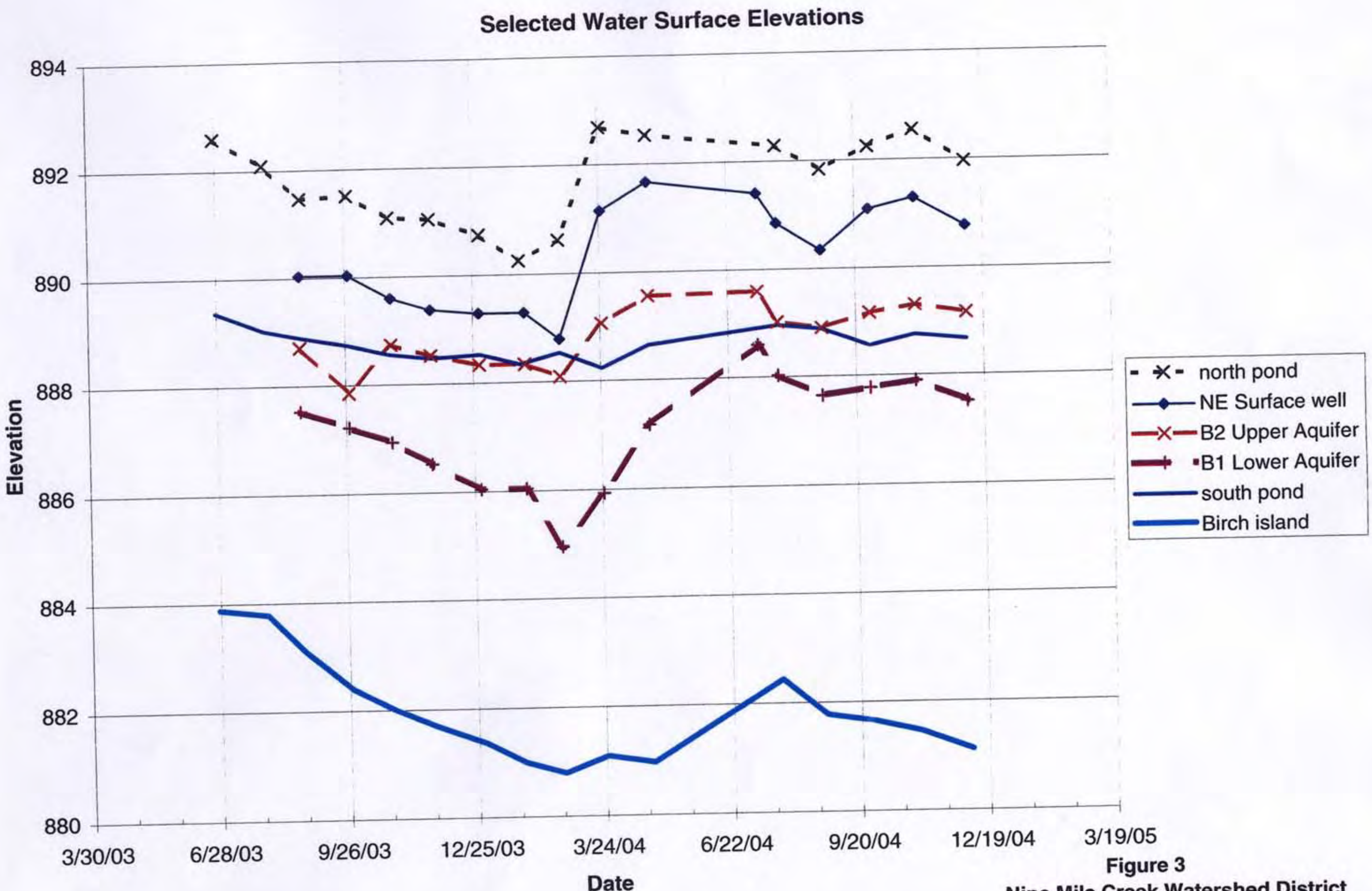


Figure 3
Nine Mile Creek Watershed District
Selected Water Surface Elevations

Figure 4
Nine Mile Creek Watershed District
One Minute Water Levels

Appendix E

Affected Property Owners

Appendix E: Affected Property Owners

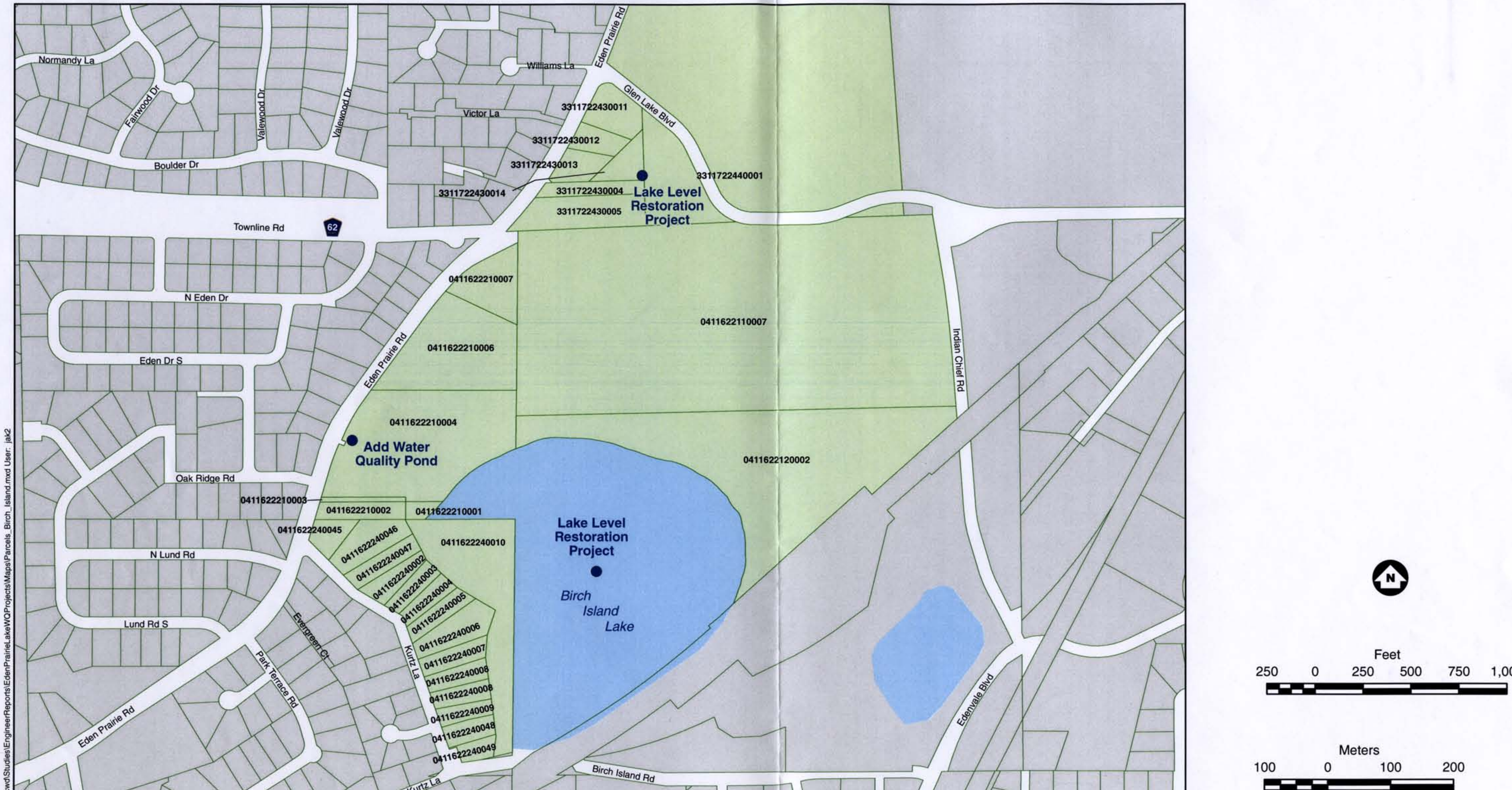


Figure E-1

AFFECTED PROPERTIES IN THE BIRCH ISLAND LAKE WATERSHED
Nine Mile Creek Watershed District
Eden Prairie, Minnesota

Barr Footer: Date: 5/30/2006 3:49:23 PM File: I:\Client\Nmcwd\Studies\EngineerReports\EdenPrairieLakeWOProjects\Maps\Parcels_Birch_Island.mxd User: jak2

