

# CEDAR LAKE WATERSHED MANAGEMENT PLAN



Submitted by:

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May 2011

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## List of Attachments

<b>ATTACHMENT A</b>	Water Quality Monitoring Plan and AICLA 2011 Results
<b>ATTACHMENT B</b>	Preliminary Invasive Species Lists
<b>ATTACHMENT C</b>	Septic System Loading Calculations Document
<b>ATTACHMENT D</b>	Preliminary Roles of a Lake Manager
<b>ATTACHMENT E</b>	Implementation Strategy Table
<b>ATTACHMENT F</b>	Wetland Protection Materials: <ol style="list-style-type: none"><li>1) Sample Ordinance Language</li><li>2) Policy Options for Cedar Lake Table</li><li>3) Information on Legal Challenges to Wetland Ordinances</li></ol>
<b>ATTACHMENT G</b>	A Primer on Muck (Dr. Douglas Pullman)
<b>ATTACHMENT H</b>	Preliminary Lake Stewards Program Information
<b>ATTACHMENT I</b>	Educational Program Priorities
<b>ATTACHMENT J</b>	Land Protection Materials: <ol style="list-style-type: none"><li>1) PA 446 Fact Sheet</li><li>2) Tax Benefits for Conservation Easements Brochure</li></ol>

## ACKNOWLEDGEMENTS

This watershed management plan document has been developed by Kieser & Associates, LLC working on behalf of the Cedar Lake Improvement Board. The information in this watershed management plan was developed by a steering committee through two years of quarterly and monthly meetings. The steering committee was comprised of a variety of local stakeholders, including township and county leaders, lake association members, property owners association, state natural resources staff, biologists, and other natural resources professionals. Their local knowledge of watershed conditions, public opinions, and general interest in improving the Cedar Lake watershed have contributed to the goals, objectives, strategies, approaches, and recommendations contained in this plan.

In particular, the steering committee and other individuals involved in this watershed management planning process would like to thank Cedar Lake property owners and the Lake Improvement Board for investing tax funds into this plan. The watershed management plan was paid for by the lake riparians through a property tax assessment. The plan provides strategies for natural resource protection and restoration in the Cedar Lake watershed that will protect and improve the lake, property values, and recreational value for generations to come.



# CHAPTER 1: INTRODUCTION

## Background

A comprehensive watershed management plan (WMP) represents a framework where watershed needs and solutions are identified to preserve, protect or restore water quality and natural resources around Cedar Lake. The WMP is not a regulation, ordinance or law, but rather serves as a template for justifying and developing such controls that may be needed. For many of the issues in the watershed, the WMP does not recommend regulatory action, but identifies voluntary efforts that the Cedar Lake Improvement Board (herein Lake Board) and other interested groups should pursue. Once approved, the complete WMP will serve as a road map for achieving community goals for sustaining Cedar Lake and its watershed. The following chapters of the WMP will: 1) provide background on the watershed and its resources; 2) include a synopsis of designated and desired uses in the watershed; 3) identify watershed concerns, threats, and impairments; 4) define watershed goals and objectives; and 5) recommend a strategy for WMP implementation with approaches and projects for protection and restoration. The WMP also prioritizes the necessary approaches and improvement projects in the watershed, based on timing and funding considerations.

The WMP describes the areas within the watershed that are more crucial, or “critical areas” where protection and restoration actions should be prioritized. Managing these critical areas to minimize impacts from future development, including drainage and diversions from Cedar Lake or increasing urban nutrient and sediment loads to the lake, is vital for protecting the watershed and its resources. The watershed goals identified in the WMP were developed through an integrated analysis of the watershed threats and concerns, designated and desired uses in the watershed, and these critical areas for protection.

## WMP Drivers

The need for a comprehensive watershed management plan for the Cedar Lake watershed was realized after results from the hydrologic study were presented to the Lake Board. The study’s findings revealed that land development and installation of a drainage system on the southeast side of the lake was a major source of water loss from the lake during summer months. In addition, the wetlands complex in the northwest part of the watershed was identified as a major source of water recharge (both through groundwater and intermittent surface flows). Such a land use change as the development in the southeast and the resulting impacts

demonstrated to the Lake Board that a watershed planning process to protect the Cedar Lake watershed and its recharge areas was extremely important in order to protect Cedar Lake for future use.

In addition to the findings of the hydrologic study, several other undesirable conditions in the watershed worked as a driver to create a watershed management plan. The Lake Board noted several water quality and resource concerns that required a new approach to managing critical areas and conditions in the watershed, beyond just the lake. Exotic and nuisance aquatic vegetation was exponentially increasing in the lake. Residents were noticing the negative impacts on recreation and aesthetics and demanding action. Fisheries and hydrology studies both indicated that flows from the tributaries and fish-spawning habitat showed declining conditions. The flux of summer lake levels was creating problems with re-suspension of anaerobic sediments, reduction in functional aquatic habitat near the shoreline, and increased nutrient concentration with low lake volumes. The final issue that created demand for developing a WMP was the lack of a cohesive plan to address water resource needs and opportunities.

Prior to the Lake Board's direct involvement, the Alcona-Iosco Cedar Lake Association, Inc. (AICLA), applied for funding through the State of Michigan Department of Environmental Quality for a watershed planning grant. When the grant request was not successful two years in a row, the AICLA petitioned the Lake Board's involvement. At that point the Lake Board agreed to pursue the project and decided to approach the public with the idea of funding the WMP through a tax assessment of the lakeshore residents. The Lake Board contracted with Kieser & Associates, LLC (K&A) in 2008 and work began on developing a WMP and facilitation of the planning process.

## **Watershed Management Planning Process**

One of the preliminary steps in the WMP process is convening a steering committee (SC) to lead the WMP planning process, consult technical resources, and provide local knowledge of the watershed and public's interest. For Cedar Lake, there was a broad-based representation of the local townships, county agencies, natural resource experts, and state representatives. Many of the members of the SC serve on the Lake Board, which has been responsible for nuisance weed management on Cedar Lake. Township and county representatives are important individuals to serve on a SC because they have assessment and planning authority, both of which have been recognized by these agencies as necessary for restoring and protecting Cedar Lake resources. The SC originally planned to meet on a quarterly basis to discuss current watershed conditions

and concerns. In order to properly address the issues in the watershed, the group began to meet every other month through 2008 to develop watershed goals and objectives and lay a solid foundation for the WMP. They worked to identify known and suspected pollutants and problematic modifications in the watershed. Because of their positions in township and county government and other positions in watershed leadership, SC members have a good sense of the public's perceived problems in the watershed, major concerns, and the expectations that must be met.

In April 2009, the SC began to meet on a monthly basis. The committee took on the task of identifying critical areas in the watershed and developing an implementation plan for the WMP. The group discussed ordinances for wetland protection and other approaches to protecting and restoring the natural hydrology in the watershed. Throughout the process, the group worked primarily through consensus to tailor recommendations to fit the needs of the public and the ecosystem of Cedar Lake. The SC meetings were open to the public and a few residents of the watershed and some county and township representatives sat in on some meetings.

The following individuals served on the SC in some capacity. A portion of the group was present at the meetings on a regular basis and participation was encouraged through conference call in the latter part of the WMP planning process:

Gary Adams, Iosco County Drain Commissioner  
Caryl Anton, Alcona-Iosco Cedar Lake Association  
Russ Anton, Alcona-Iosco Cedar Lake Association  
Jim Baier, Oscoda Township Supervisor (*replaced Rob Huebel, former Supervisor*)  
Carolyn Brummond, Alcona County Board of Commissioners  
Gina Cinquino, Lakewood Shores Property Owners Association  
Gary Crawford, SEAS, LLC  
Doug Getty, District Health Department  
Greg Goudy, Michigan Department of Environmental Quality  
Richard Karsen, Sr., Alcona County Road/Drain Commission  
Mark Kieser, Kieser & Associates, LLC  
Ryan Kruse, Natural Resources Conservation Service  
Jamie McCarthy, Kieser & Associates, LLC  
Craig Peters, Lakewood Shores Resort & Golf Course  
Doug Pullman, Aquest  
Edward Roddy, Greenbush Township Supervisor  
Roberta Roulo, Iosco County Commission

Steve Sendek, Michigan Department of Natural Resources  
Art Winter, Greenbush Township Board of Commissioners  
Rick Myrick, Alcona/Iosco County Conservation District

## Public Participation Process in WMP Development

The WMP planning process involved consistent commitment and input from a diverse group of individuals serving on the SC. Because many of the SC members from the township and county serve in elected positions, they were particularly aware of public opinion and regularly discussed how elements of the WMP must reflect the public's desires and priorities for the watershed. Public feedback was solicited through surveys distributed by the AICLA to all lake front residents and other local stakeholders. An initial survey was distributed to all lake front residents asking them to identify primary environmental concerns in the watershed. Information from the surveys was collected and compared with SC priorities to ensure all public concerns were expressed and aligned with the final watershed concerns table (see Table 3-1 in Chapter 3).

In addition to these meetings, information regarding the planning process was posted on a project website<sup>1</sup>. To obtain final public comment on the WMP, an executive summary was published in the AICLA's newsletter, *Whispering Waters*, which is distributed to all lake front property owners (member and non-member alike), as well as other interested residents of the area. A feedback form and stamped envelope were included to encourage public comments. In addition, copies of the newsletter were distributed to the Alcona County Library in Harrisville and the Clerk's Office in Oscoda Township. Public announcements were published in the two local newspapers to promote public review of the summary at the library or township office and solicit feedback from those not directly receiving the newsletter.

The feedback form distributed with the AICLA newsletter and to local government buildings asked stakeholders to review the WMP summary and answer the following: 1) are your major lake concerns reflected in the WMP goals, objectives, and approaches; 2) will you support the Lake Board in pursuing the projects and approaches in the summary; and 3) are there specific projects, approaches or activities you support that are not included in the summary? The response forms were sent to more than 700 lakeshore residents and 55 were returned with comments. The majority of the comments received supported the strategy outlined in the WMP summary. More than 60% of the respondents felt major concerns in the watershed were

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<sup>1</sup> Project website can be viewed at: [www.kalamazooriver.net/Kieser/Cedar\\_Lake\\_WMP/index.htm](http://www.kalamazooriver.net/Kieser/Cedar_Lake_WMP/index.htm)



reflected in the goals and objectives. Fewer than 10% responded with a direct answer of “no”. Many of the concerns listed on the feedback forms regarded issues that were actually addressed in the summary in one way or another or are discussed in the full WMP. Some of the main issues found in the feedback forms were:

- General interest in maintaining a healthy lake
- Maintain property values and recreational activities through increased/maintained lake levels
- Stronger rules to ensure water quality protection
- Full support of methods to control nuisance aquatic vegetation in the lake
- Flow/habitat enhancement at Sherman and Jones Creeks
- Improvements at the north spillway

The SC also has committed to developing and distributing a WMP brochure that summarizes the elements of the WMP and presents the implementation schedule to the public. The SC will continue to seek public input after this brochure is sent out to the public. Because the WMP is a living document that will change over time as the SC implements the plan, public feedback will play an important role in shaping management projects and approaches. This will be especially true when tax assessments are required to fund high-priority projects that will benefit lakeshore residents. The Lake Board abides by State of Michigan statute that requires public hearings to solicit stakeholder feedback on funding and tax issues.

## CHAPTER 2: WATERSHED DESCRIPTION

A general understanding of the characteristics of a watershed is essential for making management decisions to improve problem areas, maintain good conditions, and protect critical areas in the watershed. Several projects and studies in the watershed have involved field reconnaissance, monitoring activities, and lake and watershed surveys. These studies provided the SC with useful watershed information for describing a variety of areas and understanding the conditions of those areas. This chapter describes the natural and political features in the watershed that are relevant to the WMP planning process.

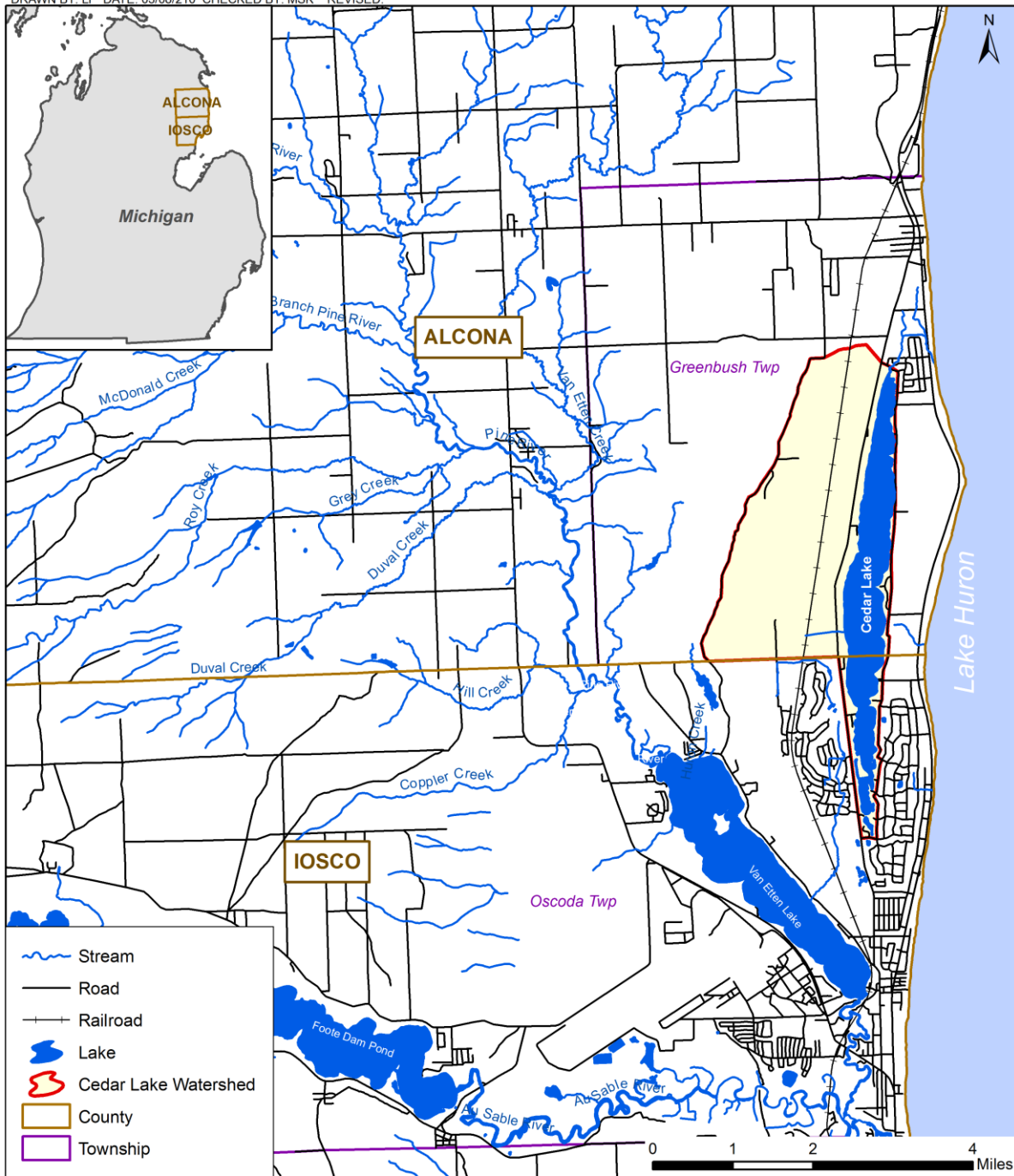
### Physical and Natural Features

The Cedar Lake watershed is located in the southeast corner of Alcona County and the northeast corner of Iosco County. The area draining to Cedar Lake is located in the HUC 04070003-0406 and is approximately 3,613 acres in size. This 1,075-acre, high-quality lake is situated approximately 0.5 miles east of the Lake Huron shoreline and one mile north of the City of Oscoda (see Figure 2-1). Cedar Lake is approximately 5.9 miles long, averaging approximately 0.2 miles wide. The lake is shallow, about 5 feet deep on average with a limited area as deep as 14 feet. The lake is used for boating, swimming, fishing, hunting, and wildlife viewing. Land uses in the area immediately surrounding and directly draining to the lake are generally comprised of residential, recreational, transportation, forests, grasslands, and wetlands. The main source of water recharge to Cedar Lake is the large wetland complex along the northwest side of the lake. The wetland is connected to Cedar Lake via intermittent streams and groundwater recharge. Because the lake is perched above other surface features, nearly 75% of the surrounding lands to the southwest, south, and east, (including shoreline areas) do not drain to the lake (Kieser & Associates, 2005). This condition presents a unique influence on both lake water level and water quality.

The lake is primarily groundwater-fed with two intermittent streams, Sherman Creek and a second unnamed creek, known locally as Jones Creek. These creeks flow during late winter months through late spring from the wetland complex in the northwest part of the watershed to Cedar Lake (see Figure 2-2). The lake has two man-made outflow drop-box structures at its north end that were constructed in the 1950's to regulate water level. Surface outflows from these structures typically occur following snowmelt through May and discharge to Lake Huron through an intermittent stream channel and another wetlands complex. Water levels in this shallow lake continue to drop dramatically through summer months once outflow ceases. Because of the importance of recharge and groundwater influences on the lake, the watershed

covered by this WMP includes areas to the north, east, and south that drain away from the lake but still require appropriate drainage and land use management. Surface and groundwater from these areas, as well as from the lake, eventually reach Lake Huron via pipes, streams, or subsurface discharge.

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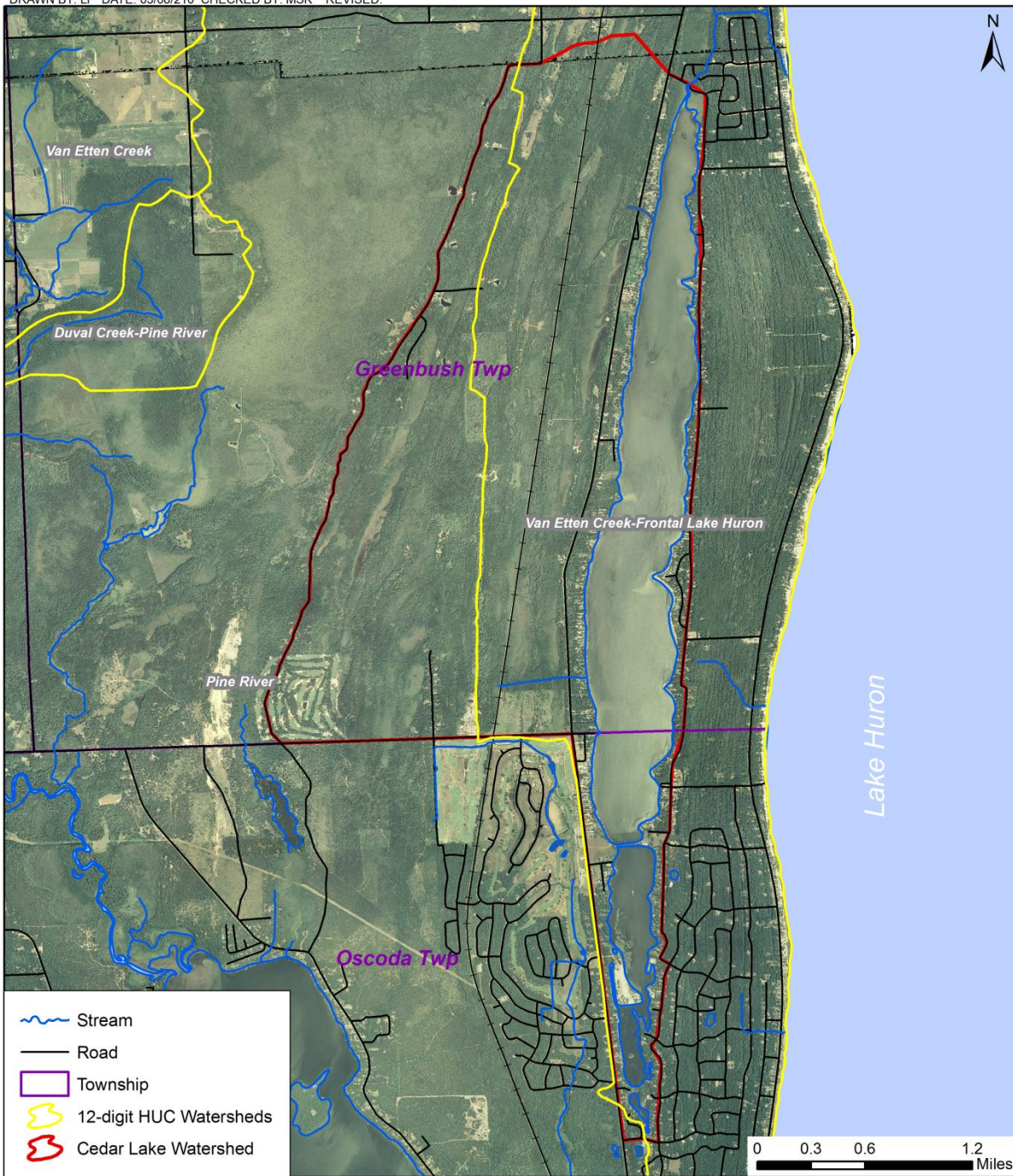
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**Figure 2-1. Site vicinity map of the Cedar Lake watershed located in northeastern Michigan in Alcona and Iosco Counties.**



The watershed boundary for Cedar Lake was delineated by the Michigan Department of Natural Resources (DNR) in a 1974 map published in *Michigan Inland Lakes and Watersheds -- An Atlas* (originally created circa 1959). This historic watershed boundary illustrates the largest contributing area of surface water and groundwater located around the cedar swamps near the northwest corner of the lake. It illustrates the entire lake perimeter as contributing to the lake and includes approximately 3,000 acres of direct surface drainage to the lake. K&A delineated a new watershed boundary based upon the surface and groundwater hydrology they studied around the lake from 2003-2006 (Kieser & Associates, 2005). The updated boundary shown in Figure 2-2 reflects the 3,613 acres of land that contribute both groundwater and surface water to the lake. One major difference is that the boundary extends further west to Poor Farm Road. The new delineation only includes major drainage from the area northwest of the lake and very limited areas immediately surrounding the lake. In the 2005 study, K&A found that groundwater moved out of the lake on the southwest, south, and east sides of the lake; therefore the watershed boundary only includes the surface drainage of small residential properties immediately adjacent to the lake.

This immediate shoreline around Cedar Lake is primarily developed with residential homes, recreational and homeowner association properties, and some natural areas. In addition to the developed areas immediately surrounding Cedar Lake, a platted housing development is located just outside of the watershed in the area immediately to the southeast and south, generally extending to the shores of Lake Huron. Although now developed for residential purposes, this area once supported large tracts of cedar swamps. Platting, road development, and housing construction beginning in the 1960s, and additional subsurface drainage improvements in the early 1980s, resulted in substantial loss of cedar swamps. One unintentional but significant ramification of these activities was the lowering of the groundwater table around Cedar Lake that has been shown to play a major role in summer time lake level losses.



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**Figure 2-2. Map of the Cedar Lake watershed (in red). The area represents the direct surface and groundwater contributing to the Lake.**

## **Topography and Elevation**

The overall change in elevation across the Cedar Lake watershed is very gradual, resulting in less than 10 feet in change from west to east. The highest elevation is found in the northwest section of the watershed, which is approximately 636 feet above sea level. The point of lowest elevation in the watershed is at the lakeshore, which is approximately 609 feet above sea level. The topography immediately east of the lake continues in a gradual downward slope and drops approximately 20 feet to Lake Huron. The topography of the Cedar Lake watershed influences and determines the hydraulic routing of surface runoff to the lake. Figure 1-3 shows the elevation contours in the watershed, which generally slope away from the lake on the southeast and east sides, routing surface water away from the lake towards Lake Huron. Although little overland flow makes its way into the lake, the watershed elevation was factored into the runoff and nutrient loading calculations in Chapter 5 that were used to estimate nutrient sources to the lake.

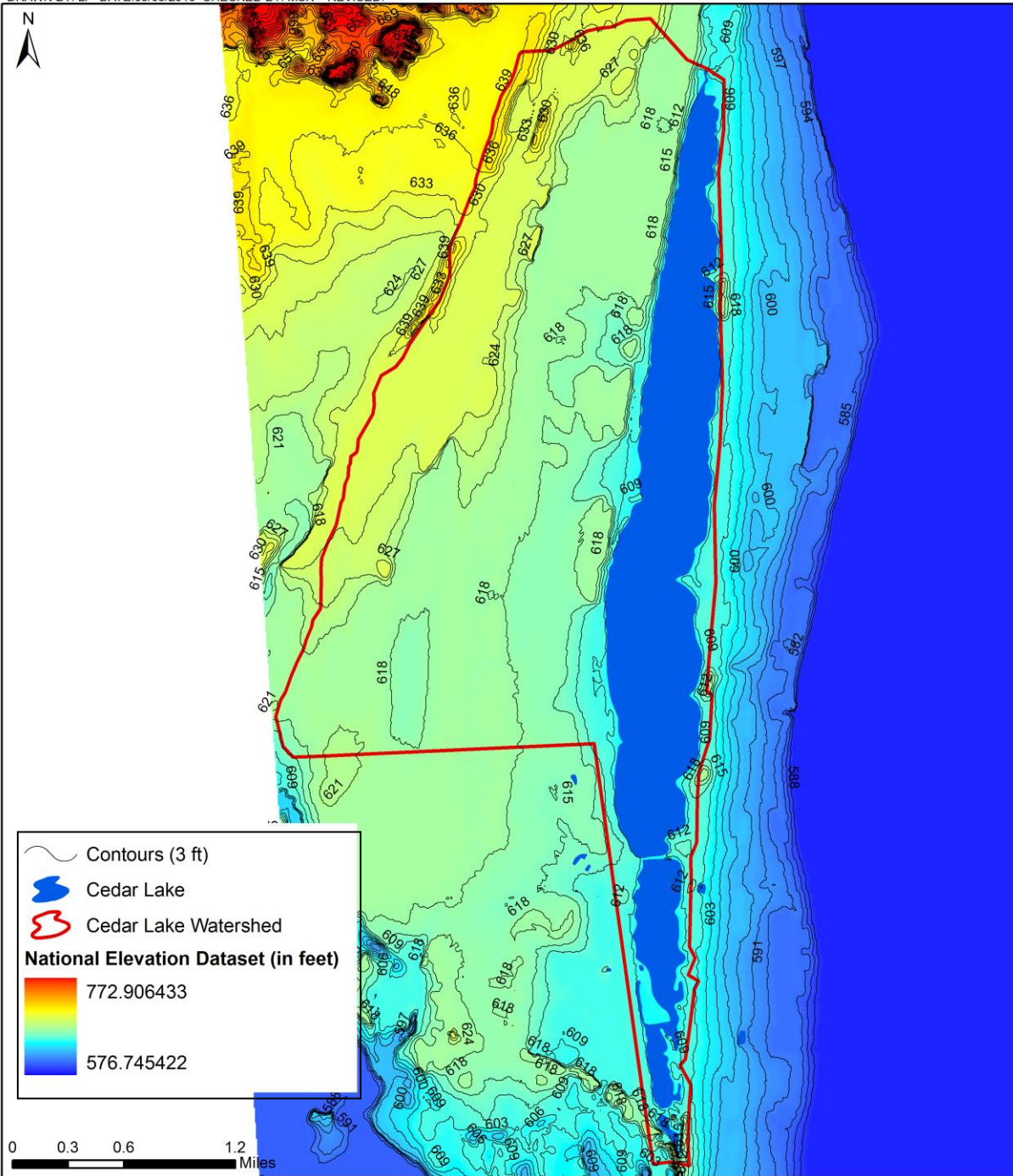
## **Surface and Groundwater Resources**

Cedar Lake is located at the center of the watershed. It is a shallow, mesotrophic lake approximately 1,075 acres in size. There are two main inlet creeks on the northwest side of the lake. The first inlet is Sherman Creek, located approximately 1,600 feet north of Kings Corner Road. This creek drains excess surface water from the cedar swamp on the west side of West Cedar Lake Road into Cedar Lake. The second inlet is an unnamed creek (locally referred to as Jones Creek) located approximately 2,300 feet south of the northern-most end of the lake. This creek also appears to drain excess water from the cedar swamp on the west side of West Cedar Lake Road (Kieser & Associates, 2005). These two creeks provide seasonal flow into Cedar Lake for approximately six weeks, following snow/ice melt in early April until approximately late May. In wet years like 2009, surface water flows in these creeks were observed into early summer and occurred intermittently after that during and immediately following rain events.

The lake has only one direct outlet, which consists of two concrete drop-box weir structures at the northern end of the lake that impound water in Cedar Lake. A court order issued in 1954 established the legal lake level at 608.5 feet above mean sea level and states the lake level must be maintained by a suitable dam or spillway. Because of the court-established legal lake level, the weir structures have been set at approximately this elevation to maintain the legal level. Once the lake outflow passes over the weir structures, it travels through a wetland area north of the lake before discharging to Lake Huron to the east. Often during the summer and fall no outflow is observed at the outlet structures due to the lake level dropping below the

outflow elevation. Similar to the inlet creeks to Cedar Lake, the outflow generally occurs for approximately six weeks after snow/ice melt. Another indirect outlet from the lake is groundwater loss to shallow aquifers on the south and south east sides of the lake that act as subsurface tile drains for shallow groundwater. In the second phase of the Cedar Lake hydrologic evaluation study conducted by K&A, results indicated that approximately 39%-44% of the annual groundwater loss in dry years could be attributed to the under-drain system (Kieser & Associates, 2006).





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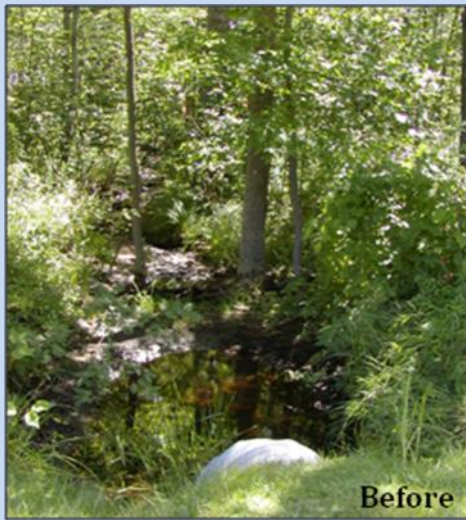
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**Figure 2-3. Topography of the Cedar Lake watershed from the national elevation dataset.**

Another man-made surface water diversion out of the watershed is present on the west side of the lake. A culvert under Kings Corner Road near West Cedar Lake Road routes from the Cedar Lake watershed south to the Van Etten/Pine River watershed via Phelan Creek. In 2006, the property on the north side of Kings Corner Road and west of West Cedar Lake Road was clear-cut. This clearing likely resulted in more evaporation of water in the wetland area and less storage of water overall. Because of the relatively small size of the Cedar Lake watershed, these sources of water loss can have a significant impact on the watershed and the lake in terms of lake level. The surface and groundwater resources found on the northwest side of the

lake in the cedar swamp have implications for wildlife, fish habitat and spawning, recreational value, water quality protection, and water quantity issues.

As mentioned, the groundwater



Before

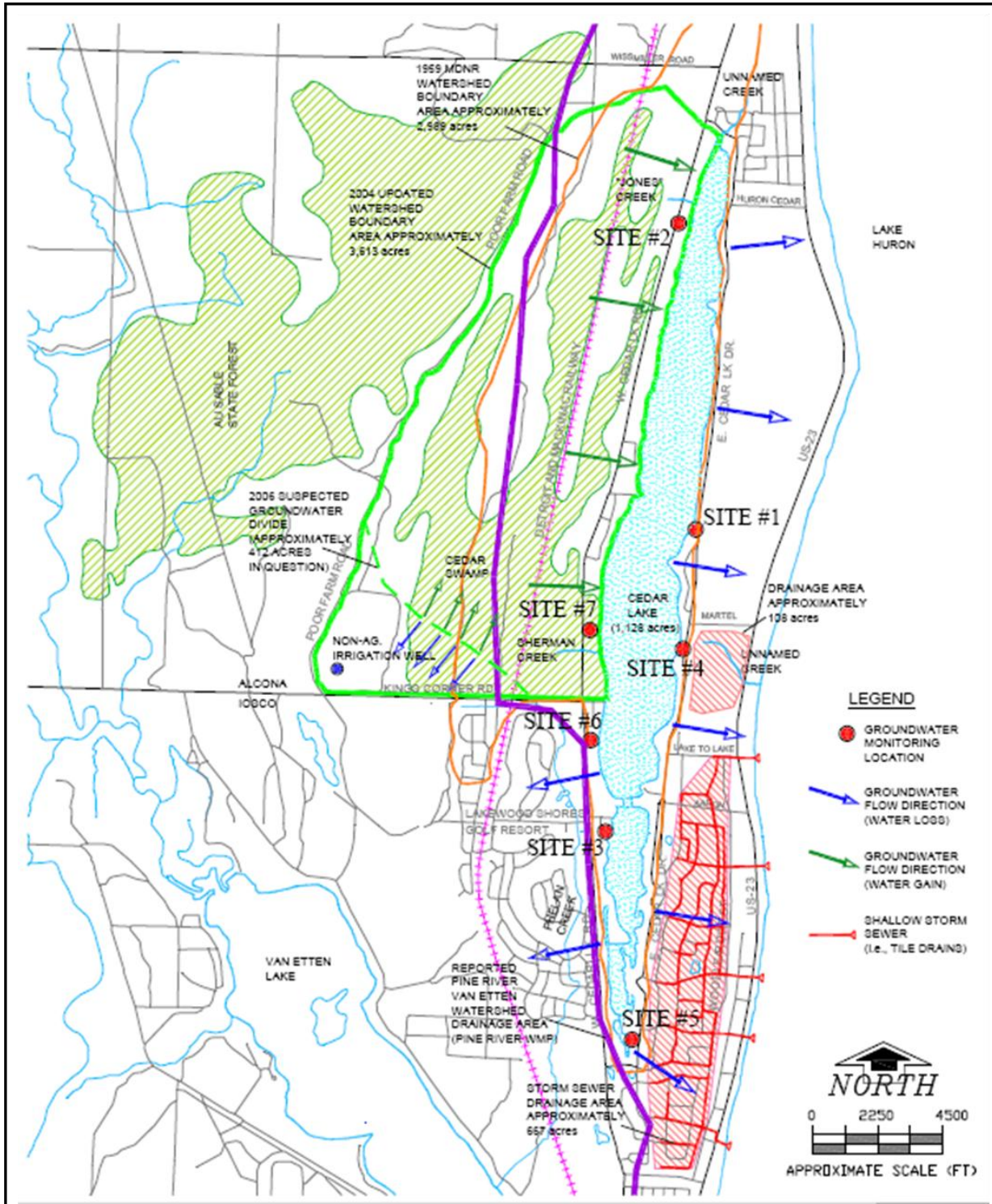


After

EXAMPLE OF AREA IN THE NORTHWEST CEDAR SWAMP BEFORE (LEFT) AND AFTER (RIGHT) CLEAR CUTTING OCCURRED IN 2006.

resources of Cedar Lake are interconnected with surface water features described above. Groundwater generally moves away from the lake on the east, south and southwest sides of the lake. On the south side of the lake, surface water from the lake is being lost to the groundwater and the surrounding watersheds (Van Etten/Pine River and Lake Huron). Figure 2-4 illustrates the movement of groundwater in the watershed. Only the cedar swamp on the northwest side of the lake contributes groundwater to the lake (marked in green). The blue arrows indicate groundwater and lake water loss to the surrounding area. Because of the impact of the drainage system in the south and southeast, the groundwater impacts in this area now increase surface water losses in dry summer months.



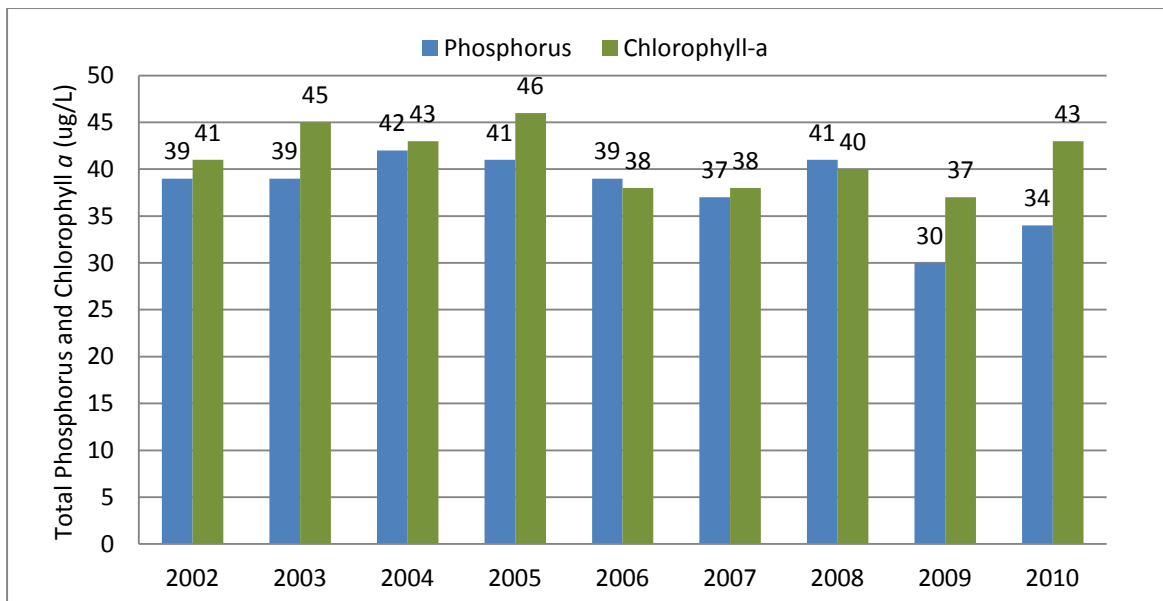


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Figure 2-4. Losing and gaining areas in along the Cedar Lake shoreline (Source: K&A, 2006).

## Water Quality

The water quality of both Cedar Lake and inlet tributaries, Sherman and Jones Creeks, is very good and consists of low nutrient and sediment concentrations. Water quality is monitored each season by volunteers as part of the Michigan Cooperative Lakes Monitoring Program (CLMP) and other AICLA efforts<sup>2</sup>. Water quality parameters measured by AICLA indicate the lake is mesotrophic. Annual phosphorus and chlorophyll *a* concentrations (ug/l) from Cedar Lake are shown in Figure 2-5. Phosphorus samples are collected twice per year (generally April and early September) at Schmidt's Pointe in Cedar lake following the state-run CLMP guidance and instructions (see Figure 2-6 for sampling locations). Chlorophyll *a* samples are collected on a monthly basis from the same location from May through September. These data serve as a very useful indicator of lake conditions related to eutrophication, which can be a problem in shallow inland lakes in Michigan. Total phosphorus concentrations in Cedar Lake have generally been in the range of 30-45 ug/l and relatively stable since 2002. Phosphorus concentrations measured in both Sherman and Jones Creeks in April 2009 were at or below 15 ug/l. A sample also was collected at the lake outlet that had a concentration of only 8 ug/l. These concentrations are relatively low for a shallow, inland lake. In general, these concentrations indicate that eutrophication is not a concern in the lake at this point. The fish biologist working with the Lake Board, Gary Crawford has indicated that low nutrient concentrations measured during some years in Cedar Lake may actually limit the fishery (AICLA, 2011).

