

LDL-899

Report

Phase III Lake Study Report

Archibald Lake, Oconto County

Scope I.D.: 00A017

May 2004



LPL-895

Archibald Lake Association Phase III Report

Contents

	Page
1. Introduction	1
1.1 Authorization	1
1.2 Purpose	1
2. Septic System Evaluation	2
3. Storm Water Impacts	5
4. Goose Population Evaluation	7
5. Gypsy Moth Impacts	8
6. Secchi Depth	9
7. Phosphorus Loading	10
7.1 Phosphorus Loading from Non-Point Sources	10
7.2 Phosphorus Loading from Point Sources	10
8. Conclusions and Recommendations	12
8.1 Conclusions	12
8.2 Recommendations	12

Figures

Figure 2-1 Septic Systems Evaluation	4
--	---

Appendices

Appendix A	Sanitary Survey Results
Appendix B	Terrace Lane Erosion Photos
Appendix C	Goose Impact 2003

1. Introduction

Archibald Lake is located in the Section 1, 2, and 3, T32N, R15E in the Town of Townsend, Oconto County, Wisconsin. The lake covers an area of 430 acres as referenced on the website www.dnr.state.wi.us/org/water/fhp/lakes/lakemap/oconto.htm, with approximately 10% of the lake area less than 3 feet in depth and approximately 42% of the lake area exhibiting a depth of over 20 feet. The maximum depth of the lake is approximately 50 feet. The lake has 7.47 miles of shoreline.

In April 2003, the Archibald Lake Association was awarded a Lake Management Planning Grant from the Wisconsin Department of Natural Resources (WDNR) to conduct a Phase III study to consider the impact of septic systems and storm water on the water quality in Archibald Lake.

1.1 Authorization

The Archibald Lake Association authorized Foth & Van Dyke and Associates Inc. to complete the Phase III study for Archibald Lake, and to prepare a report identifying the results. The study was completed through a collaborative effort between Foth & Van Dyke and the Archibald Lake Association volunteers.

1.2 Purpose

The purpose of the Phase III lake study was to address the following areas.

- ◆ Evaluate the septic systems around Archibald Lake. Determine the potential impact the septic systems have on the lake.
- ◆ Evaluate the impact of storm water runoff on Archibald Lake. Make general recommendations to improve storm water management around Archibald Lake.
- ◆ Evaluate the goose population on the lake in 2003 after reduced feeding through education was implemented.

The results of this study will be used to provide the Archibald Lake Association with an understanding of the impact from septic systems and storm water runoff on the lake water quality. This report may be used in conjunction with the Phase II study to develop a long term lake management plan for Archibald Lake.

2. Septic System Evaluation

A sanitary survey was conducted on July 5, 2003 at Archibald Lake. Staff from Foth & Van Dyke along with lake association volunteers collected information from over 70 residences. The completed survey forms are included in Appendix A.

The intent of the survey was to gather information on the type of septic system, the system age, the system location in relation to the lake, and document any problems with the septic systems. A point system was developed for each of the categories. The point system is as follows:

Category	Criteria	Points
Septic System Age	Over 20 years	1
	11 to 20 years	2
	1 to 10 years	3
Horizontal Distance From Lake	0 – 50 feet	1
	51 – 100 feet	2
	101 – 150 feet	3
	Over 150 feet	4
Vertical Distance Above Lake	0 – 5 feet	1
	6 – 10 feet	2
	11 - 15 feet	3
	16 – 20 feet	4
	Greater than 20 feet	5
Septic System Operation	Back-up, roots, overflow	1
	Odor	2
	No problem	3

A septic system that graded as the worst possible would have 4 points total with one point for each category. A septic system that graded as the best possible would have 15 points total. Generally, septic systems that score less than 10 points have a higher potential to impact the lake.

A total of 75 septic systems were evaluated for all point categories. There were 16 septic systems that scored 9 points or less. The 16 systems that scored 9 points or less have a high potential to impact the lake and represent 21% of the total systems evaluated.

The 16 systems generally had the following in common:

- ♦ System age is 15 years or more.
- ♦ The vertical distance above the lake is 12 feet or less. Subtract 4 to 5 feet for the actual piping depth where the septic system discharges.
- ♦ The horizontal distance from the septic system to the lake is 100 feet or less.

Figure 2-1 shows the location of septic systems with an impact score of nine or less.

An example of an improved septic system is 16539 Archibald Parkway. At the time of the survey, the septic system was 40 feet from the lake and less than 10 feet above the lake at the surface. The existing system was being replaced soon with a pumping system and a new disposal field over 150 feet away from the lake and much higher in elevation. The new system will have a much lower potential impact on the lake than the existing system.

Groundwater studies done in the Phase 2 report show Archibald Lake is mainly a seepage lake where lake water discharges to groundwater. The main groundwater input to the lake is near the north and west ends of the west basin. The groundwater flow direction was shown to change seasonally at most test locations. Septic systems may have an impact on the lake when groundwater flow direction is toward the lake.