Affect Parcels near Birch Island Lake - Hennepin County

PID_NO	BLDG_NUM	STREETNAME	CITY	ZIP	OWNER_NAME
0411622110007	6210	INDIAN CHIEF RD	EDEN PRAIRIE	55346	COUNTY OF HENNEPIN
0411622120002	6350	INDIAN CHIEF RD	EDEN PRAIRIE	55346	CITY OF EDEN PRAIRIE
0411622210002	6345	EDEN PRAIRIE RD	EDEN PRAIRIE	55346	JAMES E EVANS
0411622210004	6209	EDEN PRAIRIE RD	EDEN PRAIRIE	55346	CITY OF EDEN PRAIRIE
0411622210006	6225	EDEN PRAIRIE RD	EDEN PRAIRIE	55346	CITY OF EDEN PRAIRIE
0411622210007	6209	EDEN PRAIRIE RD	EDEN PRAIRIE	55346	G L RODBERG & B M RODBERG
0411622240002	6429	KURTZ LA	EDEN PRAIRIE	55346	ROGER E HARO
0411622240003	6435	KURTZ LA	EDEN PRAIRIE	55346	JACK L STEINMETZ
0411622240004	6441	KURTZ LA	EDEN PRAIRIE	55346	P W HARLOS & D HARLOS
0411622240005	6447	KURTZ LA	EDEN PRAIRIE	55346	GERI L NAPUCK
0411622240006	6451	KURTZ LA	EDEN PRAIRIE	55346	M A H FARIDI & M E FARIDI
0411622240007	6507	KURTZ LA	EDEN PRAIRIE	55346	JULIE ANNE ARTHUR-SHERMAN
0411622240008	6513	KURTZ LA	EDEN PRAIRIE	55346	BRENDA WALD
0411622240009	6521	KURTZ LA	EDEN PRAIRIE	55346	J D HASTINGS & B HASTINGS
0411622240010	6449	KURTZ LA	EDEN PRAIRIE	55346	M A H FARIDI & M E FARIDI
0411622240045	6401	KURTZ LA	EDEN PRAIRIE	55346	MARINA BERTOSH
0411622240046	6409	KURTZ LA	EDEN PRAIRIE	55346	O A WESTERMANN ETAL
0411622240047	6421	KURTZ LA	EDEN PRAIRIE	55346	NORMAN P FRIEDERICHS & WIFE
0411622240048	6527	KURTZ LA	EDEN PRAIRIE	55346	STEVEN A KLOEPPEL
0411622240049	6533	KURTZ LA	EDEN PRAIRIE	55346	D J HILGERS & J L HILGERS
0411622240050	6559	KURTZ LA	EDEN PRAIRIE	55346	CRAIG W MILLER
0411622310083	6713	DORIANN CT	EDEN PRAIRIE	55346	C L & C W KNUTSON
0411622310085	6707	DORIANN CT	EDEN PRAIRIE	55346	PATRICIA M BOTES
0411622310086	6709	DORIANN CT	EDEN PRAIRIE	55346	SANDRA L FRATZKE
0411622310091	15315	LESLEY LA	EDEN PRAIRIE	55346	JOSEPH J ROEMEN
0411622310092	15313	LESLEY LA	EDEN PRAIRIE	55346	ROBIN L KAMPEN
0411622310128	15125	LESLEY LA	EDEN PRAIRIE	55346	L A RENAUD & T A RENAUD
0411622310149	15145	LESLEY LA	EDEN PRAIRIE	55346	DAN WYNIA ET AL SUBJ/LE
0411622310185	15271	LESLEY LA	EDEN PRAIRIE	55346	ELIZABETH A LARSON
3311722430004	6131	EDEN PRAIRIE RD	MINNETONKA	55345	HENNEPIN COUNTY
3311722430005	6145	EDEN PRAIRIE RD	MINNETONKA	55345	CO OF HENN
3311722430011	6101	EDEN PRAIRIE RD	MINNETONKA	55345	ROBERT D UEECK
3311722430012	6115	EDEN PRAIRIE RD	MINNETONKA	55345	M A ESSIEN & S O ESSIEN
3311722430013	6125	EDEN PRAIRIE RD	MINNETONKA	55345	RICHARD J KARINIEMI
3311722430014	34	ADDRESS UNASSIGNED	MINNETONKA	00000	ROBERT D UEECK
3311722440001	6025	EDEN PRAIRIE RD	MINNETONKA	55345	HENNEPIN COUNTY
0411622210001	6209	EDEN PRAIRIE RD	EDEN PRAIRIE	55346	CITY OF EDEN PRAIRIE
0411622210003	6345	EDEN PRAIRIE RD	EDEN PRAIRIE	55346	JAMES E EVANS

● General Project Location

N

Feet

400 0 400 800 1,200 1,600 2,000

Meters

100 0 100 200 300 400 500 600

Figure E-2

AFFECTED PROPERTIES IN THE BRYANT LAKE WATERSHED
Nine Mile Creek Watershed District
Eden Prairie, Minnesota

Affect Parcels near Bryant Lake - Hennepin County

PID_NO	BLDG_NUM	STREETNAME	CITY	ZIP	OWNER_NAME
0211622220003	6385	BEACH RD	EDEN PRAIRIE	55344	INTERNATIONAL SCHOOL MN LLC
0211622230007	6521	BEACH RD	EDEN PRAIRIE	55344	NANCY E AHLQUIST
0211622230008	6541	BEACH RD	EDEN PRAIRIE	55344	GLORIA P GUSTILO
0211622230009	6561	BEACH RD	EDEN PRAIRIE	55344	V S OLSEN & T W OLSEN
0211622230010	6581	BEACH RD	EDEN PRAIRIE	55344	MADELAINE L MARTIN
0211622230011	6601	BEACH RD	EDEN PRAIRIE	55344	J & M SHAVER
0211622230012	61	ADDRESS UNASSIGNED	EDEN PRAIRIE	00000	NORTH BRYANT LK HMOWNRS ASSO
0211622320001	6621	BEACH RD	EDEN PRAIRIE	55344	ROHULLAH M VEDADHAGHI ET AL
0211622320002	6641	BEACH RD	EDEN PRAIRIE	55344	NORTHLAND US LLC
0211622320003	6661	BEACH RD	EDEN PRAIRIE	55344	JO ANN OMLIE
0211622320004	6681	BEACH RD	EDEN PRAIRIE	55344	FRED HO & MARTHA COX HO
0211622320005	6721	BEACH RD	EDEN PRAIRIE	55344	J M & B J LANZO
0211622320006	6741	BEACH RD	EDEN PRAIRIE	55344	DAVID E STEEN
0211622320007	6761	BEACH RD	EDEN PRAIRIE	55344	D L BACHMAN & R G BACHMAN
0211622320009	12530	BEACH CIR	EDEN PRAIRIE	55344	B J & L A PARADIS
0211622320010	12535	BEACH CIR	EDEN PRAIRIE	55344	V D & R W CARLSON JR
0211622330001	61	ADDRESS UNASSIGNED	EDEN PRAIRIE	00000	CITY OF EDEN PRAIRIE
0211622330003	6851	BEACH RD	EDEN PRAIRIE	55344	R C FRANSEN ETAL
0211622340001	6861	BEACH RD	EDEN PRAIRIE	55344	R A & J M LAMETTRY
0211622340002	6871	BEACH RD	EDEN PRAIRIE	55344	THEODORE R VICKERMAN
0211622340003	6881	BEACH RD	EDEN PRAIRIE	55344	JOSEPH & KARYN B SPAETH
0211622340004	6891	BEACH RD	EDEN PRAIRIE	55344	T C HAUNG & D HAUNG
0211622340005	6921	BEACH RD	EDEN PRAIRIE	55344	WILLIAM JACQUES GIBBS
0211622340006	6941	BEACH RD	EDEN PRAIRIE	55344	N O HELTNE & D E HELTNE TRST
0211622340007	6961	BEACH RD	EDEN PRAIRIE	55344	K D & J A MOLDE
0211622340008	6981	BEACH RD	EDEN PRAIRIE	55344	WILLIAM S MACK
0211622420003	6400	ROWLAND RD	EDEN PRAIRIE	55344	HENNEPIN CO PARK RESERVE
0211622440004	7036	WILLOW CREEK RD	EDEN PRAIRIE	55344	CURTIS A BOTKO
0211622440005	7037	WILLOW CREEK RD	EDEN PRAIRIE	55344	J R & N L SELLECK
0311622410009	6801	STONEWOOD CT	EDEN PRAIRIE	55346	DENNIS J TOUSSAINT
0311622410012	61	ADDRESS UNASSIGNED	EDEN PRAIRIE	00000	JEFFREY GUSTAFSON JR
0311622410013	6811	STONEWOOD CT	EDEN PRAIRIE	55346	ERIK GUSTAFSON
0311622410047	12951	CARDINAL CREEK RD	EDEN PRAIRIE	55346	C D CARR & T T CARR
0311622410048	12977	CARDINAL CREEK RD	EDEN PRAIRIE	55346	J E BAXTER & S L MADSEN
0311622410049	13003	CARDINAL CREEK RD	EDEN PRAIRIE	55346	JEFFREY D HOLT/KAREN M HOLT
0311622410050	13029	CARDINAL CREEK RD	EDEN PRAIRIE	55346	M J MUNSON & C N MUNSON
0311622410051	13055	CARDINAL CREEK RD	EDEN PRAIRIE	55346	BYKS REAL ESTATE LLC
0311622410053	61	ADDRESS UNASSIGNED	EDEN PRAIRIE	00000	CITY OF EDEN PRAIRIE
0311622440006	6909	EDGEBROOK PL	EDEN PRAIRIE	55346	E C MCNAUL & D A DROTAR
0311622440007	6921	EDGEBROOK PL	EDEN PRAIRIE	55346	M P DAHLEN & A A WILLIAMS