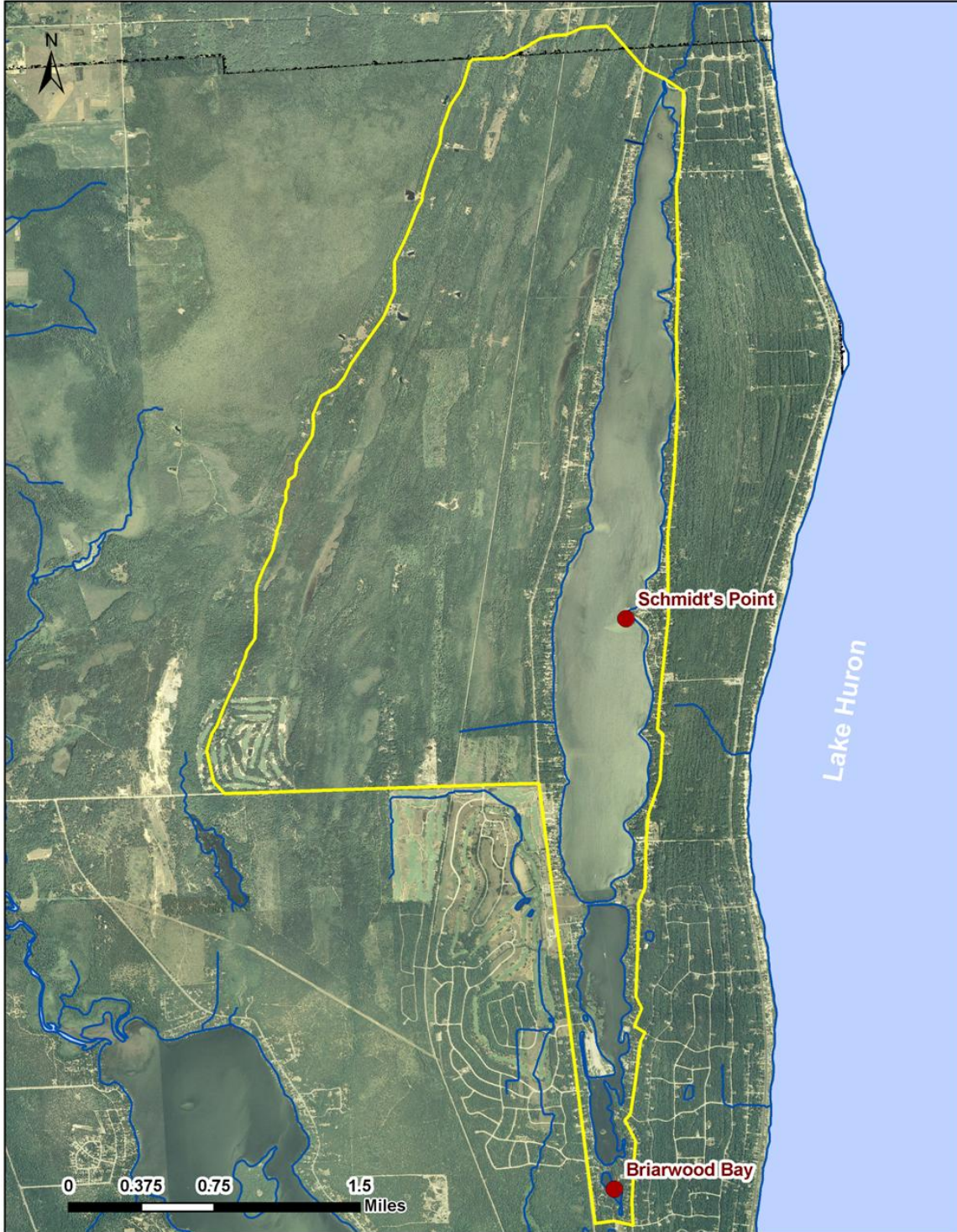


**Figure 2-5. Average annual phosphorus and Chlorophyll *a* concentrations (collected April and September) in Cedar Lake from 2002-2010 (Source: AICLA, 2011).**

<sup>2</sup> Copies of annual water quality reports can be downloaded at: <http://www.cedar-lake.org/Water-Quality.html>.



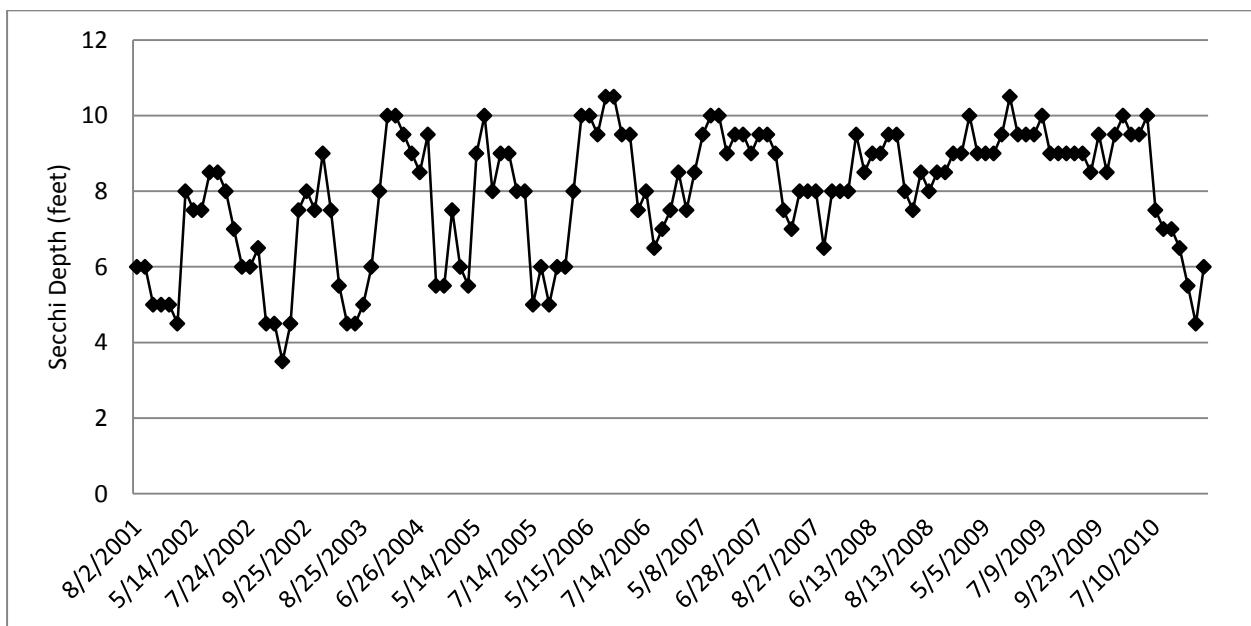
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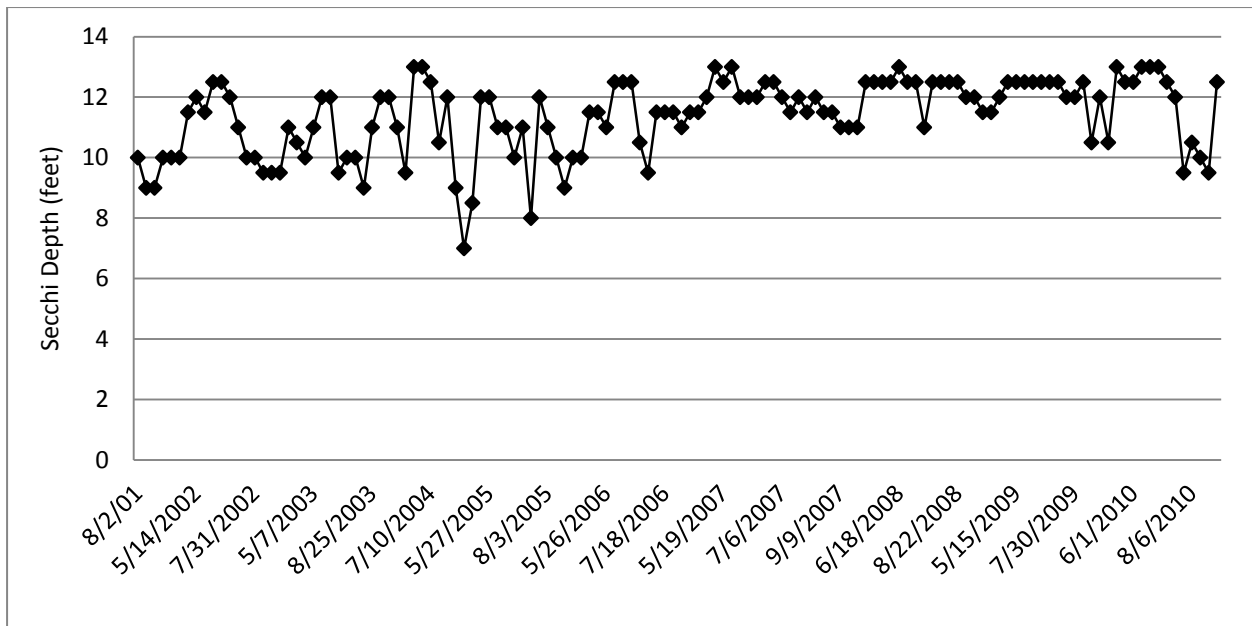
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Figure 2-6. Approximate locations of Schmidt's Pointe and Briarwood Bay sampling sites used by AICLA.

Chlorophyll *a* concentrations show a slight decreasing trend from 2002-2009. These average concentrations are within the range expected in a mesotrophic lake. The AICLA has been tracking changes in chlorophyll *a* and total phosphorus and has noted slight decreases in concentration around 2006-2007 when zebra mussels started to appear in Cedar Lake. These organisms filter substantial amounts of water and remove particles, such as algae. This filtering action can result in increase water clarity and lower chlorophyll *a* measurements, as noted in Cedar Lake. This increase in water clarity can be seen in Figures 2-7 and 2-8 below. Volunteers also measure Secchi depth at two points in the lake, Schmidt’s Point and Briarwood Bay. After 2006, the number of days when the Secchi disk could be seen all the way to the bottom of the lake increased, especially at Briarwood Bay.



**Figure 2-7. Cedar Lake water clarity depth from Secchi disk measurements at Schmidt’s Pointe, bi-weekly May-September (Source: AICLA, 2011).**

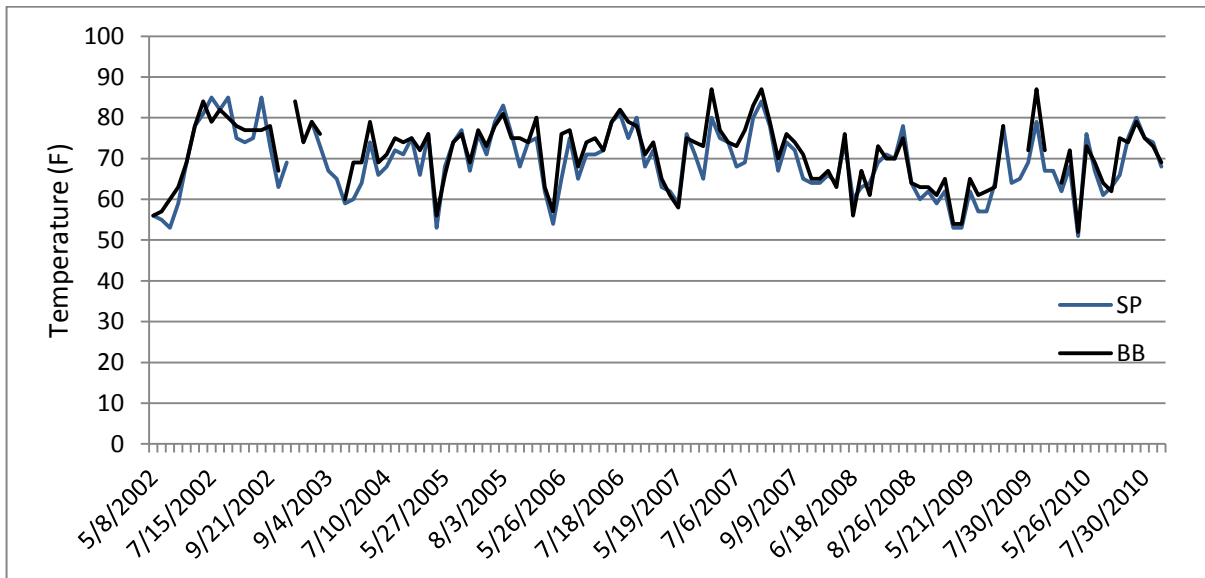


**Figure 2-8. Cedar Lake water clarity depth from Secchi disk measurements at Briarwood Bay, bi-weekly May-September (Source: AICLA, 2011).**

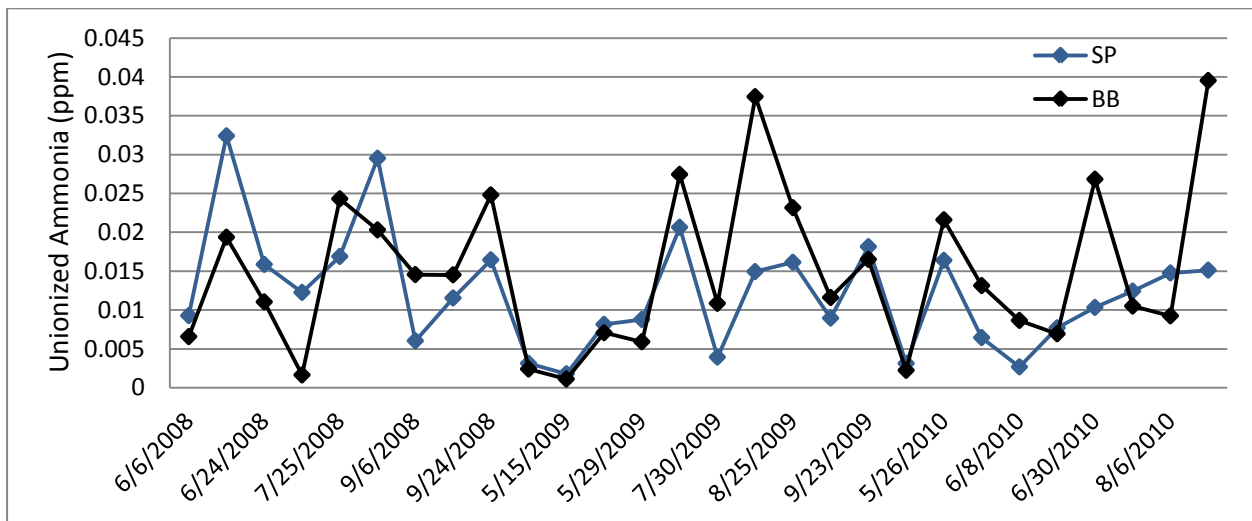
The concentration of total suspended solids (TSS) is not directly measured in Cedar Lake. Results from limited TSS sampling that was conducted in April 2009 showed TSS concentrations in both Sherman and Jones Creeks and at the lake outlet were below the laboratory detection limit of 2 mg/l. These grab samples were collected during higher flows in the creeks and indicates that very little sediment is coming from the wetland complex on the northwest side of the Cedar Lake or existing the lake at the outlet. Turbidity is measured in Cedar Lake and used to monitor solids.

Temperature and ammonia have been monitored by the AICLA to track in-lake conditions for fish habitat and other aquatic species. Dissolved oxygen is not monitored by the AICLA because the lake does not become stratified during the summer. The shallow depth of the lake and wind/wave action in the lake generally mixes the water column. Temperature and ammonia levels in Cedar Lake are generally protective of fish, but can become elevated at some points throughout the summer. This is due in part to the shallow average depth of Cedar Lake. Figure 2-9 shows water temperatures measured at two points in Cedar Lake throughout the summer from 2002-2009. Temperature is measured at approximately five feet in depth. The AICLA has measured temperatures throughout the water column in past years and has not seen a significant gradient in temperatures. Figure 2-10 shows un-ionized ammonia levels derived by

AICLA from Florida Department of Environmental Protection Methods<sup>3</sup> using pH, temperature and ammonia-nitrogen measured at the same points in Cedar Lake. Un-ionized ammonia levels are computed and tracked by AICLA to watch for problematic levels that could harm aquatic wildlife. The levels in Cedar Lake have generally been low (below 0.02 ppm), but have been measured at higher levels (above 0.03 ppm) that are not desirable for some aquatic species.



**Figure 2-9. Cedar Lake water temperature measurements at Schmidt's Pointe (SP) and Briarwood Bay (BB) at approximately five foot depth (Source: AICLA, 2011).**



**Figure 2-10. Cedar Lake ammonia levels at Schmidt's Pointe and Briarwood Bay from 2008-2009 (Source: AICLA, 2011).**

<sup>3</sup> Available at: <http://www.dep.state.fl.us/labs/docs/unnh3sop.doc>



*E. coli* sampling for Cedar Lake has been conducted by the District Health Department No. 2 since 2006. Samples are collected near the public beach at Greenbush Township Park (Lat: 44.53596, Long: -83.3266<sup>4</sup>). Because the program is grant funded, samples are collected based on available funds. Since 2006, samples have been collected either once per week or three times per week. Results are posted on the [Michigan DEQ BeachGuard](#) website and any advisories due to high levels of *E. coli* are posted on the [District Health Department's website](#). Since 2006, no violations of State of Michigan water quality standards for total body contact recreation have been measured at Cedar Lake<sup>5</sup>. The AICLA also started to monitor *E. coli* levels in several locations in Cedar Lake in 2010. During their sampling investigation, no *E. coli* levels in exceedence of water quality standards were measured. See Attachment A for additional information on water quality sampling protocol and recent results.

### **Climate and Precipitation**

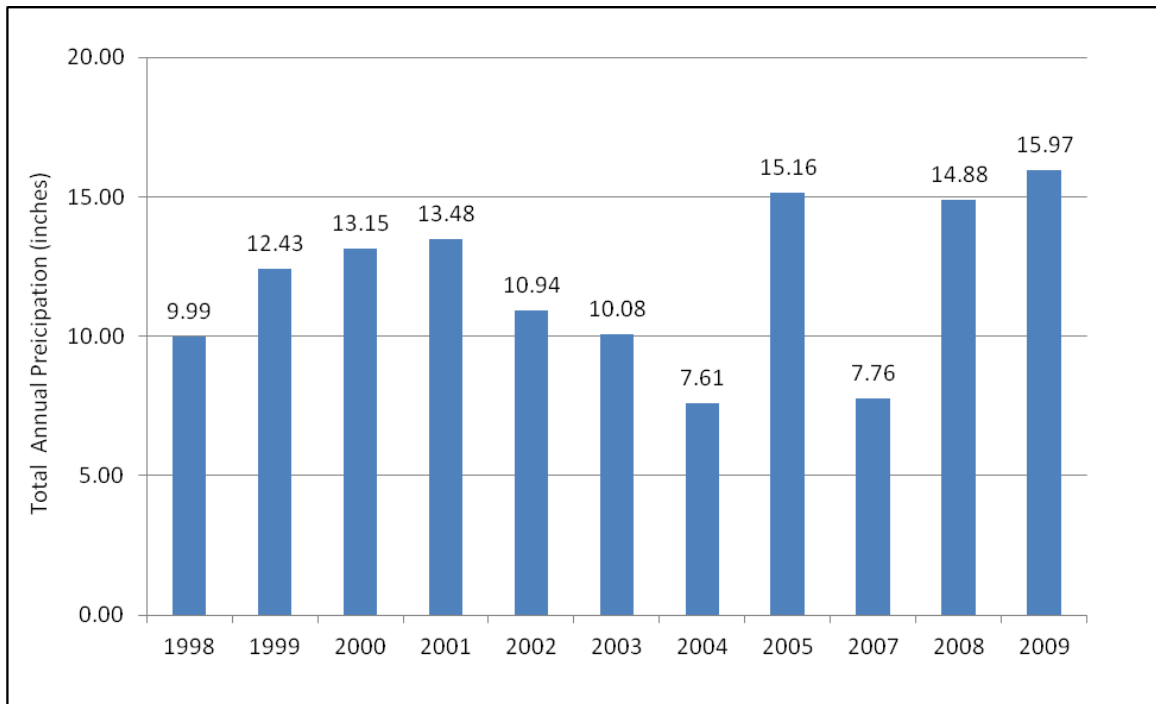
The National Oceanic and Atmospheric Administration rainfall monitoring site closest to Cedar Lake is the Harrisville station. Supplement rainfall data is collected by the AICLA during most of the year. Rainfall data from June to September for the past decade is presented in Figure 2-11. In the 2006 hydrologic study, K&A compared annual precipitation in the watershed over several years and found that years with the same amount of annual precipitation did not show the same drop in lake level, but rather the rainfall from June to September had the greatest influence on summer lake levels. From 2001 to –2007, Cedar Lake experienced low monthly rainfall from June to September, with the exception of 2006. Since that time, summer rainfall has been at relatively high levels (14.88 inches in 2008 and 15.97 inches in 2009). The annual precipitation recorded for this region of Michigan in 2009 was approximately 32 inches. Over the past decade, the regional average annual precipitation was approximately 32.5 inches<sup>6</sup>.

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<sup>4</sup> View map at: <http://maps.google.com/maps?f=q&hl=en&geocode=&q=44.53596,+83.3266&t=h> and *E. coli* results at [http://www.dhd2.org/s\\_beach](http://www.dhd2.org/s_beach).

<sup>5</sup> Part 31 of the Natural Resources and Environmental Protection Act, 1997 PA 451, as amended; R 323.1062(1) states, "All waters of the state protected for total body contact recreation shall not contain more than 130 *E. coli* per 100 ml, as a 30-day geometric mean...[or] contain more than a maximum of 300 *E. coli* per 100 ml."

<sup>6</sup> Historical precipitation records downloaded at: <http://www7.ncdc.noaa.gov/CDO/CDODivisionalSelect.jsp>



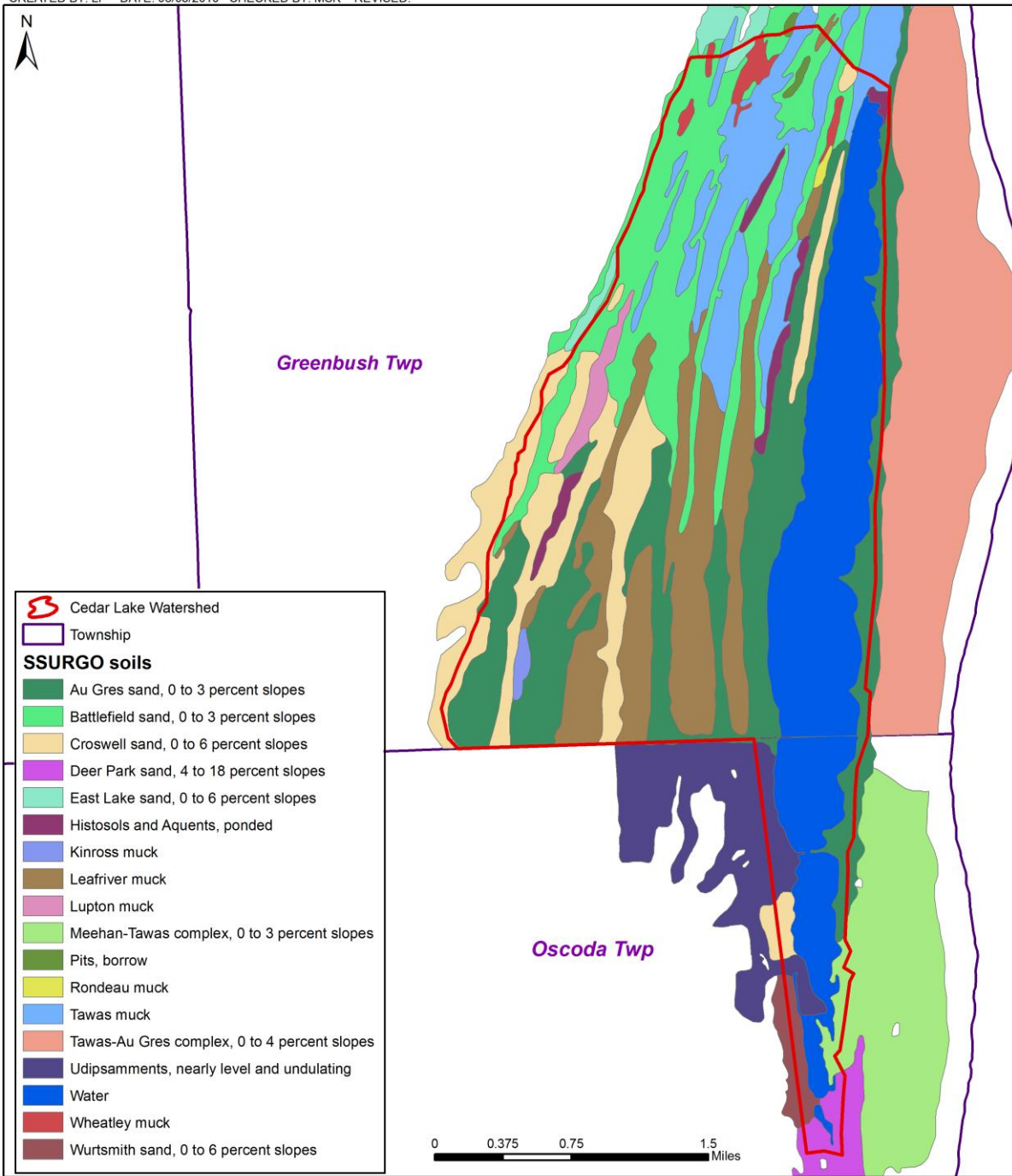
**Figure 2-11. Historical summer precipitation for Cedar Lake (June-September) from 1998-2009**  
 (Source: Harrisville, MI CO-OP Station #203628, Alcona County and AICLA).

### Geology and Soils

The major soil types in the Cedar Lake watershed include sands and mucks. As shown in Figure 2-12, the area along the east and west shoreline is composed of Au Gres sand. The north and south ends of the lake have Tawas and Lupton mucks, respectively. On the southwest corner of the lake, near Kings Corner Road, the area is described as udipsamment (slope is nearly level and undulating). This soil type basically consists of unconsolidated sand deposits with very coarse-textured material (loamy sand or coarser). The area of the watershed west of the lakeshore consists of a striated pattern of Battlefield, Au Gres, and Croswell sands interspersed with Leafriver, Lupton, and Tawas mucks. Highly organic soils also appear in this area, which is generally indicative of marsh or wetland cover. Soils are an important factor in determining the amount of overland runoff and erosion that occurs in the Cedar Lake watershed. Soils in many areas of the watershed are very permeable and allow for high infiltration rates of precipitation or runoff from impervious surfaces. High infiltration rates of runoff limit the amount of surface runoff that is likely to carry pollutants into Cedar Lake. Other areas of the watershed where muck soils are present along with high groundwater levels will experience slower surface water



infiltration when soils are already highly saturated. Low slopes slow or reduce overland flow and create standing water after spring snow melt and rain events. Due to organic muck soils in wetlands in the watershed, these areas store infiltrated runoff as groundwater and slowly release it to the lake.



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**Figure 2-12. Various soil types in and around the Cedar Lake watershed.**

## **Fishery**

Recent fisheries data collected in 2000 suggest a diverse fishery in Cedar Lake, including black crappie, bluegill, pumpkinseed, largemouth bass, northern pike, rock bass, smallmouth bass, tiger musky walleye, and yellow perch (K&A, 2006). In 2008, Aquest Corp. and Superior Environmental and Aquatic Services, LLC (SEAS) conducted a creel census under contract with the Lake Board. Results from angler surveys indicated that most fishing takes place north of the causeway, which supports better aquatic vegetative structure for the fishery. On average, anglers caught an average of 2.5 fish/hour, which is considered quite good for Michigan lakes (SEAS, 2009b). Overall, angling pressures are generally low in Cedar Lake. The report concluded that Cedar Lake is a bass/bluegill fishery, with largemouth bass and northern pike comprising nearly 75% of fish caught during the survey (SEAS, 2009b). Yellow perch, walleye, and smallmouth bass were the most harvested species during survey, but angling selectivity for fish species was generally evenly distributed. The report also concluded that Cedar Lake had the potential to support a more robust sport fishery with species such as walleye and northern pike (SEAS, 2009b).

In addition to creel census data, anecdotal information from longtime residents and local agency officials suggests that both Sherman Creek and Jones Creek once ran year round. In addition, early spring spawning runs of pike were observed annually and with such abundance that fish were frequently observed in inundated roadside ditches adjacent to these streams. Drainage modifications by county road commissions in the 1980s appear to have substantially lowered the groundwater table in the drainage areas of these creeks such that flows are now limited to select times of the year. Since these modifications, there have been limited reports of the pike spawning runs that were once commonly noted. In 2008, SEAS conducted an evaluation of the spawning migration to and from Sherman Creek and the adjacent wetland. The general conclusion was that Sherman Creek and the adjacent wetlands need to be protected from development in order to preserve and extend the duration of creek flow during spring and early summer months for fish spawning and migration (SEAS, 2009a).

## **Invasive Species**

Invasive species are a concern in the Cedar Lake watershed for several reasons. First, the lake's close proximity to Lake Huron makes it especially susceptible to transmission of invasives from the Great Lakes. Cedar Lake has seen new invasive species such as zebra mussels since their explosion in the Great Lakes. Second, recreational use of the lake and public boat launch provides another easy avenue for invasive species transmission to Cedar Lake. Watershed

stakeholders are particularly concerned about aquatic vegetation, as recent increases in water milfoil (determined to be native with perhaps an exotic hybrid) have started to show aggressive and rapid spread. A list of potential invaders was compiled by Aquest and SEAS, LLC with an indication of whether particular species have been identified in Cedar Lake. The list is included as Attachment B and does not represent a complete list of invasive species in Cedar Lake, but tracks species that technical experts have identified in the lake. Data gaps exist for upland invasive plants and other invasive wildlife species that might be present in the watershed.

## Land Use and Land Cover

The Cedar Lake watershed is a mix of developed and undeveloped land uses. Over the past half century, increased residential development has occurred around the lake. The watershed is highly recreational with many seasonal residents that live on the lake part-time. Surrounding the lake are several golf courses, swimming beaches, and a boat launch area. While the lakeshore area has felt development pressure over the past few decades, much of the watershed is still undeveloped. Residential land use and transportation make up approximately less than a quarter of the land in the watershed and represent the impervious areas in the watershed. The remaining land in the watershed is relatively natural or covered by surface water (see Figure 2-13). Figure 2-14 shows a map of the different land uses in the watershed and how residential and transportation land use is primarily clustered around the perimeter of the lake. The north end of the lake is less developed with some residential land use primarily on the northwestern shore and fewer on the northeastern side. The northern end of the lake contains a mix of wetlands and lowland forested wetlands.

Aside from the residential development around the perimeter of the lake, the large majority of the land draining to Cedar Lake is located on the northwest side of the lake. This area is mostly undeveloped wetlands and forests with limited residential development. The residential homes are mostly located along the west side of West Cedar Lake Road. One golf course is located within the southwest corner of this wetlands area and has recently expressed interest in expanding. As of 2009, the golf course was in talks with the State of Michigan to potentially purchase State-owned land in order to build another course adjacent to the existing course. Predictions of future build-out around the watershed are examined in Chapter 5 of the WMP. The State of Michigan owns several hundred acres of land in the middle of the northwest wetland area. The remaining land is generally privately owned.

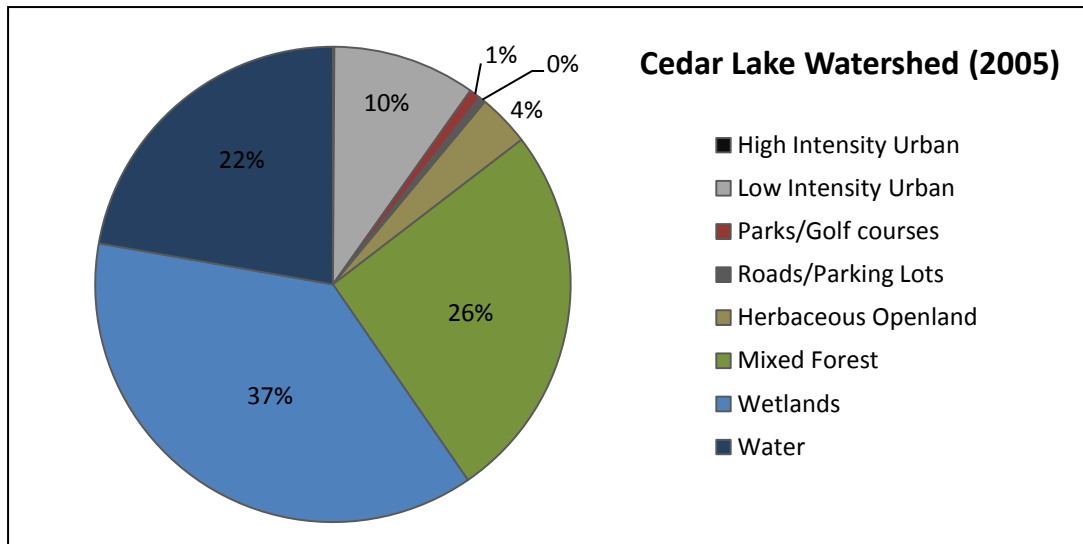
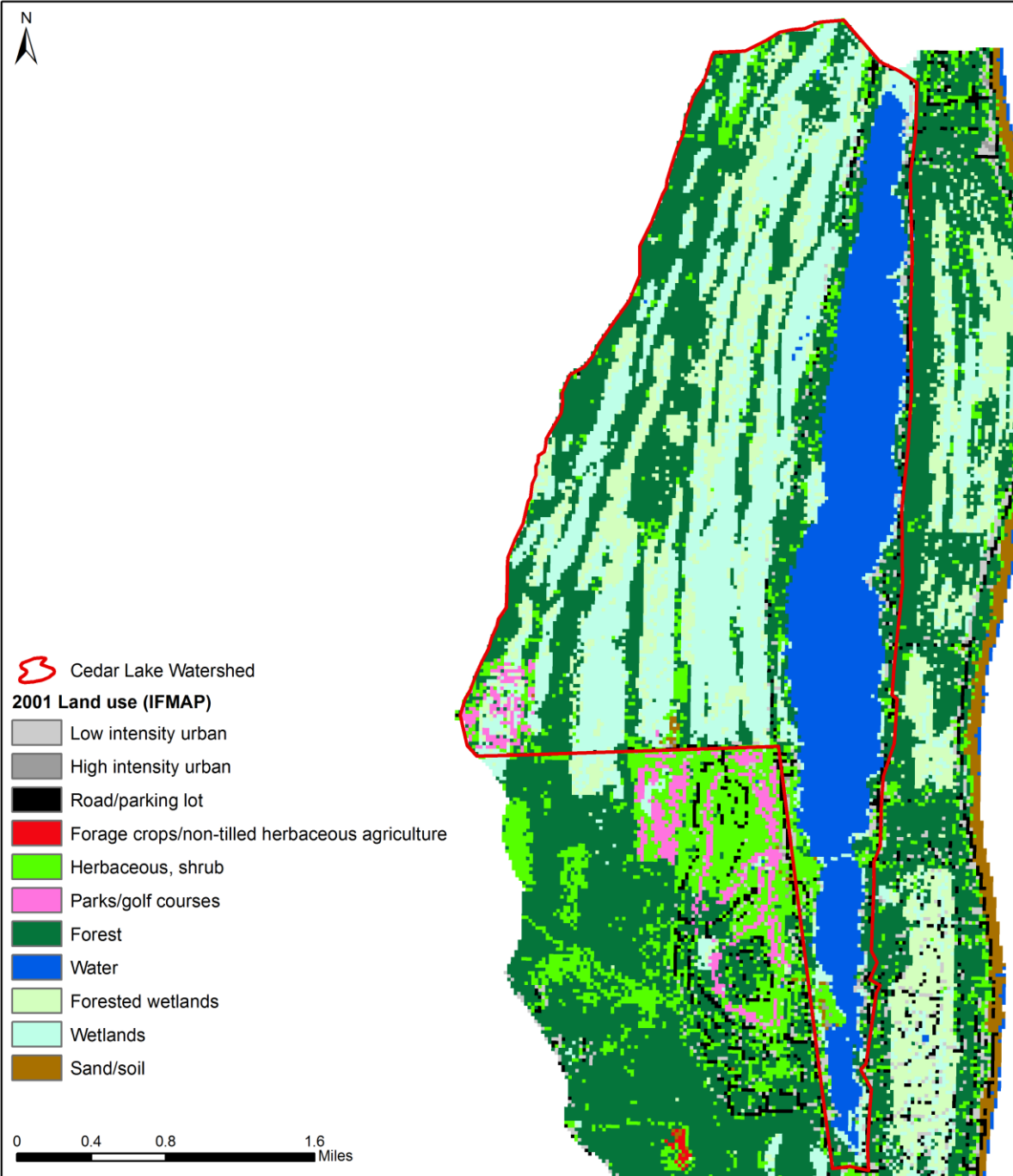


Figure 2-13. Distribution of land uses in the Cedar Lake watershed by percent cover.



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Figure 2-14. 2001 distribution of land use in the Cedar Lake watershed.



## Political Characteristics

The northern half of the Cedar Lake watershed is located in Alcona County (population: 10,942<sup>7</sup>) and the southern half of the watershed is in Iosco County (population: 25,887<sup>7</sup>). The watershed is also split between Greenbush Township on the north end and Oscoda Township on the south end. The large majority of the watershed (northwest corner) is located in Alcona County and Greenbush Township (see Figure 2-1). Cedar Lake contributes a much greater percentage of the Greenbush Township tax base than in Oscoda Township. There are over 700 individual property owners around the lake. Many of the residents around Cedar Lake are part-time and use the property primarily for recreation. Both of the townships have zoning ordinances that affect the watershed. Several elements in the zoning ordinances<sup>8</sup> are relevant to WMP efforts, including:

- Vegetative Buffer Zoning: Oscoda Township requires 50 feet of the water's edge to be vegetated; no buffer zoning in Greenbush Township.
- Waterfront Setback Zoning: Oscoda Township requires a minimum 50 feet setback of structures from the water's edge in residential zoning; Greenbush Township requires a minimum 100 feet setback.
- Percent Impervious Cover Zoning: Oscoda Township restricts impervious cover to 35% maximum coverage for residential lots; Greenbush Township restricts coverage to a maximum of 35% coverage for lots within the shoreline protection district.

Another important political boundary in the watershed is the Lakewood Shores drainage district on the southern and eastern sides of the lake in Iosco County. The district is under the jurisdiction of the Iosco County Drain Commissioner, who serves on both the Lake Board and Cedar Lake WMP SC. Subsurface drains in this area impact Cedar Lake levels through a shallow groundwater connection, and many homes in the drainage district rely on the subsurface drains to keep their homes and properties dry during parts of the year. If 50% or more of the residents in the drainage district petition the Commissioner to expand the drain, modifications could take place that would have a negative impact on Cedar Lake water levels.

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<sup>7</sup> 2010 U.S. Census, available at: <http://2010.census.gov/2010census/data/>.

<sup>8</sup> Oscoda Township Zoning Ordinance available at:

[http://www.oscodatwp.com/uploads/Oscoda\\_Zoning\\_Ordinance.pdf](http://www.oscodatwp.com/uploads/Oscoda_Zoning_Ordinance.pdf)

Greenbush Township Zoning Ordinance not available online. Information taken from Pine River Van Etten Lake (PRVEL) Watershed Management Plan (2008).

An important factor in the issues surrounding Cedar Lake water level is the court-ordered lake level set in 1954. The ruling set the official lake level for Cedar Lake at 608.5 feet above sea level. This order legally constrains the lake level and spillway at the north end of the lake. At no time during the year is the lake level supposed to exceed the 608.5 feet level, and the Drain Commissioner is responsible for managing the lake in such a way as to maintain the level at or below 608.5 feet. The court-ordered lake level has implications for Cedar Lake in terms of limiting the storage capacity of the lake, which during dry years can deplete quickly (as much as 2.2 feet in 2004).