★ Septic Systems with an impact score of 9 or less.

— 0% groundwater flow to lake

— Less than 50% groundwater flow to lake

— Greater than 50% groundwater flow to lake



This drawing is neither a legally recorded map nor a survey and is not intended to be used as one. This drawing is a compilation of records, information and data used for reference purposes only.

Source: U.S.G.S. 7.5-minute topographic quadrangle.
Townsend (1972) - Oconto County, Wisconsin.



0 200 400 600 800 1000 Feet

m:\00a017\apr\townsend3.apr

ARCHIBALD LAKE

FIGURE 2-1
SEPTIC SYSTEMS EVALUATION

Scale: AS SHOWN

Date: May 18, 2004

Drawn By: kpk1

Checked By: pak

Scope: 00a017

3. Storm Water Impacts

Storm water can affect the lake water quality by carrying pollutants into the lake. The pollutants get into storm water when the storm water erodes soil or when contaminants are dissolved from the soil surface. Improving storm water management around the lake can reduce the amount of pollutants that enter the lake.

The sanitary survey form also included questions and space for drawing storm water runoff patterns at each lot. Appendix A contains the sanitary survey forms. Information on storm water is contained on the back side of each form. Erosion and storm water runoff are difficult to quantify thus the survey form did not include numerical values for each lot. The information obtained did contain general trends that showed the following:

- ◆ Many lots have a relatively high slope that contributes to runoff and erosion.
- ◆ Most lots slope to the lake.
- ◆ The soils around the lake are generally sandy. The soil is highly permeable but vegetation growth is often poor.
- ◆ Runoff and erosion are common around the house due to downspouts or drains from the roof.
- ◆ Many lots are terraced with stone or rip rap walls near the lakeshore.

Based on the observations made during the sanitary survey, Foth & Van Dyke recommends that homeowners take advantage of the sandy soils to provide areas that promote infiltration into the soil. The soil will filter out pollutants and slowly release the storm water to the groundwater. The following recommendations can be used by homeowners to improve storm water management on their property.

- A. If a house has no gutters, install a raised gravel bed beneath the roofline. Storm water will run off the roof and fall onto the raised gravel bed. There the water will be stored and soak into the ground without causing runoff and erosion.
- B. If a house has gutters and downspouts, there are several alternatives to reduce runoff and erosion:
 - ◆ Directly connect the downspouts to buried perforated plastic tubing that allows the rainwater to infiltrate into the ground.
 - ◆ Directly connect the downspouts to dry wells that allow water to soak into the soil.
 - ◆ Install non-eroding channels to direct water to an infiltration area. The infiltration area can be a gravel bed, dry well, or flat area on the lawn.
- C. Where water comes from driveways or offsite, use non-eroding channels directed to infiltration areas to minimize runoff.

- D. Construct terraces on sloped lots to reduce runoff.
- E. Remove leaves and other vegetation from the yard in areas where storm water can wash the vegetation into the lake. Leaves contain high concentrations of phosphorus and nitrogen that can break down in the lake releasing the nutrients as potential food for algae and lake weeds.

In addition to runoff on residential property, significant runoff can occur from construction sites and roads. These areas can be concentrated sources of pollutants.

In the summer of 2003, some erosion was observed at the intersection of Terrace Lane and Archibald Parkway on the west side of the lake. Silt fencing was used to minimize the transport of sediment into the lake. This area has a steep slope and a drainage channel to the lake. Appendix B contains photos of this area. Construction of a subdivision to the north and west of this intersection contributed excess water and sediment downstream to the drainage channel. To prevent further erosion, control devices should be maintained until vegetation is established.

While subdivisions and erosion control along public road ways are out of the control of the lake association, where erosion is observed, lake association members can contact the county highway department to make sure erosion control devices are maintained. If runoff continues to be an erosion problem in the Terrace Lane area, consideration could be given to constructing a storm water management facility such as storm sewer, detention pond, or an infiltration area.

4. Goose Population Evaluation

Dick Boyer from Archibald Lake Association observed goose populations on Archibald Lake during the 2003 open water season. The goose population was steady at 16 geese through July. From August until the end of the year, the population was observed to be 15 geese. One goose was found dead in August.

The impact from the geese during 2003 was approximately 320 pounds of fecal matter including 5 pounds of phosphorus. A detailed calculation on fecal matter associated with geese is found in Appendix C.

The number of geese using Archibald Lake in 2003 was significantly lower than in 2001. The Association worked to educate members on the harm that geese could do and advised residents against feeding geese. These efforts have paid off and the goose population is down by over 80%.

5. Gypsy Moth Impacts

During the sanitary survey, gypsy moth larvae were observed at many sites along the lake. While gypsy moths are considered a forest pest, the health of the lake is directly related to the health of the forest around the lake.