Affect Parcels near Bryant Lake - Hennepin County

PID_NO	BLDG_NUM	STREETNAME	CITY	ZIP	OWNER_NAME
0311622440008	6933	EDGEBROOK PL	EDEN PRAIRIE	55346	R J WAGNER & D L WAGNER
0311622440009	6945	EDGEBROOK PL	EDEN PRAIRIE	55346	DONALD K ASBY ET AL W/L EST
0311622440010	6957	EDGEBROOK PL	EDEN PRAIRIE	55346	C A NORGREN & L J NORGREN
0311622440011	6969	EDGEBROOK PL	EDEN PRAIRIE	55346	G P KELLEY & C Y KELLEY
0311622440012	6981	EDGEBROOK PL	EDEN PRAIRIE	55346	T E & C M BANBURY
0311622440013	6993	EDGEBROOK PL	EDEN PRAIRIE	55346	MARIAN A WINES TRUSTEE
0311622440014	6995	EDGEBROOK PL	EDEN PRAIRIE	55346	R W WOOD & T M WOOD
0311622440027	61	ADDRESS UNASSIGNED	EDEN PRAIRIE	00000	CITY OF EDEN PRAIRIE
0311622440029	6997	EDGEBROOK PL	EDEN PRAIRIE	55346	F & J SIEFFERMAN
0311622440047	61	ADDRESS UNASSIGNED	EDEN PRAIRIE	00000	CITY OF EDEN PRAIRIE
0311622440048	7000	EDGEBROOK PL	EDEN PRAIRIE	55346	G J N & L M AAMODT
0311622440049	6848	STONEWOOD CT	EDEN PRAIRIE	55346	MARK ROBERT GIBBON
0311622440050	6852	STONEWOOD CT	EDEN PRAIRIE	55346	CATHERINE L AMICK
0311622440052	6804	STONEWOOD CT	EDEN PRAIRIE	55346	CHRISTOPHER TOUSSAINT ET AL
0311622440053	6900	STONEWOOD CT	EDEN PRAIRIE	55346	J M SMITH & M G SMITH
0311622440054	6896	STONEWOOD CT	EDEN PRAIRIE	55346	JUDITH C SMITH
0311622440055	6815	STONEWOOD CT	EDEN PRAIRIE	55346	JEFFREY SVEN GUSTAFSON
0311622440056	6864	STONEWOOD CT	EDEN PRAIRIE	55346	T A & P D TOUSSAINT
0311622440057	6868	STONEWOOD CT	EDEN PRAIRIE	55346	MARCELO A LOMBARDI
0311622440058	6816	STONEWOOD CT	EDEN PRAIRIE	55346	P A BERNAL & M C COOK
0311622440059	6820	STONEWOOD CT	EDEN PRAIRIE	55346	S C BADENOCH & M L BADENOCH
0311622440060	6903	STONEWOOD CT	EDEN PRAIRIE	55346	P PASSENTINO/D E PASSENTINO
0311622440061	6907	STONEWOOD CT	EDEN PRAIRIE	55346	PHYLLIS A BARNO
0311622440062	6832	STONEWOOD CT	EDEN PRAIRIE	55346	J R CARLSON & J L CARLSON
0311622440063	6836	STONEWOOD CT	EDEN PRAIRIE	55346	M G & L J GORDON
0311622440064	6880	STONEWOOD CT	EDEN PRAIRIE	55346	J J & S M WERNER
0311622440065	6884	STONEWOOD CT	EDEN PRAIRIE	55346	S L GARBIN & G A BLONN
0311622440066	6843	STONEWOOD CT	EDEN PRAIRIE	55346	VIRGINIA K KRAUSE
0311622440067	6847	STONEWOOD CT	EDEN PRAIRIE	55346	ALAN & REVA GREENBERG
0311622440068	6831	STONEWOOD CT	EDEN PRAIRIE	55346	BARBARA L BAER
0311622440069	6835	STONEWOOD CT	EDEN PRAIRIE	55346	DIANE ALINE MERRIFIELD
0311622440070	6800	STONEWOOD CT	EDEN PRAIRIE	55346	D E DONATELLE/J A DONATELLE
0311622440071	13085	CARDINAL CREEK RD	EDEN PRAIRIE	55346	J & M TURNER
0311622440072	6821	STONEWOOD CT	EDEN PRAIRIE	55346	T A MILLER & J D MILLER
0311622440073	6825	STONEWOOD CT	EDEN PRAIRIE	55346	IVANKA J ZDRAHALA TRUSTEE
0311622440074	6855	STONEWOOD CT	EDEN PRAIRIE	55346	D A & M F VIKRE
0311622440075	6859	STONEWOOD CT	EDEN PRAIRIE	55346	R J & P A VAGNONI
0311622440076	6871	STONEWOOD CT	EDEN PRAIRIE	55346	MARY J SEBALD
0311622440077	6875	STONEWOOD CT	EDEN PRAIRIE	55346	P D & S J JOHNSON
0311622440078	6887	STONEWOOD CT	EDEN PRAIRIE	55346	R & C MEDOWER

Affect Parcels near Bryant Lake - Hennepin County

PID_NO	BLDG_NUM	STREETNAME	CITY	ZIP	OWNER_NAME
0311622440079	6891	STONEWOOD CT	EDEN PRAIRIE	55346	DUANE & GLORIA JACQUES
1011622110004	7120	GERARD DR	EDEN PRAIRIE	55346	J T MILLER ETAL
1011622110043	7022	DONLEA LA	EDEN PRAIRIE	55346	SCOTT & LISA NELSON
1011622110044	7019	DONLEA LA	EDEN PRAIRIE	55346	EUGENE P & MARGARET L PREISS
1011622110045	7027	DONLEA LA	EDEN PRAIRIE	55346	M B WRIGHT & L J WRIGHT
1011622110050	12800	GERARD DR	EDEN PRAIRIE	55346	BARBARA M KAERWER
1011622110051	61	ADDRESS UNASSIGNED	EDEN PRAIRIE	00000	CITY OF EDEN PRAIRIE
1011622110057	7000	SLEEPY HOLLOW LA	EDEN PRAIRIE	55346	CHRISTOPHER P & JULIE T OLIG
1011622110058	61	ADDRESS UNASSIGNED	EDEN PRAIRIE	00000	CITY OF EDEN PRAIRIE
1111622110009	7160	WILLOW CREEK RD	EDEN PRAIRIE	55344	B & M DUOOS
1111622110010	7140	WILLOW CREEK RD	EDEN PRAIRIE	55344	J D & B L GABBERT
1111622110011	7130	WILLOW CREEK RD	EDEN PRAIRIE	55344	WESLEY H BURNHAM TRUSTEE
1111622110012	7120	WILLOW CREEK RD	EDEN PRAIRIE	55344	ESTELLE H KNUDSEN
1111622110013	7011	WILLOW CREEK RD	EDEN PRAIRIE	55344	D W CROWTHER/L M CROWTHER
1111622110023	7032	WILLOW CREEK RD	EDEN PRAIRIE	55344	J J & G K DOCTER
1111622110024	7034	WILLOW CREEK RD	EDEN PRAIRIE	55344	J F CAVANAUGH & E CAVANAUGH
1111622110036	7010	WILLOW CREEK RD	EDEN PRAIRIE	55344	J W PERKINS & R F PERKINS
1111622110037	7012	WILLOW CREEK RD	EDEN PRAIRIE	55344	NATHAN D BERGELAND
1111622110038	7014	WILLOW CREEK RD	EDEN PRAIRIE	55344	C M WATKINS & P S WATKINS
1111622110039	7020	WILLOW CREEK RD	EDEN PRAIRIE	55344	STUART H & PAMELA K NOLAN
1111622130003	11840	VALLEY VIEW RD	EDEN PRAIRIE	55344	SUPER VALUE STORES INC
1111622140005	61	ADDRESS UNASSIGNED	EDEN PRAIRIE	00000	J C DUNCAN & K A DUNCAN
1111622140006	7220	WILLOW CREEK RD	EDEN PRAIRIE	55344	R J & M SEIDENSTRICKER
1111622140012	7240	WILLOW CREEK RD	EDEN PRAIRIE	55344	R H KLUGE & N M KLUGE
1111622140015	61	ADDRESS UNASSIGNED	EDEN PRAIRIE	00000	TYRONE THAYER ET AL
1111622140016	61	ADDRESS UNASSIGNED	EDEN PRAIRIE	00000	TYRONE THAYER ET AL
1111622210001	11902	VALLEY VIEW RD	EDEN PRAIRIE	55344	SUPER VALUE STORES INC
1111622220004	12774	GORDON DR	EDEN PRAIRIE	55346	J D STONEBURG/B A STONEBURG
1111622220005	12772	GORDON DR	EDEN PRAIRIE	55346	K L SCHROEDER/M M SCHROEDER
1111622220006	12764	GORDON DR	EDEN PRAIRIE	55346	MARSHA E RICHARDSON
1111622220007	12762	GORDON DR	EDEN PRAIRIE	55346	ERIC J WESSELS
1111622140001	61	ADDRESS UNASSIGNED	EDEN PRAIRIE	00000	W J & C A BEARMAN ET AL
1111622140017	61	ADDRESS UNASSIGNED	EDEN PRAIRIE	00000	KATHLEEN J THAYER ET AL
1011622120040	13410	KERRY LA	EDEN PRAIRIE	55346	A VLODAVER & S P VLODAVER
1011622120041	13398	KERRY LA	EDEN PRAIRIE	55346	E & J STEVENSON
1011622120042	13386	KERRY LA	EDEN PRAIRIE	55346	J H SYLVESTRE/B L SYLVESTRE
1011622120053	61	ADDRESS UNASSIGNED	EDEN PRAIRIE	00000	CITY OF EDEN PRAIRIE
1011622110056	7018	SLEEPY HOLLOW LA	EDEN PRAIRIE	55346	C A PATOW & S M PATOW