## CHAPTER 3: WATERSHED CONDITIONS

Cedar Lake watershed conditions are generally good in terms of water quality indicators. The watershed provides recreational opportunities for lake users and supports a large tract of natural wetlands. Yet several specific conditions have created concern among watershed stakeholders. Hydrology in the watershed has been degraded by decades of drainage and building in wetlands. Nuisance and exotic aquatic plant species have shown exponential growth in parts of the lake, causing great concern for the recreational and ecological function of Cedar Lake. As part of the WMP, the SC worked to develop a comprehensive list of the watershed concerns in order to more fully address and influence the overall conditions of the Cedar Lake watershed.

UNDERSTANDING CONDITIONS IN THE WATERSHED WILL HELP POINT FINANCIAL RESOURCES IN THE RIGHT DIRECTION TO ADDRESS PROBLEM AREAS IN THE MOST COST-EFFECTIVE MANNER.

### **Watershed Assessments and Concerns**

Many of the concerns and conditions in the Cedar Lake watershed have been well identified over the past decade. Under the direction of the Lake Board and through studies commissioned by the AICLA, several technical experts have investigated issues in and around Cedar Lake. These studies have involved countless hours assessing conditions in Cedar Lake and the surrounding watershed. In 2005 and 2006, K&A produced two hydrologic reports for Cedar Lake. These reports involved field investigations on hydrologic routing of both surface and groundwater. The mass balance for the lake was updated in the 2006 report after more groundwater monitoring and modeling was performed. The report attributed issues associated with low lake levels during dry years to storm sewers in the LS drainage district (39-44% of loss), King's Corner Road culvert diversion, evaporation, and direct water use by residents. In general, modifications of the hydrologic mass balance in the watershed result in negative impacts on Cedar Lake during dry years.

Aquatic plant and fishery management efforts at Cedar Lake have resulted in annual reports assessing the condition of Cedar Lake. Recent assessment of the aquatic plant community in Cedar Lake indicates that past conditions in Cedar Lake have been good to very good in terms of the aquatic plant community; however, in recent years nuisance species have demonstrated the potential to threaten conditions in Cedar Lake. The opportunistic aquatic species water milfoil (Eurasian and green/variable varieties) continues to be a high-priority plant for eradication due to its spread in Cedar Lake and lack of response to treatment in select areas in

2007 to 2008 (Pullman, 2008). Other potentially threatening species noted in the lake include starry stonewort and blue-green algae. In conjunction with the aquatic plant surveys, fishery management activities at Cedar Lake have also characterized watershed conditions. Habitat for bass and sunfish spawning is adequate, although in general the spawning habitat utilization is slightly below average for Michigan (Crawford, 2008). The report recommends expanding habitat to increase recruitment.

Additional watershed assessments have been conducted as part of the WMP and the augmentation pilot by K&A. Monitoring of existing groundwater wells in and along important surface water and wetland locations in the watershed provided useful information in terms of watershed runoff. Past watershed investigations have indicated that Sherman and Jones Creeks flow from March to early June. In 2009, data collected from monitoring wells estimates the annual surface flow from these creeks to be approximately 35.8 million cubic feet of water each year during this period. This information was used to inform the empirical calculations used to estimate pollutant loads to Cedar Lake (see Chapter 5).

In order to develop a robust list of concerns specific to the watershed, the SC worked through a list of common watershed concerns and past reports of Cedar Lake conditions. Table 3-1 contains the compiled ranking of all of the watershed concerns that the SC identified through an iterative process during meetings in April-June 2008. SC members were given a blank table and asked to fill in their concerns about the Cedar Lake watershed from their perspective. During the meeting, members of the committee discussed the various issues and prioritized them as high (H), medium (M), or low (L) concerns. Members of the SC requested input on these watershed concerns from the public through AICLA contacts in order to compile a comprehensive list. Public feedback was collated and the SC used this information to develop and rank the concerns on a consensus basis.

The concerns in the watershed that ranked high among the SC and the public were sediments (or composition of lake bottom), habitat loss (especially wetlands), aquatic plants and wildlife (or biota), hydrologic modification, and development. Of medium concern was nutrient loading to the lake and improper disposal of yard waste into the lake. Pathogens and parasites were ranked as a low concern due to low frequency of reported problems from lake residents. Drainage and development in wetlands were of particular concern to watershed stakeholders and this is represented in several categories in Table 3-1. In addition to ranking the concerns, the SC identified which concerns presented a threat to the watershed or where indicators of a degraded ecosystem. “Degraded” is an intermediate term used to describe ecosystem functions that are not yet “impaired”, but are more severe than the “threatened” designation.

<b>Table 3-1. Watershed concerns ranked by priority and evaluated in terms of uses in the watershed.</b>									
<b>Cedar Lake Watershed Concerns</b>		<b>RANK of Importance</b>	<b>Warmwater Fisheries</b>	<b>Indig. Aquatic Wildlife</b>	<b>Partial Body Contact Rec.</b>	<b>Full Body Contact Rec.</b>	<b>Groundwater protection</b>	<b>Maintain lake level</b>	<b>Habitat Protection</b>
<b>SEDIMENTS</b>		<b>H</b>	D	D	D	T		D	D
Lake bottom muck accumulation		H							
Accumulation of dying weeds in lake		H							
Minor erosion around lakeshore		L							
<b>HABITAT LOSS</b>		<b>H</b>	D	D	T	NA	D	D	D
Wetland development in watershed (esp. NW side of lake)		H							
Loss of fish spawning areas (streams/wetlands)		H							
Loss of fish nursery areas (nearshore wetlands)		H							
Loss of fish and wildlife habitat (due to low lake levels)		H							
<b>BIOTA</b>		<b>H</b>	D	T	T	T			T
Invasive aquatic plants in lake		H							
Native aquatic plant overgrowth in lake		H							
Purple loosestrife/other invasives around shoreline areas		M							
Invasive fish and mussels (esp. gobies and zebra mussels)		M							
Invasive macroinvertebrates (rusty crawfish)		H							
Nuisance waterfowl (especially geese)		H							
Nuisance cormorants around lake		H							
Blue-green algae/other species growth in lake		H							
<b>URBANIZATION &amp; LAND USE</b>		<b>H</b>	T	T	T		D	D	D
Lot development (draining lots)		H							
Road access in wetlands (especially filling wetlands)		H							
<b>HYDROLOGIC MODIFICATION</b>		<b>H</b>	D	D	T	T	D	D	D
Drainage of wetlands for development		H							
Surface water/stormwater drainage into lake		H							
Pumping water from lake for irrigation		H							
Changes to spillway		H							
Stream modification (Sherman/Jones Creeks)		H							
Road ditches that drain water away from lake		H							
<b>LOSS OF WETLANDS</b>		<b>H</b>	D	D	T		D	D	D
Development in wetlands (esp. filling wetlands)		H							
Drainage of wetlands		H							
Loss of lake recharge capacity		H							
<b>LITTER</b>		<b>M</b>			T	T			T
Dumping lawn waste into water bodies		M							
<b>NUTRIENTS</b>		<b>M</b>			T	T			T
Runoff of lawn fertilizers to lake		M							
Leaking septic systems around lake		M							
Stormwater runoff to lake		M							
<b>PATHOGENS/PARASITES</b>		<b>L</b>			T	T			
Leaking septic systems around lake		M							
Runoff of waterfowl/pet waste to lake (esp. geese)		L							
Swimmers itch		L							

*(The fish consumption designated use was not included in this table because the only impairment is from mercury deposition, which is being addressed at the state/federal level and is beyond the scope of this plan).*

## Designated Uses and Desired Uses

Specific ways that water can be used are called “designated” uses and are recognized uses of water established by federal and state water quality laws and programs (Brown, *et al.*, 2000).

Designated uses were first identified in the federal Clean Water Act (1972) and are included in the State of Michigan’s Natural Resources Protection Act (R323.1100 of Part 4 of PA 451, 1994, revised 4/2/99). For water bodies in Michigan, all of the designated uses must be met. The State of Michigan is in the process of assessing all waters of the state to determine if State Water Quality Standards are being met (see list of standards in Table 3-2). If a violation of Water Quality Standards is measured, the waterbody is listed on the 303(d) list of impaired waters.

Cedar Lake and its tributaries are not listed on the 303(d) list (in the Integrated Report<sup>9</sup>) except for fish consumption. The State of Michigan has issued a statewide impairment for mercury contamination due to atmospheric deposition for all waterbodies. This impairment is not addressed in this WMP because it is being addressed at the state/federal level and is beyond the scope of this WMP. Since none of the other designated uses are impaired, the SC evaluated Cedar Lake in terms of whether the designated use is “threatened” or perceived to be close to “impaired” status, which is referred to as “degraded” in this WMP.

DESIGNATED USES FOR ALL WATER IN THE STATE OF MICHIGAN INCLUDE:
AGRICULTURE
INDUSTRIAL WATER SUPPLY
NAVIGATION
WARM WATER FISHERY
FISH CONSUMPTION
OTHER INDIGENOUS AQUATIC LIFE/WILDLIFE
PARTIAL BODY CONTACT RECREATION
TOTAL BODY CONTACT RECREATION (MAY 1-OCTOBER 31)

**Table 3-2. State of Michigan Water Quality Standards.**

Parameter	Michigan Water Quality Standards*	Affected Designated Use(s)
Chlorides	125 mg/l monthly average	Public water supply
Dissolved Oxygen	Minimum 7 mg/l for coldwater designated streams and Great Lakes/connecting waterways Minimum 5 mg/l daily average for all other waters	Cold water fishery Warm-water fishery
<i>E. coli</i>	130 <i>E. coli</i> /100 ml 30-day geometric mean	Total body contact recreation

<sup>9</sup> The 303(d) list of impairments as part of the Integrated Report is available at: [http://www.michigan.gov/documents/deq/wb-swas-ir-final-appC\\_230022\\_7.pdf](http://www.michigan.gov/documents/deq/wb-swas-ir-final-appC_230022_7.pdf).



	(from 5 or more samples) 300 <i>E. coli</i> /100 ml (maximum per sample) 1,000 <i>E. coli</i> /100 ml (as maximum)	Partial body contact recreation
pH	6.5 - 9.0	Warm-water fishery Other indigenous aquatic life and wildlife
Phosphorus	1 mg/l monthly average for point source discharges (Rule 60) (Only narrative criteria developed for nonpoint sources)	All
Radioactive Substances	Pursuant to U.S. nuclear regulatory commission and EPA standards	All (except navigation)
Taste/Odor-Producing Substances	Any concentrations	Industrial Water Supply Public Water Supply Agricultural Water Supply Fish Consumption
Temperature	Natural daily and seasonal fluctuations shall be: (Monthly average for inland lakes, like Cedar Lake) J F M A M J J A S O N D 45 45 50 60 70 75 80 85 80 70 60 50	Warm-water fishery Other indigenous aquatic life and wildlife
Total Dissolved Solids	500 mg/l monthly average or 750 mg/l at one time	All
Toxic Substances	DDT and metabolites: 0.00011 ug/l Mercury (and methylmercury): 0.0013 ug/l PCBs: 0.00012 ug/l 2,3,7,8-TCDD: $3.1 \times 10^{-9}$ ug/l	All (except navigation)

\*Water Quality Standards can be found under Sections 3103 and 3106 of 1994 PA 451, MCL 324.3103 and 324.3106

The designated uses evaluated by the SC as part of the WMP were identified as: 1) warm-water fishery, 2) indigenous aquatic wildlife, 3) partial body contact recreation, and 4) total body contact recreation. The watershed appears to be meeting the partial body and total body contact recreation designated uses. Several of the other designated uses do not apply to Cedar Lake, although they would likely be met if required. For instance, there is no agricultural land use identified in the watershed and no industrial facilities using surface water. The lake is also not used for navigation; rather, the lake is generally used for recreational purposes.

In addition to the designated uses that all waters must meet, the SC identified desired watershed uses. In terms of watershed planning, the desired uses are based on factors that are

important to the watershed community beyond the designated uses (Brown, *et al.*, 2000). SC members discussed their individual impressions of the public's additional needs and uses in the watershed in the context of the WMP. By consensus, the SC determined that other desired uses of the Cedar Lake watershed included: 1) protecting groundwater, 2) maintaining legal lake level, and 3) protecting habitat. Groundwater is an important natural resource in the Cedar Lake watershed that is not specifically addressed through the designated uses. The resource is important for the hydrology of the region and the wetlands surrounding the lake. The hydrology is also linked to the lake level, which has been threatened in recent years. During dry years, many lake uses have been greatly degraded by extremely low lake levels. A specific factor of importance to Cedar Lake is maintaining the legal lake level as much as possible. The elevation of the existing spillway, guarantees, to a certain extent, that the lake level will not rise above the court-ordered level. However, levels can drop below this limit during years with little precipitation. Another factor recognized by the SC as a desired watershed use was habitat protection. A strategic effort to preserve natural, undeveloped habitat in the watershed will serve to meet many of the watershed goals in addition to protecting valuable habitat for native species in the watershed beyond just the lake.

## Degraded Uses and Water Quality Threats

After establishing the designated and desired uses in the watershed, the next step in the WMP process was to determine which uses are degraded or threatened. In the State of Michigan 2008 Integrated Report, many of the Cedar Lake designated uses were assessed as part of the requirements of the Clean Water Act Part 303(d). The Integrated Report does not specifically list any known impairments for Cedar Lake (all state waterbodies are impaired for mercury). Cedar Lake was found to fully support the navigation, industrial water supply, agriculture, and other indigenous aquatic life/wildlife designated uses. The state did not assess the lake for partial and total body contact recreation or fisheries.

The SC discussed and identified known and suspected threats in the watershed using information available through existing reports and watershed assessments. Table 3-3 lists the designated and desired uses of the watershed and distinguishes impaired (I), degraded (d) and threatened (T) uses. Deficiencies in the Cedar Lake fishery (e.g., stunted bluegill population and walleye stocking) indicated to the SC that the warm-water fishery was degraded. The SC also developed a list of suspected and known pollutants or concerns that likely contribute to the degradation. Sediments, modified hydrology, and invasive species all likely contribute to the problems with the fishery. The same pollutants were determined to be degrading indigenous aquatic life/wildlife by disturbing native species habitat. Partial and total body contact

recreation were both identified as being threatened by potential increases in sediments and nutrients and modified hydrology already present in the watershed.

**Table 3-3. Impaired, degraded and threatened watershed uses with known or suspected pollutants/problems.**

IMPAIRED, DEGRADED OR THREATENED USE	POLLUTANT
<b>Designated Uses</b>	
Fish Consumption (I)	Atmospheric deposition of mercury <i>(Mercury impairment is statewide and being addressed at state/federal level; actions not listed in WMP as it is beyond our scope)</i>
Warmwater Fishery (D)	Sediments Modified hydrology Invasive, non-native species
Indigenous Aquatic Wildlife (D)	Sediments Modified hydrology Invasive, non-native species
Partial Body Contact Recreation (T)	Sediments Nutrients Modified hydrology
Total Body Contact Recreation (T)	Sediments Nutrients Modified hydrology Pathogens
<b>Desired Uses</b>	
Groundwater Protection (I)	Modified hydrology
Maintain Legal Lake Level (I)	Sediments Modified hydrology
Habitat Protection (T)	Sediments Nutrients Modified hydrology Invasive, non-native species

(I)=Impaired (D)=Degraded (T)=Threatened

Note: Not all pollutants identified for a particular designated use in this table are used in the formal evaluation process by DEQ to determine use support. However, the local community has determined that the identified pollutants may directly or indirectly degrade the identified designated use in Cedar Lake.

Both groundwater and lake level desired uses were determined to be degraded. Modified hydrology is the primary watershed issue causing deficiency in groundwater that naturally recharges Cedar Lake. Other modifications impact surface water recharge to Cedar Lake, which negatively impacts lake level during dry years. The desired use for habitat protection in the watershed was determined to be threatened by modified hydrology, invasive species, and the

potential for increased sediment and nutrient loads from increased development in the watershed.

## CHAPTER 4: POLLUTANT SOURCE ASSESSMENT

In order to address the watershed threats and concerns identified by the SC, it was important to clearly identify the potential pollutants associated with the threats and concerns in the watershed. Potential pollutants were identified through existing reports and study findings, anecdotal experiences from SC members, and pollutants perceived by the public as problematic (as identified by SC members who regularly interact with the public and seek their input). By clearly listing likely pollutants, the SC was able to link them with the potential sources and ultimately the causes in the watershed that produce or result in excess pollutants.

It is important to note that, in the WMP process, the SC identified common pollutants that are generally implicated with the threats and impairments in the watershed as well as problematic conditions or modifications in the watershed, such as modified hydrology (both surface and groundwater). Pollutants and modifications are grouped together in the WMP as just “pollutants” for simplification purposes. The pollutants identified in the WMP are generally nonpoint source (NPS), as no specific point sources are present in the watershed. The SC prioritized the information presented in this section by consensus, which was used to develop management strategies to control the potential sources and problems in the watershed (see Chapter 7).

### Known or Suspected Pollutants and Concerns

The SC compiled a list of known and suspected pollutants for the watershed from the threats and degradations in the watershed discussed during their meetings. Pollutants were identified through a search of available water quality data for Cedar Lake, past hydrologic reports for the watershed, and empirical modeling to determine the likely problematic pollutants in the watershed. Table 4-1 lists the pollutants of concern and distinguishes between *known* and *suspected* pollutants. Known pollutants are those that have been measured and/or observed while suspected pollutants are those that are likely or common to a particular impairment. The SC is comprised of watershed stakeholders with a working knowledge of conditions in the watershed. As part of the watershed assessment for the development of this WMP, SC knowledge was used to identify suspected pollutants. Other watershed assessments were used to identify or confirm known pollutants. Investigations and inventories include: 1) public surveys on septic systems, watershed concerns, and privately-owned lakefront conditions and uses; 2) aerial imagery and GIS mapping; 3) visual field inspections by technical consultants; 4) past water quality monitoring reports; and, 5) groundwater and lake level/quantity monitoring.

The known and suspected pollutants are listed in Table 4-1. Past water quality monitoring data from AICLA and the CLMP program indicate that phosphorus, dissolved oxygen, and temperature are not at levels that would cause impairment or pose an immediate threat to designated or desired uses. The AICLA continues to monitoring these parameters as they are good indicators of problems. If problematic levels are detected, the Lake Board is prepared to take action. At this time, these common water quality parameters are not included in Table 4-1. Each member of the SC assigned the problematic pollutants a prioritization ranking of high (H), medium (M), or low (L) priority. Each member individually evaluated the pollutants or watershed problems based on overall importance in the context of their role or duty in the watershed. In addition to their general perspective, the SC also incorporated public opinion and ease of implementation into their priority ranking. Then as a group, the SC ranked the pollutants, sources, and causes based on consensus.

**Table 4-1. Known and suspected sources of pollution or concerns in the Cedar Lake watershed.**

Rank	Pollutants	Sources of Pollution	Priority
1	Modified hydrology (K)	Diversion/reduced recharge (NW area/wetlands) Drainage/lowered groundwater table (SE area, residential storm sewers)	H
2	Invasive, non-native species (K)	Boats (boat launch areas) carrying invasive species Birds and other wildlife transporting invasives Bait/fishermen introducing potential invasives	H
3	Sediments (K)	Lakeshore erosion Internal plant production Leaf matter/human contribution Stormwater/lawn runoff Road-stream crossings/culverts Stream bank erosion	H
4	Nutrients (S)	Leaking septic systems Residential fertilizer runoff Pet/geese waste runoff Natural plant die-off	M
5	Pathogens (S)	Pet/geese waste runoff Leaking septic systems	L

(H)=High      (K)=Known  
(M)=Medium    (S)=Suspected  
(L)=Low



## Potential Causes and Sources of Pollutants and Concerns

Modified hydrology in the watershed is a known “pollutant” or problematic modification in the watershed. Phase I and II hydrologic studies of the watershed developed a mass balance that indicated modifications to groundwater and surface hydrology negatively impact local wetlands and lake level during dry periods. For this reason, modified hydrology is considered a high priority on the list of pollutants. Sources of this modification are shown in Table 4-2 and include diversion of water from the wetlands in the northwest corner of the watershed where recharge water for the lake is stored. Diversion out of the watershed through a culvert under Kings Corner Road (diverting water to the south) is well known to SC members as it relates to shunting water away from Cedar Lake during early spring months. In addition, wetland drainage through a shallow storm sewer system on the southeast side of the lake has a known negative impact on lake levels during dry summer months (Kieser & Associates, 2006). This system was studied and continues to be monitored by K&A to fully understand the relationship between lake levels and groundwater as it moves from the lake to shallow aquifers on the southeast side.

Invasive, non-native species are a high-priority problem in the lake that impair and threaten recreation and the fishery in Cedar Lake. This known problem has been documented in the watershed through annual reports and surveys of the lake by the aquatic plant manager and fisheries biologist. There are several potential sources of invasive species. First, the SC identified boats that are transferred from other waterbodies to Cedar Lake as a very likely source, especially because of Cedar Lake’s proximity to several other inland lakes, rivers, and Lake Huron. Second, birds and wildlife naturally transport species between watersheds. Last, Cedar Lake is a desirable fishing lake for many visitors and lake residents, which can result in use and disposal of bait in the lake and serve as a source of invasive species transmission.

Sediment loading to Cedar Lake was classified as a known pollutant due to lakefront resident surveys conducted by the AICLA in 2007-2008. The survey results indicate slight to moderate lakeshore erosion for the majority of the residents. In addition to public surveys, slight bank scour was observed on Sherman and Jones Creeks streambanks downstream of culverts under West Cedar Lake Road. Potential sources of sediments to Cedar Lake are listed in the second column of Table 4-1. The sources include confirmed sites of erosion in the watershed, common sources (such as road-stream crossings), and natural biological processes (which generally contribute low volumes of sediment or organic materials). Sediment loading to Cedar Lake was ranked as a high priority because the public has been vocal about the issue as it relates to in-lake bottom sediments, which impact recreation and aesthetics. The problematic

lake-bottom sediments are made up of mostly flocculent, organic material that is likely historical material that has remained at the bottom of the lake since centuries ago when highly productive wetlands predominated in the area. Investigation of new sources of sediment and modeling of the watershed (see Chapter 5) indicated that sources of sediment are moderate to low. However, overall sediment issues are important to residents; therefore, it was ranked as number 3 in the watershed.

Although nutrients are a very common NPS pollutant in most watersheds, Cedar Lake generally has low levels of nutrients. This is illustrated by phosphorus concentrations measured through monitoring efforts, including the AICLA, CLMP, and DEQ data from the MiSWIMS database<sup>10</sup>. For this reason, nutrients were given a medium priority ranking. Maintaining low to moderate levels of nutrient inputs was identified as an extremely important preventative measure to protecting the lake against accelerated eutrophication over time due to anthropogenic impacts. The District Health Department No. 2 has measured relatively low levels of pathogens at in Cedar Lake at the Greenbush Township beach. Recently the AICLA also has been sampling for *E. coli* and has not measured persistently high or problematic concentrations in Cedar Lake. The pollutant was ranked as a low priority because of the lack of violations in the *E. coli* water quality standard. Both nutrients and pathogens should be re-prioritized in the future if monitoring data reveal potential problematic levels or a trend in increasing concentrations.

In order to further investigate and confirm likely pollutants, sources, and causes in the Cedar Lake watershed, K&A quantified pollutant loads using a scientifically based empirical method. In the quantification method, information specific to Cedar Lake was collected and used with state of Michigan default values. The final output is an estimation of the likely pollutant loads from several land uses in the watershed. More information about the inputs and outputs are discussed in the next chapter. To identify critical areas for protection and restoration, the SC used the information ranked in this chapter, along with the results from empirical loading calculations. Identifying critical areas serves to further refine the management recommendations in the WMP that will help managers work toward reaching watershed goals.

All of the potential causes are listed in Table 4-2. The prioritization of pollutant sources was accomplished through SC consensus, as described on page 26.

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<sup>10</sup> The Michigan Surface Water Information System is available at: <http://www.mcqi.state.mi.us/miswims>.

**Table 4-2. Potential sources and causes of pollution in the watershed ranked from high (1) to low (11) priority.**

Rank	Sources of Pollutants	Priority	Potential Causes	Priority
1	Drainage (K)	H	Current zoning (K)	H
			Residential development (K)	H
			No wetland protection (i.e., ordinances) (K)	H
2	Diversion (K)	H	No wetland protection (i.e., ordinances) (K)	H
			Filling wetlands for driveways (K)	H
			Culverts (S)	M
3	Stream flow modification (K)	H	Upstream development (S)	H
			Dewatering of wetlands (S)	H
4	Stormwater runoff (K)	H	Lakeshore management (K)	H
			Manicured lawns (K)	M
5	Residential fertilizer runoff (K)	M	Improper or excessive fertilizer application (S)	H
			No soil testing prior to fertilizer application (S)	M
6	Leaking septic systems (S)	M	Old septic systems (S)	M
			Improper maintenance (S)	M
7	Lakeshore erosion (K)	M	Manicured lawns (K)	M
			Soil instability (K)	M
			Nuisance waterfowl (S)	M
8	Leaf dumping in lake (K)	M	Lack of education for lakefront residents and less education for non-lakefront residents (S)	M
9	Pet/geese waste runoff (S)	M	Improper disposal of pet waste (S)	L
			Nuisance geese in yards (no deterrent) (K)	M
10	Stream bank erosion (S)	L	Intermittent high flows/limited vegetation (S)	L
11	Road-stream crossings/culverts (S)	L	Deteriorating culverts/infrastructure (S)	L

(H)=High            (K)=Known  
(M)=Medium        (S)=Suspected  
(L)=Low

## CHAPTER 5: LINKING POLLUTANT LOAD TO WATER QUALITY

Estimating the likely pollutant loads from different land uses in a watershed can inform WMP recommendations for implementation projects and approaches. Identifying areas with high total loads or high loading per unit area can provide key information for prioritizing projects. Relative loading information also can assist in quantifying the expected load reductions from implementation projects. In addition, the information is useful for many types of future planning activities, including land use and zoning, regulatory or ordinance measures, and general watershed management. Beyond estimating current pollutant loads, predicting future loads from land use changes over time is a useful tool in determining and controlling future unintended impacts to water quality. Water quality parameters, such as total phosphorus (TP), total nitrogen (TN), and total suspended solids (TSS) can negatively impact aquatic ecosystems in excess, yet play an essential role in maintaining healthy and functioning water resources at balanced levels. This chapter describes the quantification methods used to estimate current pollutant loads (TP, TN, and TSS), surface water runoff volume, and predicted future loading and runoff in order to identify key critical areas in the watershed for protection and restoration efforts.

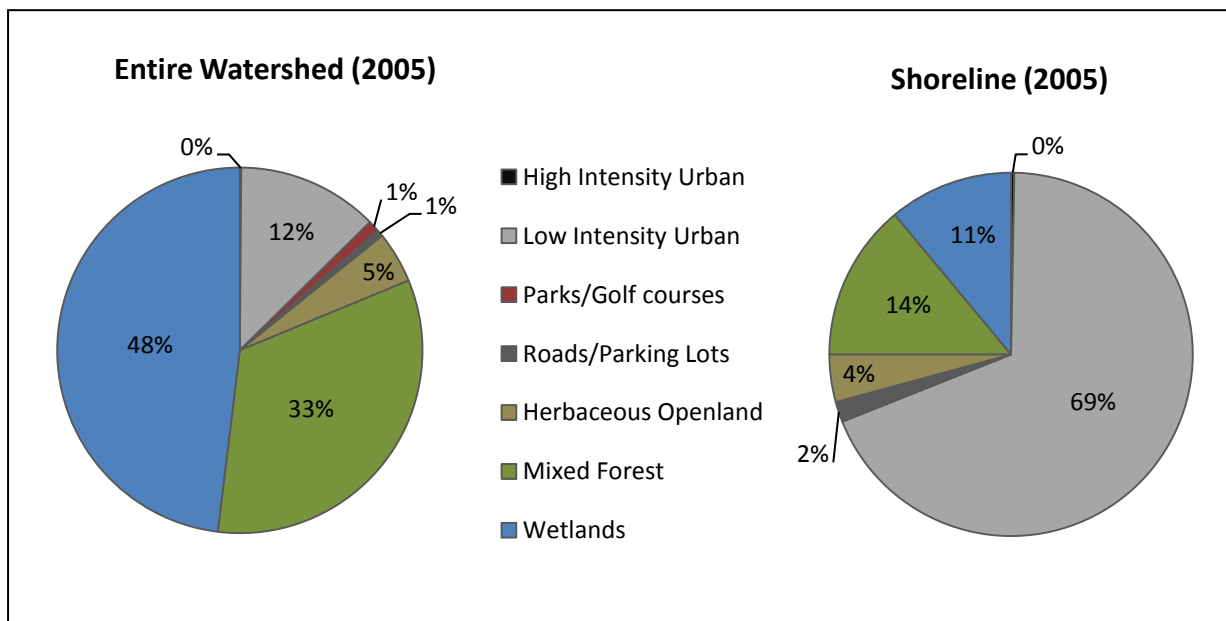
ESTIMATING NUTRIENTS AND SEDIMENTS THAT RUNOFF INTO THE LAKE PROVIDES WATERSHED LEADERS WITH A TOOL TO IDENTIFY AND PRIORITIZE PROBLEMS AREAS IN THE WATERSHED.

### Land Use Change

Nonpoint source surface runoff washes nutrients and sediments from the landscape into water bodies. The land use types in a watershed impact the quality and quantity of the runoff. In order to quantify the nutrient and sediment loads to Cedar Lake, percent land use by type was determined using the 2001 land use data layer. Because many of the developed parcels along the shoreline are tree covered, the land use map designates them as “forest” land use. In order to better estimate the true residential land use around Cedar Lake, the 2001 land use layer was updated by visually delineating the urbanized parcels using a 2005 aerial image (USDA, 2005). From this updated inventory of land uses, the majority of the watershed is forest and wetland, which comprise approximately 81% of the land use (not including surface water of Cedar Lake, which covers approximately 22% of watershed, or 1,075 acres). Just over 13% of the watershed is classified as developed (low and high intensity urban and roads) and less than one percent of the land use in the watershed is golf course. The majority of the developed area is located near the shoreline of Cedar Lake and comprises more than 71% of the shoreline land use. Figure 5-1

shows the distribution of land use in the entire watershed compared to the distribution of land use in the shoreline area.

A predicted future land use map for the watershed was developed from the Land Transformation Model for comparison to the 2005 land use breakdown. This model is a GIS-based land use change model developed by researchers from Michigan State University (Pijanowski, *et al.*, 2000, 2002)<sup>11</sup>. The future land use depicts an estimation of what land use potentially will be in 2030 in the Cedar Lake watershed. The land use layer was developed from a model that predicts land use changes by combining spatial rules with artificial neural network routines. Spatial rules take into account a variety of geographical, political, and demographic parameters such as population density, population growth projections, location of rivers and public lands, distance from roads, and topography (Pijanowski *et al.*, 2002). The final 2030 land use distribution or “build-out” was created by comparing the change in land use type (in acres) of the 2001 to 2030 data layers. The predicted change was then applied to the updated 2005 land use distribution, which relied upon visual delineation of the watershed (from 2005 aerial imagery) and field reconnaissance information.



**Figure 5-1. Comparison of 2005 land use distribution for the entire watershed and the shoreline area only.**

When comparing the land use distribution from 2005 to 2030, changes in future land use in

<sup>11</sup> The LTM is currently hosted by Purdue University and available at: <http://ltm.agriculture.purdue.edu/ltm.htm>

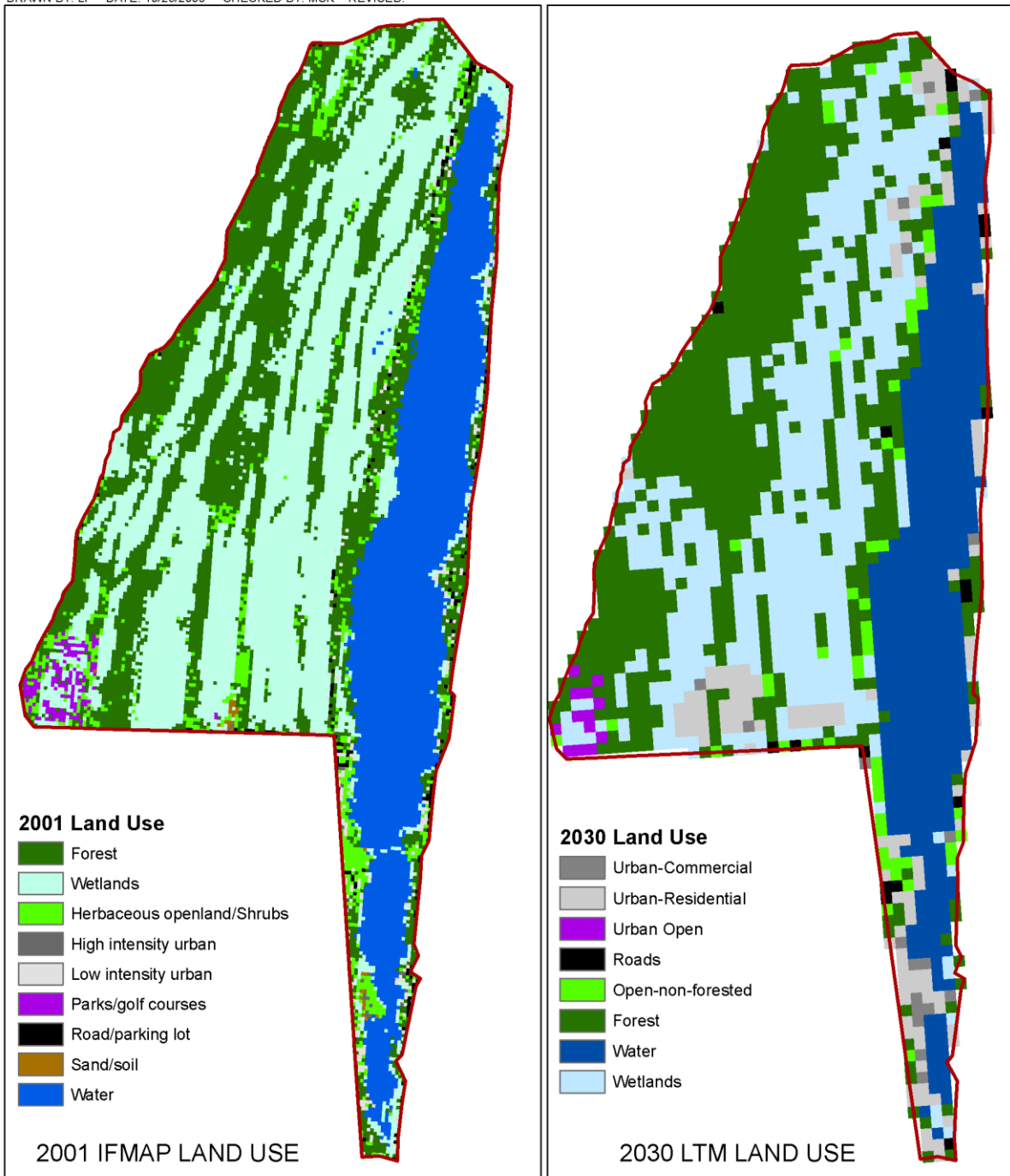
Cedar Lake show a predicted increase in urban and residential areas as undeveloped areas become built out. As Table 5-1 shows, the largest loss of a single land use category is wetlands, which has a predicted loss of approximately 435 acres. The majority of the lost acreage, which is converted to residential land use (see Figure 5-2), is shown in the northwest wetlands, especially along Kings Corner Road and in the northwest section of the watershed. Loss of more than 100 acres of herbaceous openland is also predicted to occur by 2030, which is also shown in the northwest wetland section of the watershed. Forest land is predicted to increase by 20%, which is a reasonable prediction for the Cedar Lake watershed as wetland areas are filled or drained and upland forest species flourish in areas with reduced groundwater inundation. It is also important to note that the pixel size of the 2001 land use breakdown and 2030 predicted build-out are not equal (30m x 30m and 100m x 100m, respectively); therefore, some of the predicted land use change might be a result of this discrepancy and is not a direct prediction of the model<sup>12</sup>.

**Table 5-1. Distribution of land use for the entire watershed and shoreline area from 2005 and 2030 and predicted change in land use by type.**

Land Use	Entire Watershed Area (Acres)				Shoreline Area (Acres)			
	2005	2030	Change	%	2005	2030	Change	%
High Intensity Urban	4.7	41.8	<b>37.1</b>	790%	2.0	32.2	<b>30.2</b>	1500%
Low Intensity Urban	470.0	703.9	<b>233.9</b>	50%	466.1	571.1	<b>105.0</b>	23%
Parks/Golf Course	37.4	37.4	<b>0</b>	0%	0	0	<b>0</b>	0%
Roads/Parking Lots	22.0	44.5	<b>22.5</b>	102%	12.2	12.2	<b>0</b>	0%
Herbaceous Openland	171.2	65.2	<b>-106.0</b>	-61%	28.7	8.7	<b>-20.0</b>	-70%
Mixed Forest	1,247.6	1,495.1	<b>247.5</b>	20%	94.7	39.4	<b>-55.3</b>	-60%
Wetlands	1,807.5	1,372.5	<b>-435.0</b>	-24%	75.0	15.0	<b>-60.0</b>	-81%
Water	1,075	1,075	<b>0</b>	0%	1,031.0	1,031.0	<b>0</b>	0%

<sup>12</sup> All land use values are meant to provide a general sense of land use change in the future and help guide watershed management activities, and should not be expected to be an exact representation or prediction of current or future land uses in the watershed.





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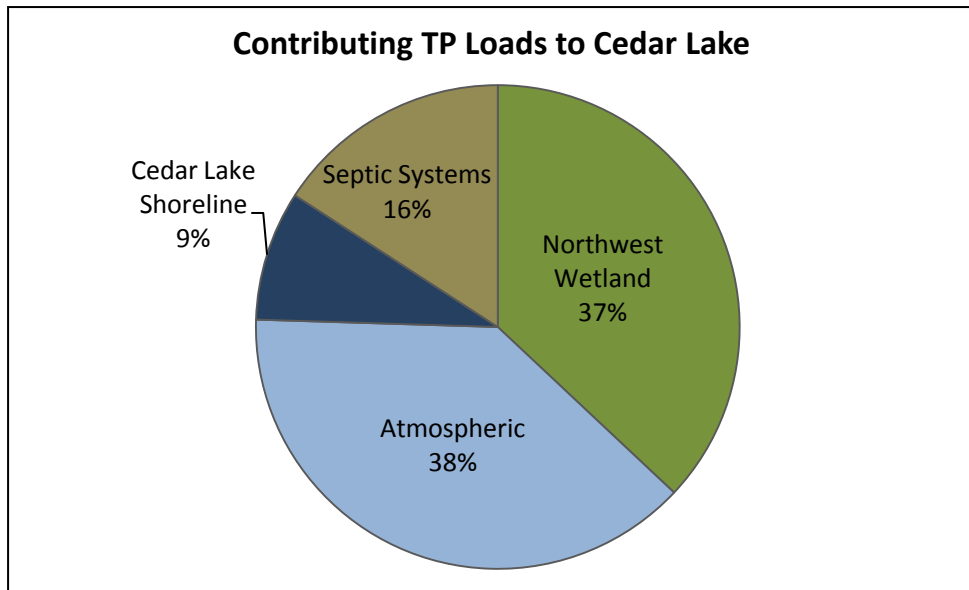
**Figure 5-2. Comparison of 2001 and 2030 land use for the Cedar Lake watershed (note: pixel size is 30x30m in 2001 and 100x100m in 2030).**

## Estimation of Pollutant Loads

Phosphorus and sediment loads to Cedar Lake were quantified using the Unit Area Load (UAL) method and the predicted land use change in the watershed from 2005-2030. This approach assumes that loading of phosphorus and sediments resulting from surface runoff at a given location can be reasonably approximated as a function of the land use activity, soil type, and slope. Given the relatively small size of the watershed and the specific runoff and groundwater sources to the lake (K&A, 2006), this method provides an appropriate and simple estimate of likely sources of pollution in the watershed. Runoff models such as L-THIA and the event mean concentration method would not likely derive loading values that are very accurate for Cedar Lake. Phosphorus and sediment loads were combined with other likely loading sources to the lake to develop a mass balance for Cedar Lake. Water quality samples collected from within the wetland show extremely low concentrations of phosphorus and sediments when compared to other aquatic ecosystems in Michigan.