Gypsy moths can defoliate forest areas when populations are high. Although trees can grow new leaves later in the year, the erosion potential is high when the leaves are off the trees. Rainfall normally is deflected by the tree leaves and gently falls to the ground. When the leaves are gone, rain falls directly on the ground and causes more erosion and runoff. This increases the amount of pollutants that are washed into the lake. Other negative impacts on the lake include warmer soil and water temperatures, pollution from larva droppings, and potential tree death.

Controlling gypsy moths around Archibald Lake should be considered a priority in maintaining a healthy ecosystem around the lake and reducing runoff pollution from entering the lake.

6. Secchi Depth

The original work scope for the Phase 3 project was to extend the secchi depth readings past Phase 2 for the remainder of the 2003 season. Work was delayed in starting the Phase 2 work and all secchi depth readings taken in 2003 are contained in the Phase 2 report.

7. Phosphorus Loading

7.1 Phosphorus Loading from Non-Point Sources

The non-point phosphorus budget was revised based on information collected in the Phase 2 and Phase 3 studies. The revised phosphorus budget is as follows:

Land Use Class	Acreage	Phosphorus lbs/acre/yr	Phosphorus lbs/yr	% of Total Phosphorus
Row Crop	2.9	0.89	3	1%
Mixed Ag	2.7	0.71	2	1%
Pasture/Grassland	8.9	0.27	2	1%
Rural Residential	450	0.089	40	16%
Emergent Wetland/Meadow *	119	0.089	11	4%
Forested *	1476	0.08	118	46%
Lake Surface	430	0.089	38	15%
Waterfowl **	N/A	N/A	44	17%
Total			258	100%

Notes: * - Stream loading from Phase 2 report = 62 lbs/yr phosphorus. Stream loading included in Forested/Wetland categories.

** - Waterfowl data based on 2001 counts.

The largest phosphorus loading categories are forested, waterfowl, rural residential, and the lake surface. Controlling erosion and runoff in the watershed will minimize the impact from forested areas and the lake surface. Waterfowl and residential sources can be controlled in a variety of ways and should be the primary focus of the lake association.

7.2 Phosphorus Loading from Point Sources

On-site wastewater treatment systems are used by residents on Archibald Lake. These systems typically consist of a septic tank and a disposal field or dry well. Phosphorus is discharged from the septic tank to the soil and into the groundwater. Where groundwater flows into the lake, phosphorus from septic systems can be a source of pollution.

Phosphorus reacts with chemicals in the soil to be retained on soil particles. Newer septic systems typically have much of the phosphorus discharged retained on the soil. As the system ages, the soil reaches capacity for retaining phosphorus and phosphorus can pass through the soil into the groundwater and reach the lake. In the case of Archibald Lake, most of the groundwater flow is away from the lake and it is estimated that only 25% of the septic systems flow into the lake.

The following table summarizes the potential phosphorus loading from septic systems around Archibald Lake.

Septic tank phosphorus loading

Phosphorus output - lbs/capita/year =	1.1	
Assume 100 residences/3.0 people per residence/50 days per year =	41	capita-years
Total phosphorus output from septic tanks =	45	pounds/year
Phosphorus retained by soil =	80%	
Groundwater flow to lake =	25%	
Total phosphorus discharge to lake =	2.3	pounds/year

The estimated phosphorus discharge can change depending on the age of the septic systems and how much phosphorus is retained by the soil. Improving and maintaining septic systems is an important part of lake management because that source is readily accessible.

8. Conclusions and Recommendations

8.1 Conclusions

- ◆ Approximately 20 % of the homes around the lake have septic systems that may be contributing nutrients into the lake. These systems typically are 15 years old or more, are within 100 feet of the lake, and are less than 12 feet above the lake level. These systems are predominantly on the south side of the lake.
- ◆ The sandy soil around the lake allows rapid infiltration of storm water but the soil also is poorly vegetated and steep slopes can be eroded.
- ◆ Some erosion was noticed in the area of Terrace Lane and Archibald Parkway.
- ◆ The goose population on Archibald Lake in 2003 was less than 20% of the 2001 goose population.
- ◆ Gypsy moths were found during the on-site survey.
- ◆ The major sources of phosphorus to Archibald Lake are non-point type with forested and residential areas the largest contributors. Waterfowl also can be a significant source of phosphorus. Septic systems were not a major source of phosphorus but are a source that can be impacted by good management.

8.2 Recommendations

- ◆ Provide education regarding septic systems around lake areas to encourage proper septic system operation.
- ◆ Provide information on storm water management on lake property. A brochure handed out at an annual lake association meeting would be an effective method of education.
- ◆ Contact county highway department to establish vegetation on the corner of Terrace Lane and Archibald Parkway and to maintain erosion control measures.
- ◆ Continue education regarding feeding geese and ducks and monitor waterfowl population yearly.
- ◆ Provide educational materials on gypsy moths. Work with county extension office to maintain a healthy forest.
- ◆ Incorporate findings from the three completed study phases into a lake management plan.