Affect Parcels near Bryant Lake - Hennepin County

PID_NO	BLDG_NUM	STREETNAME	CITY	ZIP	OWNER_NAME
0211622220003	6385	BEACH RD	EDEN PRAIRIE	55344	INTERNATIONAL SCHOOL MN LLC
0211622230007	6521	BEACH RD	EDEN PRAIRIE	55344	NANCY E AHLQUIST
0211622230008	6541	BEACH RD	EDEN PRAIRIE	55344	GLORIA P GUSTILO
0211622230009	6561	BEACH RD	EDEN PRAIRIE	55344	V S OLSEN & T W OLSEN
0211622230010	6581	BEACH RD	EDEN PRAIRIE	55344	MADELAINE L MARTIN
0211622230011	6601	BEACH RD	EDEN PRAIRIE	55344	J & M SHAVER
0211622230012	61	ADDRESS UNASSIGNED	EDEN PRAIRIE	00000	NORTH BRYANT LK HMOWNRS ASSO
0211622320001	6621	BEACH RD	EDEN PRAIRIE	55344	ROHULLAH M VEDADHAGHI ET AL
0211622320002	6641	BEACH RD	EDEN PRAIRIE	55344	NORTHLAND US LLC
0211622320003	6661	BEACH RD	EDEN PRAIRIE	55344	JO ANN OMLIE
0211622320004	6681	BEACH RD	EDEN PRAIRIE	55344	FRED HO & MARTHA COX HO
0211622320005	6721	BEACH RD	EDEN PRAIRIE	55344	J M & B J LANZO
0211622320006	6741	BEACH RD	EDEN PRAIRIE	55344	DAVID E STEEN
0211622320007	6761	BEACH RD	EDEN PRAIRIE	55344	D L BACHMAN & R G BACHMAN
0211622320009	12530	BEACH CIR	EDEN PRAIRIE	55344	B J & L A PARADIS
0211622320010	12535	BEACH CIR	EDEN PRAIRIE	55344	V D & R W CARLSON JR
0211622330001	61	ADDRESS UNASSIGNED	EDEN PRAIRIE	00000	CITY OF EDEN PRAIRIE
0211622330003	6851	BEACH RD	EDEN PRAIRIE	55344	R C FRANSEN ETAL
0211622340001	6861	BEACH RD	EDEN PRAIRIE	55344	R A & J M LAMETTRY
0211622340002	6871	BEACH RD	EDEN PRAIRIE	55344	THEODORE R VICKERMAN
0211622340003	6881	BEACH RD	EDEN PRAIRIE	55344	JOSEPH & KARYN B SPAETH
0211622340004	6891	BEACH RD	EDEN PRAIRIE	55344	T C HAUNG & D HAUNG
0211622340005	6921	BEACH RD	EDEN PRAIRIE	55344	WILLIAM JACQUES GIBBS
0211622340006	6941	BEACH RD	EDEN PRAIRIE	55344	N O HELTNE & D E HELTNE TRST
0211622340007	6961	BEACH RD	EDEN PRAIRIE	55344	K D & J A MOLDE
0211622340008	6981	BEACH RD	EDEN PRAIRIE	55344	WILLIAM S MACK
0211622420003	6400	ROWLAND RD	EDEN PRAIRIE	55344	HENNEPIN CO PARK RESERVE
0211622440004	7036	WILLOW CREEK RD	EDEN PRAIRIE	55344	CURTIS A BOTKO
0211622440005	7037	WILLOW CREEK RD	EDEN PRAIRIE	55344	J R & N L SELLECK
0311622410009	6801	STONEWOOD CT	EDEN PRAIRIE	55346	DENNIS J TOUSSAINT
0311622410012	61	ADDRESS UNASSIGNED	EDEN PRAIRIE	00000	JEFFREY GUSTAFSON JR
0311622410013	6811	STONEWOOD CT	EDEN PRAIRIE	55346	ERIK GUSTAFSON
0311622410047	12951	CARDINAL CREEK RD	EDEN PRAIRIE	55346	C D CARR & T T CARR
0311622410048	12977	CARDINAL CREEK RD	EDEN PRAIRIE	55346	J E BAXTER & S L MADSEN
0311622410049	13003	CARDINAL CREEK RD	EDEN PRAIRIE	55346	JEFFREY D HOLT/KAREN M HOLT
0311622410050	13029	CARDINAL CREEK RD	EDEN PRAIRIE	55346	M J MUNSON & C N MUNSON
0311622410051	13055	CARDINAL CREEK RD	EDEN PRAIRIE	55346	BYKS REAL ESTATE LLC
0311622410053	61	ADDRESS UNASSIGNED	EDEN PRAIRIE	00000	CITY OF EDEN PRAIRIE
0311622440006	6909	EDGEBROOK PL	EDEN PRAIRIE	55346	E C MCNAUL & D A DROTAR
0311622440007	6921	EDGEBROOK PL	EDEN PRAIRIE	55346	M P DAHLEN & A A WILLIAMS

Affect Parcels near Bryant Lake - Hennepin County

PID_NO	BLDG_NUM	STREETNAME	CITY	ZIP	OWNER_NAME
0311622440008	6933	EDGEBROOK PL	EDEN PRAIRIE	55346	R J WAGNER & D L WAGNER
0311622440009	6945	EDGEBROOK PL	EDEN PRAIRIE	55346	DONALD K ASBY ET AL W/L EST
0311622440010	6957	EDGEBROOK PL	EDEN PRAIRIE	55346	C A NORGREN & L J NORGREN
0311622440011	6969	EDGEBROOK PL	EDEN PRAIRIE	55346	G P KELLEY & C Y KELLEY
0311622440012	6981	EDGEBROOK PL	EDEN PRAIRIE	55346	T E & C M BANBURY
0311622440013	6993	EDGEBROOK PL	EDEN PRAIRIE	55346	MARIAN A WINES TRUSTEE
0311622440014	6995	EDGEBROOK PL	EDEN PRAIRIE	55346	R W WOOD & T M WOOD
0311622440027	61	ADDRESS UNASSIGNED	EDEN PRAIRIE	00000	CITY OF EDEN PRAIRIE
0311622440029	6997	EDGEBROOK PL	EDEN PRAIRIE	55346	F & J SIEFFERMAN
0311622440047	61	ADDRESS UNASSIGNED	EDEN PRAIRIE	00000	CITY OF EDEN PRAIRIE
0311622440048	7000	EDGEBROOK PL	EDEN PRAIRIE	55346	G J N & L M AAMODT
0311622440049	6848	STONEWOOD CT	EDEN PRAIRIE	55346	MARK ROBERT GIBBON
0311622440050	6852	STONEWOOD CT	EDEN PRAIRIE	55346	CATHERINE L AMICK
0311622440052	6804	STONEWOOD CT	EDEN PRAIRIE	55346	CHRISTOPHER TOUSSAINT ET AL
0311622440053	6900	STONEWOOD CT	EDEN PRAIRIE	55346	J M SMITH & M G SMITH
0311622440054	6896	STONEWOOD CT	EDEN PRAIRIE	55346	JUDITH C SMITH
0311622440055	6815	STONEWOOD CT	EDEN PRAIRIE	55346	JEFFREY SVEN GUSTAFSON
0311622440056	6864	STONEWOOD CT	EDEN PRAIRIE	55346	T A & P D TOUSSAINT
0311622440057	6868	STONEWOOD CT	EDEN PRAIRIE	55346	MARCELO A LOMBARDI
0311622440058	6816	STONEWOOD CT	EDEN PRAIRIE	55346	P A BERNAL & M C COOK
0311622440059	6820	STONEWOOD CT	EDEN PRAIRIE	55346	S C BADENOCH & M L BADENOCH
0311622440060	6903	STONEWOOD CT	EDEN PRAIRIE	55346	P PASSENTINO/D E PASSENTINO
0311622440061	6907	STONEWOOD CT	EDEN PRAIRIE	55346	PHYLLIS A BARNO
0311622440062	6832	STONEWOOD CT	EDEN PRAIRIE	55346	J R CARLSON & J L CARLSON
0311622440063	6836	STONEWOOD CT	EDEN PRAIRIE	55346	M G & L J GORDON
0311622440064	6880	STONEWOOD CT	EDEN PRAIRIE	55346	J J & S M WERNER
0311622440065	6884	STONEWOOD CT	EDEN PRAIRIE	55346	S L GARBIN & G A BLONN
0311622440066	6843	STONEWOOD CT	EDEN PRAIRIE	55346	VIRGINIA K KRAUSE
0311622440067	6847	STONEWOOD CT	EDEN PRAIRIE	55346	ALAN & REVA GREENBERG
0311622440068	6831	STONEWOOD CT	EDEN PRAIRIE	55346	BARBARA L BAER
0311622440069	6835	STONEWOOD CT	EDEN PRAIRIE	55346	DIANE ALINE MERRIFIELD
0311622440070	6800	STONEWOOD CT	EDEN PRAIRIE	55346	D E DONATELLE/J A DONATELLE
0311622440071	13085	CARDINAL CREEK RD	EDEN PRAIRIE	55346	J & M TURNER
0311622440072	6821	STONEWOOD CT	EDEN PRAIRIE	55346	T A MILLER & J D MILLER
0311622440073	6825	STONEWOOD CT	EDEN PRAIRIE	55346	IVANKA J ZDRAHALA TRUSTEE
0311622440074	6855	STONEWOOD CT	EDEN PRAIRIE	55346	D A & M F VIKRE
0311622440075	6859	STONEWOOD CT	EDEN PRAIRIE	55346	R J & P A VAGNONI
0311622440076	6871	STONEWOOD CT	EDEN PRAIRIE	55346	MARY J SEBALD
0311622440077	6875	STONEWOOD CT	EDEN PRAIRIE	55346	P D & S J JOHNSON
0311622440078	6887	STONEWOOD CT	EDEN PRAIRIE	55346	R & C MEDOWER