The mass balance inputs of phosphorus into Cedar Lake come from the northwest wetland area, the Cedar Lake shoreline area, atmospheric inputs directly to Cedar Lake, and septic system loading from the individual sewer systems near the shoreline. Figure 5-3 shows the approximate mass balance of contributing TP sources to Cedar Lake. The pie chart shows that approximately 25% of the loading comes from residential land uses and the remaining 75% of the loading is split evenly between atmospheric deposition and loading from the northwest wetlands. It is important to note that groundwater is a large source of water to the lake; however, extremely low surface water concentrations of TP indicate that groundwater concentrations are likely insignificant and therefore are not included in this analysis.

Total phosphorus (TP) loads to Cedar Lake were calculated by applying a UAL to each of the land use types. For the northwest wetland area, actual data collected in 2009 were used to calculate a UAL. The average TP concentrations from water samples collected at Sherman Creek, Jones Creek, and near Kings Corner Road and West Cedar Lake Road were used to obtain an average TP concentration (0.131 mg/l). The surface and groundwater monitoring data collected at the same locations were used to calculate an average volume of runoff from the wetland to Cedar Lake (298 million gallons/year). The resulting UAL was applied to the entire area in the northwest wetlands to calculate “current” TP loading from Sherman and Jones Creeks.



**Figure 5-3. Sources and approximate distribution of estimated TP loads to Cedar Lake from 2005 land use.**

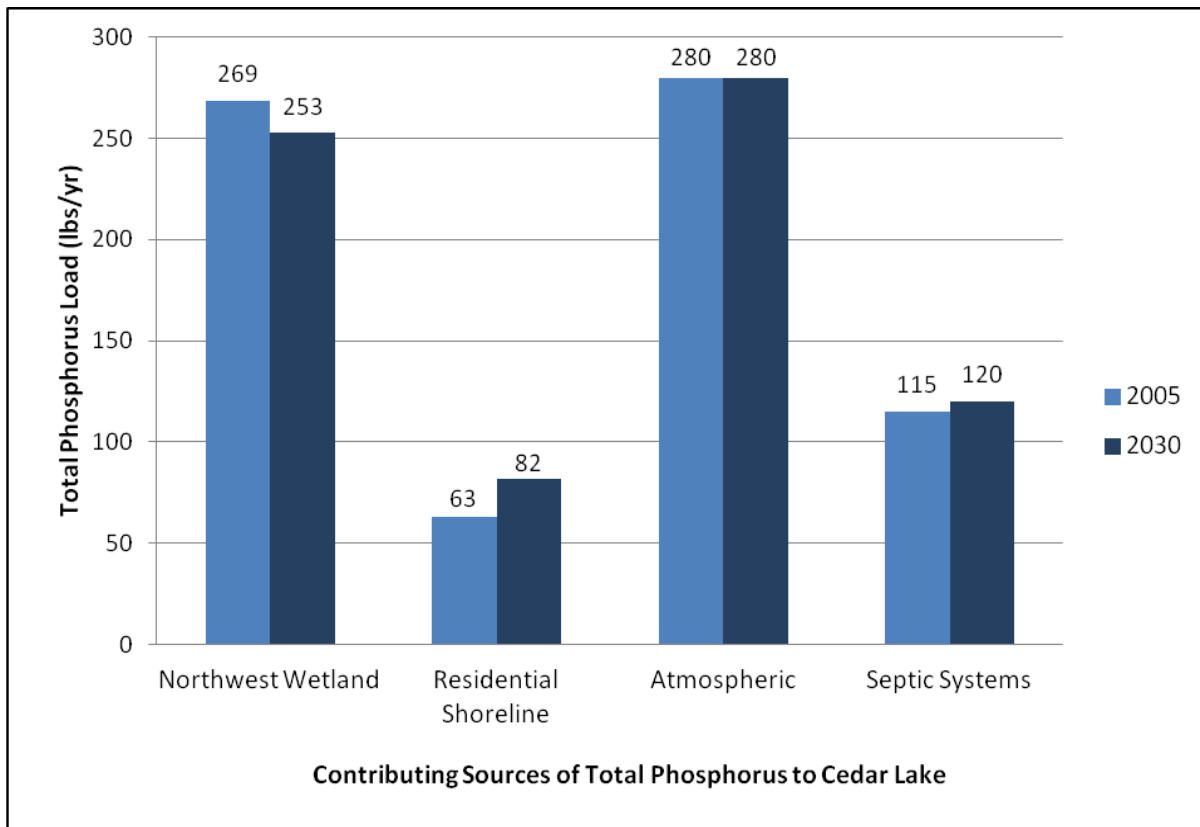
The current TP load from the Cedar Lake shoreline was calculated using an average low-intensity residential UAL and applying a delivery factor. In order to determine the delivery factor for surface runoff from residential areas along the shoreline, soil and slope characteristics were taken into account. The three main soil types around the shoreline are all in hydrologic soil group A, which is defined as soils with high infiltration rates with well drained to excessively well drained sands and gravels. The sands around the lake are primarily Au gres sand and Crosswell sand. Because of the high infiltration rates and high hydraulic conductivity, a large portion of precipitation during a storm event infiltrates and is routed to the lake via groundwater. Because of these characteristics, a delivery factor of 0.5 was applied to all residential shoreline areas. The shoreline area also included a load associated with transportation roads and parking lots, which was taken from literature documenting common high-intensity urban UALs in Michigan (Reckhow *et al.*, 1980).

For wetland, forest, and herbaceous openland in the shoreline area, the same UAL from the northwest wetland was applied to determine TP loading to the lake with a delivery factor of 1. The UAL calculated from actual 2009 data represents the actual load delivered to the lake, so no additional discount factor is necessary.

A method for estimating the contribution of TP to lakes from shoreline septic system is outlined in Reckhow, *et al.* (1980). The method estimates the inefficiency of shoreline septic systems in trapping phosphorus and preventing it from entering the lake through groundwater. The

method involves calculating a soil retention coefficient and using site-specific average conditions of the septic systems and users in order to accurately estimate the TP load. In order to gather this information, a septic system survey was distributed to riparian homeowners around Cedar Lake. Riparian homeowners were asked to provide information on: 1) the age of their septic systems, 2) distance from the lakeshore, 3) maintenance schedule, 4) number of permanent residents, 5) number of visitors, and 6) use of a dishwasher. A full description of the methods and variables used is included as Attachment C. The surveys from the northwest side of the lake were used to determine loading to the lake due to findings in the Phase II hydrologic study by K&A (2006). The study found that only groundwater on this side of the lake moves toward the lake. All other areas around the lake exhibit groundwater movement away from Cedar Lake. The final TP loading results for the 189 parcels on the northwest side of the lake is approximately 115 pounds of TP per year. In order to estimate future TP loading from septic systems, the average age of each septic system was increased by 20 years.

The TP loads from the different contributing sources are shown in Figure 5-3. Loads from the 2030 land uses were calculated with the same methods used to quantify “current” loads (2005). One additional calculation was performed to account for the conversion of land in the northwest wetland to urban land use. The UAL for low-intensity urban was used to determine the increased urban load from this part of the watershed in 2030. Even though residential urban land use increased in the northwest wetland, the overall TP load is predicted to decrease slightly by 2030. This is due in part to the low to moderate UAL for low-intensity urban and the discounting affect of the delivery factor (0.5).



**Figure 5-3. Contributing TP loads to Cedar Lake from various sources in the watershed for 2005 and 2030.**

The residential shoreline TP load is expected to increase by almost 30% by 2030. Because the size of the lake remains the same in 2030, no additional atmospheric loading was added to the 2030 TP loading, although the atmospheric UAL could potentially change in the next 25 years. The TP load from septic systems shows a potential increase in loading of approximately 5 more pounds of loading to the lake. This takes into account the natural aging of existing septic systems and does not factor in any replacement of failed systems from 2005 to 2030, increased per capita usage, increased maintenance practices, or additional installation of systems by 2030.

In addition to TP loading, sediment contributions to Cedar Lake also were quantified. Sources of sediment, or total suspended solids (TSS), to Cedar Lake include surface runoff and erosion from the northwest wetland area and shoreline area. These loads were calculated using the UAL method and land use values from 2005 and 2030. The UAL for the northwest wetland area was calculated using 2009 TSS data collected at Sherman and Jones Creeks and the Kings Corner Road Culvert near West Cedar Lake Road. The average TSS concentration calculated from the

data was very low at only 1.73 lbs/acre/year.

Values derived from a similar study in Kalamazoo, Michigan were used to determine the low-intensity residential and transportation UAL. UAL values for TSS near Woods Lake in Kalamazoo, MI were approximately 13.86 lbs/acre/year. The area is highly developed with large amounts of impervious surface. The UAL from this area was used to calculate loading from transportation (roads and parking lots) in the Cedar Lake watershed. An average of the low wetland UAL and higher transportation UAL was calculated and used for low intensity residential in the shoreline area (7.8 lbs/acre/year). The resulting TSS loads for contributing sources to Cedar Lake in 2005 and 2030 are shown in Figure 5-4. In general, approximately half of the TSS load to Cedar Lake comes from the northwest wetland area and half from the shoreline area. Figure 5-4 shows little to no change in TSS loading from the northwest wetland area even with increased build-out in 2030 (6% decrease in loading from 2005 to 2030). The largest increase in TSS in 2030 comes from the residential shoreline area, which has the potential to increase by almost 40% with the build-out predicted in the 2030 land use data.

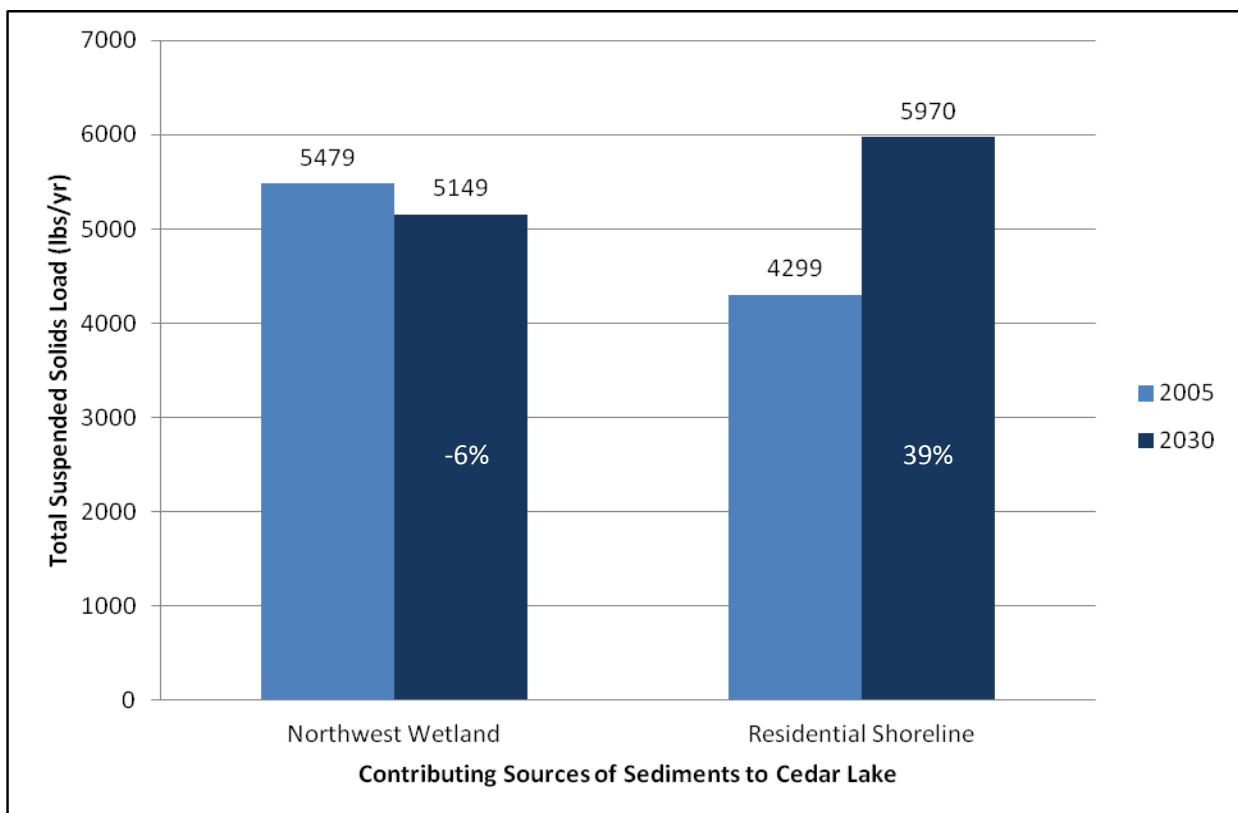


Figure 5-4. Sources of TSS loading to Cedar Lake in 2005 and 2030 with percent change indicated in white.



## Estimation of Hydrologic Runoff

The two main sources of water to Cedar Lake are surface runoff and groundwater. The hydrologic mass balance of Cedar Lake was investigated in a hydrologic study by K&A in 2005 to 2006 to determine the causes of major lake level loss during dry years. One main reason watershed stakeholders are interested in developing a WMP for Cedar Lake is to better manage activities in the watershed to protect recharge areas. The hydrologic mass balance for Cedar Lake from June to September 2004 is shown in Figure 5-5 (K&A, 2006). During this period, the watershed received approximately 7.6 inches of precipitation, which is approximately two-thirds the historical average precipitation for this same period. At the same time, the lake level dropped approximately 2.2 feet. In 2005, the June to September precipitation was 15.2 inches and the lake dropped approximately 1.1 feet. In 2009, the June to September precipitation was approximately 16 inches. The lake level was at or near the spillway elevation for the majority of the summer in 2009.

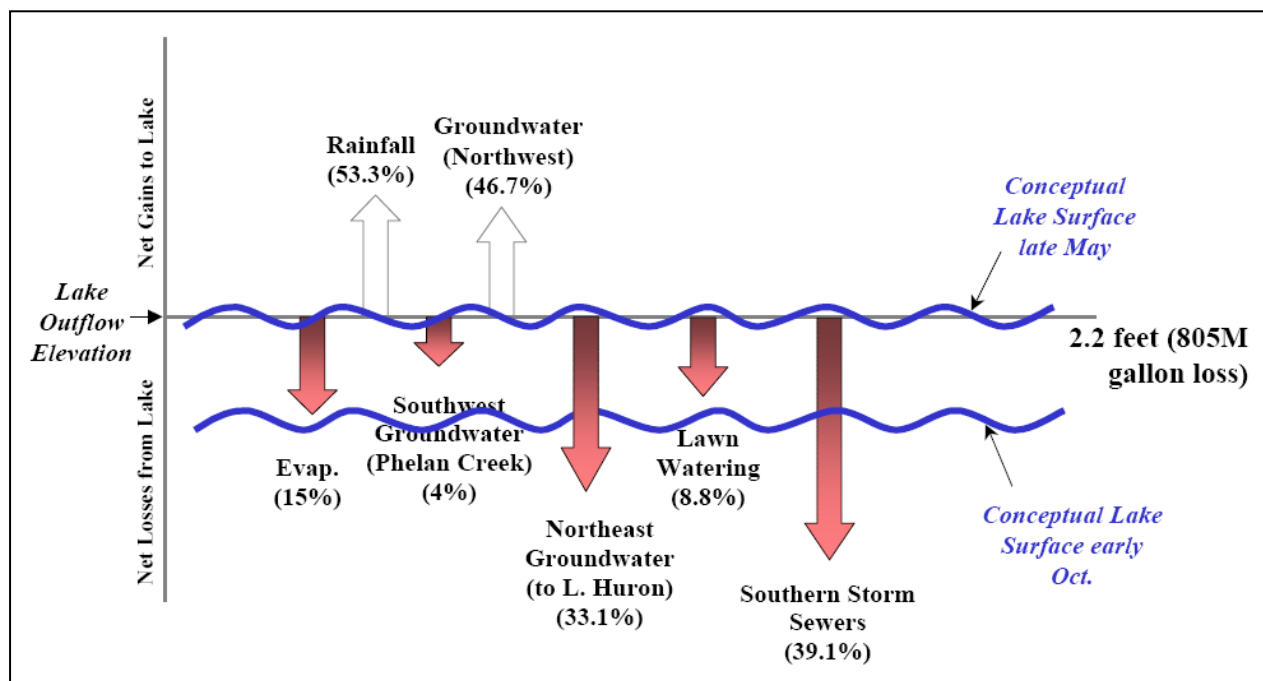


Figure 5-5. Sources of water gains to and losses from Cedar Lake from June-September, 2004 (Source: K&A, 2006).

Monitoring of groundwater, precipitation, and surface flows in the northwest wetland was performed by K&A in 2009 as part of the WMP watershed investigation, in addition to data

collected in 2004 and 2005 as part of the hydrologic study. These data provide useful information on the approximate volume of runoff coming from Sherman and Jones Creeks and the surface water loss to the south from the culvert under Kings Corner Road that diverts water to the Van Etten Lake/ Pine River watershed via Phelan Creek.

The approximate surface runoff volumes of Sherman and Jones Creek, as well as the water loss from the Kings Corner Road culvert for the 2009 water year, are shown in Table 5-2. The large majority of surface runoff occurs in late winter to later fall from both Sherman and Jones Creeks. The culvert at Kings Corner Road showed a majority of runoff in late fall through early spring during the 2009 water year. During this same period in the 2009 water year, almost no water discharged from the lake outlet (i.e., lake levels were likely below the outlet structure for most of this period). The volume of water diverted out of the watershed at Kings Corner Road equates to approximately 187 acre-feet water, which is more than 15% of the volume of water loss experienced in 2005.

**Table 5-2. Approximate volume of surface runoff from the northwest wetland area after losses from the diversion at Kings Corner Road culvert.**

	<b>Spring Runoff*</b> <b>(million gallons)</b>	<b>Annual Runoff</b> <b>(million gallons)</b>
Jones Creek	32.0	49.2
Sherman Creek	236.8	279.1
Kings Corner Road Culvert	-8.2	-52.8
<b>Total Runoff to Cedar Lake</b>	<b>260.6</b>	<b>275.5</b>

\*In the 2009 water year, spring runoff was observed from February 7 through June 28 in Sherman and Jones Creeks and January 9 through June 28 for Kings Corner Road culvert.

The relative sources of surface water gains and losses for Cedar Lake are important for planning and implementation efforts associated with the WMP implementation strategy. Many of the watershed goals and objectives are focused on maintaining balanced lake levels, even during dry summer months. As these goals and objectives are worked into the implementation strategy, it will be necessary to determine the likely volumetric impacts of the recommended BMPs, projects, and approaches. Other considerations of the impacts of the implementation phase of the WMP will be how changing runoff patterns in the watershed will affect: 1) pike spawning in Sherman Creek, 2) residents in the northwest wetlands, and 3) groundwater levels in the Lakewood Shores housing development.

## Critical Areas in the Watershed

Critical areas are described in the State of Michigan WMP Guidance document as a geographic portion of the watershed that is contributing a majority of the pollutants and is having a significant impact on the waterbody (Brown, *et al.*, 2000). For the purposes of the Cedar Lake WMP, the SC considered areas of the watershed that were critical for protection or restoration in terms of lake recharge and lake levels, critical fish and wildlife habitat, and water quality. The SC drew upon the identified designated and desired uses; watershed concerns and issues; known and suspected pollutants, sources and causes; and, the estimated current and future pollutant loads to Cedar Lake to pin point specific locations in the watershed where protection and restoration is most needed. Protecting and improving these particular areas will provide the most benefit to the lake and its watershed.

In general, the large tracts of wetlands in the northwest portion of the watershed have been identified as extremely significant for providing the majority of the surface water to Cedar Lake, especially through two small creeks, Sherman and Jones Creeks. These creeks convey surface water from spring to early summer that is collected and stored in the wetlands and then discharged to the lake. Figure 5-6 shows the specific locations that are identified as critical areas for protection in the northwest wetlands. Other areas that were identified as critical for protection are in-lake fish habitat and natural shorelines. While these critical areas are more broad in scope, specific pockets of fish habitat and parcels with natural shorelines have been identified through surveys and assessments in the watershed. These specific types of land are identified as critical for projects that will provide habitat protection, including educating stakeholders. The remaining critical areas identified in Figure 5-6 have been selected because restoration projects are most needed in these select areas. The critical areas are labeled 1-8 in Figure 5-6 and include the following:

- 1) Sherman Creek: This creek serves as the main source of surface water to Cedar Lake during the spring and early summer (note volumes in Table 5-2). The creek also provides spawning habitat for several fish species (including pike) important to the Cedar Lake fishery. The creek is one of the last major connections between the lake and wetland and provides nursery habitat for young fish before they move into the lake via Sherman Creek. Very limited streambank erosion has been observed along the stream corridor. Sherman Creek is on a single property that is privately owned and was for sale during the WMP planning period. This property should be permanently protected to

preserve Sherman Creek, its streambanks, and the connection it provides to the wetland.

- 2) Jones Creek: This creek is smaller than Sherman Creek but also provides surface runoff from the wetland into Cedar Lake. Jones Creek also provides fish habitat and has relatively stable streambanks. This stream and its corridor should be protected as it is an important connection between the wetland and lake.
- 3) Sherman Creek Drainage: The land immediately draining to Sherman Creek is outlined in white in Figure 5-6. This area is a priority area with the entire wetland complex for protection because of the volume of water this area provides to Cedar Lake during the spring and early summer. The 166-acre drainage area should be protected from development (including filling and clearing) to protect the storage capacity and water supply to Cedar Lake.
- 4) Kings Corner Rd. Diversion: A culvert is located under Kings Corner Road near West Cedar Lake Road. This culvert diverts water from the wetland on the north side of the road to the south. This creates a diversion of water out of the Cedar Lake Watershed and into the adjacent watershed (Pine River/Van Etten Lake). The culvert should be modified to prevent water from diverting out of the watershed. This diversion is critical in order to restore the wetland hydrology in this particular area and conserve surface water for Cedar Lake.
- 5) Lakewood Shores Drainage District: This critical area lies just outside of the Cedar Lake Watershed but is hydrologically linked through a groundwater connection. The lake naturally loses water to shallow groundwater aquifers on the south end of the lake. The Lakewood Shores residential development has naturally high groundwater, so a subsurface drainage system was installed to drain water towards Lake Huron. The drain system was identified in the Phase II hydrologic study as the largest water loss from Cedar Lake during summer months (K&A, 2006). Restoration is not the major objective for this area, since residents in this area rely on the existing drain to keep their houses from being inundated with water during wet months. The SC determined that educating builders and new residents about the flooding issues around this area is likely the best approach. The main goal for this area is to eliminate the need to expand the subsurface drainage system as more building occurs on undeveloped lots in Lakewood Shores.
- 6) In-lake Fish Habitat: Pockets of fish habitat have been identified by fisheries biologists in Cedar Lake and are shown in Figure 5-7. The specific habitat locations shown in the figure were identified as critical fish habitat in the 2009 Aquatic Plant Management Program Update Report (Pullman, 2009). Monitoring of these habitat areas should continue, as has been done by SEAS, LLC in the past.





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**Figure 5-6. Critical areas for protection and restoration in the Cedar Lake Watershed.**

- 7) Lake Outlet: The outlet to Cedar Lake is located at the far northern end of the lake. Two concrete spillway structures were constructed to direct water from the lake outlet under Cedar Lake Road and into a small stream to the north. The structures were set at the approximate elevation of the court-ordered lake level to stop the lake from rising above this elevation. These structures are aging and should be assessed in the near future and likely replaced or modified.
- 8) Cedar Lake Shoreline: Most of the Cedar Lake shoreline has been developed for residential use and parks and recreation. Results from a 2007-2008 shoreline survey conducted by the AICLA indicated that mowed turf grass is the most common lawn cover near the shore. The survey also asked riparians to indicate if they had seawalls (steel, wood, or concrete). Figure 5-6 shows developed parcels along the shores of Cedar Lake. Those without seawalls are critical areas for protection. These residents should be targeted for education on natural shorelines to deter building of additional hard shoreline structures/seawalls.



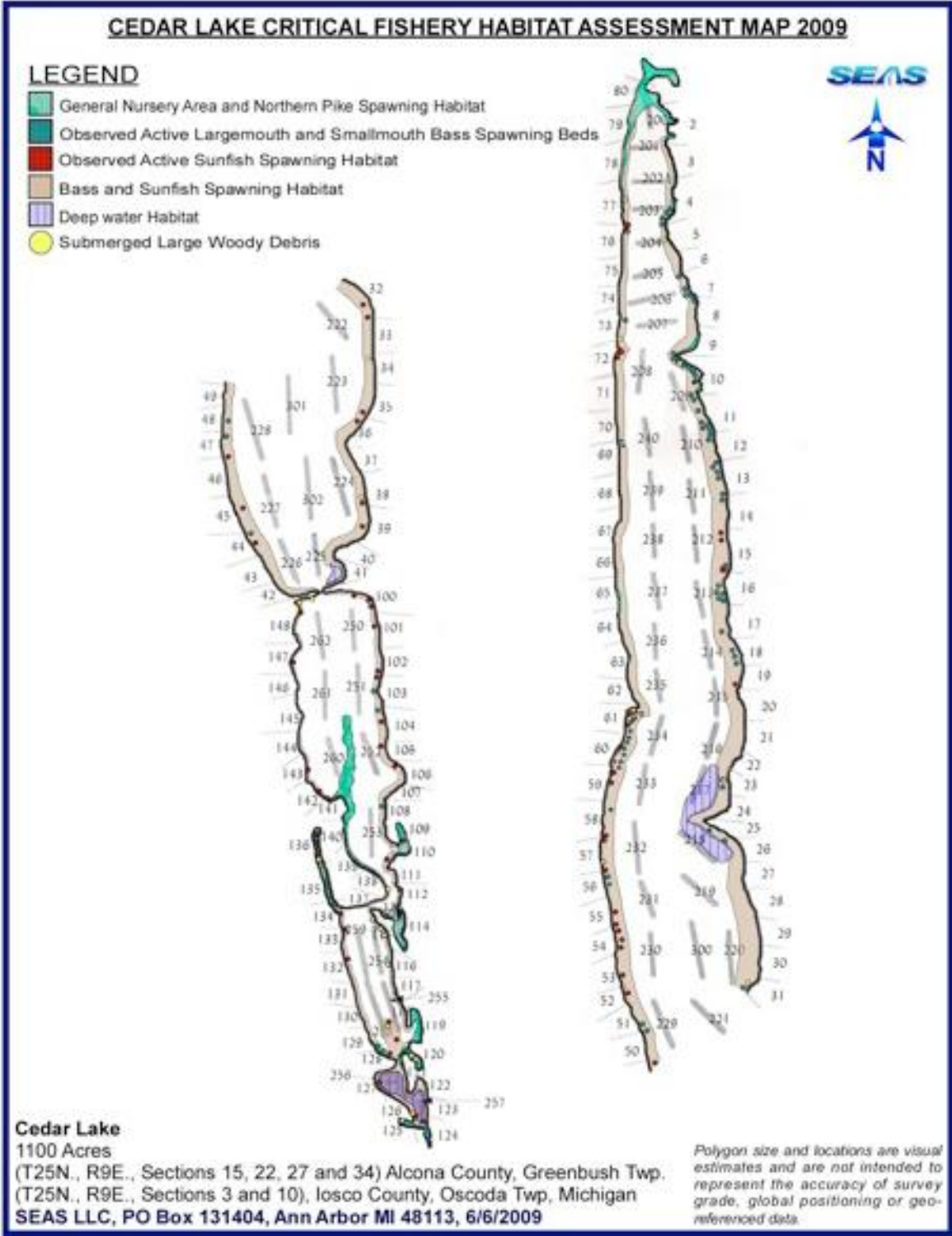


Figure 5-7. Critical fish habitat identified in Cedar Lake in 2009 (Source: SEAS, LLC).

## CHAPTER 6: WATERSHED GOALS AND OBJECTIVES

The SC developed goals for the watershed are based on restoring and protecting the designated and desired uses of Cedar Lake. These goals outline the overall desired outcomes in the watershed. The goals were developed to be broad and flexible so they can accommodate changes in watershed management over time, yet still direct managers to the outcomes the SC initially intended.

### Watershed Goals

Comprehensive watershed goals were developed to reflect the issues surrounding each threatened use or concern in the watershed. The goals reflect the final desired outcome of the WMP, which is to attain and protect the designated and desired watershed uses. The goals are listed below in an order that follows the list of designated and desired uses in the watershed from Table 3-1 and do not reflect any priority ranking. Each goal that has been set for the watershed should be considered “equal”, in that successful implementation of the WMP will need to work toward achieving all of the watershed goals. For example, it would be difficult to determine if protecting the Cedar Lake fishery is more important than maintaining a balanced aquatic plant community. The ultimate goal of the WMP will be to reach both goals, thereby resulting in a healthy aquatic ecosystem. The final desired outcome of the WMP, which is to meet all designated and desired uses, will be achieved by collectively accomplishing all of these goals. The overall goals for the Cedar Lake watershed are:

SETTING WATERSHED GOALS PROVIDES A CLEAR DIRECTION FOR EFFORTS IN AND AROUND CEDAR LAKE. OBJECTIVES PROVIDE A MORE DETAILED DESCRIPTION OF HOW GOALS CAN BE ACCOMPLISHED.

1. Restore and protect the warm-water fishery to support healthy populations of native fish species
2. Maintain a balanced and healthy aquatic plant and wildlife community in Cedar Lake and the watershed
3. Maintain open and clear waterways for recreation
4. Preserve good water quality and reduce and/or minimize muck sediments for full body contact recreation
5. Protect groundwater levels for lake recharge to achieve balanced lake levels
6. Maintain the legal lake level by protecting recharge sources and surface water inputs
7. Conserve and restore wetland and aquatic habitat for ecosystem function and service

In order to accomplish these goals, the SC worked through a process to identify and define objectives for each of the goals. A comprehensive WMP requires objectives for each goal that help develop the actions used in the implementation phase of the WMP. The objectives point to specific areas and suggest particular projects or approaches that are needed to reduce pollutants or resolve other watershed issues or problems. These objectives are another part of the WMP that serves as the road map for watershed managers.

## Watershed Objectives

The objectives developed for each of the watershed goals outline ways that designated and desired uses in the watershed will be restored or protected. The objectives are developed in such a way as to accomplish goals through a variety of more-detailed actions, including ordinances, projects, BMPs, education, and other approaches. These approaches are further outlined in the implementation strategy found in Chapter 7. Objectives I through III listed below relate to protection of groundwater and surface water that recharge the lake. The importance of these recharge sources is captured in Goals 5 and 6. These objectives point out specific areas and resources in the watershed that require protection to reach watershed goals. Objective IV relates to both Goal 1 and specifically identifies improvements in the watershed that would protect and benefit the fishery. In general, adequate lake level, enhanced flows in the creeks, improvement in available spawning habitat, and wetland protection in the northwest part of the watershed are all specific items that must be addressed to meet the fishery goal for Cedar Lake.

Objective V points management efforts toward protection of waterways (Goal 3) by identifying the need to combat the threat of invasive species and control existing nuisance aquatic species already found in Cedar Lake. These efforts will maintain and increase the recreational and aesthetic value of Cedar Lake. Objectives VI through VIII address in-lake conditions for partial and full body contact recreation as they relate to Goal 4. Existing organic muck sediments impact aesthetics of the lake. One of the most common approaches to improving the composition of lake bottom sediments is removal of flocculent organic sediments. Efforts to determine if the removal of sediments is feasible or cost-prohibitive are specifically outlined in the objective. Water quality issues related to pathogens and excessive nutrients are not currently an issue in Cedar Lake. Therefore, Goal 4 emphasizes the need to take measures to preserve and protect the existing water quality conditions in Cedar Lake and Objective VII points to monitoring efforts as an important tool to track concentrations. Lastly, Objective VIII highlights the need for educating lakefront residents, in particular regarding practices they can implement on their properties to protect lake quality and prevent degradation of water quality

over time.

Objective IX provides a specific approach to conserving and restoring important wetland habitat in relation to Goal 7. The objective calls for the use of land conservation tools (such as conservation easements or purchase of development rights) in order to permanently protect important habitats and the associated ecosystem services and functions they provide to the watershed. The following is a complete list of watershed objectives with the related watershed goal listed in brackets:

- Objective I: Protect critical wetlands identified along the northwest side of Cedar Lake from drainage or diversion (and loss of wetland function) [Goals 1, 5 and 7]
- Objective II: Prevent additional groundwater loss from the lake on the southeast side due to storm sewer infrastructure [Goals 5 and 6]
- Objective III: Pursue augmentation feasibility study to choose suite of lake level management options for implementation [Goal 5]
- Objective IV: Improve the sport fishery in Cedar Lake through enhanced lake levels, creek levels, habitat, and wetland protection [Goal 1]
- Objective V: Work to stop the spread of invasive, non-native species to the Cedar Lake watershed and control existing nuisance species [Goals 2 and 3]
- Objective VI: Seek ways to improve composition of lake bottom sediments (determine feasibility of muck reduction) [Goal 4]
- Objective VII: Continue water quality monitoring of pathogens and nutrients to protect good water quality and recreational value of Cedar Lake [Goal 3]
- Objective VIII: Educate lakeshore residents about natural lakescaping methods, green buffers, and other BMPs that can be used to benefit the lake [Goals 2, 3 and 7]
- Objective IX: Utilize conservation options with the local land conservancy as a habitat protection tool [Goals 1 and 7]

## CHAPTER 7: IMPLEMENTATION STRATEGY

This chapter of the WMP describes the recommended implementation strategy that will serve as the road map for meeting watershed goals. It outlines the technical and financial resources necessary to implement the WMP and provides an estimate of the results of many of the BMPs, projects, and approaches recommended in the implementation phase. In addition, key organizations whose participation is necessary to successfully accomplish the recommendations are included for each of the objectives described in Chapter 6. This chapter provides milestones and methods of evaluating success in the watershed and will serve as a stand-alone document for the Lake Board and other watershed stakeholders to use in the implementation phase of the WMP.

THE WATERSHED IMPLEMENTATION PLAN SERVES AS TURN-BY-TURN DIRECTIONS ON HOW TO MEET THE FINAL WATERSHED GOALS AND OBJECTIVES. THE IMPLEMENTATION PLAN PROVIDES INFORMATION ABOUT PROJECT COSTS, TIMING, KEY STAKEHOLDERS, AND POTENTIAL FUNDING SOURCES.

### Current Management Strategies and Recommendations

In the past, activities in the Cedar Lake watershed have been pursued primarily when particular concerns or desires surfaced among the AICLA members or other citizen groups. The AICLA has pursued and implemented a number of projects and studies over the past decade, including fishery and wildlife projects; investigations into lake level issues, sediment composition, and water quality; and a variety of educational efforts. More recently, the Cedar Lake Improvement Board was developed under the Part 309 Inland Lake Improvement Statute (Natural Resources and Environmental Protection Act 451 of 1994). The Lake Board consists of a number of representatives from various levels of government, including township, county, and state agency representatives and a member representing the local lake association. The board originally was formed for the purposes of weed control and they still hold a contract with a limnologist and chemical applicator to treat nuisance aquatic plants. Recently, the contract was expanded from simply employing a weed control/chemical applicator to a more comprehensive aquatic plant management approach. Using this approach, technical consultants implement an aquatic plant management and fisheries management strategy with weed control/chemical treatment subcontracted to a licensed company and overseen by the limnologist.

Recently, the Lake Board has started down a path to further expand this approach to an all encompassing lake management scheme. An appropriately credentialed lake manager will be

under contract to the lake board to advise and guide in all phases of all lake management matters handled by the lake board, including the implementation of this plan. Current aquatic plant and fisheries management strategies will be incorporated into this expanded approach. Public hearings to determine the practicability and funding of this expanded lake management effort will be completed during the summer of 2010, with a goal to have a lake manager under contract by 2011. This position is further described in the sections below and included in Attachment D.

## Implementation Strategy

A number of implementation projects and approaches were developed and prioritized by the SC in order to meet watershed goals and objectives. A detailed table is included in Attachment E. For each of the objectives, the SC selected a priority ranking based on four factors: 1) degree to which the approach is needed in the watershed, 2) level of implementation required, 3) cost effectiveness of the project or approach, and 4) feasibility of funding. The approaches were then given a ranking of 1 to 3, where 1 would be implemented in years 1 through 3 of the implementation phase, 2 implemented in years 4 through 5, and 3 implemented in years 6 through 10+. The approaches described below are organized by objective and include a summary of background information, other relevant or ancillary information, concerns discussed by the SC, and recommendations. Key implementation steps and organizations are listed for many of the objectives.

### **OBJECTIVE I: Protect critical wetlands in the Cedar Lake watershed to the northwest of the lake from drainage, filling, and diversion (and resulting loss of wetland function)**

The SC discussed several ways to restore and protect the wetlands on the northwest side of Cedar Lake in the only directly draining watershed areas for the lake. Accomplishing these objectives will help the watershed meet the goal of protecting surface and groundwater sources to Cedar Lake. The following implementation projects and approaches will help protect areas that provide source water to the lake and ultimately mitigate lake level losses during summer months:

- 1) Support and work to implement a wetlands protection ordinance to protect critical wetlands and their functions
- 2) Restore hydrology of the wetlands in the watershed
- 3) Acquire property in the northwest wetlands to restore hydrology and habitat, as well as



provide public viewing as a “wetlands preserve”

The SC explored the option of developing and enacting a wetland protection ordinance to effectively meet watershed goals. An ordinance is considered to be the most effective protection against development of critical wetlands that would drain or divert water out of the wetland, negatively impacting an important water source to Cedar Lake. The major purpose of any wetlands protection ordinance is to provide an additional layer of oversight on development in wetlands to protect against destruction and loss of function. Additionally, the group discussed a large-scale project to restore hydrology in the wetlands and create a wetlands preserve in a portion of the wetland near Kings Corner Road and West Cedar Lake Road.

The watershed of Cedar Lake is comprised primarily of wetlands and wooded wetlands, with some drier upland areas. This complex of wetlands provides the majority of the recharge and source water to Cedar Lake (Kieser & Associates, 2005). Decades of flood management, particularly in developed areas immediately southeast of the lake, have caused an imbalance in lake hydrology, so much so that during dry years the lake level can drop by more than two feet. For this reason, wetlands in the northwest corner of the watershed have been identified as “critical” for protection in the watershed. In addition to recharging the lake, the wetlands serve as important habitat for fish and other wildlife. Pike have been observed migrating up the two small streams that feed Cedar Lake from these wetlands (Sherman and Jones Creek) to spawn during spring months. Reduced water levels in the wetlands decrease the flow from these creeks and interrupt or stop pike from using the wetlands for vital spawning purposes. Wetlands also serve to filter sediments and pollutants, thereby improving or protecting water quality conditions in downstream waters.

The wetlands in the northwest have already been compromised by a large diversion near Kings Corner Road and West Cedar Lake Road. A culvert currently drains water from the wetland to the south side of Kings Corner Road where it travels to Phelan Creek and eventually to the Van Etten Lake/Pine River watershed. This effectively removes water from the wetland that would otherwise drain to Cedar Lake (Kieser & Associates, 2005). Historic filling of wetlands has occurred along West Cedar Lake Road and along the lakeshore to allow for building of homes and driveways. This slow development over time has changed the flow of water in the watershed, has likely contributed to lower lake levels and would further impact water quantities if left unchecked.

A wetlands protection ordinance was discussed in depth at SC meetings and members generally

agreed that an ordinance would be the most effective means of protection. The ordinance also would be a low-cost option, and therefore a good measure to prevent further jeopardizing of lake levels. Due to the effectiveness of ordinances, such an option has been prioritized as Tier 1, which is the highest priority in the WMP. It is recommended that watershed stakeholders and township representatives work on implementing an ordinance shortly after the WMP is complete. In addition to stopping further degradation of the wetlands, the SC discussed two other action items that would help restore the hydrology of the wetlands that has been impacted over the past years. One project has been incorporated into the lake level augmentation pilot that will look at enhancing and restoring the hydrology of the wetlands to hold more water during spring and early summer. This water would then be available to recharge the lake in drier summer months. Secondly, the SC is seeking opportunities to purchase land for sale near Kings Corner Road and West Cedar Lake Road to create a wetland preserve. The potential preserve would be permanently protected with a conservation easement, allow public access, and educate the public with signage at the high-profile site.

Several concerns about a wetlands ordinance were discussed during the SC meetings for the WMP. Townships enacting a wetlands ordinance will take on the legal responsibility of the new ordinance, enforcement issues, and administrative costs. There also are legal and economic issues of concern that will need to be addressed in the ordinance language. The following table summarizes the concerns voiced by SC members and includes practical examples and responses. To date, few examples of court cases with rulings against townships have occurred. Generally, judges have sided with townships in the case of wetlands ordinances, and in a case involving the City of Ann Arbor, a judge ruled that the wetlands protection section of their city zoning ordinance was constitutional (see Attachment F).

**Table 7-1. Concerns and other considerations discussed by the SC in regards to potential wetlands protection ordinances enacted by the townships.**

Concern	Consideration
Potential lawsuits or litigation	Huron River Watershed Council in Ann Arbor, MI conducted a study on Michigan townships that have enacted wetlands ordinances. They found few examples of litigation where the township was ruled against when ordinances were contested. <i>(Summary is included in Attachment F)</i>
Landowner development rights / takings issues	In the Huron River report, no legal issues brought to court were deemed a “takings” by a judge.
Discouraging economic development	A wetlands ordinance can be designed to provide oversight for development in areas where wetlands are likely to exist (using potential wetlands map). The ordinance does not prohibit development, but rather it provides extra protection of wetlands and property values by requiring a site plan review that will discourage building in areas that are wetlands and areas with seasonal wet periods.
Administrative costs	Both townships in the Cedar Lake watershed (Greenbush and Oscoda) already have zoning ordinances that require some level of administrative responsibility. Administrative costs could be minimized if they can be paired with existing programs (such as site review plan for larger developments through the zoning ordinance, etc.)

**KEY STEPS**

*Enacting a Wetlands Ordinance*

*(This list is not meant to be an exhaustive or comprehensive list of all steps necessary to lawfully enact an ordinance at the township level. For instance, ordinances require public notice periods, which were not included in this list of general steps.)*

1. Adopt language for an ordinance specific to each township using the model ordinance as a starting point (model language provided as Attachment F)
  - a. Convene group to modify model ordinance language to be township-specific
  - b. Vet language with public or steering committee
  
2. Present the draft wetlands ordinance to the township planning/zoning board and discuss the needs and desires of the community and the benefits of enacting such an

ordinance around Cedar Lake

3. Township planning/zoning board must determine appropriate and acceptable ordinance language, including:
  - a. What uses will require a permit and what activities will be allowable without a permit
  - b. If wetlands are identified on the site, what limits will be put on the property owner (unbuildable, must have site plan review that will require specific building elevations, selectively build with appropriate under drainage, etc.)
  - c. Determine township administration necessary to issue permits, review site plans, and enforce ordinance
  - d. Determine penalties for violating ordinance
4. Once acceptable ordinance language is adopted, the township planning/zoning board must approve a map for use in the ordinance (DEQ's wetland maps are included here; maps will be used as a guide for land owners to determine if they are located within a "potential" wetland; if this is the case, they must apply for a special use permit and get a wetland delineation on their property). The map should include parcel boundaries (if possible) to allow township administrators the ability to "look up" a particular parcel and determine whether it is located in the "potential" wetlands area.
5. Township passes ordinance into law (public review/comment periods apply)

## **KEY STEPS**

### *Creating a Wetlands Preserve*

1. Secure grants or other funds to purchase parcel(s) near Kings Corner Road and West Cedar Lake Road (where Sherman Creek drains to Cedar Lake) OR partner with a land conservancy to acquire land, solicit donation, or purchase conservation easements
  - a. Discuss purchase, donation, or conservation easements with current land owners to gauge interest in selling their property or protecting it (with tax benefit as compensation)
  - b. If interest is limited, investigate other potential areas with similar benefits
  - c. If parties are interested, write a grant or meet with a land conservancy to explain ecological and hydrological importance of the area
2. Execute land purchase, donation, or conservation easement on properties of interest. Work with townships, counties, non-profits, or other groups that would be interested in

maintaining and managing the wetland preserve over the long-term.

3. Using information from the lake level augmentation pilot (from K&A), select an appropriate restoration strategy or solicit recommendations from K&A to restore hydrology and vegetation in the wetland.

## **KEY ORGANIZATIONS**

Alcona-Iosco Cedar Lake Association  
Cedar Lake Improvement Board  
Greenbush Township

### **OBJECTIVE II: Prevent additional lake water loss to groundwater on the east and southeast sides of Cedar Lake**

The SC explored the issue of lake water loss to the groundwater table on the east and southeast sides of Cedar Lake (in the Lakewood Shores drainage district). Several approaches and implementation projects were developed, including:

- Support and work to implement a wetlands protection ordinance to prevent further hydrologic impacts from building in low-lying wetland areas (which increases the need for groundwater drainage and storm sewers)
- Hold meetings with the county building inspector (and state regulatory agency, as necessary) to ensure residential building codes are enforced and buildings are constructed in areas above high groundwater mark
- Modify LSPOA Architectural Standards to ensure homes are built above high groundwater mark (to avoid flooding issues that increase the need for storm sewers)
- Hold workshops to educate homeowners and potential builders on practices or measures that will reduce the risk of flooding in homes

During dry summers, lake level losses can have a dramatic impact on Cedar Lake, affecting recreation, aesthetics, and habitat around the lake with severe drops in water levels. A hydrologic study of Cedar Lake performed by Kieser & Associates, LLC in 2006 concluded that storm sewers located in the Lakewood Shores drainage district have resulted in unintentional and accelerated drainage of lake water to the groundwater table. These storm sewers act as tile drains that shunt water from Cedar Lake to Lake Huron and are the major source of water

level loss during drier summer months. Since the drainage system that services the Lakewood Shores community was established prior to state wetlands protection laws, the only recourse to address the adverse effects of the existing drainage system is civil litigation, which would be divisive to the community, costly, and would create no-win situations for the opposing interests in this matter. A community-based solution is preferred over litigation, where impacted parties compromise on a solution that would serve to mitigate the adverse effects of the drain, while minimizing adverse effects on the Lakewood Shores community. Therefore, a major objective of the Watershed Management Plan (WMP) is to prevent additional lake water loss to groundwater on the east and southeast sides of the lake beyond what the current storm sewers already drain off each year.

In order to address this objective and effectively stop additional lake water loss to groundwater from the Lakewood Shores storm sewer system, the WMP recommends a set of actions to prevent the need for expansion or further improvements to the existing storm sewer system. A driving force behind storm sewer expansion is the flooding of homes in the Lakewood Shores housing development. Homes built in low-lying wetlands are prone to wet conditions, especially in the spring. SC members discussed the complication of builders buying parcels and building homes during drier months and then selling the property before wet conditions become apparent to the new owners. The SC discussed ways to prohibit and discourage building in low-lying wetland areas, protect homeowners from additional flooding, and educate the public on ways to improve their properties without requiring a development-wide expansion of the storm sewer system.

The actions recommended for this objective in the WMP include tasks that will prevent the additional need for storm sewer expansion in the Lakewood Shores drainage district. Under current law, if the drain commissioner is officially petitioned by more than 50% of the drainage district, the commissioner is required to install more subsurface drainage to address the problem of flooding or high groundwater table during wet months. By enacting a wetlands ordinance that requires builders or residents to have a wetlands delineation performed at their property and obtain a special use permit if wetlands were identified on-site, flooding problems in homes could be avoided. Fewer homeowners experiencing seasonal dampness and flooding should reduce demand for storm sewer expansion. [Members of the SC expressed concern over legal and economic issues of a wetlands ordinance. Objective I includes a table listing these concerns and responses or considerations that townships can use when drafting ordinance language.]

A secondary action to meet this objective is to work with existing local regulations to ensure



homes are built in a way that will reduce the risk of seasonal flooding. First, the WMP recommends convening a meeting with the local county building inspector to discuss: 1) the existing building codes enforced in the Lakewood Shores area, 2) the options builders might use to protect homes against flooding (e.g., extra on-site tile drains, building above a set elevation, or sump pump options), or 3) the potential for the inspector to require additional items to obtain certificate of occupancy. Second, the local Architectural Standards of the Lakewood Shores Property Owners Association (LSPOA) should be modified to add additional building requirements if the local county building inspector is unable to require these as part of the existing Michigan Residential Building Code. Standards on building appearance, setbacks, and size are already in place through the LSPOA. The board should discuss and decide ways to modify or add to the existing Architectural Standards to ensure builders protect future homeowners from flooding during wet periods. Working with the LSPOA on such language will be important and necessary to ensure potential adoption.

Another recommended action for this objective is distributing information about flooding issues and educating the public and builders about building in or near wetlands. Almost all wetlands experience seasonal surface water or saturated soils. Filling in wetlands to build can worsen flooding during rainy periods on a local or regional scale. Storm sewer systems can be overwhelmed and water can back up into homes. Residents should be made aware of the risks of building in wetlands, what retrofit options they can use to reduce the risk of flooding in their home, and professional contractors they can contact for assistance.

The last action considered by the SC was conserving wetlands in the Lakewood Shores area using conservation easements. This option might be viable for larger tracks of land along the east side of the lake, but has limited application in platted areas with small parcels. The Headwaters Land Conservancy met with the SC to discuss the options of conservation easements in the summer of 2009. The Conservancy outlined their organization's requirements to oversee and receive conservation easements, which require that a parcel be adjacent to water and/or large in size (greater than 40 acres). The platted parcels in Lakewood Shores would not qualify for consideration by the Conservancy, and landowners would have to cover legal expenses if they wanted to put a conservation easement on a smaller parcel of land<sup>13</sup>. For this reason, conservation easements should be pursued to protect larger parcels of critical wetlands throughout the Cedar Lake watershed, but are not a specific recommendation for the Lakewood Shores area.

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<sup>13</sup> *Tax benefits are limited by certain requirements. Refer to Section 170(h) of the Federal Internal Revenue Code for more information on qualified conservation contributions and Attachment I.*

## KEY STEPS

### *Enacting a Wetlands Ordinance*<sup>14</sup>

The following list provides direction to the Lake Board or other entity interested in establishing a wetlands protection ordinance at the township level. This list recommends that an ordinance be written and passed that includes both Oscoda and Greenbush township to extend the benefits of wetland protection to both townships while minimizing administrative efforts associated with developing and establishing two separate ordinances. The SC decided that in the event both townships could not agree on the same language for a collective wetlands ordinance, each township should consider passing separate ordinances.

1. Adopt language for a wetlands ordinance in both Oscoda and Greenbush Townships using the model ordinance as a starting point (model language provided as E)
  - a. Convene group to modify model ordinance language to specifically include both townships
  - b. Vet language with steering committee and/or public
2. Present the draft wetlands ordinance to the township planning/zoning board and discuss the needs and desires of the community and the benefits of enacting such an ordinance around Cedar Lake
3. Township planning/zoning board must determine appropriate and acceptable ordinance language, including:
  - a. What uses will require a permit and what activities will be allowable without a permit
  - b. If wetlands are identified on the site, what limits will be put on the property owner (unbuildable, must have site plan review that will require specific building elevations, selectively build with appropriate foundation under drainage, etc.)
  - c. Determine township administration necessary to issue permits, review site plans and enforce ordinance
  - d. Determine penalties for violating ordinance
4. Once acceptable ordinance language is adopted, the township planning/zoning board must approve a map for use in the ordinance (DEQ's wetland maps are included here;

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<sup>14</sup> *This list is not meant to be an exhaustive or comprehensive list of all steps necessary to lawfully enact an ordinance at the township level. For instance, ordinances require public notice periods which were not included in this list of general steps.*

maps will be used as a guide for land owners to determine if they are located within a “potential” wetland; if this is the case, they must apply for a special use permit and get a wetland delineation on their property). The map should include parcel boundaries (if possible) to allow township administrators the ability to “look up” a particular parcel and determine whether it is located in the “potential” wetlands area.

5. Township passes ordinance into law (public review/comment periods apply)

## **KEY STEPS**

### *Improving Building Requirements*

1. The Lake Board convenes a meeting with the Iosco County Building Department and Michigan DEQ to determine current building code requirements, when to notify DEQ about proposed building in wetlands, and additional requirements that could prohibit or discourage building in wetlands or areas prone to flooding.
2. The Lake Board convenes a set of meetings with the LSPOA and board members to discuss the issues of flooding and building in wetlands. The Lake Board recommends additional building requirements be integrated into the current LSPOA Architectural Standards that the county building inspector is unable to enforce, but would improve individual home sites.
3. Partnership between the Lake Board and LSPOA to distribute informational material to residents about the risks of building in a wetland, site-specific options to control flooding and protect homes, and a list of professional contractors they can contact for individual consultation.

## **KEY ORGANIZATIONS**

Cedar Lake Improvement Board  
Lakewood Shores POA  
Oscoda Township  
Greenbush Township  
Iosco County Building Department/Inspector

**OBJECTIVE III: Pursue augmentation feasibility study to choose suite of lake level management options for implementation**

K&A has completed two studies commissioned by the Lake Board to determine and revise the lake's mass balance and determine major sources of lake water supply and losses. The Phase II study concluded that the main source of water loss is the Lakewood Shores drain system on the southeast side of the lake. As previously described under Objective II, this drain system was established before state wetland protection laws were in place. Civil litigation is the only recourse to address the adverse effects of the drainage system, but it has been concluded that this process would be divisive to the community, costly, and would create no-win situations for the opposing interests. In order to address the lake level issues experienced during dry summer months, the Lake Board has invested in a lake level management/augmentation feasibility study that will examine and test feasible ways to increase water going into the lake during dry periods. The other recommendations under this objective are 1) implementation of appropriate measures to sustain lake levels by the Lake Board after selecting a suite of lake level management approaches from K&A recommendations (determined through the augmentation feasibility study), and 2) holding public hearings and informational sessions about the project to gain taxpayer support for assessment to fund lake level management.

The Lake Board has contracted with K&A to monitor groundwater levels around the lake, including areas in Lakewood Shores that experience high groundwater levels (and subsequent flooding problems) during wet periods. This information will be used to preliminarily design and/or engineer potential lake level solutions, including the direct pumping of groundwater via augmentation wells. The feasibility study includes tasks to address legal issues and impacts on natural resources and/or other water users. In addition, the study includes installation of aquifer testing wells to evaluate potential groundwater yield and interference to surrounding resources (as directed by the Lake Board).

A final lake level management strategy will include selecting a proposed lake level management project or suite of projects to enhance lake levels during dry months or periods. The Lake Board will be responsible for selecting lake level management projects from K&A recommendations and will solicit public feedback and support. The Lake Board will need to contract final engineering, permitting, potential construction bidding, and installation/construction of the selected project.

Concurrent with the watershed management planning process undertaken by the Lake Board and watershed stakeholders, several public meetings were held to solicit input and support of a

tax assessment to fund the lake level management/augmentation feasibility study. The Lake Board voted in favor of contracting with K&A to perform the study and provide recommendations on strategies to augment low lake levels during dry periods. Table 7-2 describes potential lake level management projects or scenarios that will be investigated and/or preliminarily designed by K&A as part of the augmentation feasibility study.

**Table 7-2. Benefits and potential issues with a variety of lake level management options being tested through the augmentation pilot study.**

Potential Lake Level Management Option	Pros	Potential Issues
Phelan Creek Diversion	<ul style="list-style-type: none"> <li>▪ Water originates in Cedar Lake watershed (diverted water)</li> <li>▪ Formerly a county drain</li> <li>▪ Volume of water</li> </ul>	<ul style="list-style-type: none"> <li>▪ Downstream impacts need to be investigated</li> <li>▪ Maybe a designated trout stream in some segments</li> <li>▪ Golf course water supply prior to 2004</li> </ul>
Kings Corner Modifications	<ul style="list-style-type: none"> <li>▪ Simple engineering - use stop board at culvert on seasonal basis</li> <li>▪ Store water in localized wetland area and “divert” to Sherman Creek</li> <li>▪ Water levels less than spring peak levels</li> </ul>	<ul style="list-style-type: none"> <li>▪ Property ownership issues</li> <li>▪ Reduced flows to Phelan Creek</li> </ul>
Sherman/Jones Creeks Modifications	<ul style="list-style-type: none"> <li>▪ Modify culverts/use berm to slow release of springtime surface water from wetlands</li> <li>▪ Enhance spawning habitat during spring/early summer</li> <li>▪ Control water level to just less than spring peak levels</li> </ul>	<ul style="list-style-type: none"> <li>▪ Property ownership issues and prolonged flooding</li> <li>▪ Design culvert structure to allow for fish passage</li> </ul>
Harvest Wet Weather Lake Outlet flows	<ul style="list-style-type: none"> <li>▪ Recycle weir overflow water through wetland area</li> <li>▪ Other options for storage include quarry NW of Cedar Lake</li> <li>▪ Outlet structure would be modified</li> </ul>	<ul style="list-style-type: none"> <li>▪ Timing/effectiveness</li> <li>▪ Drawdown rate</li> <li>▪ Cross boundary transfer</li> <li>▪ Downstream impacts</li> <li>▪ Amount of piping, location of piping</li> </ul>
Groundwater Augmentation Well: Feeding Surface Water into Wetlands	<ul style="list-style-type: none"> <li>▪ Enhanced habitat and fish spawning</li> <li>▪ Use creeks to convey water instead of piping</li> <li>▪ Control water levels to just less than spring peak levels</li> <li>▪ More control over water volumes</li> </ul>	<ul style="list-style-type: none"> <li>▪ Properties might be affected by flooding</li> <li>▪ Creek flow rates must accommodate fishery (determine water velocity limits)</li> </ul>

**Table 7-2. Continued.**

<p>Groundwater Augmentation Well: Direct Piping of Water</p>	<ul style="list-style-type: none"> <li>▪ More flexibility in location of augmentation well(s)</li> <li>▪ More control of the volume of water</li> <li>▪ Location near golf course or Lakewood Shores</li> </ul>	<ul style="list-style-type: none"> <li>▪ Property issues and agreements for pumping houses</li> <li>▪ Consideration of Lakewood Shores flooding</li> </ul>
<p>Lakewood Shores Drainage Re-circulation</p>	<ul style="list-style-type: none"> <li>▪ Use water already being removed from lowland areas</li> <li>▪ Complex collection system in conjunction with existing infrastructure</li> </ul>	<ul style="list-style-type: none"> <li>▪ Very limited season for re-circulation</li> <li>▪ Very limited volume</li> </ul>
<p>Lake Huron Pumping to Cedar Lake</p>	<ul style="list-style-type: none"> <li>▪ Control the amount of water as necessary</li> <li>▪ Precedent set by Genesee County for pumping from Lake Huron</li> </ul>	<ul style="list-style-type: none"> <li>▪ Property agreements for pump houses</li> <li>▪ Great Lakes invasive species transmission to Cedar Lake</li> </ul>

**KEY ORGANIZATIONS**

Cedar Lake Improvement Board  
 Kieser & Associates, LLC (currently under contract)  
 Lakewood Shores POA  
 Oscoda Drain Commissioner  
 Alcona Road Commission  
 Michigan DEQ

**SPILLWAY RECOMMENDATIONS**

The legally mandated lake level is passively regulated by the spillway structures at the north end of the lake. During dry years, the lake level regularly drops below top of the spillway structure, dropping below the legal lake level. In the past, cracks in the concrete structure of the spillway have caused water loss at an elevation below the top of the spillway/legal lake level. The AICLA coordinated with the Alcona County Drain Commission to repair the structure. The major concerns for association members and lake stakeholders in general, are the impacts that low lake levels have on recreation, fishery, property values, and aesthetics of Cedar Lake. More recently, additional cracking has been observed at the spillway. In the spring of 2010, a SC member reported that water appeared to be leaking from damage below the top of the spillway. Repairing the spillway to stop lake water loss below the top of the structure is a lake level management recommendation of the WMP.



The SC also expressed the desire to modify or improve the spillway structure in the event that major repair is needed. This modification or improvement was brought on by the recent augmentation study efforts and relates to lake level management. The augmentation study efforts will provide recommendations on how to prevent or lessen draw down during summer months in dry years. These efforts will likely decrease the natural fluctuations in lake level to a certain degree. One of the concerns SC members expressed was the impact that higher water levels may have on the biology of Cedar Lake. Natural drawdown periods in a lake allow for deeper freezing of the lake during winter months and can naturally control excessive aquatic plant growth the following season. Absent these natural drawdowns there is, at least, antidotal evidence from the last two years of high water levels caused by greater than normal rainfall that aquatic plant growth increases rapidly to the nuisance level.

The last issue of concern regarding the spillway is flooding in areas around the lake. During years with substantial rainfall, flooding can be a problem in residential areas on the southeast side of the lake. The SC expressed the desire to be able to manage lake levels via drawdown during the fall, if flooding issues persist during wet years or with successful augmentation.

General information is provided below related spillway replacement with a water level control structure, such as a dam. Estimations of the major costs, consideration, and benefits of constructing a water control structure are included below. General steps that the Lake Board, Drain Commission, and Road Commission would need to take in order to implement this change are also listed.

**Design, Review, Engineering, Permitting, and Construction:** [approximately \$200,000-\$500,000]

- Initial engineering design for new water control structure to replace spillway
- Review with DEQ to approve project design and determine potential impacts (an impact study might be required and would constitute additional costs)<sup>15</sup>
- Permitting of the project and new control structure/dam
- Final engineering and construction of new control structure/dam

**Operation, Maintenance, and Inspection:** [approximately \$1,000-\$5,000/year]

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<sup>15</sup> Information on lake level manipulation and legal lake levels can be accessed at: [www.michigan.gov/documents/deq/lwm-dams-ellv\\_202774\\_7.PDF](http://www.michigan.gov/documents/deq/lwm-dams-ellv_202774_7.PDF)

- Annual operation by delegated authority (Drain Commissioner)
- Regular maintenance to continue function and water level control capabilities
- Inspections on a three-year rotation (under current regulations, which is subject to change)

**Advantages of Lake Level Control**<sup>16</sup>:

- Maximize recreational benefits
- Drawdown can minimize shoreline ice damage
- Flood control and protection of personal property and property values
- Minimize erosion during periods of high water level in fall and spring
- Drawdown can provide control of some aquatic weeds
- Provide means whereby all benefited property owners and political subdivisions share in the cost of maintaining the necessary lake level control facilities

**ALTERNATIVE:** Another option for modification of the spillway would be re-engineering the outlet to incorporate a stop board system, in lieu of building a full dam structure. If this could be done at a time when the road or spillway requires repair, the costs would be a fraction of the costs associated with construction of a functioning dam. This system would allow manual removal of boards in order to lower outflow, and subsequently, the lake level. Modifying the spillway from a passive system to one that will allow manual water level changes will involve some or all of the following:

- Engineering and design services
- Participation of the drain and road commissions
- Permitting
- Potential impact analysis
- Construction services
- Policy and management planning for when/how water levels will fluctuate

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<sup>16</sup> Adapted from the Natural Resources and Protection Act, Part 307, Stabilizing Inland Lake Levels.

**OBJECTIVE IV:            Improve sport fishery in Cedar Lake through enhanced lake levels, creek levels, and wetland/habitat protection measures**

The Lake Board has recently put more focus on assessing and enhancing the sport fishery at Cedar Lake. The Lake Board has contracted with Aquest Corp. who sub-contracts to SEAS, LLC to develop a fishery management plan. SEAS in particular has conducted several assessments, surveys, and studies of the sport fishery. Most recently, SEAS has performed: 1) an extensive evaluation of the spawning migration of Northern Pike in and around Sherman Creek; 2) annual fishery assessment of the lake since 2004; 3) annual spawning and habitat improvement survey since 2004; and, 4) a recreational season-long creel survey. The recommendations from several of these surveys served as the basis for the recommendations of the WMP to be implemented over the next five years. These recommendations include:

- 1) Protect and restore/enhance hydrology of wetlands in the northwest for fish spawning
- 2) Protect wetlands through policy/ordinances and conservation easements
- 3) Pursue and fund recommendations of the fishery management studies and reports through Lake Board contracts
- 4) Continue aquatic plant management and control of nuisance species to avoid potential overgrowth conditions that could stunt growth of pan fish
- 5) Continue relationship with Michigan DNR so that walleye fingerling stocking continues on an “as needed” basis

The type of adaptive management strategy used by the fisheries consultant is an effective and useful watershed management tool. For this reason, the recommendations from these studies and reports have been integrated into the WMP. Overall, the WMP recommends that the Lake Board continue contracting a fishery management consultant to annually assess the fishery, implement projects necessary to maintain and enhance the fishery, and provide the Lake Board with information related to future management needs (e.g., the 2008 fishery assessment report noted problematic invasive species such as starry stonewort that Cedar Lake should be monitoring and treating).

Beyond studying the fishery directly, the SC discussed ways to protect essential fish habitat and spawning areas. One area identified by SEAS in a recent report is the wetland complex on the northwest side of the lake. This wetland is connected to Cedar Lake through Jones and Sherman Creeks. Sherman Creek was monitored in 2008 for Northern Pike (pike) spawning and migration. The report concluded that the wetlands contain ideal spawning habitat for the Northern Pike due to the good water clarity, flow, vegetation, and stable bottom substrate.

The WMP recommends implementing a wetlands protection ordinance in order to limit development pressure in the wetlands complex. In addition, the wetland area directly adjacent to Sherman Creek should be permanently protected using tools such as conservation easements to protect this spawning habitat in perpetuity.

The hydrology in the wetland complex should be enhanced in such a way as to prolong water flow from the wetlands to Cedar Lake later in the spring and early summer. Monitoring data from Sherman Creek shows that, on average, creek flows stop some time during early June. The pike assessment notes that extending the duration of flow in the creek (especially during dry years) will enable fry to stay in the creek longer, which will ultimately increase their success once they emigrate to Cedar Lake. The Lake Board has already initiated a feasibility study to address overall lake water levels during summer months, whereby the flows from Sherman and Jones Creek also will be evaluated. These two creeks are the main supply of surface water to the lake. Sustained flows during early summer months would not only improve overall lake levels, but also would restore the severely damaged pike emigration. The recommendations of the augmentation feasibility study should take into account the Northern Pike spawning habitat if the wetland complex is used to supply more surface water to the lake during dry years. The recommendations should include design ideas that would enhance the pike fishery, as well.

A wetland protection ordinance to protect critical spawning habitat in the watershed is described more fully under Objective I. Objective III discusses potential restoration and modification efforts in the wetlands adjacent to Sherman Creek as it relates to the augmentation pilot study. In addition to these approaches, Steve Sendek from the Michigan DNR, who served on the SC, recommended continued stocking of walleye fingerlings and the control of aquatic plant species to ensure conditions in the lake that will encourage pan fish growth. The SC included these recommendations in the WMP and agreed they were high priority approaches for a healthy and balanced fish population. SEAS recommendations also have been prioritized by the SC for inclusion in WMP approaches. Table 7-3 describes recommendations from previous fishery reports by SEAS with associated WMP tasks:

**Table 7-3. Recommendations from the SEAS from previous studies and reports of the Cedar Lake fishery.**

Recommendations	WMP Task	Priority
Conduct a fish population assessment	<ol style="list-style-type: none"> <li>1. Conduct fish population assessment using gill nets, trap nets, seines, and electro fishing units to characterize fish population</li> <li>2. Conduct analysis of fish scales and spines to assess age and growth</li> </ol>	2
Conduct critical fish habitat assessment	Assess changes in fish habitat usage as a result of the aquatic vegetation management and fish habitat enhancement activities on an annual basis and provide findings to stakeholders (in report)	1
Provide habitat enhancement for walleye and channel catfish and document use	<ol style="list-style-type: none"> <li>1. Assess potential walleye spawning areas at Sherman Creek</li> <li>2. If viable, enhance/increase walleye spawning habitat by providing fallen logs/woody structure/stony substrate</li> </ol>	1
Maintain or increase size and number of adult bass	<ol style="list-style-type: none"> <li>1. Develop creel limit language (e.g., limit of 3 fish over 14" and release of all bass over 18" and discourage angling for bass on nests)</li> <li>2. Implement limit and education on new limit</li> </ol>	1
Re-assess angling benefits and potential of stocking Redear sunfish to establish an increased fishery/increase bluegill spawning habitat	<ol style="list-style-type: none"> <li>1. Research success of established Redear sunfish populations north of Bay City (other lakes)</li> <li>2. Conduct angler interviews or voluntary mailings to determine catch rates, fishing pressure, and angler use</li> <li>3. Increase size of spawning habitat in documented critical areas to increase recruitment</li> <li>4. Plant Redear sunfish, if suitable</li> </ol>	1
Stocking of walleye fingerlings by DNR on an "as needed" basis until a self-sustaining population can be established	<ol style="list-style-type: none"> <li>1. Continue communication with DNR contact serving on Lake Board</li> <li>2. Coordinate necessary elements for stocking every 2 years</li> </ol>	1
Monitor benefits of spawning benches installed in Cedar Lake and install more if successful	<ol style="list-style-type: none"> <li>1. Assess success of artificial spawning benches placed in Cedar Lake in January 2009 during annual assessment</li> <li>2. Plan to install more benches as needed if previous project shows use by fish populations</li> </ol>	1

## KEY STEPS

1. See Objective I for key steps to enacting a wetlands ordinance
2. Enhance wetland hydrology and permanent protection of Sherman Creek and adjacent wetland using a conservation easement:
  - a. Use recommendations from the augmentation feasibility study to determine if additional surface water can be stored in Sherman Creek wetland complex through creek modifications and/or augmentation well
  - b. Research property values and contact property owners to determine interest in: 1) selling land, 2) donating or selling a conservation easement (or development rights) but retaining ownership of land, 3) donating land (and managing entity/township would get conservation easement on parcels)
  - c. Use land conservancy or legal entity to complete purchase and/or conservation easements
  - d. Obtain project funding through grant or tax assessment to implement wetland modifications (as necessary for increased flow period) and potential wildlife viewing area
3. The Lake Board implements fishery action items through the direction and recommendations of the fishery management consultant and following priorities outlined in the table above

## KEY ORGANIZATIONS

Cedar Lake Improvement Board  
Fishery Management Consultant  
Michigan DNR

### **OBJECTIVE V: Control existing invasive species and excessive aquatic plants and prevent new invasive species from entering Cedar Lake and the watershed**

The SC identified a need to control and prevent invasive species in and around Cedar Lake. Excessive native aquatic plant growth also can become a nuisance species to people recreating in an overly weedy lake. Milfoil species in Cedar Lake have been of particular concern in the last few years; they appear to be at a tipping point and could grow to very problematic levels



quickly. In order to address weedy aquatic vegetation and problematic invasive species, the lake improvement board began working with Dr. G. Douglas Pullman on an aquatic plant management plan. The primary management goal of the plan is to, “Modify conditions within the lake to enhance species and habitat diversity and thereby stabilize the ecosystem by promoting the production of conservative species and inhibiting the production of those plants that are weedy or more opportunistic”<sup>17</sup>. Recent lake management efforts and specific short-term management goals include:

- Mitigation against cultural and natural disturbances by modifying the quality of Cedar Lake flora through the prescriptive use of selective plant management agents and strategies
- Improve opportunities for recreation, increase aesthetic values, and provide improvements in the structure of the flora for critical fish habitat
- Specifically target problematic species (such as Eurasian watermilfoil that is currently present in the lake and has been a controlled nuisance for approximately the last ten years) and species that have appeared in the lake more recently (such as starry stonewort)
- Survey and monitor the lake’s aquatic plant population and algae species as an indicator of general water quality and the effect on the lake’s fishery

Invasive species in particular can out-compete native species for the resources they need to survive. While new methods to control invasive species are developed over time, the best way to control invasive species is to prevent their introduction to a lake or watershed<sup>18</sup>. For this reason, the SC directed its focus on preventing the introduction of new invasive species to the watershed and lake, in addition to controlling current nuisance species. As part of the implementation of the WMP, the Lake Board should pursue efforts to educate watershed residents on what they can do to prevent the spread of invasives, continue monitoring and treatment of invasive and nuisance aquatic plants on an annual basis, and strategically place signage and boat cleaning resources near the lake to prevent new invasive species from entering the lake.

The SC identified several actions to help prevent the spread of invasive species and control

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<sup>17</sup> Taken from Cedar Lake Management Program Update Report, 2008.

<sup>18</sup> Guide to Lake Protection and Management, 2004. Published by the Freshwater Society in cooperation with the Minnesota Pollution Control Agency, 2<sup>nd</sup> Edition.

current invasives and native nuisance aquatic plant species already in the lake and watershed. Invasive and nuisance native aquatic plants are treated and controlled through the aquatic plant management plan. This plan uses an adaptive management strategy to monitor and treat the lake each year in response to changes in the plant community in Cedar Lake. Since this strategy has been effective at controlling potentially problematic species, the WMP recommends continuing the support and funding of this strategy. In addition, the Cedar Lake fishery is monitored both by the Michigan DNR and, more frequently, by a fish biologist funded by the Lake Board and AICLA. This level of monitoring should continue in order to detect problems caused by invasive species early on and develop a treatment strategy as needed to protect the fishery.

The management of the aquatic plant environment is accomplished through two contracts initiated and managed by the Lake Board. One is a contract with an herbicide applicator for the treatment of pre-determined aquatic plant problems. The second contract is for professional services to conduct an analysis of the aquatic plant environment, develop a formal aquatic plant management plan that is updated annually, and develop the treatment plan for each recreational season. This second contract has evolved over the years to include a fishery and fishery habitat management plan.

The Lake Board redefined itself in 2007 to remove the narrow restrictions on its mission that were established at its creation. The Lake Board now is tasked with addressing all lake management matters for Cedar Lake. The first task the Lake Board initiated after this mission change was the development of this WMP. There is a strong need for the Lake Board to have a reliable source of technical guidance available to it on a regular and as-needed basis, as evidenced by the findings of this WMP and the list of critical, costly, and in many cases highly technical tasks that will be an inevitable outgrowth of it, as-well-as other lake management matters that will arise. A technically competent resource is needed that also has an overall and detailed knowledge of the specifics of the Cedar Lake environment. The Lake Board does not possess within its membership the needed technical expertise to deal with the complex issues of lake management apparent in Cedar Lake's future.

Therefore, it is recommended that the Lake Board further develop and expand the professional services contract to provide an overall lake management function that will include both the plant and fishery management functions of the current contract. These functions will be part of an overall lake management concept that also integrates WMP recommendations and all other matters related to Cedar Lake's management, including augmentation or any other matter that might be brought to the Lake Board for consideration.

Both of the aquatic plant management contracts expire at the end of 2010. Solicitation for the new professional services contract, now known as the lake management contract, will include this major change. The current tax assessment limit of the plant management effort offers room for a significant increase in the cost of contracts; however, the Lake Board will need to clearly define the lake manager responsibilities and develop a cost model to determine if an increase of assessment beyond their authority is needed to do this job. If an increase beyond the current limit of \$120 per lakefront property, per year, is needed, the public hearing process to allow that increase will need to be completed by mid-summer 2010.

A draft of potential roles and responsibilities for this position is included in Attachment D.

One area that presents a high risk of introducing aquatic invasive species into Cedar Lake is the boat launch and other access points. Lake users bringing their boats from other lakes can easily transport potentially harmful invasive species to Cedar Lake (such as nuisance aquatic plant, fish and wildlife viruses, opportunistic algae, invasive fish larvae or eggs, and many other potentially harmful invaders). Additional signage should be posted at road ends where boaters might be accessing the lake to remind them of the risk of invasive species and how to inspect and clean their boat before and after they use the lake. In addition, the SC recognized the desire to create a boat cleaning station in order to encourage boat inspection and cleaning each time they use the lake. The cleaning station was prioritized as a Tier 3 task, which means the project would be implemented in years 5 to 10 after approval of the WMP.

Another recommended action for this objective relates to the education of lake residents and users about invasive species. Residents should be aware of potential invasive species and how they could threaten the lake and watershed, what organizations they should report sightings to, and practices that can reduce the risk of transmission of invasive species. Currently, the AICLA holds an annual meeting at the end of each summer to educate and raise awareness on these issues of invasive species at Cedar Lake. The AICLA brings experts in aquatic plant management and treatment, fisheries experts, and local conservationists together to present to the group each year. The meeting provides a discussion and question/answer forum that is open to all watershed stakeholders. These meetings should be used each year because they have proven to be the most successful way to educate and outreach to the public. Another recommendation is continued updates in the AICLA newsletter or a new brochure or homeowner's guide that will disseminate important information on current invasive species in the lake or watershed and invasives in the state that could threaten Cedar Lake. Table 7-4 outlines the recommended actions for this objective with specific WMP tasks and costs.

**Table 7-4. Recommended actions for invasive species and aquatic plant management efforts.**

Action or Practice	WMP Task	Cost
Educate lake residents and users on ways to prevent transmission of invasive species	Promote public attendance at AICLA meetings (plant meeting held annually in August) to educate on new invasive threats, prevention, and treatment	\$500-2,000
Raise awareness of current and potential invasive species in Cedar Lake	Produce a homeowner's guide following WMP approval to educate riparians about current and potential invasives and to report sightings	\$3,000-6,500
Further develop Lake Board technical consultant contracts to employ a lake manager	Adapt and expand contracts that will start in 2011	\$50,000-100,000/year
Create boat cleaning station and/or signage to reduce risk of invasive species transmission via boats/bait	Post signage in public areas (informal boat launch areas) to educate lake users on invasive species and work to create a boat cleaning station near the boat launch	\$800-1,500 (signs) \$10,000-60,000 (boat cleaning station <sup>19</sup> )
Continue efforts to adaptively manage aquatic plants and control nuisance species	Continue aquatic plant management and fishery studies to monitoring species and track potential nuisance invasive species <sup>20</sup>	\$50,000-\$70,000/year

## KEY STEPS

1. Develop new contract between the Lake Board and a lake manager that builds on existing aquatic plant management contract (for implementation in 2011). Set roles, responsibilities, and budget and any necessary changes in the tax assessment amount. Solicit qualifications for new contract and hold regular meetings with the manager to provide the Lake Board with updates, recommendations, and progress on WMP implementation priorities (directed by Lake Board following WMP).
2. Use existing information about invasive species at Cedar Lake and potential invaders from Attachment B in a homeowner's guide or newsletter to provide the following information:
  - a. List of invasive species identified in the lake and surrounding watershed and how problematic species are currently being controlled

<sup>19</sup>Personal communication with Higgins Lake Foundation; boat cleaning station cost approximately \$60,000.