Affect Parcels near Bryant Lake - Hennepin County

PID_NO	BLDG_NUM	STREETNAME	CITY	ZIP	OWNER_NAME
0311622440079	6891	STONEWOOD CT	EDEN PRAIRIE	55346	DUANE & GLORIA JACQUES
1011622110004	7120	GERARD DR	EDEN PRAIRIE	55346	J T MILLER ETAL
1011622110043	7022	DONLEA LA	EDEN PRAIRIE	55346	SCOTT & LISA NELSON
1011622110044	7019	DONLEA LA	EDEN PRAIRIE	55346	EUGENE P & MARGARET L PREISS
1011622110045	7027	DONLEA LA	EDEN PRAIRIE	55346	M B WRIGHT & L J WRIGHT
1011622110050	12800	GERARD DR	EDEN PRAIRIE	55346	BARBARA M KAERWER
1011622110051	61	ADDRESS UNASSIGNED	EDEN PRAIRIE	00000	CITY OF EDEN PRAIRIE
1011622110057	7000	SLEEPY HOLLOW LA	EDEN PRAIRIE	55346	CHRISTOPHER P & JULIE T OLIG
1011622110058	61	ADDRESS UNASSIGNED	EDEN PRAIRIE	00000	CITY OF EDEN PRAIRIE
1111622110009	7160	WILLOW CREEK RD	EDEN PRAIRIE	55344	B & M DUOOS
1111622110010	7140	WILLOW CREEK RD	EDEN PRAIRIE	55344	J D & B L GABBERT
1111622110011	7130	WILLOW CREEK RD	EDEN PRAIRIE	55344	WESLEY H BURNHAM TRUSTEE
1111622110012	7120	WILLOW CREEK RD	EDEN PRAIRIE	55344	ESTELLE H KNUDSEN
1111622110013	7011	WILLOW CREEK RD	EDEN PRAIRIE	55344	D W CROWTHER/L M CROWTHER
1111622110023	7032	WILLOW CREEK RD	EDEN PRAIRIE	55344	J J & G K DOCTER
1111622110024	7034	WILLOW CREEK RD	EDEN PRAIRIE	55344	J F CAVANAUGH & E CAVANAUGH
1111622110036	7010	WILLOW CREEK RD	EDEN PRAIRIE	55344	J W PERKINS & R F PERKINS
1111622110037	7012	WILLOW CREEK RD	EDEN PRAIRIE	55344	NATHAN D BERGELAND
1111622110038	7014	WILLOW CREEK RD	EDEN PRAIRIE	55344	C M WATKINS & P S WATKINS
1111622110039	7020	WILLOW CREEK RD	EDEN PRAIRIE	55344	STUART H & PAMELA K NOLAN
1111622130003	11840	VALLEY VIEW RD	EDEN PRAIRIE	55344	SUPER VALUE STORES INC
1111622140005	61	ADDRESS UNASSIGNED	EDEN PRAIRIE	00000	J C DUNCAN & K A DUNCAN
1111622140006	7220	WILLOW CREEK RD	EDEN PRAIRIE	55344	R J & M SEIDENSTRICKER
1111622140012	7240	WILLOW CREEK RD	EDEN PRAIRIE	55344	R H KLUGE & N M KLUGE
1111622140015	61	ADDRESS UNASSIGNED	EDEN PRAIRIE	00000	TYRONE THAYER ET AL
1111622140016	61	ADDRESS UNASSIGNED	EDEN PRAIRIE	00000	TYRONE THAYER ET AL
1111622210001	11902	VALLEY VIEW RD	EDEN PRAIRIE	55344	SUPER VALUE STORES INC
1111622220004	12774	GORDON DR	EDEN PRAIRIE	55346	J D STONEBURG/B A STONEBURG
1111622220005	12772	GORDON DR	EDEN PRAIRIE	55346	K L SCHROEDER/M M SCHROEDER
1111622220006	12764	GORDON DR	EDEN PRAIRIE	55346	MARSHA E RICHARDSON
1111622220007	12762	GORDON DR	EDEN PRAIRIE	55346	ERIC J WESSELS
1111622140001	61	ADDRESS UNASSIGNED	EDEN PRAIRIE	00000	W J & C A BEARMAN ET AL
1111622140017	61	ADDRESS UNASSIGNED	EDEN PRAIRIE	00000	KATHLEEN J THAYER ET AL
1011622120040	13410	KERRY LA	EDEN PRAIRIE	55346	A VLODAVER & S P VLODAVER
1011622120041	13398	KERRY LA	EDEN PRAIRIE	55346	E & J STEVENSON
1011622120042	13386	KERRY LA	EDEN PRAIRIE	55346	J H SYLVESTRE/B L SYLVESTRE
1011622120053	61	ADDRESS UNASSIGNED	EDEN PRAIRIE	00000	CITY OF EDEN PRAIRIE
1011622110056	7018	SLEEPY HOLLOW LA	EDEN PRAIRIE	55346	C A PATOW & S M PATOW

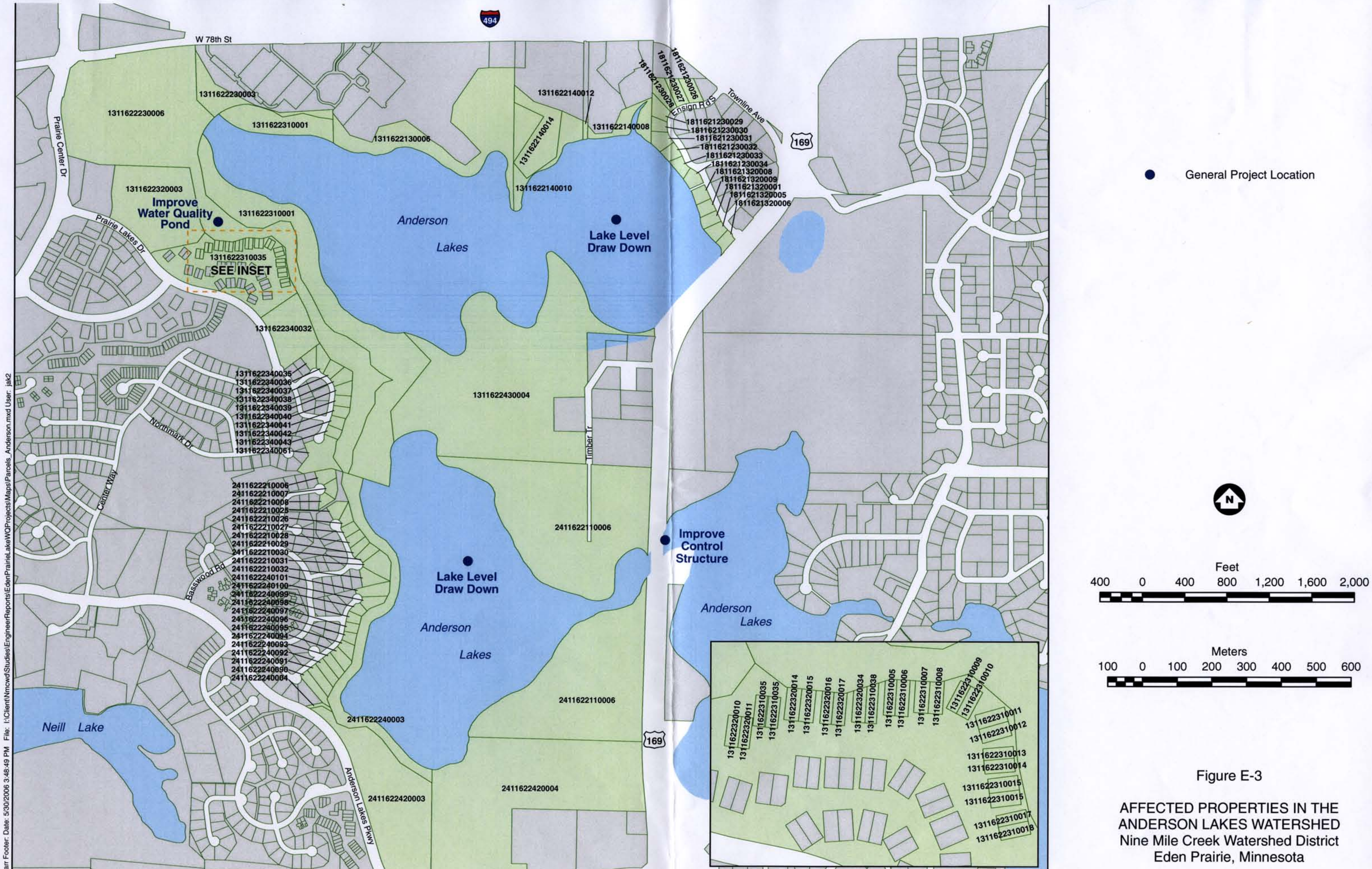


Figure E-3

AFFECTED PROPERTIES IN THE ANDERSON LAKES WATERSHED
Nine Mile Creek Watershed District
Eden Prairie, Minnesota