<sup>20</sup>Aquatic plant management is discussed in further detail in Objective VIII, including treatment of aquatic plant species using adaptive management strategy, as necessary.

- b. Pictures of potential invasive species, how transmission can be avoided, and to whom homeowners should report sightings
  - c. How boat cleaning, proper disposal of bait, and careful inspection of other fishing and recreation equipment should be done to avoid an invasive species “hitch hiker”
- 3. Continue to use local newsletter resources to educate residents about invasive species. Use other outreach avenues, such as a watershed brochure, local newspapers, or workshops to broaden message to the entire watershed. Transfer this information to the AICLA website and update regularly.
- 4. Convene a subcommittee to raise funding and support for educational signage and potential boat cleaning station near the boat launch:
  - a. Small signs produced by the DNR can be obtained from the Michigan Office of the Great Lakes (517-335-4056) that raise awareness about aquatic invasive species and how to properly inspect a boat; placing these at road ends where users access the lake is recommended
  - b. Determine if a larger area near the boat launch could be dedicated to a more pronounced sign with disinfectant cleaners, buckets, and brushes for cleaning boats, in addition to wastewater and plant/debris disposal containers
  - c. Develop plans for a larger boat cleaning station that would provide sprayers and wastewater and debris disposal for more efficient cleaning of boats

## **KEY ORGANIZATIONS**

Cedar Lake Improvement Board  
Michigan DNR  
Alcona-Iosco Cedar Lake Association

## **FUTURE CONSIDERATIONS**

One major item highlighted by select members of the SC was the potential risk of increased aquatic plant growth with higher water levels due to augmentation. Cedar Lake naturally experiences fluctuations in water levels during annual cycles of high and low precipitation. The augmentation pilot will investigate ways to mitigate against low water levels during dry years, the potential for more higher water levels is possible. As decisions are made for augmenting lake levels, it will be very important for the Lake Board and aquatic plant consultant or lake

manager to closely monitor the response of aquatic plant growth to increased lake levels. SC members have indicated that modification of the existing spillway could be necessary to provide more control of lake levels, especially at the end of the summer recreational season. A managed drawdown of the lake could help to control aquatic plant growth, as it would naturally occur during low water level years. Deeper freezing due to lower winter water levels has been found to control aggressive aquatic vegetation in some settings. Replacing the spillway with a water level control structure (e.g., a dam structure) would have multiple benefits and costs and should be considered in the following situations:

- In the event that increased nuisance aquatic plant growth is correlated with consistently high water levels
- Road construction is planned at the spillways, which might provide for more convenient or cost-effective modification of the spillway structures
- In the event of a major failure in the existing spillway structures, if extensive maintenance or replacement is required, or if other problems are encountered with their performance

Further information on the costs associated with a water level control structure or modification of the existing spillway are included under Objective III on page 64.

#### **Objective VI: Improve composition of lake bottom sediments and determine feasibility of muck reduction**

A major issue with lake riparians is the organic lake bottom sediment found in certain locations in Cedar Lake. These organic sediments, often described as “muck”, are derived from a complex blend of organic matter that accumulates on the lake bottom and begins to decay over time. The muck found in certain lake bottom areas of Cedar Lake is very flocculent and can impede recreation activities such as swimming and other water contact sports. Lake residents generally desire a more sandy lake bottom in areas where the muck is present. It was important for the SC to understand the potential source of this muck so they could determine if the WMP should address options that assume a fixed amount of muck or options that address accumulation over time. A primer on the complex issues of muck was prepared by Dr. Pullman, the lake’s aquatic plant biologist, and is included as Attachment G. He concludes that organic materials contributing to muck accretion generally enter lakes from an external source and are most commonly composed of emergent or upland plant materials that do not break down

quickly over time. Muck is especially prevalent in lakes with a small surface area and large volume of water. The opposite condition prevails in Cedar Lake.

The SC prioritized the issue of lake bottom muck sediments as very high. To address the issue, the SC reviewed and discussed different approaches and practices that could prevent the potential for further muck sediment accumulation now and to remove existing muck. The potential approaches range from low-cost, long-term riparian practices to more immediate, higher cost solutions. Ultimately, the most effective way to reduce the muck layer is to remove it. The SC wanted to have some indication of whether removal of this muck material would have lasting effects. Research on sediment accretion rates in a lake in Canada found that on average the sediment accumulation rate was approximately 1.2 mm/yr<sup>21</sup> (average between areas with and without macrophyte beds). The report indicated that this rate is similar to other accretion rates measured throughout North America. An average annual sediment accretion rate was calculated for Cedar Lake. Assuming approximately 350 acres of Cedar Lake contains macrophyte beds, it would take approximately 28 years to accumulate an additional 1 inch of sediment. It is important to note that sediment accumulates unevenly throughout any lake depending on lake morphology, wave action, location of macrophyte beds, and internal energy.

In addition to these average rates of accretion, SC members discussed at a meeting examples of past dredging. Members recalled that a lakefront property owner did localized dredging in a small section on the south end of the lake that still seemed to have sandy sediments several years later. Aeration with bioaugmentation was one potential method that was previously explored by lake stakeholders to remove existing muck. Dredging was also discussed in the context of immediate results at the highest cost. Educational workshops to modify and improve riparian lawn practices (that would also complement other tasks to prevent increased nutrient inputs to the lake) are lower-cost and longer-term approaches that would potentially reduce the potential of additional muck accumulation over time.

Dr. Pullman's primer on muck concludes that muck removal is the most effective way to improve the lake bottom sediments. He explains that many methods exist that try to increase decay of muck through aeration or additions of nitrate, but these do little to increase the breakdown process, as he describes in the primer. One outcome of aeration has been to increase dissolved oxygen in stratified lakes. This can be used to prevent fish kills during winter ice-cover in shallow lakes (that do not stratify or deeper ones that do)<sup>22</sup>. Substantial

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<sup>21</sup> Taken from Rooney, N. and J. Kalff, 2003. *The role of submerged macrophyte beds in phosphorus and sediment accumulation in Lake Memphremagog, Quebec, Canada. Limnol. Oceanogr.* 48(5).

<sup>22</sup> *Guide to Lake Protection and Management, 2004. Published by the Freshwater Society in cooperation with the*



reduction of sediments is not highly recognized as a benefit of lake aeration in most natural lakes. Limno-Tech, Inc. of Ann Arbor, Michigan conducted a controlled study on Austin Lake, located in Portage, Michigan to evaluate the effectiveness of aeration and bioaugmentation at decreasing sediment thickness<sup>23</sup>. Field studies were conducted in Austin Lake in the summer and fall of 2005. Two aeration units were installed (one as a control and the other for treatment). The study also explored bioaugmentation to determine if adding bacteria would decrease the sediment thickness at a greater rate than aeration alone. The study concluded that aeration and aeration with bioaugmentation were not successful. It also concluded that no significant sediment removal could be achieved using in-situ aeration and bioaugmentation as it was applied in the study. The use of Bacta-Pur (bacteria mix from a manufacturer) along with aeration did not provide a greater rate of sediment removal than aeration alone. In addition, researchers found that the background sites (untreated sites measured over the same period for comparison) had the same loss rate of 3 inches over the 3-month period as the aeration sites. The findings suggest that possible annual cycling of sediments was occurring.

At East Twin Lake in Lewiston, Michigan, a decrease of several inches of sediment was noted at one end of the lake that was attributed to the aeration project implemented near the same end of the lake<sup>24</sup>. These results are based on repeated measurements taken at four sites in the lake. While it was reported that some riparians noted sandy lake bottom in some places on the lake, it would be interesting to see more measurements taken throughout the lake to determine if sediments are being completely decomposed or whether displacement of sediments could be taking place. One major concern discussed by the Cedar Lake was that aeration of lakes has a moderate to high cost and limited consistency of positive results. To date, there appear to be no peer-reviewed scientific publications that have identified how and if sediment thickness decreases with aeration.

Past research on the potential of dredging lake bottom sediments has been done at Cedar Lake by Affiliated Researchers in 2001. They measured sediment depth at 15 sites around the lake, which resulted in limited information on sediment composition, depth, and water depth in Cedar Lake. They also measured the organic content of sediment samples and found more than 50% organic content at the north end of the lake and approximately 23% organic content at the south end of the lake. Additional investigation into sediment thickness, composition, and water depth is necessary to fully characterize the lake bottom sediments and water depths to fully

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*Minnesota Pollution Control Agency, 2<sup>nd</sup> Addition.*

<sup>23</sup> *Final Project Report: Evaluation of Aeration and Bioaugmentation for Decreasing Sediment Thickness in Austin Lake, 1995. Limno-Tech, Inc., Ann Arbor, Michigan.*

<sup>24</sup> *Aeration Project Report, East Twin Lake Aeration Association, LLC.*

address dredging options and needs. For the purposes of the WMP, and in order to estimate an approximate cost for dredging, it was assumed that one foot of sediment would be hydraulically dredged from the entire lake bottom footprint (approximately 1,128 acres).

The table below lists WMP recommendations for actions to remove muck and prevent the potential additional accumulation of muck through education and good lawn care practices. The SC recommendations for muck removal involve first sampling and mapping the sediment thickness and composition throughout the lake. If a desirable end point is found in the sediment cores (i.e., sandy sediments found below the muck layer), the project team could opt to have the sediments tested to determine if they could be land-applied once removed from the lake. If the sediment contamination levels are greater than acceptable state standards, landfill disposal of contaminated sediments would be required (which greatly increases project costs, adding approximately \$40 per cubic yard of material dredged). Table 7-5 outlines recommendations to evaluate muck and potential costs and feasibility of the project (including whether the potentially high costs can justify the benefits).

**Table 7-5. Recommended tasks to address feasibility of muck removal and prevention.**

Action or Practice	WMP Task	Cost <sup>25</sup>
<b>Muck Removal</b>		
Sediment thickness study and bathymetric mapping	Map sediment thickness throughout lake using sediment cores/sampling	\$8,000-10,000
Sediment dredging	Use mapping to select areas to dredge; coordinate disposal of sediments (pay for disposal if contaminated)	\$3.6-9 million (dredge & land application costs) \$47 million (landfill disposal)
<b>Muck Prevention</b>		
Stop riparian practice of dumping lawn/leaves in lake	Education: workshops and/or riparian homeowner’s guide/brochure, educating riparians on good lawn care practices	\$5,000-6,500
Recognize or create incentive for riparians to adopt BMPs	Lake Stewards Program	\$2,500-5,000

<sup>25</sup> Assuming approx. 1 ft of material hydraulically dredged from the entire lake bottom at a cost from \$2-\$5/cubic yard (assumes a total of approx. 1.8 million cubic yards dredged). The second cost range is for landfill disposal of contaminated sediments, if necessary (dewatered approximately 65% of dredged volume) at \$40/cubic yard. It is important to note that the sediment thickness and bathymetric mapping action item would provide information that will likely change the volume of sediment that is required to be dredged. Variability within these unit costs includes accessibility for mobilization/demobilization, proximity of adjacent areas for dewatering, vertical elevation of adjacent land, and water depth, etc.

## KEY STEPS

1. Determine if dredging will be effective to remove muck and what costs will be involved
  - a. Sample lake bottom sediment composition throughout Cedar Lake through soil core sampling, characterization, thickness mapping and bathymetric mapping (select a consultant to perform this level of sampling)
  - b. Using sediment mapping results, determine if adequate sandy soils exist, whether volume of muck sediments for dredging are cost prohibitive, and what areas of the lake require dredging (costs can be greatly reduced if just a portion of the lake were dredged)
  - c. Develop a comprehensive dredging plan for Cedar Lake
2. If dredging is feasible, cost-effective, and funded through a tax assessment or similar mechanism, select a contractor for dredging work (or use a consultant to coordinate the project) and secure adequate dumping area to place dredged sediments (if no contamination is detected)
3. Coordinate speaker to give presentation at the summer lake association meeting(s) to educate riparians about muck sediment composition and depth. Also educate riparians about proper lawn care and leaf disposal (keeping excess materials out of the lake) that is beneficial for the lake in several ways, including preventing the potential for additional muck accumulation and keeping additional phosphorus from entering the lake (complementing other WMP tasks and goals). Develop a printed lakefront homeowner's guide to educate riparians that might not participate in lake association meeting(s).
4. Convene a sub-committee of lake association members and other stakeholders to administer the "Lake Stewards" program to educate and incentivize good lake stewardship practices

## KEY ORGANIZATIONS

Lake Improvement Board  
Alcona-Iosco Cedar Lake Association  
County Drain Commissioner/Road Commission  
Michigan DNR

**Objective VII: Educate watershed residents about natural lakescaping methods, native buffers, and other best practices for residents and the potential benefits**

Throughout the watershed management planning process, the SC discussed various educational needs for lakeshore residents in order to promote BMPs that will reduce runoff from lawns, control erosion, and provide natural habitat for wildlife (e.g., native birds and pollinators). Encouraging lakefront residents to change their normal practices will require education, incentives, and demonstration projects to make residents aware of the benefits and enable them to change behaviors and practices.

The major action items identified for this objective include developing a lake stewards program that will both guide and educate residents on good BMPs and provide incentives and recognition for implementation. The program would provide direction to lakefront residents that want to start changing their practices to benefit the lake and provide an incentive by recognizing them as a good steward of the lake. The program would encourage lakefront residents to implement several good practices that generally protect water quality and the environment. Practices that would be required to become a “lake steward” could include native lakescaping with riparian buffers, use of phosphorus-free fertilizers with a no-mow and/or no-fertilize buffer near the lakeshore (or no fertilizers at all), regular septic system maintenance and clean-out, and erosion control practices (see Attachment H). The program could involve a public meeting or “lake day” that could involve activities such as a tour of native buffers/lakescaping sites (and potentially other BMPs), a native plant sale or exchange, and educational opportunities (and/or promotion of lake association membership/benefits). This could build on efforts of the AICLA, which offers many of these opportunities to their members and the watershed community in general. Partnership with a local master gardeners club and/or Michigan State University Extension Office could provide resources for a sale or volunteers to organize the event.

A preliminary lake stewards program framework is included as Attachment H and includes requirements that the SC has identified will reach WMP goals. Included with the framework in Attachment H is a useful guidance tool developed from the Home\*A\*Syst Tool from the Michigan Water Stewardship Program and Michigan State University Extension. The tool provides information specific to protecting water quality through implementation of practices on Michigan shorelines. Several of the assessments could be incorporated into the Cedar Lake stewards program and tailored to meet the needs of the lake and reach the goals of the WMP.

Additional educational strategies in the WMP include an educational program that would

include a series of workshops or presentations given at the current AICLA meetings. These meetings could include a guest speaker to discuss practices that lakeshore residents can enact to help protect the lake. The WMP has identified several educational topics that should be covered. (Potential speakers and local organizations are identified in Objective V.) In addition to these educational workshops, a native buffer demonstration project should be pursued near the causeway.

Another action item recommended for this objective is a native buffer demonstration project around the lake. The SC developed a demonstration project idea while discussing this watershed objective that would involve a native buffer demonstration project on the causeway. This area is highly visible for many lake users and would give residents a better idea of what a buffer can look like in their yard and provide educational signage to outline the benefits a buffer can provide. The buffer demonstration site would also show visible outcomes of the WMP, community partnership, and general support of good practices. The Lake Board should partner with Lakewood Shores POA to determine which area could be used. The Lake Board would then contract with an environmental organization or consultant to design the garden. Using volunteers to plant the majority of the native plants can provide cost savings. A sign should be developed to provide educational information to lake users about the benefits of native vegetation along the shoreline as opposed to conventional turf grass that is regularly mowed.

Another task is implementing an educational program for lakeshore residents to provide information about BMPs they can implement to protect the lake. A workshop series or educational program calendar will be provided as part of the WMP. This educational program could be incorporated into the AICLA meetings. During the WMP process, two lakescaping workshops were held in the summer of 2009. Participation at the workshops was limited, due in part to a limited advertising budget. Another consideration that should be taken into account is the fact that many seasonal residents visit the lake to recreate and vacation, therefore their participation in weekend events such as workshops will be limited. By pairing the educational program with the current AICLA meetings, the overall number of weekend events will be lowered, which might promote more participation. The AICLA would invite a speaker to present on a new topic relevant to lakeshore residents. A preliminary list of topics is included as Attachment I.

## **KEY STEPS**

1. The Lake Board, working in partnership with the AICLA, develops a final version and

approves the Lake Stewards Program framework that provides exact details on the program requirements. The Lake Board/AICLA seeks funding<sup>26</sup> to purchase several flags (input on the design of the flag could come from the public)

2. The Lake Board, in partnership with the Lakewood Shores POA, seeks permission to use a portion of the causeway for a native buffer strip and implements the project by:
  - a. Getting a design for the project with conceptual drawing/specifications, including appropriate native plants, re-grading, and final maintenance instructions (assistance from a technical consultant or environmental organization might be necessary)
  - b. Contract with landscaping or excavation service (as necessary) to complete re-grading and prepare ground for planting (including any erosion materials and/or permits, as required)
  - c. Purchase native plants from specialized nursery and organize volunteers to plant native plants
  - d. Install sign near the native buffer that explains the project, the benefits of native plants and riparians buffers, and gives information for lakefront residents to plant their own buffers
  
3. The Lake Board, working in partnership with the AICLA, implements the education program through regular meetings or a separate workshop series. Seek out speakers from local organizations and other environmental/ conservation organizations to provide speakers for the workshops (see Objective V for list).

## KEY ORGANIZATIONS

Cedar Lake Improvement Board  
Lakewood Shores POA  
Alcona-Iosco Cedar Lake Association

## Objective VIII: Continue monitoring water quality parameters and *E. coli* levels to protect water quality, human health, and recreational value of Cedar Lake

In terms of water quality monitoring, the AICLA conducts sampling approximately weekly from

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<sup>26</sup>The local community foundation grants could be a potential source of funding for an initial flag purchase (grants total up to \$3,000 each and should have matching funds to be competitive).

May - September each year. This is done both through the CLMP and other monitoring efforts. A description of water quality parameters, methods, locations, and sampling frequency is included in Attachment A. Results from 2011 are also included in Attachment A. Each year, the AICLA issues a water quality report to lake riparians and the public on important water quality indicators. Using Carlson's Trophic index, the AICLA tracks Secchi depth and Chlorophyll *a* and Total Phosphorus concentrations to determine the lake's trophic status. Secchi depth is measured at Schmidt's Pointe and Briarwood Bay (see Figure 2-6) weekly. Often the Secchi disk can be seen all the way on the bottom of the lake. Chlorophyll *a* is measured approximately once per month from May-September at Schmidt's Pointe and Total Phosphorus is measured twice per summer (once approximately 10 days after ice out and once in September) at Schmidt's Pointe. Nutrients are generally low in Cedar Lake and other water quality parameters indicate that Cedar Lake is in good condition and in a mesotrophic state (see Water Quality Section starting on page 16 and information in Attachment A).

Alkalinity, ammonia-nitrogen, turbidity, pH, conductivity, total dissolved solids, total calcium and magnesium (and water clarity as Secchi depth) is measured weekly from May-September at Schmidt's Pointe and Briarwood Bay using grab samples. The AICLA generally follows CLMP protocols (when applicable). AICLA has added carbon dioxide to this list of protocols. In 2011, the AICLA is going to be placing monitoring buoys in the lake to continuously monitor lake temperature and pH. An additional parameter the AICLA started to monitor in 2010 is *E. coli* bacteria levels. *E. coli* samples were collected approximately weekly from June-September in 2010 at the three beaches on Cedar Lake, the SE shoreline, months of Sherman and Jones Creeks, at the lake outlet, and along a transect across the lake on the western and eastern shoreline and in the middle of the lake. (See Water Quality Section starting on page 16). In 2010, there were no *E. coli* levels in exceedence of water quality standards (see Attachment A).

The SC discussed ways to prevent *E. coli* from becoming a problem in the future and whether additional sampling is necessary. The WMP has focused on preventative measures such as education about septic system maintenance and clean-out and stressing that picking up after pets and deterring excessive waterfowl will help prevent future problems. The AICLA is planning on continuing their monitoring efforts around the lake. One of the implementation recommendations previously outlined was a Lake Stewards program. This program will encourage lake riparians to improve lawn and septic system maintenance that will curb nutrient runoff to the lake and reduce potential *E. coli* issues. In addition, the program will serve as an educational opportunity for the entire lake community. A recommended action in the WMP for this objective is to continue participation with the CLMP and other water quality sampling in order to continue monitoring water quality in Cedar Lake and to gain important information on



lake management. Table 7-6 outlines each action recommended for this objective and provides specific tasks and costs for each action.

For aquatic vegetation and fisheries monitoring, the Lake Board has a contract with Dr. Doug Pullman of Aquest and Mr. Gary Crawford of SEAS, LLC. Another recommendation of the WMP is to continue contracts with qualified consultants (such as Aquest and SEAS, LLC) to continue closely monitoring the health of the aquatic plant community and fishery in Cedar Lake. These consultants use an adaptive management approach to managing resources of Cedar Lake through close monitoring of the in-lake conditions and implementing important treatment and improvement strategies. Aquest and SEAS, LLC issue an annual report on the aquatic plant community and fishery of Cedar Lake<sup>27</sup>. Dr. Pullman also works closely with a licensed commercial applicator under permit by my MDEQ to treat aquatic vegetation with herbicides each year.

In general, both Aquest and SEAS, LLC survey the lake using predetermined Bio Assessment Sites (BOS) and observations are recorded on maps and spreadsheets. The lake is also delineated into Tiers. Aquatic vegetation is evaluated by several indices, including plant species diversity, richness, distribution and density, “weediness” (calculated as an index value), percent cover, coefficient of conservatism, nuisance species counts and prevalence, and phytoplankton community diversity and density. The fishery survey records spawning locations around the lake on a BOS basis. Refuge and nursery habitat are also evaluated and tracked. A map of recorded habitat from SEAS, LLC is included in Figure 7-1.

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<sup>27</sup> Copies of annual reports can be found on the AICLA website at: <http://www.cedar-lake.org/donations.html>.

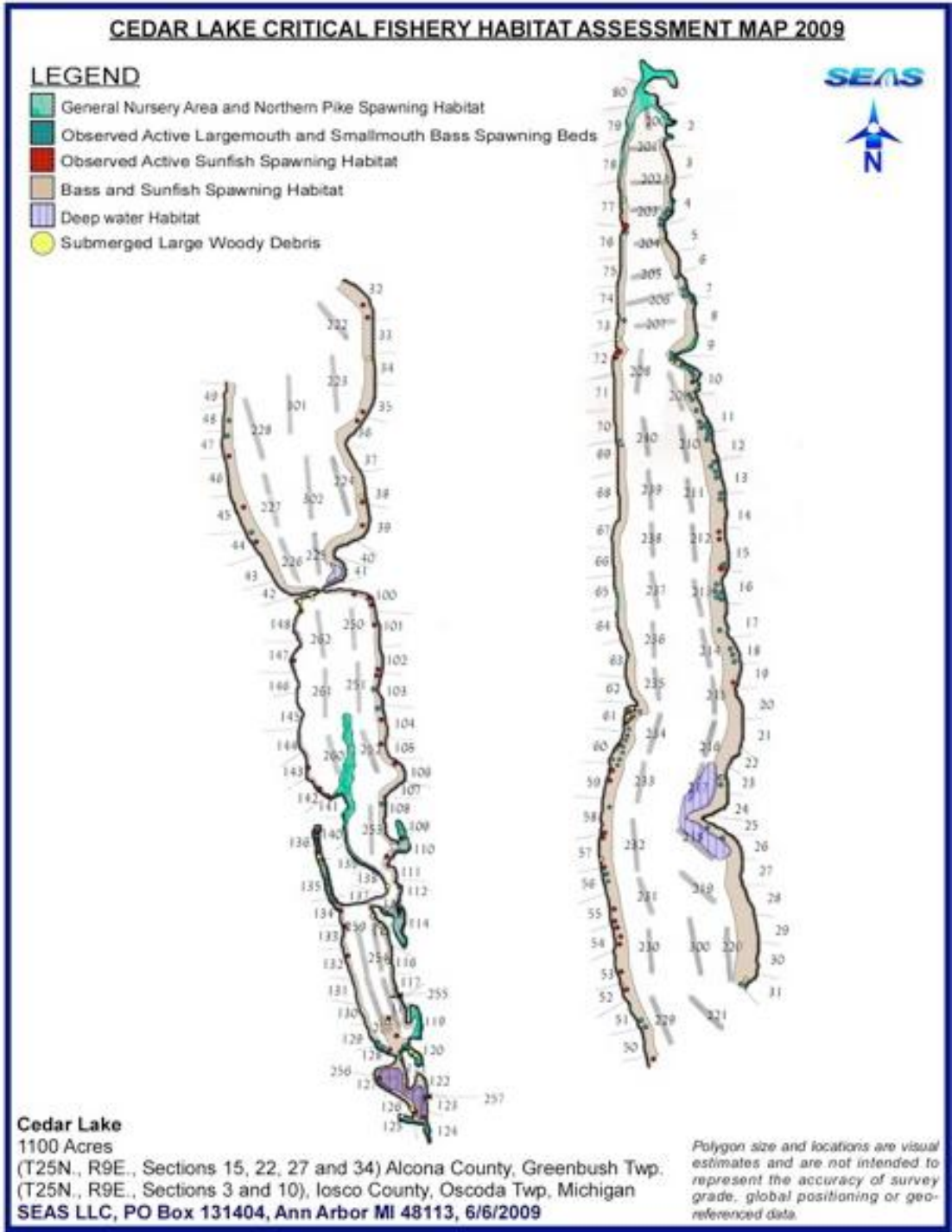


Figure 7-1. Cedar Lake Critical Fishery Habitat Map from SEAS, LLC 2009 Annual Report.

**Table 7-6. Recommended practices and approaches to monitor water quality conditions and encourage best practices for riparian homeowners.**

Action or Practice	WMP Task	Cost
Further develop volunteer monitoring of <i>E. coli</i>	Fully develop (AICLA) sampling strategy, continue to use samples as a “screening” tool, establish credibility of sampling methods/protocol, evaluate if program is necessary in the future, and coordinate sampling efforts and results with Lake Board and District Health Department	\$250-1,000/year
Continue water quality monitoring on a volunteer basis	Work with the CLMP to continue monitoring water quality indicators and incorporate new information into lake management strategy, as necessary	\$500/year (MSLA fee)
Prevent increased nutrient loading to the lake	Implement the Lake Stewards program to educate and encourage proper lakefront BMPs; educate residents about proper pet waste disposal and how to deter waterfowl from yards; information and education on proper septic system maintenance and clean-out	\$2,500-5,000

**KEY ORGANIZATIONS**

Cedar Lake Improvement Board  
 Alcona-Iosco Cedar Lake Association  
 Michigan DEQ  
 District Health Department No. 2

**Objective IX: Utilize conservation options with local land conservancy groups as a habitat protection tool**

Early in the WMP process, the SC identified habitat protection as an important objective of the WMP. Cedar Lake has large tracts of undeveloped land that serve as important fish and wildlife habitat, provide important ecological value and services, and provide recreational opportunities. The critical areas within the northwest wetland have been identified as high priority for permanent protection. During the course of the WMP development, several parcels in the northwest were explored as potential candidates for conservation easements. The Headwaters Land Conservancy presented at one of the SC meetings in order to provide more

insight into conservation tools available for land protection. One of the main implementation tasks of the WMP is for the Lake Board and other interested watershed stakeholders to engage with a local land protection organization or land conservancy to evaluate the potential for conservation easements in the northwest wetlands area (see Attachment E). The land conservancy or organization might be able to serve as a liaison with property owners to commit to protection measures on their properties. The second approach recommended by the SC is exploring the option of purchasing parcels of land near the Sherman Creek critical areas in the west part of the watershed. Those parcels adjacent to streams or other surface water bodies are high priority for permanent protection. Information on the potential benefits of conservation easements and other land protection tools is provided in Attachment J.

## **Public Information and Education**

A large portion of the implementation strategy involves constant dissemination of information to the public and education (I&E). This is due in large part to the fact that residential land use is the largest source of pollution to the lake that can be reasonably reduced. This effort will take a variety of resources and approaches to educate the public on behavior they can modify and practices to implement to protect the lake and restore natural shoreline habitat. Therefore, the SC recognized that in order to prevent future degradation of natural resources, it is important to educate watershed stakeholders in order to mitigate future increases in pollutant loading to the lake and creating a network of stakeholders that can prevent transmission of or identify invasive species (accomplished to date through AICLA annual summer meetings).

The public I&E strategies, tools, and tasks outlined in the various watershed objectives are summarized below. A major task of the AICLA over the past few years has been public education. Although they welcome and encourage the general public to attend their events, there is a need to continue outreach to riparian homeowners who are not members of the AICLA and non-riparian landowners in the watershed. Currently there are several I&E mechanisms in the watershed. First, the AICLA has a strong presence in the watershed and regularly distributes information to all riparian homeowners via their regular newsletter. They also hold regular meetings during the summer for the public. These efforts are the most successful in the watershed to date and should be used in the future for I&E efforts on particular topics of interest listed in Attachment I of the WMP. Attachment I includes a timeline of when the I&E efforts should be implemented (broken down into years 1-3, 4-5, and 6-10 after WMP is approved). I&E tasks are also included in Table 7-9 (below) with more specific timeline information. In addition to the efforts of the AICLA, the Lake Board regularly engages with the public, though not in a consistent, education-based way that the AICLA has done for

years. The Lake Board provides the public with information at public hearings and meetings before deciding on tax assessment issues related to aquatic vegetation and lake management. As the Lake Board works to implement the WMP, they must continue to engage the public and outreach to and partner with other organizations in the watershed to meet the WMP I&E goals and objectives. The following objectives involve an I&E component and comprise the public involvement portion of the WMP:

- **Objective II:** Hold workshops to educate homeowners and potential builders on practices or measures that will reduce the risk of flooding in homes [Approx. Cost: \$1,000-3,000]
- **Objective III:** Hold educational meetings to present augmentation pilot results and solicit support for recommended implementation of augmentation project(s) [Approx. Cost: \$800-1,000]
- **Objective IV:** Educate the public on fisheries-related management efforts, such as a potential creel limit and habitat protection areas in the lake to avoid when fishing (AICLA does educate the public on these issues regularly) [Approx. Cost: \$800-1,000]
- **Objective V:** Create and distribute a homeowner's guide to Cedar Lake to educate watershed residents about aquatic invasive species and potential threats; install signage for public information; regularly post important information regarding invasive species and nuisance aquatic plants in local newsletters, newspapers, and other sources [Approx. Cost: \$1,200-6,500]
- **Objective VII:** Implement a Lake Stewards program to educate the public on good residential practices, how to prevent the spread of invasives, benefits of native buffers and lakescaping, and promote workshops to educate the public on priority topics (see Attachment I) [Approx. Cost: \$2,500-5,500]
- **Objective VIII:** Educate the public on proper pet waste disposal, how to deter waterfowl from yards and public areas, and proper septic system maintenance and clean-out schedule [Approx. Cost: \$2,500-5,500]
- **Objective IX:** Provide educational and informational materials and meetings to the public regarding land protection opportunities [Approx. Cost: \$2,500-5,000]

- **Total I&E Costs (for 5-10 year implementation period):** Approx. \$22,500

## Estimated Pollutant Loading Reductions

The main focus of the Cedar Lake WMP is on projects and approaches necessary to protect the habitat, water quality, and open space in the watershed. Since most of the projects and approaches listed in the implementation table in Attachment E involve preventative and protective measures, no change in nutrient or sediment load was estimated. Some of the recommended projects are expected to offset a potential future load if no action were taken, but most of the projects relate to educational efforts and habitat protection measures. The implementation table in Attachment E includes information on the expected benefits to the lake or watershed from the proposed projects, in lieu of providing quantitative benefits in terms of nutrient or sediment reduction.

The implementation projects that have been developed for restoration purposes are listed in Table 7-13 below. Predicted reductions or changes in nutrient loads, sediments loads, or runoff volumes have been quantified for restoration projects, as appropriate. Some educational efforts, such as promoting native buffers in residential shoreline areas, likely will provide a benefit to the lake in terms of reducing TSS and TP loading to the lake. In order to quantify this, it was assumed that at a 25% implementation rate, the buffer strips would be 75% efficient at filtering TP and 65% efficient at filtering TSS. The resulting load reduction is shown in Table 7-7. For septic system education, the goal will be to improve residential clean-out practices, so to quantify the loading reduction to Cedar Lake, the septic system clean-out frequency was reduced to once every five years and resulted in a reduction of 5 pounds per year to the lake. For the Kings Corner Road culvert, restoring the diversion of water to the Van Etten Lake watershed would result in approximately 58.2 million gallons per year routed back to Cedar Lake. The resulting increase in flow would add approximately 958 pounds TSS and 47 pounds TP per year to Cedar Lake.

**Table 7-7. Estimated TP and TSS load reductions and impacts on hydrology from proposed restoration projects.**

	<b>Application</b>	<b>TSS Load Reduction (lbs/year)</b>	<b>TP Load Reduction (lbs/year)</b>	<b>Volume (million gallons)</b>
Native Buffer Strips <sup>(1)</sup>	Low Intensity Residential (25% of shoreline residential)	296.7	14.9	N/A
Improved Septic System Clean Out Frequency (once every 5 years)	Northwest Residential Septic Systems (100%)	N/A	5	N/A
Modify Kings Corner Road Culvert	Retain 100% of diverted runoff	-958.0 <sup>(2)</sup>	-47.0 <sup>(3)</sup>	52.8

<sup>(1)</sup> (MDEQ, 1999).

<sup>(2)</sup> Estimated increase in TSS loading to Cedar Lake using 52.8 million gallons flow and average 2.67 mg/l TSS from 2009 sampling data.

<sup>(3)</sup> Estimated increase in TP loading to Cedar Lake using 52.8 million gallons flow and average 0.131 mg/l TP from 2009 sampling data.

It is important to note that changes in hydrology, such as stopping the diversion at Kings Corner Road in the northwest part of the watershed, would likely impact nearby residential dwellings and buildings. This hydrologic impact is in addition to increasing the nutrient and sediment loading to the lake, although the concentration of nutrients in Cedar Lake is extremely low. The potential trade-off in this scenario of an increase in the flow of water to Cedar Lake increasing nutrients and sediments should be weighed carefully. In many ways, the increase in loading might be acceptable for mitigating dry summers when large drops in water level are likely to occur and negatively impact the watershed.

## **Cost Estimates and Technical Assistance**

A number of estimated cost ranges for the projects described in the implementation strategy were included in the objective summary section. The entire list of estimated costs has been provided along with recommendations for necessary technical assistance in the implementation table found in Attachment E. The objectives that require technical assistance and recommended professionals are summarized below:

- **Augmentation Pilot and Implementation:** Kieser & Associates, LLC is an environmental engineering firm currently under contract with the Lake Board to perform an



augmentation feasibility and pilot project for Cedar Lake; future technical services from a qualified environmental engineering firm will be necessary to implement recommendations from the pilot project

- **Wetland Protection Ordinance:** legal review by a qualified attorney will be necessary when drafting final wetlands ordinance language; these services may be provided by the township legal counsel
- **Conservation Easements and Land Protection Tools:** technical services from both legal counsel and other organizations familiar with conservation easements will be necessary as easements and other land protection tools are utilized in the watershed
- **Home Flooding Education:** a home building expert experienced with flooding issues and methods to reduce flooding in existing homes should be consulted when preparing education materials for Lakewood Shores residents
- **Fisheries Management:** the Lake Board will continue to use the services of a fisheries management professional to implement the tasks outlined in the Cedar Lake fisheries objective
- **Homeowner's Guide:** an environmental consulting firm or non-profit organization with relevant experience might be necessary when developing materials for the homeowner's guide to Cedar Lake
- **Native Buffer Implementation Project:** technical services from an environmental consulting firm or master gardener experienced with native plants will be necessary to design and manage installation of the native buffer for the demonstration project
- **Information & Education Program:** technical assistance might be needed as the educational strategy is implemented; a list of potential speakers and other experts is presented under Objective V

It is important to note the potential funding sources also included in the implementation table in Attachment E. Much of the work done in the watershed to date has been funded through tax assessments and AICLA funds collected voluntarily. Ongoing management efforts in the watershed, such as aquatic plant and fisheries management, will involve annual tax assessments on riparian properties, which are likely to increase in the future. The limited

resources of the tax base will control the rate of WMP implementation unless outside funding is pursued. These outside funding sources are included in the table and often require grant proposals to secure funding. The Lake Board should solicit services for proposal writing or identify current board members that might be able to serve in this capacity.

Table 7-8 below provides a summary breakdown of the recommended implementation tasks and approximate costs (note: when a cost range was provided in Attachment E, the highest value in the range was selected and when costs overlapped between tasks, the cost were split). Several of the objectives in the implementation plan overlap in terms of costs, therefore, the cost figures in Table 7-8 are estimates and could be less or more based on the final strategy implemented. It is also important to note that the costs will be split among watershed stakeholders, for instance, change architectural standards in Lakewood Shores would involve legal fees and time for meetings that will be taken on by the Lakeshores Property Owners Association. The table also includes a separate breakdown of I&E costs.

**Table 7-8. Estimated total costs for implementing WMP objectives.**

<b>Objective</b>	<b>WMP Task</b>	<b>Cost Estimate</b>
I	Wetland ordinance	\$20,000
	Restore wetland hydrology	\$300,000
	Protect Sherman Creek critical areas	\$200,000
	<b>Subtotal</b>	<b>\$520,000</b>
II	Building meetings & architectural standards	\$10,000
	Conservation easements	\$100,000
	<b>Subtotal</b>	<b>\$110,000</b>
III	Lake level management project(s) <i>(some cost could overlap with Objective I)</i>	\$250,000
	<b>Subtotal</b>	<b>\$250,000</b>
IV	Fisheries management tasks (over 5+ years)	\$26,000
	<b>Subtotal</b>	<b>\$26,000</b>
V	I&E (over 5-10 years; includes I&E from other objectives)	\$22,500
	Lake manager/fisheries manager	\$250,000
	Aquatic plant management program (over 10 years)	\$500,000
	<b>Subtotal</b>	<b>\$772,500</b>
VI	Sediment study	\$30,000
	Dredging project	\$500,000
	Lake stewards program	\$6,500
	<b>Subtotal</b>	<b>\$536,500</b>

**Table 7-8. Continued.**

VII	Annual stewardship activities	\$3,000
	Native buffer demonstration project	\$10,000
	<b><i>Subtotal</i></b>	<b><i>\$13,000</i></b>
VIII	Water quality monitoring (over 10 years)	\$50,000
	Membership fees/I&E (over 10 years)	\$10,000
	<b><i>Subtotal</i></b>	<b><i>\$60,000</i></b>
IX	Conservation easements/purchase property	\$200,000
	<b><i>Subtotal</i></b>	<b><i>\$200,000</i></b>
	<b><i>Total Estimated Costs</i></b>	<b><i>\$2,488,000</i></b>

### **Implementation Priorities and Schedule**

The SC developed the implementation table in Attachment E and a prioritization ranking for the implementation phase of the WMP. The priority rankings of projects and tasks might change over time as the Lake Board tracks watershed milestones and as new issues or concerns emerge. Using the priority ranking and information from SC meetings, an implementation schedule was developed to guide the Lake Board and other watershed stakeholders in selecting projects and tasks. The schedule takes into consideration the ranking of watershed concerns, pollutant sources, and overall watershed goals. In addition, sequential timing of projects, amount of time necessary to complete projects, amount of expected public engagement and acceptance, and the availability of funding were all taken into account when developing the schedule. Table 7-9 list projects and approaches by objective and provides an approximate start date (by year) and duration to complete the activity.

**Table 7-9. Implementation schedule for the Cedar Lake WMP.**

	YEAR	2011	2012	2013	2014	2015	2016+
<b>Objective I</b>							
I-1 Wetland ordinance							
I-2 Restore wetland hydrology							
I-3 Sherman Creek critical area							
<b>Objective II</b>							
II-1 Protect NW hydrology (ordinance)							
II-2 DEQ/building inspector meetings							
II-3 LSPOA architectural standards							
II-4 Workshops on building							
II-5 Conservation easements							
<b>Objective III</b>							
III-1 Public support for augmentation							
III-2 Implement augmentation project(s)							
<b>Objective IV</b>							
IV-1 (see I-2)							
IV-2 Wetlands protection policy/easements							
IV-3 Fisheries management implementation	*	(5)*	(3)*	(4)*	(1)*		*
<b>Objective V</b>							
V-1 Invasive species I&E							
V-2 Boat cleaning station/signage							
V-3 Riparian owners brochure							
V-4 Develop Lake Manager contract							
V-5 Aquatic vegetation treatment							
<b>Objective VI</b>							
VI-1 Dredging feasibility							
VI-2 Riparian best practices I&E							
VI-3 Lake stewards program							
VI-4 (see V-3)							
<b>Objective VII</b>							
VII-1 Lakescaping I&E							
VII-2 Native buffer demonstration							
VII-3 (see VI-3)							
VII-4 (see V-3)							
VII-5 Lake stewards events							
<b>Objective VIII</b>							
VIII-1 CLMP							
VIII-2 Septic system I&E							
VIII-3 Water quality & aquatic plant monitoring							
<b>Objective IX</b>							
IX-1 Conservation easements							
IX-2 Land purchase options							

\* denotes annual fish habitat assessment (currently under contract with SEAS, LLC)

(1)-(5) denotes years when fisheries management tasks will be conducted (see full implementation table)

## Milestones to Measure Progress

Interim milestones were developed to monitor the progress of WMP implementation and distributed to the SC for feedback. The SC was asked to give input on whether the list of milestones would serve the Lake Board and other organizations involved in tracking annual watershed progress toward WMP tasks and meeting the overall goals. The final list of WMP milestones is presented below and is generally organized by watershed goal in chronological order. In this format, the list will serve as an annual “check list” for the Lake Board to review and monitor the progress of implementing the WMP. The “check list” provides criteria that the Lake Board can quickly and easily answer in a yes/no manner. Items that are not accomplished will become priorities or they will be adapted to fit current concerns, short-term goals, or grouped with other opportunities presented to the Lake Board. The Lake Board will regularly review the milestones, add new milestones as projects evolve, and remove items that have already been completed. Where appropriate, methods of measuring and monitoring progress are included in parenthesis to assist in determining progress in the watershed. Sampling and monitoring of lake conditions has been on-going through AICLA and Lake Board contracts with technical consultants (including aquatic vegetation management and treatment, fisheries management, and hydrology). The Lake Board should continue to use data and results from established monitoring programs to track and gauge progress toward WMP goals and objectives.

### ***Cedar Lake Fishery***

- Continued commitment of walleye stocking by MDEQ on an as-needed basis (consistent contact with MDEQ to determine if Cedar Lake will be receiving fingerlings each year)
- Walleye spawning habitat assessment complete, and habitat improvement measures identified within year one; spawning habitat improvements completed by year two, and assessment of their use documented by year three (monitoring walleye population to assess if natural spawning is occurring)
- Creel limit language developed by fishery biologist and vetted by the Lake Board by year two, and limit introduced to the public through educational efforts by year three (monitor outcomes by measuring population increases)
- Reporting on fish stocking progress presented to Lake Board by year two and habitat improvements and additional stocking needs assessed by year three
- Fish population assessment and analysis of fish age/growth completed in year five

### ***Aquatic Plants and Wildlife***

- Lake Stewards Program framework completed within year one
- Functioning Lake Stewards Program with five active lakefront residents participating in

the program by the end of year two

- Educational materials on threatening invasive species distributed by newsletter or special mailing to watershed residents by year two
- Invasive species signage posted around lake access points (road ends) by year three
- One highly visible native buffer demonstration site established on lakeshore by year three
- Ten new native buffers established on the lake by year five

### ***Partial Body Contact/Recreation***

- Water quality sampling through Michigan Cooperative Lakes Monitoring Program completed and summarized by AICLA each year for tracking results
- Lake Manager or similar contract in place each year that actively works on aquatic plant management, treatment, and other issues as needed to improve and protect recreational value in Cedar Lake (continue established lake monitoring for aquatic vegetation in order to compare data over time)

### ***Full Body Contact/Recreation***

- No violations of *E. coli* water quality standard measured by the District Health Department No. 2 at Cedar Lake beaches
- AICLA to complete quality control evaluation of their *E. coli* monitoring protocol in year one
- Lake Stewards Program framework completed within year one
- Lake Stewards Program implemented by Lake Board and AICLA partnership by year two
- Partner with organization like District Health Department to get septic system educational materials to public (through newsletter, local newspaper, or AICLA meeting) by year three
- Sediment thickness/mapping study and evaluation of ecological impacts of dredging completed by year three

### ***Groundwater Protection***

- Hold one groundwater/flooding workshop within year two
- Wetlands protection ordinance drafted in year one and formally presented to the township zoning boards in year two

### ***Lake Level***

- Final list of K&A recommendations from augmentation pilot within year one and prioritized by the Lake Board with public hearings by year two
- Greater than 50% public support of selected augmentation measures by year two

### ***Habitat and Natural Area Conservation***

- Property description and aerial photos of Sherman Creek wetland area sent to local land conservancy with invitation to view and discuss property in year one
- 50-100 acres of wetlands permanently protected in the northwest wetland critical area before year five

## **Evaluation Framework**

As with many management efforts, a lead watershed organization is necessary for sustaining the WMP and related implementation efforts and accomplishing the goals and objectives set through this process. In the Cedar Lake watershed, the Lake Board has taken on this leadership role through an expansion of their charter, which will ensure a long-term commitment to the WMP. The consistent, dedicated implementation of the WMP by the Lake Board will ensure goals established through this planning process will be achieved. Because the Lake Board is comprised of a variety of watershed stakeholders, including township, county, and state agency representatives, along with local lake association members, the Lake Board will serve as a steering committee for the WMP implementation. In addition to overseeing the implementation of the WMP, the Lake Board will also be responsible for evaluating environmental response to WMP implementation efforts to ensure conditions do not degrade over time. The organization meets several times each year to perform administration duties, discuss watershed and lake issues, and make decisions on contractual services. Their existing responsibility is to the benefit of the lake, and for this reason, adding the responsibility of implementing tasks of the WMP will work well in the existing organization's framework.

The general evaluation framework for the Lake Board is constructed from their current operating process, whereby the group meets regularly to discuss lake issues, perform administrative duties, and make progress toward select priorities. The following framework will be used to specifically address the WMP:

- Lake Board meets approximately every other month (as necessary) from April to December each year and will incorporate regular evaluation of the WMP progress into these meetings.
- Once per year the Lake Board will review the WMP milestones and make modifications, check-off those that have been completed, and use current and future milestones and management activities selected by the Lake Manager to set lake protection/restoration priorities and tasks for the coming year.
- The Lake Board will review the progress and annual reports from the lake manager at



regular meetings and solicit input from technical consultants on whether major water quality indicators (such as nutrients, *E. coli*, etc. -- see benchmark discussion below) show good conditions in the lake or any growing concerns. The Lake Board will use any available data or conclusions from technical consultants to adapt priorities or add additional tasks to the WMP to continue progress toward overall watershed goals.

The Lake Board will use quantitative and qualitative benchmarks to evaluate the effectiveness of the WMP in terms of protecting and restoring natural resources. The benchmarks come from technical services contracted by the Lake Board, Michigan water quality standards, AICLA water quality data, and existing watershed information (see Attachment A for 2011 water quality results). They will allow the Lake Board to check annual environmental monitoring results against a criteria specific to the Cedar Lake watershed. When annual monitoring results are outside of the set benchmarks, this will trigger the Lake Board to examine the results and determine whether a potential problem exists. In some cases, the benchmarks will be revised as new data are available. In other cases, the Lake Board will work with the Lake Manager to develop a strategy to address the environmental concern.

As detailed in the WMP, the Lake Manager will provide periodic updates, recommendations, and annual reports to the Lake Board. The data reported from the Lake Manager, such as composition of the aquatic plant community, will be indicators to the Lake Board to determine if the WMP should be adapted, priorities changed, or additional strategies added. The Lake Board will use the benchmarks in Table 7-10 to evaluate conditions in the watershed and adapt priorities and strategies accordingly.

**Table 7-10. Benchmarks for evaluating WMP effectiveness in protecting and restoring natural resources of the watershed.**

Evaluation	Benchmark
Aquatic Plant Community	<ul style="list-style-type: none"> <li>• Mean plant community “C” value for all BOSs greater than or equal to 5</li> <li>• Mean “weediness” factor for all BOSs equal to or less than 5</li> <li>• Total plant biodiversity value of 40 or greater</li> </ul>
Fishery	<ul style="list-style-type: none"> <li>• No statistically significant decreases in the percentage of fish habitat found in BOSs at both north and south end of Cedar Lake (see Pullman, 2009; page 54)</li> </ul> <p>[North = 57% active spawning habitat, 17% nursery habitat, 10% deep water habitat, 13% submerged woody structure            South = 58% active spawning habitat, 38% nursery habitat, 13% deep water habitat, 19% submerged woody structure]</p>
Water Quality	<ul style="list-style-type: none"> <li>• Dissolved oxygen: not less than 5 mg/L daily average</li> <li>• pH: monthly average pH measurements between 6.5-9.0</li> </ul>

	<ul style="list-style-type: none"> <li>• Phosphorus: no annual average total phosphorus concentrations greater than 40 ug/L</li> <li>• Chlorophyll <i>a</i>: no annual average concentrations greater than 45 ug/L</li> <li>• Temperature: no average monthly temperatures above the following limits: May (70), June (75), July (80), August (85), September (80)</li> <li>• Secchi depth: monthly average depth measurements greater than 6 ft (at Schmidt's Pointe &amp; Briarwood Bay)</li> <li>• <i>E. coli</i>: not more than 130 counts/100 mL monthly average or not more than 300 counts/100 ml maximum per each sample</li> </ul>
Lake Level	<ul style="list-style-type: none"> <li>• No summer lake level losses greater than 6-8 inches after augmentation measures are installed</li> </ul>

BOS = Bio Assessment Sites

## Monitoring Program

The Lake Board will use continued monitoring of the watershed to assess environmental conditions against the benchmarks in Table 7-10. Results from monitoring conducted by the AICLA annually (and described in Attachment A) will be compared to the water quality benchmarks. The water quality monitoring program includes weekly grab samples at two established sampling sites in Cedar Lake: Schmidt's Pointe and Briarwood Bay (see Figure 2-6). Water clarity and temperature are also measured during these sampling trips. A Secchi disk is used to measure water clarity and temperature is measured at Schmidt's Pointe at 5 feet depth and at the bottom. At Briarwood Bay temperature is measured at 5 feet depth, 10 feet depth, and at the bottom. Using a LaMotte Smart2 Colorimeter, samples are tested for alkalinity, ammonia-nitrogen, color, and turbidity. Conductivity and total dissolved solids are tested using a handheld LaMotte EC/TDS/Salt Tracer, and pH is recorded using a handheld LaMotte pH Tracer. Total calcium and magnesium are tested via a LaMotte Test Kit Titrator.

Starting in 2011, the AICLA will be using autosamplers to take pH and temperature readings every two hours using a Madgetech pHtemp101 data logger. Temperature is measured at approximately mid-depth. Two basic observation buoys will be installed near Schmidt's Pointe and Briarwood Bay. The AICLA also collects grab samples each year as part of the CLMP. Samples collected monthly from May-September are analyzed by the State of Michigan Laboratory for Chlorophyll *a*. Two grab samples collected approximately 10 days after ice-out and September 15 each year are analyzed by the State of Michigan Laboratory for total phosphorus.

The Lake Board will continue contracting with a qualified lake manager or aquatic limnologist to conduct annual aquatic vegetation surveys (which often involve surveying plants several times throughout the growing season). Aquest is currently under contract with the Lake Board to conduct these surveys and provide aquatic plant management and lake management services. Fisheries studies will also continue on an annual basis under the same contract (which is currently subcontracted to SEAS, LLC). Both aquatic vegetation and fishery surveys will be conducted on the BOS basis Aquest and SEAS, LLC have used in the past (see past reports for more information<sup>28</sup>). Lake level has been monitored in the past by Kieser & Associates, LLC through a separate contract with the Lake Board. The monitoring involves several ground water monitoring wells (with continuous level loggers) and level loggers placed directly in the lake (at the causeway and lake outlet) that track changes in water level. When this monitoring contract ends, lake level and groundwater will continue to be monitored by the AICLA using the existing level loggers and monitoring wells.

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<sup>28</sup> Past annual reports from Aquest and SEAS, LLC are available at: <http://www.cedar-lake.org/donations.html>.

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# ATTACHMENT A

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Water Quality Monitoring Plan and AICLA 2011 Results

**AICLA - 2011 Water Quality Monitoring Program**

TEST	METHOD	FREQUENCY	LOCATION*	RANGE	COMMENT
Alkalinity	Colorimeter	Approx. Weekly May - Sept.	SP, BB	0 - 200 ppm as CaCO <sub>3</sub>	LaMotte Smart2 Colorimeter
Ammonia-Nitrogen	Colorimeter	Approx. Weekly May - Sept.	SP, BB	0.00 - 4.00 ppm Ammonia Nitrogen	LaMotte Smart2 Colorimeter
Color	Colorimeter	Approx. Weekly May - Sept.	SP, BB	0 - 1,000 Platinum Cobalt Scale	LaMotte Smart2 Colorimeter
Turbidity	Colorimeter	Approx. Weekly May - Sept.	SP, BB	0 - 400 FTU, Calibrated to NTU	LaMotte Smart2 Colorimeter
pH	Colorimeter	Approx. Weekly May - Sept.	SP, BB	8.0 - 9.6	Starting in 2011 - Compare & Validate Hand Held Reading
pH	Handheld	Approx. Weekly May - Sept.	SP, BB	0.00 - 14.00/ + or - 0.01 pH	LaMotte pH Tracer
Conductivity	Handheld	Approx. Weekly May - Sept.	SP, BB	0 -199 uS, 200 - 1999 uS, 0.1 uS - 19.99 mS 0.1 uS Resolution, + or - 1% accuracy	LaMotte EC/TDS/Salt Tracer
Total Dissolved Solids (TDS) & Salinity	Handheld	Approx. Weekly May - Sept.	SP, BB	0 - 99.9 ppm, 100 - 999 ppm, 1.00 - 9.99 ppt, 0.1 ppm resolution, + or - 2% accuracy	LaMotte EC/TDS/Salt Tracer
Total Calcium & Magnesium Hardness	LaMotte Test Kit	Approx. Weekly May - Sept.	SP, BB	0 - 200 ppm using a direct read titrator	Measures hardness expressed as ppm CaCO <sub>3</sub> , Magnesium & total hardness via direct reading a titrator with each minor division on the titrator scale = 4 ppm
E. Coli	LaMotte Coliscan Easygel EZ Method	Approx. Weekly June - Sept.	3 beaches SE shoreline Mouths of 2 creeks Lake outlet W, Mid and E shore	Number of E. Coli colonies per ml of water	Weekly sampling at up to 8 locations around the lake every week
Water Clarity	Secchi Disk Depth	Approx. Weekly May - Sept.	SP, BB	Feet of visibility	ML&SA CLMP
Chlorophyll-a	CLMP Defined	Monthly May - September	SP	(no defined limit) 1% reject rate	ML&SA CLMP sample procedure, frozen samples sent to state lab for processing
Phosphorus	CLMP Defined	Approx. 10 days after ice-out and approx. Sept. 15 (2/yr)	SP	(no defined limit)	ML&SA CLMP sample procedure, frozen samples sent to state lab for processing
Streaming pH/Temp	Madgetech/Omega pHtemp101 logger with pH/temperature probe	Approx. weekly (hourly 24/7 after 2011 implementation; see comments)	SP (5 ft depth and bottom) BB (5 ft, 10 ft and bottom)	Take hourly sample readings of pH & temp at the 2 sampling locations	2 Basic Observation Buoys (BOB) will be built in spring of 2011 (according to NOAA design), a custom made OtterBox will be mounted on the BOB. It will house & protect a Madgetech pHtemp101 datalogger. An Omega cable will be output from the datalogger thru a sealed fitting on the OtterBox. The cable will be attached to an Omega probe hanging below water. BOB's will be at our 2 sampling locations, attached to mooring buoy's permanently anchored at these two locations. Construction of the BOB's will begin in late May. The mooring buoy's will be anchored in place in late May. The monitoring equipment will be purchased by late May. The planned implementation of the BOB monitoring effort is NLT mid-July 2011.

\*See Figure 2-5 for sampling locations

SP = Schmidt's Pte

BB = Briarwood Bay



## E-Coli Testing Results Summer 2010

Conditions -as of Various Sample Dates Listed

submitted by Merry Paulson 739-2937

edited on June 30,2010

### Notes:

1) All samples taken at center of beach area, 22" of water depth, samples collected 6" from the bottom

2) Sample size is **1mL The target range should be between 20 and 300 colonies Below 20 colonies, the results will not be significant**

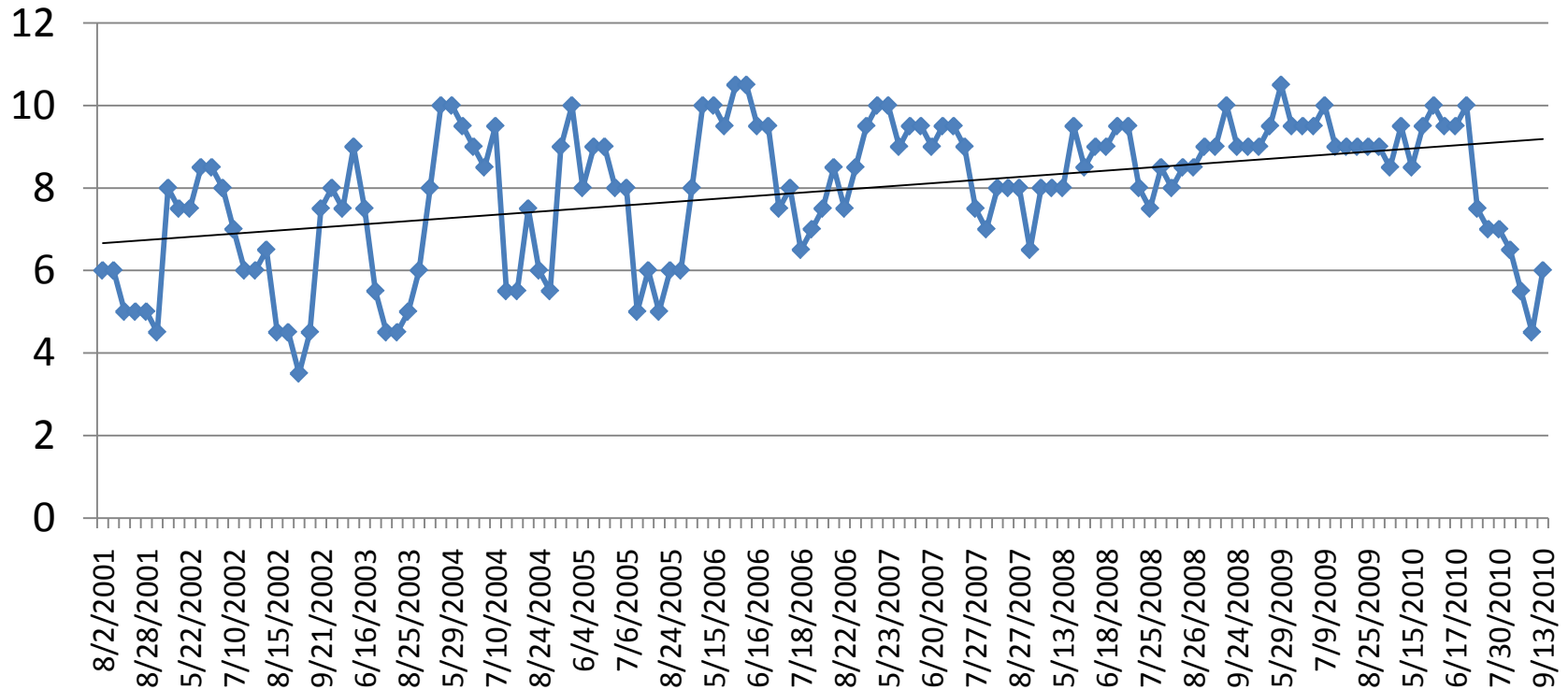
3) E Coli count is determined 24-30 hours after the beginning of incubation period, incubation takes place in a controlled environment at 95 degrees

4) Our testing method is conducted as instructed by LaMotte Company, using their testing materials and their directions.

**DATES: LOCATIONS**

	LWSPOA Briarwood Beach	LWSPOA Clubhouse Beach	Greenbush Beach	Southeastern/ County Drain Shoreline	"Jones Creek" North Inlet	North End Spillways (Dams)	Sherman Creek South-inlet	East/West Across the Lake Transect #1	East/West Across the Lake Transect #2	East/West Across the Lake Transect #3
June 22, 2010 Conditions: Lake Activity:	12 Mostly cloudy Nothing in area	18 Mostly cloudy Nothing in area	18 Overcast Nothing in area	4 Mostly cloudy Nothing in area	12 Overcast Nothing in area	44 Overcast Dead fish	15 Partly cloudy Nothing in area			
6/29/2010 Conditions: Lake Activity:	20 Sunny Nothing in area	12 Sunny Nothing in area	38 Sunny Nothing in area	12 Sunny Nothing in area	67 Sunny Leaves/Debris	61 Sunny Leaves/Debris	74 Sunny Weeds			
7/6/2010 Conditions: Lake Activity:	6 Sunny Swimmers	12 Sunny Swimmers	22 Sunny Nothing in area	34 Sunny Nothing in area	108 Sunny Leaves/Debris	169 Sunny Leaves/Debris	77 Sunny Weeds			
7/13/2010 Conditions: Lake Activity:	3 Sunny Nothing in area	9 Sunny Nothing in area	23 Sunny Nothing in area	3 Sunny Leaves/Debris	72 Sunny Nothing in area	74 Sunny Leaves/Debris	52 Sunny Weeds			
7/27/2010 Conditions: Lake Activity:	13 Sunny Swimmers	12 Sunny Nothing in area	31 Sunny Dead fish	52 Sunny Nothing in area	51 Sunny Weeds	108 Sunny Leaves/Debris	10 Sunny Weeds	32 Sunny Nothing in area	8 Sunny Weeds	14 Sunny Nothing in area
8/3/2010 Conditions: Lake Activity:	44 Sunny Nothing in area	1 Sunny Nothing in area	1 Sunny Nothing in area	4 Sunny Nothing in area	85 Partly cloudy Nothing in area	4 Sunny Nothing in area	95 Sunny Weeds			
8/10/2010 Conditions: Lake Activity:	36 Sunny Nothing in area	11 Sunny Nothing in area	16 Sunny Nothing in area	31 Partly cloudy Leaves/Debris	39 Sunny Weeds	too many to count Sunny Weeds	93 Partly cloudy Weeds	7 Sunny Nothing in area	5 Sunny Nothing in area	10 Sunny Nothing in area
8/17/2010 Conditions: Lake Activity:	15 Sunny Nothing in area	88 Partly cloudy Geese/ ducks	23 Sunny Nothing in area	44 Sunny Weeds	Almost no flow No flow of water	Almost no flow No flow of water	Almost no flow No flow of water	47 Sunny Nothing in area	11 Sunny Nothing in area	7 Sunny Nothing in area
8/24/2010 Conditions: Lake Activity:	22 Sunny Nothing in area	72 Sunny Nothing in area	56 Sunny Nothing in area	61 Sunny Leaves/Debris	No flow of water	No flow of water	No flow of water	11 Partly cloudy Weeds	52 Partly cloudy Nothing in area	16 Partly cloudy Nothing in area
9/1/2010 Conditions: Lake Activity:	20 Overcast Nothing in area	55 Overcast Nothing in area	82 Overcast Nothing in area	91 Overcast Nothing in area	No flow of water	No flow of water	No flow of water	41 Overcast Nothing in area	26 Overcast Nothing in area	27 Overcast Nothing in area

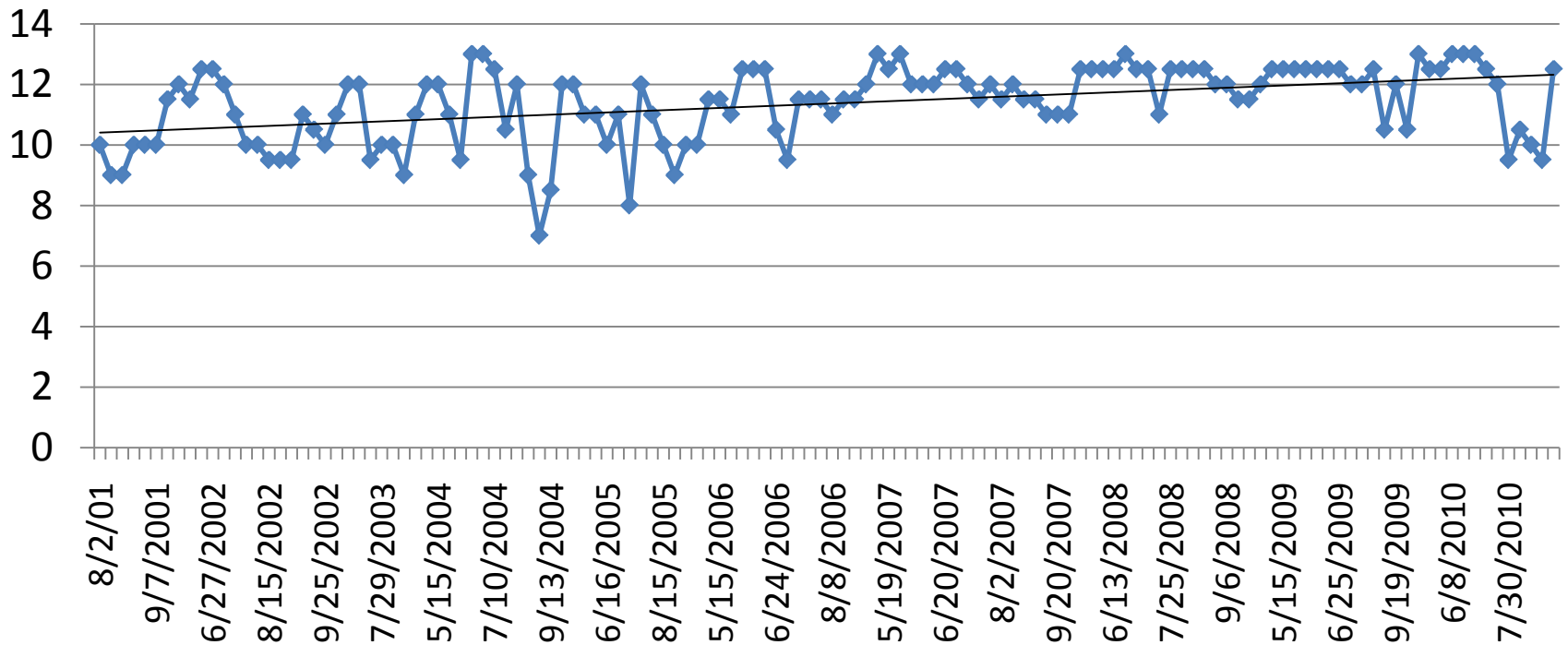
# Cedar Lake Water Clarity Secchi Readings at Schmidt's Pte Sampling Site, 2001 - 2010



## Number of Readings When It Was "Clear to Bottom" During a Given Year of Sampling

\_2001 – 0 of 7, 2002 – 5 of 16, 2003 – 3 of 9, 2004 – 2 of 11, 2005 – 1 of 13, 2006 – 5 of 15, 2007 – 13 of 18, 2008 – 12 of 17, 2009 – 15 of 15, 2010 – 5 of 13

# Cedar Lake Water Clarity Secchi Readings at Briarwood Bay Sampling Site, 2001 -2010

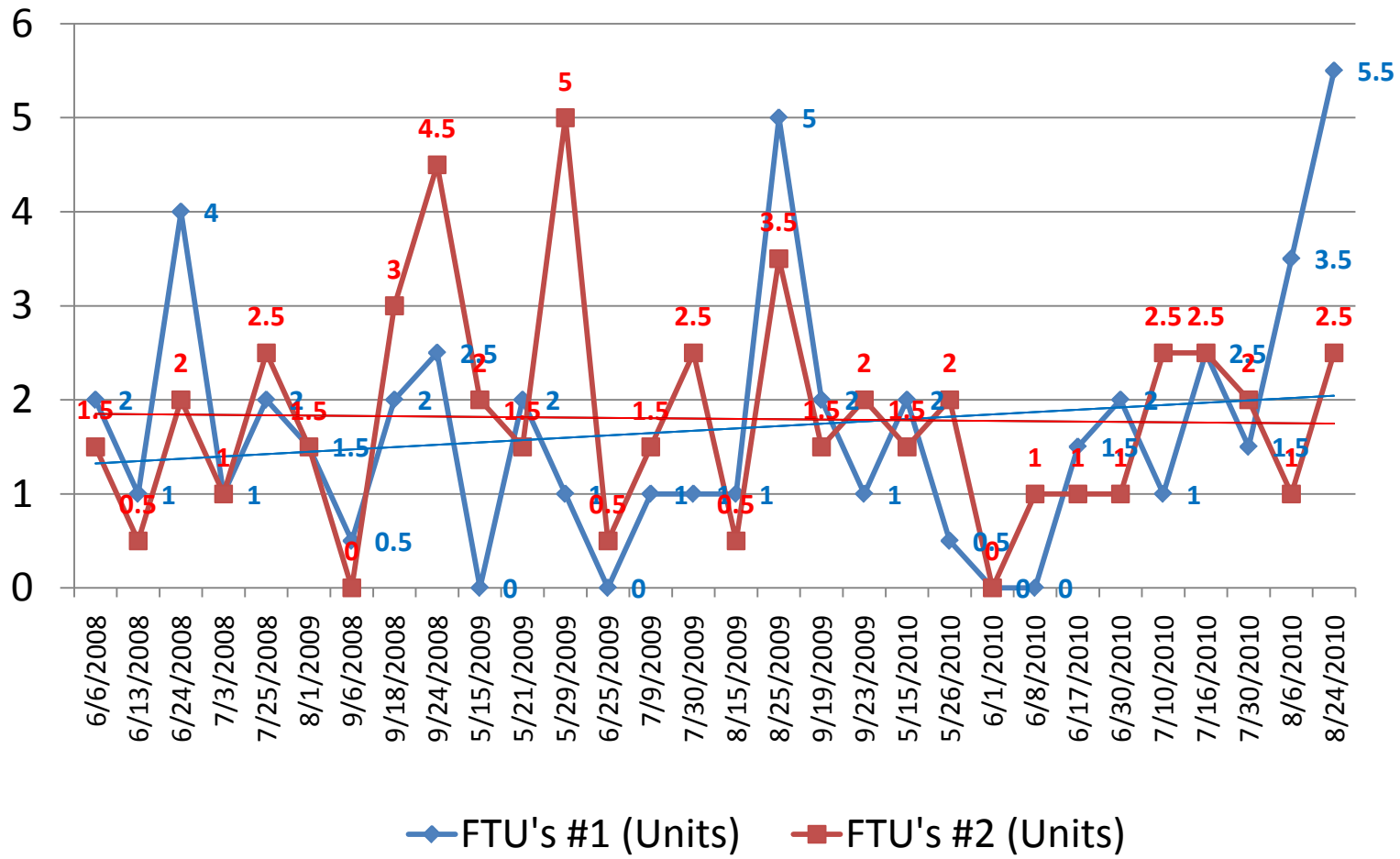


## Number of Readings When it Was "Clear to Bottom" During a Given Year of Sampling

2001- 0 of 7, 2002 – 3 of 15, 2003 – 1 of 8, 2004 – 2 of 12, 2005 - 0 of 13, 2006 – 2 of 15, 2007 – 17 of 18, 2008 – 15 of 17, 2009 – 10 of 13, 2010 – 7 of 13

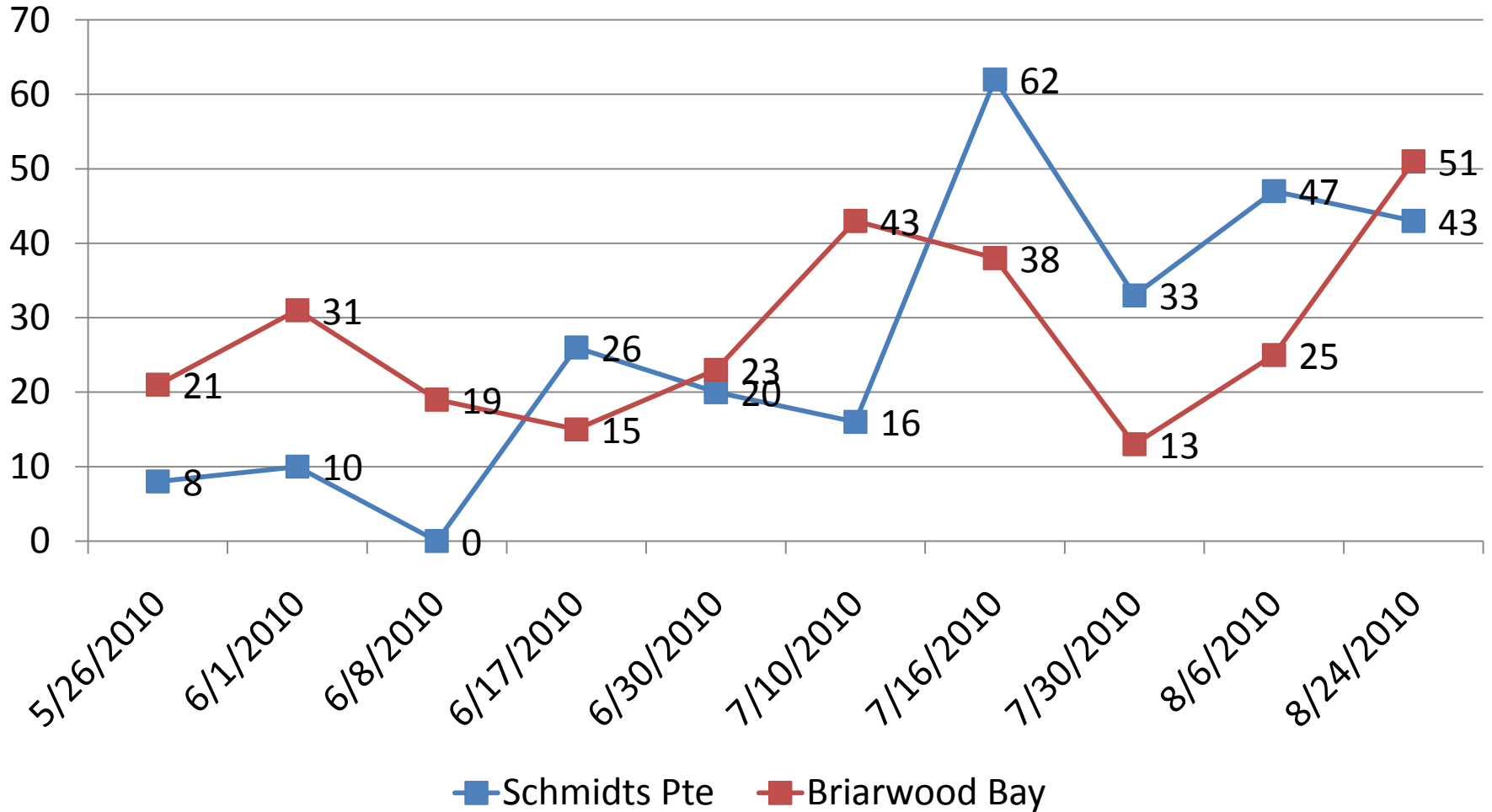
# Cedar Lake Water Clarity FTU's

## Schmidt's Pte (#1) & Briarwood Bay (#2) Sampling Sites 2008 - 2010



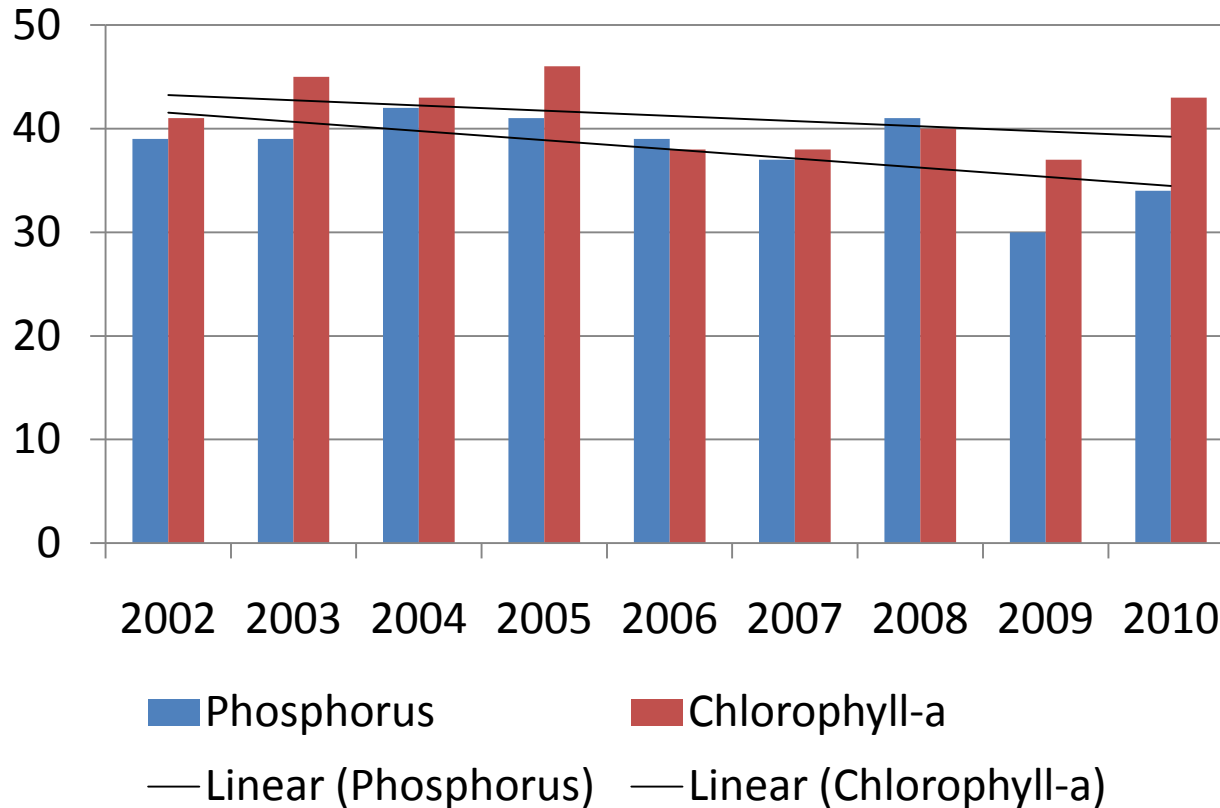
Our colorimeter FTU readings were calibrated to equal EPA NTU's using a formazin solution as prescribed in the colorimeter operator's manual. No standard found on NTU/FTU turbidity readings in lakes; grossly, less than 50 is required for a healthy fishery.