Barr Footer: Date: 5/30/2006 3:48:49 PM File: I:\Client\Nmcwd\Studies\EngineerReports\EdenPrairieLakeWQProjects\Maps\Parcels_Anderson.mxd User: jak2

Affect Parcels near Anderson Lakes - Hennepin County

PID_NO	BLDG_NUM	STREETNAME	CITY	ZIP	OWNER_NAME
1311622130006	61	ADDRESS UNASSIGNED	EDEN PRAIRIE	00000	HENNEPIN CO PARK RESERVE
1311622140008	61	ADDRESS UNASSIGNED	EDEN PRAIRIE	00000	HENN COUNTY PARK RES DIST
1311622140010	61	ADDRESS UNASSIGNED	EDEN PRAIRIE	00000	CITY OF EDEN PRAIRIE
1311622140012	61	ADDRESS UNASSIGNED	EDEN PRAIRIE	00000	CITY OF EDEN PRAIRIE
1311622140014	61	ADDRESS UNASSIGNED	EDEN PRAIRIE	00000	SUB HENN REG PARK DIST
1311622230003	61	ADDRESS UNASSIGNED	EDEN PRAIRIE	00000	GELCO CORPORATION
1311622230006	61	ADDRESS UNASSIGNED	EDEN PRAIRIE	00000	CITY OF EDEN PRAIRIE
1311622310001	61	ADDRESS UNASSIGNED	EDEN PRAIRIE	00000	HENN COUNTY PARK RES DIST
1311622310005	10790	KIAWAH DR	EDEN PRAIRIE	55344	GARY M ARNDT
1311622310006	10788	KIAWAH DR	EDEN PRAIRIE	55344	C W YEUNG & J Y YEUNG
1311622310007	10760	KIAWAH DR	EDEN PRAIRIE	55344	X ZHU & X LIU
1311622310008	10758	KIAWAH DR	EDEN PRAIRIE	55344	N KUGA & J YOSHIDA
1311622310009	10730	KIAWAH DR	EDEN PRAIRIE	55344	D J WAGNER/L A WAGNER TRSTES
1311622310010	10728	KIAWAH DR	EDEN PRAIRIE	55344	LUANN W PRIN/DAVID PRIN TRS
1311622310011	10700	KIAWAH DR	EDEN PRAIRIE	55344	J P & E J SIEFF
1311622310012	10698	KIAWAH DR	EDEN PRAIRIE	55344	DOUGLAS J WATERMAN
1311622310013	10670	KIAWAH DR	EDEN PRAIRIE	55344	P K SMITH & G W SMITH
1311622310015	10640	KIAWAH DR	EDEN PRAIRIE	55344	T L ALTHAUSER/A B ALTHAUSER
1311622310016	10638	KIAWAH DR	EDEN PRAIRIE	55344	D C & C L KIND
1311622310017	10610	KIAWAH DR	EDEN PRAIRIE	55344	R D & D L E POTTINGER
1311622310018	10608	KIAWAH DR	EDEN PRAIRIE	55344	R R & K O SCHLANGEN
1311622310035	61	ADDRESS UNASSIGNED	EDEN PRAIRIE	00000	WEST ON WOODS ON ANDERSON LK
1311622310038	10818	KIAWAH DR	EDEN PRAIRIE	55344	P T & J M OGDAHL
1311622320003	11010	PRAIRIE LAKES DR	EDEN PRAIRIE	55344	MSP INVESTORS I, L L C
1311622320010	10940	KIAWAH DR	EDEN PRAIRIE	55344	W D & K A KLINGEL
1311622320011	10938	KIAWAH DR	EDEN PRAIRIE	55344	C L & L M FRIEND
1311622320014	10880	KIAWAH DR	EDEN PRAIRIE	55344	SUSAN M CLEMENS
1311622320015	10878	KIAWAH DR	EDEN PRAIRIE	55344	D R NELSON & G L NELSON
1311622320016	10850	KIAWAH DR	EDEN PRAIRIE	55344	E KAPUSTIN & R KAPUSTIN
1311622320017	10848	KIAWAH DR	EDEN PRAIRIE	55344	LINDA K WILMARTH
1311622320032	10910	KIAWAH DR	EDEN PRAIRIE	55344	MICHAEL J FADELL
1311622320033	10908	KIAWAH DR	EDEN PRAIRIE	55344	EDNA W LACEY
1311622320034	10820	KIAWAH DR	EDEN PRAIRIE	55344	R C BUE & M A BUE
1311622340032	10700	PRAIRIE LAKES DR	EDEN PRAIRIE	55344	GELCO INFORMATION NETWORK
1311622340036	8477	CRANE DANCE TR	EDEN PRAIRIE	55344	M J & M D PERPICH
1311622340037	8491	CRANE DANCE TR	EDEN PRAIRIE	55344	G M & L B KENNEDY
1311622340038	8505	CRANE DANCE TR	EDEN PRAIRIE	55344	J R & V A CHRISTENSEN
1311622340039	8519	CRANE DANCE TR	EDEN PRAIRIE	55344	CHERYL L DESNICK
1311622340040	8533	CRANE DANCE TR	EDEN PRAIRIE	55344	STEPHEN B & DENISE M WAGNER

Affect Parcels near Anderson Lakes - Hennepin County

PID_NO	BLDG_NUM	STREETNAME	CITY	ZIP	OWNER_NAME
1311622340041	8547	CRANE DANCE TR	EDEN PRAIRIE	55344	S B & D M WAGNER
1311622340042	8561	CRANE DANCE TR	EDEN PRAIRIE	55344	JUREN DING & FENG WANG
1311622340043	8575	CRANE DANCE TR	EDEN PRAIRIE	55344	L J KOTOK & S G KOTOK
1311622340061	8603	CRANE DANCE TR	EDEN PRAIRIE	55344	MARTIN G & SARA L SKEELS
1311622430004	61	ADDRESS UNASSIGNED	EDEN PRAIRIE	00000	HENN CO PARK RES DIST
1811621230031	8064	ENSIGN RD	BLOOMINGTON	55438	T & E BATTA
1811621230032	8100	ENSIGN RD	BLOOMINGTON	55438	ANN L BYE
1811621230033	8108	ENSIGN RD	BLOOMINGTON	55438	W C & P J PETER
1811621230034	8116	ENSIGN RD	BLOOMINGTON	55438	RUSSELL W BELK SUBJ/L E
1811621320001	8200	ENSIGN RD	BLOOMINGTON	55438	DORIS K FERRELL
1811621320005	8208	ENSIGN RD	BLOOMINGTON	55438	MILDRED B WETTERLIN
1811621320006	8216	ENSIGN RD	BLOOMINGTON	55438	M HARTMAN & C J MORICAL
1811621320008	8124	ENSIGN RD	BLOOMINGTON	55438	LINDA M GOETZ
1811621320009	8132	ENSIGN RD	BLOOMINGTON	55438	M S BENDSTEN & E K BENDSTEN
2411622110006	8620	TIMBER TR	EDEN PRAIRIE	55344	HENNEPIN FORFEITED LAND
2411622210006	8650	BLACK MAPLE DR	EDEN PRAIRIE	55344	CHARLES E GRAVELLE
2411622210007	8655	BLACK MAPLE DR	EDEN PRAIRIE	55344	F & M LE VOIR
2411622210008	8665	BLACK MAPLE DR	EDEN PRAIRIE	55344	R A SWANSON & C J SWANSON
2411622210025	8701	BENTWOOD DR	EDEN PRAIRIE	55344	DIANE LOUISE FJELLAND
2411622210026	8705	BENTWOOD DR	EDEN PRAIRIE	55344	R SAMIDE & L B SAMIDE
2411622210027	8709	BENTWOOD DR	EDEN PRAIRIE	55344	NANCY WASHBURN MCLEAN
2411622210028	8719	BENTWOOD DR	EDEN PRAIRIE	55344	R D HILDRETH ETAL TRUSTEES
2411622210029	8729	BENTWOOD DR	EDEN PRAIRIE	55344	J & K COLLA
2411622210030	8739	BENTWOOD DR	EDEN PRAIRIE	55344	KENNETH T BARRETT
2411622210031	8743	BENTWOOD DR	EDEN PRAIRIE	55344	RICHARD D KEIVES
2411622210032	8747	BENTWOOD DR	EDEN PRAIRIE	55344	RALPH A NELSON JR & WIFE
2411622240003	61	ADDRESS UNASSIGNED	EDEN PRAIRIE	00000	HENN CO PARK RESERVE DIST
2411622240004	61	ADDRESS UNASSIGNED	EDEN PRAIRIE	00000	THE PRESERVE ASSOCIATION
2411622240090	8893	HIDDEN OAKS DR	EDEN PRAIRIE	55344	G & H BERGREN
2411622240091	8887	HIDDEN OAKS DR	EDEN PRAIRIE	55344	W MANDEL & M AUSTIN
2411622240092	8883	HIDDEN OAKS DR	EDEN PRAIRIE	55344	R & M ERICKSON
2411622240093	8867	HIDDEN OAKS DR	EDEN PRAIRIE	55344	WILLIAM A CROSLEY
2411622240094	8863	HIDDEN OAKS DR	EDEN PRAIRIE	55344	CURTIS L FISCHER ET AL TRSTE
2411622240095	8859	HIDDEN OAKS DR	EDEN PRAIRIE	55344	R G & A D HOFFMAN
2411622240096	8855	HIDDEN OAKS DR	EDEN PRAIRIE	55344	MARY LOU CHAMBERLAIN
2411622240097	8851	HIDDEN OAKS DR	EDEN PRAIRIE	55344	P B BRAWNER & C C BRAWNER
2411622240098	8845	HIDDEN OAKS DR	EDEN PRAIRIE	55344	R & S APPLEBAUM
2411622240099	8839	HIDDEN OAKS DR	EDEN PRAIRIE	55344	E E AUDRAIN & D M AUDRAIN
2411622240100	8833	HIDDEN OAKS DR	EDEN PRAIRIE	55344	WILLIAM H LYKKEN

Affect Parcels near Anderson Lakes - Hennepin County

PID_NO	BLDG_NUM	STREETNAME	CITY	ZIP	OWNER_NAME
2411622240101	8826	HIDDEN OAKS DR	EDEN PRAIRIE	55344	R F & R F MILLER
2411622420003	61	ADDRESS UNASSIGNED	EDEN PRAIRIE	00000	HENN CO PARK RESERVE DIST
2411622420004	61	ADDRESS UNASSIGNED	EDEN PRAIRIE	00000	HENN CO PARK RESERVE DIST
1311622310014	10668	KIAWAH DR	EDEN PRAIRIE	55344	MARGARET A WALLER
1311622340035	8463	CRANE DANCE TR	EDEN PRAIRIE	55344	J S JOHNSON & S A JOHNSON
1811621230026	8016	ENSIGN RD	BLOOMINGTON	55438	J R LINDAHL & J M LINDAHL
1811621230027	8032	ENSIGN RD	BLOOMINGTON	55438	EDWARD G HOWE ETAL
1811621230028	8040	ENSIGN RD	BLOOMINGTON	55438	J T WETMORE & C J WETMORE
1811621230029	8048	ENSIGN RD	BLOOMINGTON	55438	MARIAN E SAMPSON
1811621230030	8056	ENSIGN RD	BLOOMINGTON	55438	E J RINGQUIST/B A RINGQUIST

Appendix F

Petition of the City of Eden Prairie to the NMCWD for a Basic Water Management Project, and Accompanying City Council Resolution

Appendix F: The following is the Petition of the City of Eden Prairie to the NMCWD for a Basic Water Management Project, and Accompanying City Council Resolution

EDEN PRAIRIE
LIVE • WORK • DREAM

OFC 952 949 8300
FAX 952 949 8390
TDD 952 949 8399

8080 Mitchell Rd
Eden Prairie, MN
55344-4485

edenprairie.org

September 13, 2005

Mr. Bob Obermeyer
Riley-Purgatory-Bluff Creek Watershed District
c/o Barr Engineering
4700 W. 77th Street
Minneapolis, MN 55435-4803

Re: Basic Water Management Project Petition and Resolution for
Northwest Anderson, Southwest Anderson, Birch Island and Bryant Lakes

Dear Mr. Obermeyer:

Enclosed is a signed copy of the Petition and Resolution of the City of Eden Prairie to the Nine Mile Creek Watershed District for the Water Quality Improvement Projects for Northwest Anderson, Southwest Anderson, Birch Island and Bryant Lakes. The petition and resolution include a funding request for the following items.

<u>Northwest and Southwest Anderson Lakes</u>

- Develop management goals for Northwest and Southwest Anderson Lakes that call for management of the lakes as a wildlife sanctuary that would reflect limited access to the lakes. This would include re-evaluation of the water quality goals for the lakes in relation to the proposed management strategy and lowered water elevations that would result in a shallow, macrophyte-managed lake system.
- Partner with the City, Three Rivers Park District and the Department of Natural Resources (MDNR) to conduct a water level draw-down in Northwest and Southwest Anderson Lakes. This would include drawing down the lake levels for one or two winters to assist in control of noxious weeds and improve the water quality of the lake.
- Reestablish the water levels for Northwest and Southwest Anderson Lakes at 837.5 MSL.
- Add stormwater basins for areas without stormwater management ponds (SW-AL-9 and NW-AL-9)
- Upgrade existing stormwater management basins that do not meet current standards (NW-AL-12, NW-AL-17, NW-AL-18 and SW-AL-8).

Bryant Lake

- Develop an invasives species treatment plan based on current research by the MDNR.
- Develop a comprehensive database of in-lake conditions for vegetation, including stem density and biomass counts, prior to development of aquatic plan treatment alternatives.
- Restore and upgrade the historical wetland along County Ditch 34 leading into Bryant Lake (BL-11) to provide increased stormwater treatment capacity.
- Develop a Master Plan for and construct a trail system within the Cardinal Creek Conservation Area that would reflect the use of the property and highlight the wetland restoration work proposed for County Ditch 34. A letter was submitted to the Board on July 7, 2005 by Mr. Robert Lambert, Director of Parks and Recreation. Please refer to this transmittal for more detailed information on the Master Plan project.
- Treat Bryant Lake with a single in-lake alum treatment.
- Develop a fisheries management plan.

Birch Island Lake

- Conduct a water level restoration project.
- Add one new stormwater management basin (BIL4-1).
- Upgrade one stormwater management basin to current standards (BIL8).

Miscellaneous Actions

- Assist the City in developing public education materials to inform the public about the proposed projects.
- Coordinate the proposed aquatic macrophyte surveys with the City's ongoing survey efforts. Copies of the 2004 aquatic survey results for Smetana Lake and Anderson Lakes are submitted under separate cover.
- Develop a monitoring and ongoing evaluation program for the proposed improvements.

Please contact me at 952-949-8327 or lstovring@edenprairie.org if you have any questions regarding this transmittal.

Sincerely,

Leslie A. Stovring
Environmental Coordinator

PETITION OF THE CITY OF EDEN PRAIRIE TO NINE MILE CREEK WATERSHED DISTRICT FOR THE NORTHWEST ANDERSON, SOUTHWEST ANDERSON, BIRCH ISLAND AND BRYANT LAKE BASIC WATER MANAGEMENT PROJECTS

I. AUTHORITY

The City of Eden Prairie petitions the Nine Mile Creek Watershed District, pursuant to the provisions of the Minnesota Statutes Sections 103D.201, 103D.605, 103D.705, and 103D.905, to undertake a basic water management project to protect and improve the water quality in Northwest Anderson, Southwest Anderson, Birch Island, Bryant and Smetana Lakes.

II. PURPOSE

The purpose of the project is to improve the water quality of the lakes within the Nine Mile Creek watershed by reducing internal and external sources of phosphorus in and to the lakes that contribute to alga growth, resulting in decreased water quality, clarity and transparency. The Board of Water and Soil Resources approved and the Board of Managers adopted a watershed management plan that assessed the condition of the lake through determination of its physical, chemical, and biological qualities. The approved and adopted watershed management plan dated May 1996 is incorporated by reference.

The project for the cities of Eden Prairie, Minnetonka and Bloomington will help remedy water quality impacts from increased urbanization within the watershed. The Use Attainability Analyses for Anderson Lakes (June 2003, reissued Draft January 2005), Birch Island Lake (June 2000), Bryant Lake (October 2003, reissued Draft March 2005) and Smetana Lake (May 2003) and the Water Level Investigation Report for Birch Island Lake (July 2005) are incorporated by reference.

III. GENERAL DESCRIPTION OF WORK PROPOSED AND PURPOSES

A series of stormwater management and water quality improvement projects are proposed to manage and improve the water quality of the Anderson, Birch Island, Bryant and Smetana Lakes. The management options and proposed improvements are designed to limit impacts from increased urbanization within each lake's watershed.

Within the City of Eden Prairie, the proposed projects are listed below.

Stormwater Management

- Add storm water basins within the Anderson Lakes system for areas without stormwater management ponds (SW-AL-9 and NW-AL-9).
- Upgrade existing storm water management basins to meet NURP standards within the Anderson Lakes system (NW-AL-12, NW-AL-17, NW-AL-18 and SW-AL-8).
- Add one new (BIL4-1) and upgrade one (BIL8) storm water management basin for Birch Island Lake. The location for the new pond must be coordinated with the City's Parks Department to avoid historically significant areas.
- Restore and upgrade the wetland area within County Ditch 34 for Bryant Lake (BL-11).

The new and upgraded basins should conform to the standards for the National Urban Runoff Ponding Basins and the requirements of the Minnesota Pollution Control Agency to the fullest extent possible.

Water Quality Management

- Develop management goals for Northwest and Southwest Anderson Lakes that call for establishment of a wildlife sanctuary that would reflect limited access to the lakes for interpretive programming only.
- Evaluate the water quality goals for Northwest and Southwest Anderson Lakes in relation to the proposed management strategy and lowered water elevation. The Minnesota Pollution Control Agency (MPCA) has expressed an interest in not placing shallow, macrophyte-managed lakes on the impaired waters list for nutrients.
- Treat Bryant Lake with a single in-lake alum treatment for temporary phosphorus reduction in the lake.
- Develop and coordinate a fisheries management plan for Bryant Lake with the DNR that would include fish stocking.
- Conduct the work proposed in the Water Level Investigation Report to restore water levels within Birch Island Lake to more historical levels.
- Continue monitoring of the lakes as needed to evaluate and monitor changes in water quality.

Aquatic Plant Management

- Draw down the water level within Northwest and Southwest Anderson Lakes for one to two years. The drawdown should result in the bottom sediments freezing over winter. A control structure would need to be constructed between Southwest and Southeast Anderson Lakes to maintain the water in Southeast Anderson at its current level. The project will need to be coordinated with the Department of Natural Resources (DNR) and the City of Bloomington.
- Reestablish the water levels for Northwest and Southwest Anderson Lakes at an elevation of 837.5, the elevation originally intended for the lake.
- Develop a comprehensive database of in-lake conditions for vegetation within Bryant Lake. This would include stem density and biomass counts prior to development of final aquatic plant treatment alternatives.
- Evaluate Eurasian water milfoil and curly leaf treatment options for Bryant Lake based on the results of the DNR study currently being conducted on similar lakes. The treatment alternative(s) selected should be coordinated with the Three Rivers Park District's current treatment program.
- Coordinate aquatic macrophyte (plant) survey with the City's ongoing plant survey program

Public Education

- Develop a trail system within the Cardinal Creek Conservation Area that would reflect the use of the property as a passive recreational area and would highlight the wetland restoration work for County Ditch 34 (BL-11).

- Assist with developing public education materials in conjunction with the City's watershed education efforts to inform residents about the water quality projects proposed for the lakes.

Continued monitoring and re-evaluation of the effect of constructing the proposed improvements for the purpose of determining whether additional controls are required are requested.

IV. DESCRIPTION OF THE LANDS OVER WHICH THE PROPOSED IMPROVEMENTS ARE LOCATED

The project will be located on property that is directly or indirectly tributary to Anderson Lakes, Birch Island Lake, Bryant Lake and Lake Smetana within the Nine Mile Creek watershed that is located on the northern and eastern boundaries of Eden Prairie. The cities of Minnetonka and Bloomington are within this area also. Within Eden Prairie, the project will be located within the Nine Mile Creek watershed. In general area this includes the area south of Highway 62, east of Eden Prairie Road, west of the City boundary with Bloomington and north of Anderson Lakes Parkway. The improvement locations are described in detail in the Anderson, Birch Island, Bryant and Smetana Lake Use Attainability Analyses, which are incorporated by reference.

V. GENERAL DESCRIPTION OF THE PART OF THE DISTRICT AFFECTED

The affected lands are located in the cities of Eden Prairie, Minnetonka and Bloomington. The area within the City of Eden Prairie includes the Nine Mile Creek watershed, including the riparian and tributary drainage areas to Anderson Lakes, Birch Island Lake, Bryant Lake and Lake Smetana as well as Nine Mile Creek.

Northwest and Southwest Anderson Lakes are primarily in Eden Prairie. Northwest Anderson does extend eastward into the City of Bloomington. The watershed contains woodlands, marsh, residences, parks and open spaces. Nine Mile Creek is the outlet from Southeast Anderson Lake.

Birch Island Lake is located within Eden Prairie but the watershed extends northward into the City of Minnetonka. The watershed consists primarily of commercial, residential, agriculture and park/open space development. Future land use is anticipated to include a switch from agriculture and open space to more residential and highway as well as some commercial. The current stormwater ponding system for the lake's current and future watershed is inadequate.

Bryant Lake is a 176 acre lake within an urbanized watershed. Two main tributaries enter the lake from the north and from the west. They contribute 22% of the lake's annual phosphorus load. The remaining is primarily from internal phosphorus recycling, the lake's direct watershed and from atmospheric deposition. The proposed recommendations address the internal loading and the two main tributaries.

Smetana Lake is a 56.5 acre lake with an urbanized watershed. The primary sources of phosphorus to the lake were natural conveyance systems, which includes runoff from streams and storm drains. The proposed recommendations address the non-treated water inputs from natural conveyance systems.

VI. NEED AND NECESSITY FOR THE PROPOSED IMPROVEMENT

Continued development in tributary areas necessitates water quantity management and treatment of water quality to protect and improve the scenic, recreational and wildlife of those specific lakes and the overall water quality of the District.

VII. THE PROPOSED IMPROVEMENT WILL BE CONDUCIVE TO THE PUBLIC HEALTH, CONVENIENCE AND WELFARE

The City of Eden Prairie petitions for the project because it will be conducive to the public health, convenience and welfare of the District and the City. Completion of the project, and associated recreational improvements, will preserve and enhance the public use and enjoyment of the lakes and adjacent parklands, all of which are significant natural resources of the District and region.

VIII. FINANCING OF THE PROPOSED IMPROVEMENT

The project is identified in the Nine Mile Creek Watershed District Water Management Plan and is a priority project of common benefit to the entire District. Minnesota Statutes Section 103D.905, Subdivision 3 provides for the project financing of the basic water management features of the project. The District will fund 100% of the costs of the project with the exception of any easement or property acquisition and trail construction. The City will share 75% in the cost of the cost of any such acquisitions and 50% in the cost of trail construction. The City will also fund 100% of any related activities that are not covered under the basic water management features of this proposal such as distribution of educational materials and aquatic plant surveys.

IX. PROJECT ABANDONMENT

The City of Eden Prairie hereby states and acknowledges that it will pay all costs and expenses that may be incurred by the activities described in this petition in the event the project is dismissed, no construction contract is let, or the City withdraws its project petition.

CITY OF EDEN PRAIRIE

Nancy Tyra-Lukens

Mayor of City of Eden Prairie

CITY OF EDEN PRAIRIE

Scott H. Neal

City Manager

CITY OF EDEN PRAIRIE
HENNEPIN COUNTY, MINNESOTA

RESOLUTION NO. 2005-104

RESOLUTION RELATING TO THE NINE MILE CREEK WATERSHED DISTRICT LAKE WATER QUALITY IMPROVEMENT PROJECTS

WHEREAS, the lakes within the Nine Mile Creek Watershed District, including Northwest Anderson, Southwest Anderson, Bryant, Birch Island and Smetana Lakes, are important features within the City of Eden Prairie; and

WHEREAS, the City Council is committed to water quality improvement within Nine Mile Creek watershed and its tributary lakes; and

WHEREAS, there is a documented relationship between deteriorating water quality within Nine Mile Creek and its tributary lakes and the current stormwater ponding system; and

WHEREAS, the City of Eden Prairie has determined that improvements to the quality of the lakes, stormwater treatment systems and fishery habitats are required to fully realize the recreational potential of the lakes.

NOW, THEREFORE, BE IT RESOLVED, the City Council desires to complete those items recommended within the Use Attainability Analyses to improve the water quality of Northwest Anderson, Southwest Anderson, Bryant, Birch Island and Smetana Lakes and hereby approves the attached petition to the Nine Mile Creek Watershed District to:

- Manage Northwest and Southwest Anderson Lakes as a wildlife sanctuary with a permanent water elevation of 837.5,
- Partner with the City, Three Rivers Park District and Dept. of Natural Resources to conduct a water level draw-down in Northwest and Southwest Anderson Lakes,
- Complete the stormwater pond upgrades and installations proposed for Birch Island, Northwest and Southwest Anderson Lakes,
- Develop an invasive species treatment plan for Bryant Lake based on research currently being conducted by the Minnesota Department of Natural Resources (DNR) and completion of an in-lake analysis of vegetation (including stem density and biomass) and coordinate implementation of the selected treatment option with Three Rivers Park District,
- Restore the historical wetland along County Ditch 34 leading into Bryant Lake,
- Develop a plan for and construct a trail system in conjunction with the wetland restoration along County Ditch 34 and within the Cardinal Creek Conservation Area.
- Treat Bryant Lake with a single in-lake alum treatment,
- Develop a fisheries management plan for Bryant Lake,
- Conduct a water level restoration project for Birch Island Lake,

- Develop public education materials in conjunction with the City's watershed education efforts to inform the public about the proposed projects, and
- Coordinate the proposed aquatic macrophyte surveys with the City's ongoing survey efforts.

BE IT FURTHER RESOLVED, the City Council does request that the Nine Mile Creek Watershed District participate in funding these activities with a cost share of 25 to 100% as defined in the attached petition.

ADOPTED by the Eden Prairie City Council August 16, 2005.

Nancy Tyra-Lukens, Mayor

SEAL

ATTEST:

Kathleen Porta, City Clerk