# Color Analysis – Platinum Cobalt Method - 2010



Color in water may be attributed to humus, peat, plankton, vegetation, and natural metallic ions, such as iron, manganese or industrial waste. The Platinum cobalt method is a visual method of color measurement of essentially light colored liquids with color characteristics close to those of the platinum cobalt scale. Those characteristics are generally described as “yellowish brown”. The measurement range is from 0 – 500. Distilled water is “0”. The permissible drinking water color limit in India is “5”.

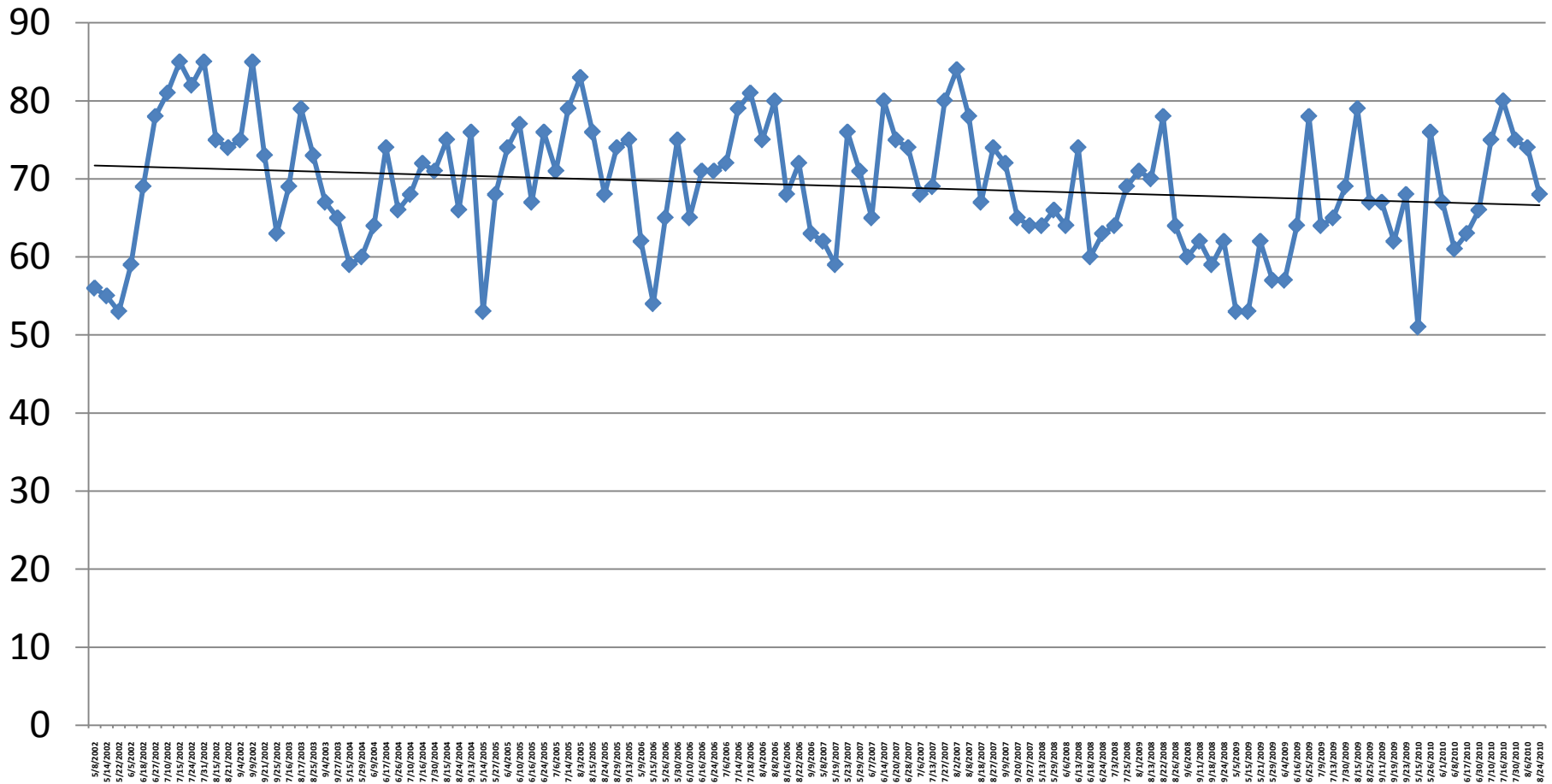
# Total Phosphorus & Chlorophyll-a 2002 - 2010



## Carlson's Trophic Index

- Oligotrophic – 20 – 35
- Mesotrophic – 40 – 50
- Eutrophic – 55 – 63
- Hypereutrophic – 66 - 80

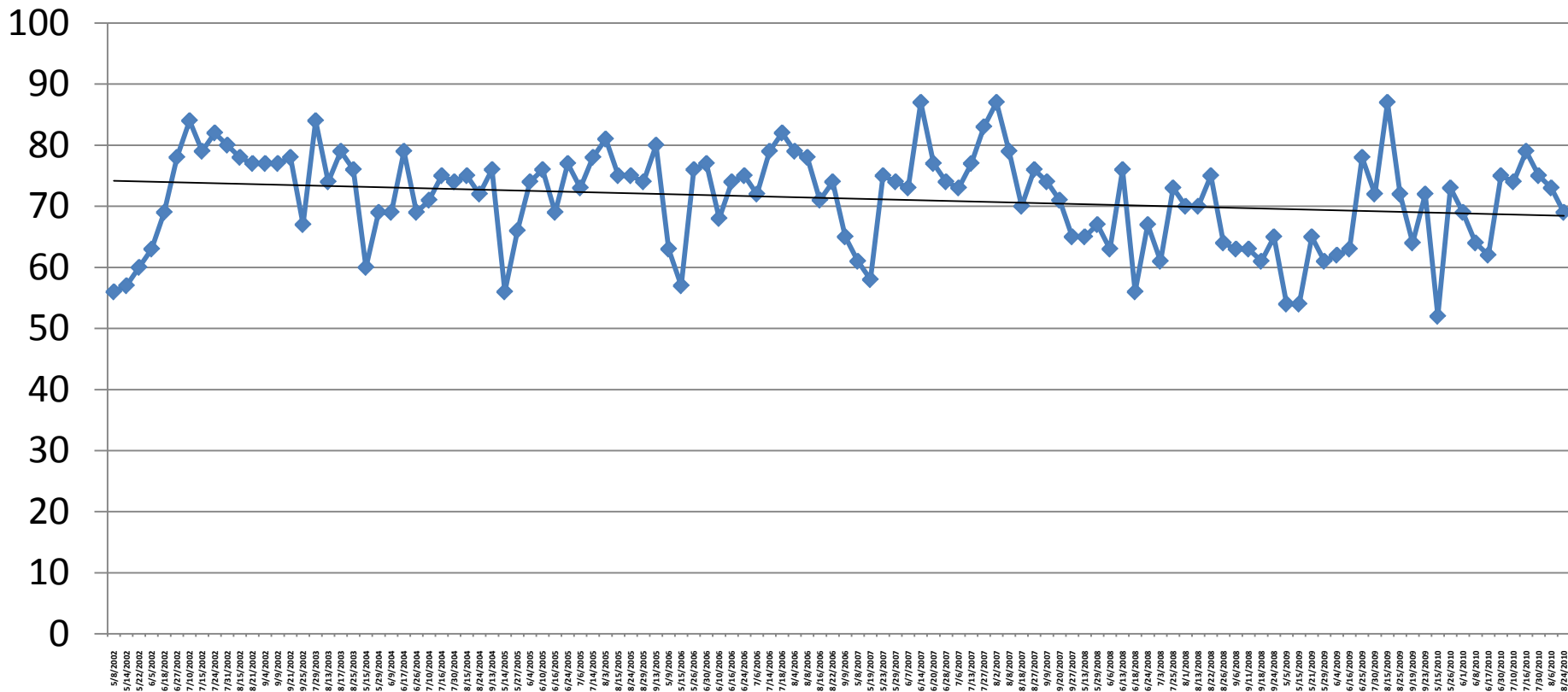
# Cedar Lake Water Temperatures at Schmidt's Pte Sampling Site 2002 - 2010



Degrees Fahrenheit, temperature taken 5 feet below the surface

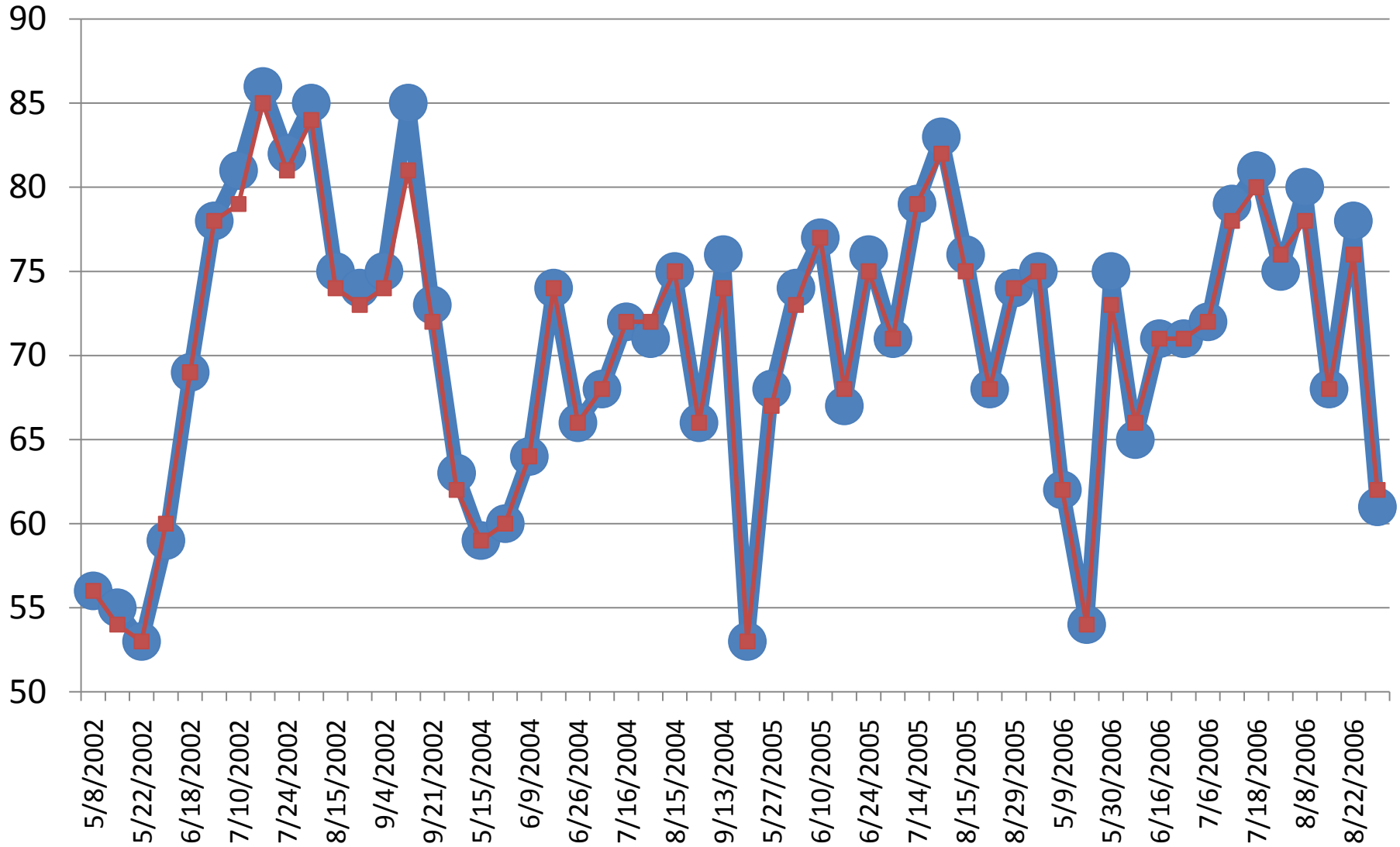


# Cedar Lake Water Temperatures at Briarwood Bay Sampling Site 2002 - 2010



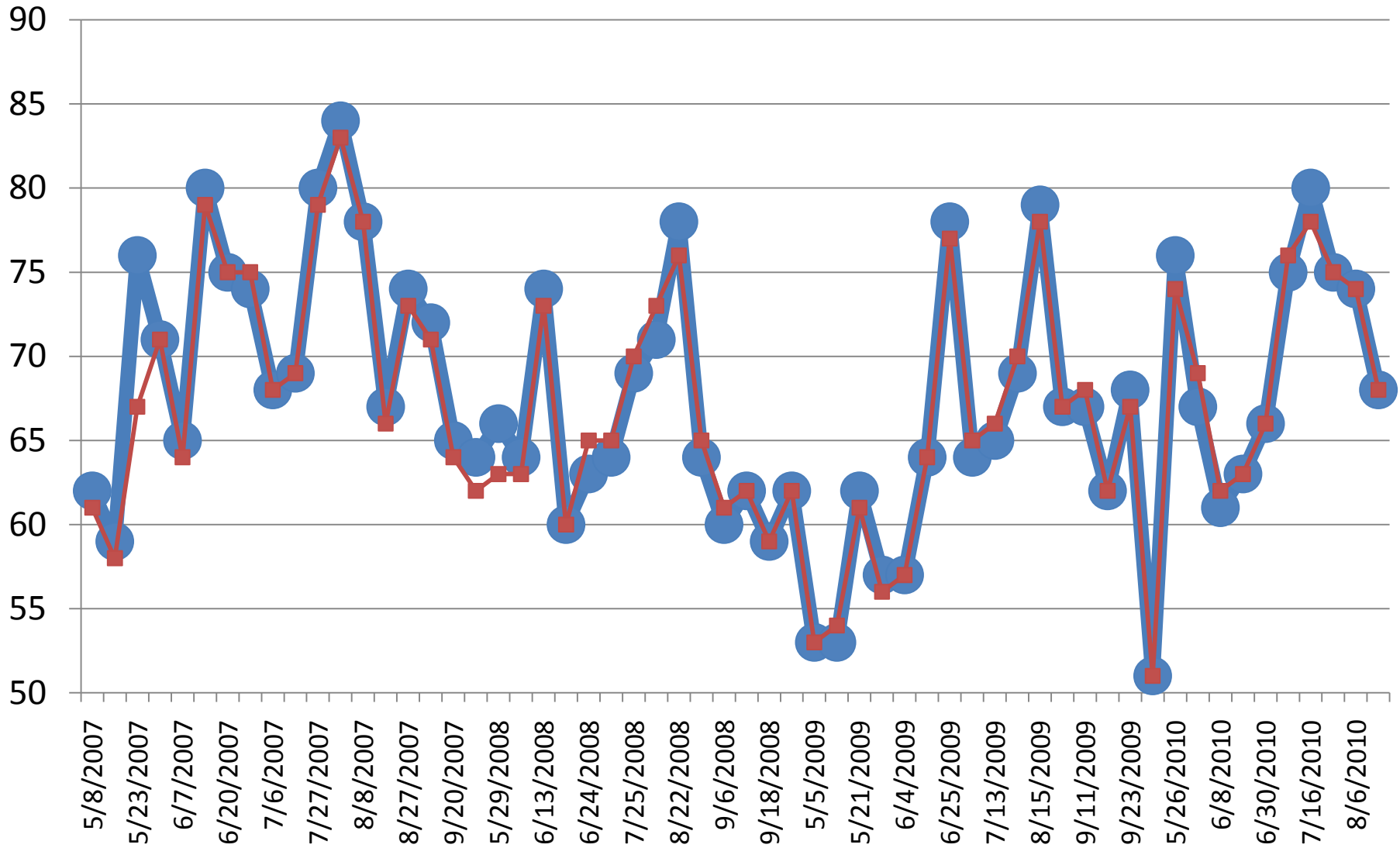
Degrees Fahrenheit, temperature taken 5 feet below the surface

# Water Temperatures to the Bottom – Schmidt's Pte 2002 - 2006 – Page # 1



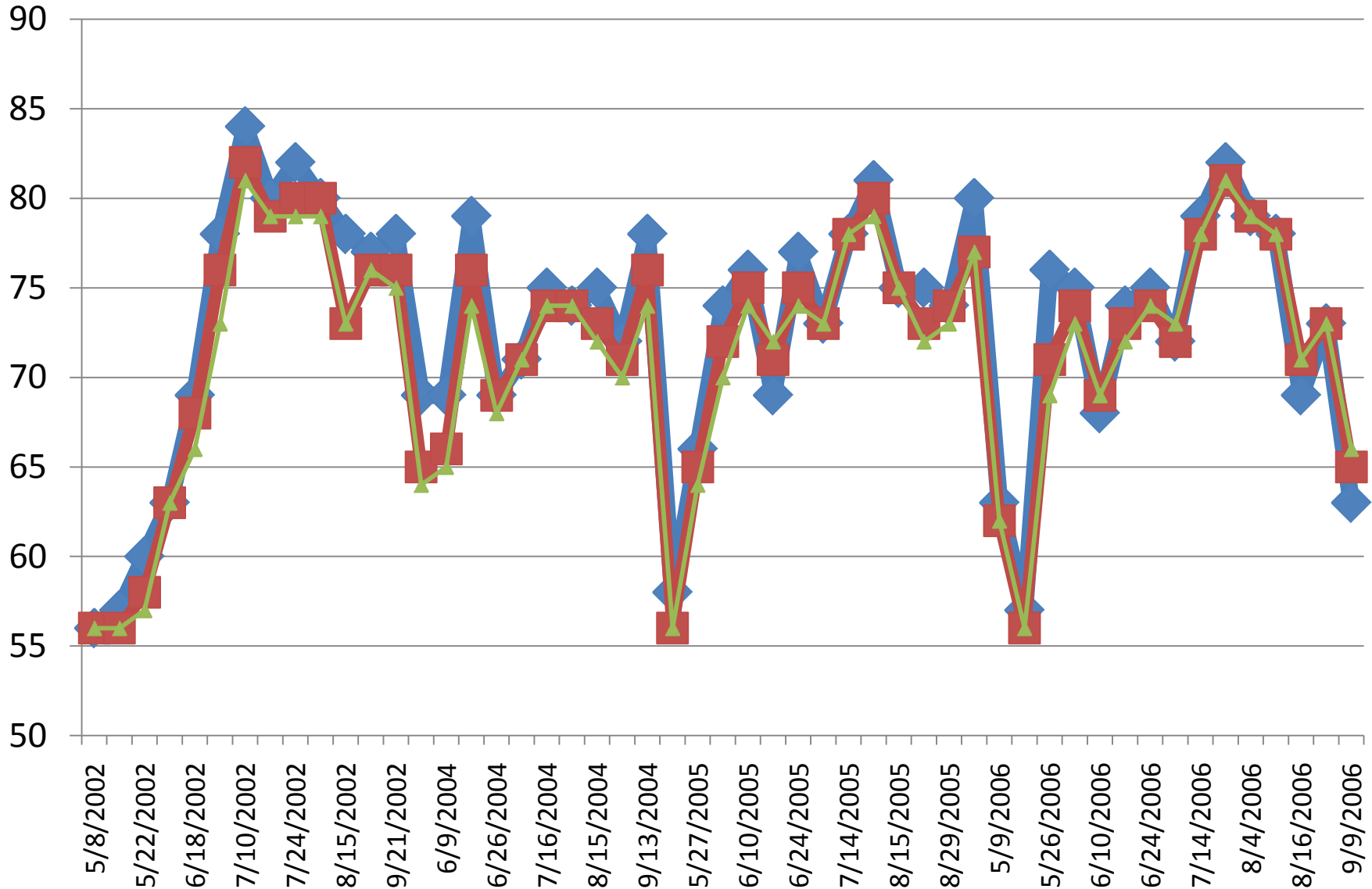
**Blue Line – 5 feet below the surface    Red Line – On the bottom**

# Water Temperatures to the Bottom – Schmidt's Pte 2007 - 2010 – Page # 2



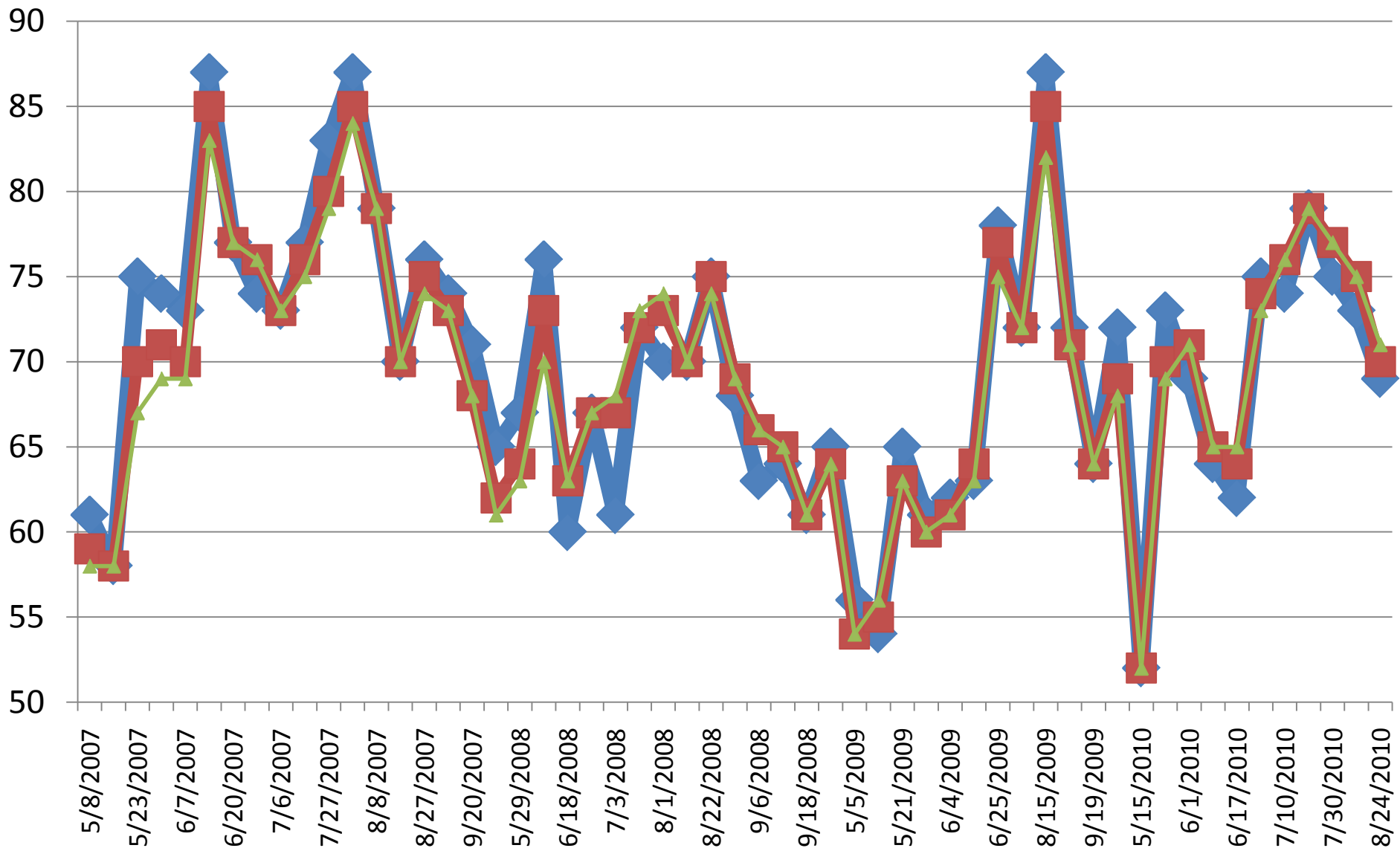
**Blue Line – 5 feet below the surface    Red Line – On the bottom**

# Water Temperatures to the Bottom – Briarwood Bay 2002 – 2006 - Page # 1



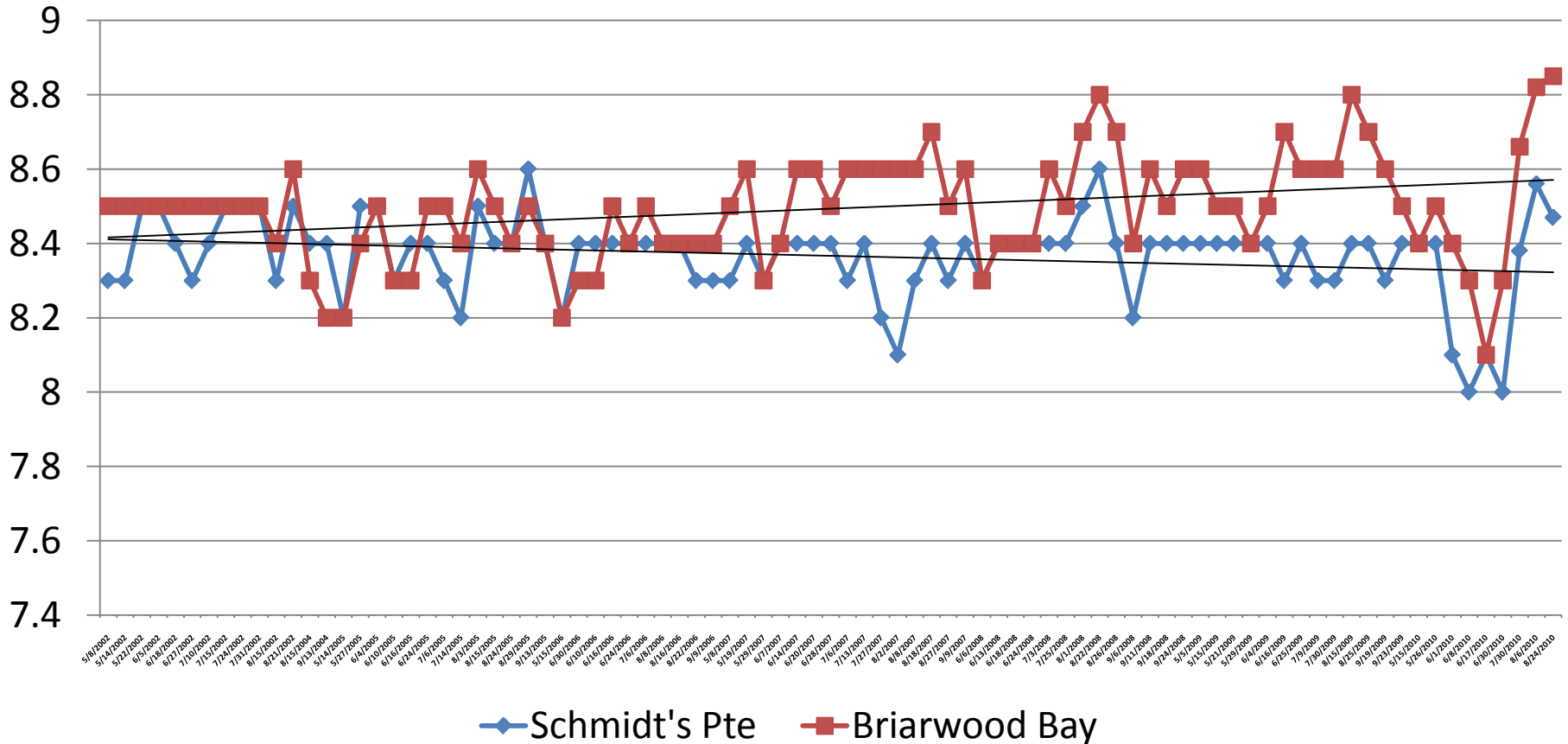
Blue – 5 feet below the surface, Red – 10 feet below the surface, Green – On the bottom

# Water Temperatures to the Bottom – Briarwood Bay 2007 - 2010 – Page # 2



Blue – 5 feet below the surface, Red – 10 feet below the surface, Green – On the bottom

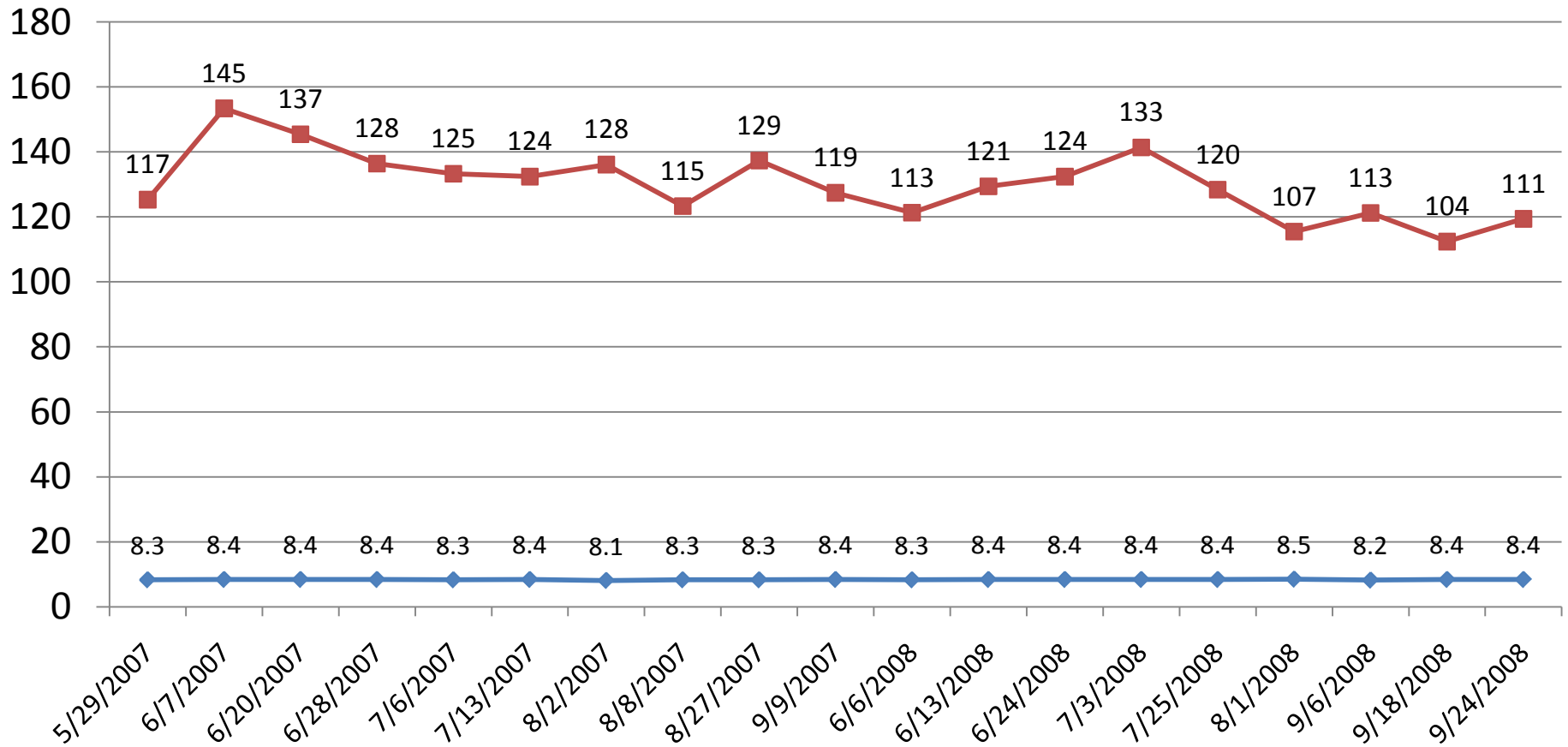
# Lake pH at Schmidt's Pte & Briarwood Bay Sample Sites 2002 – 2010



Legend: S = Schmidt's Pte, B = Briarwood Bay

After our pH gauge broke on 7/1/10, a new pH gauge was put into service on 7/30/10. It is more accurate & double calibrated.

# Schmidts Pte – Alkalinity & pH, 1 of 2 2007 – 2008

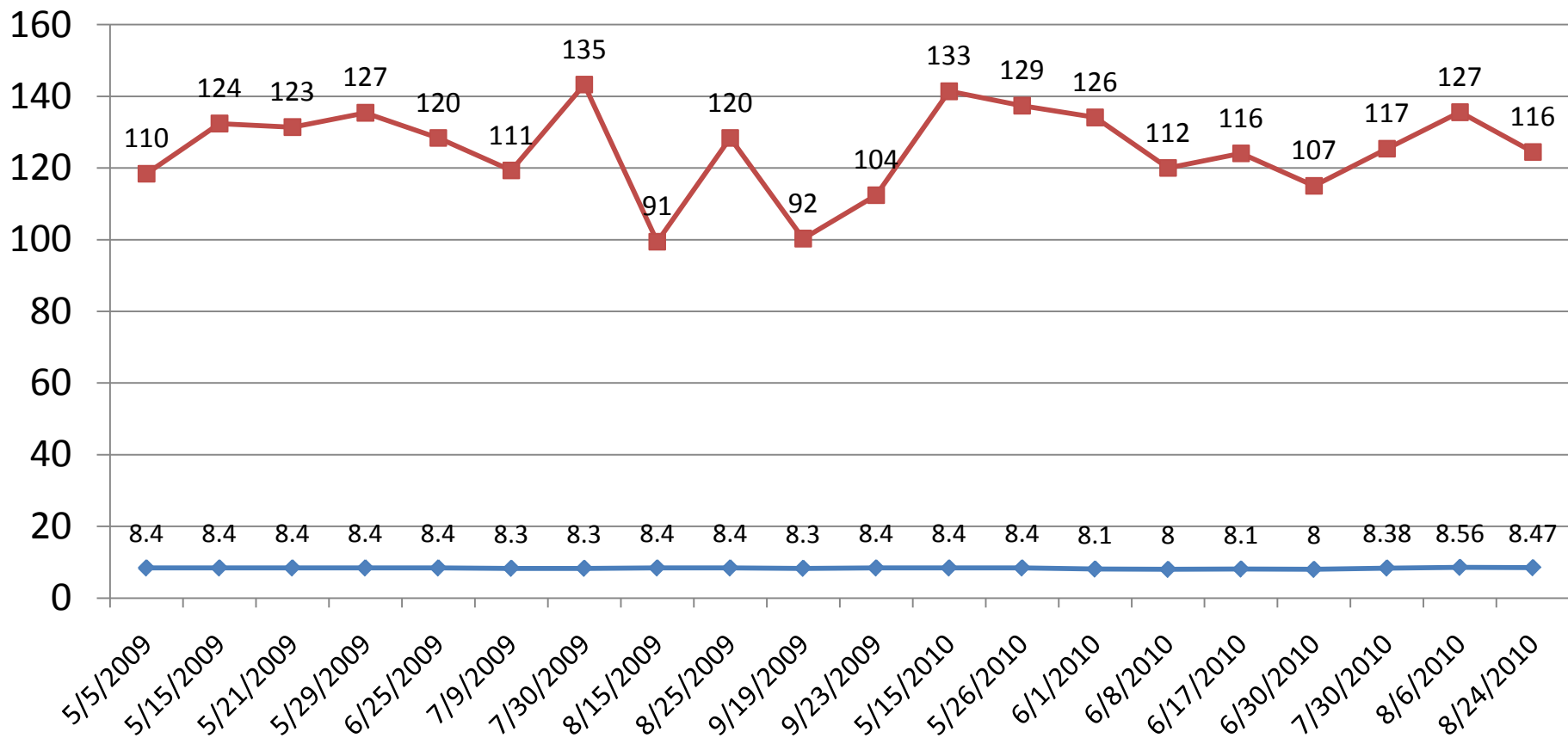


Top red line – Alkalinity in parts per million (ppm)

Bottom blue line – pH reading



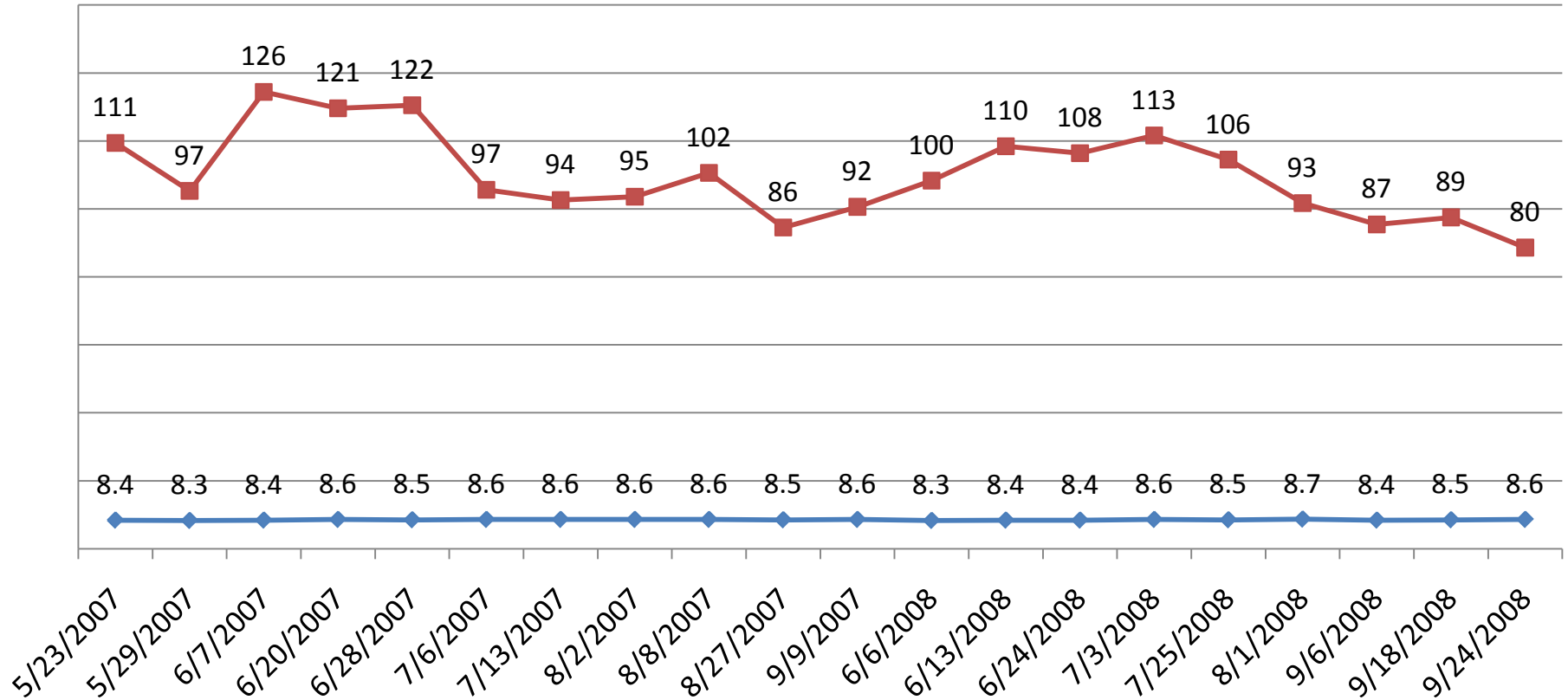
# Schmidts Pte – Alkalinity & pH, 2 of 2 2009 – 2010



Top red line – Alkalinity in parts per million (ppm)

Bottom blue line – pH reading

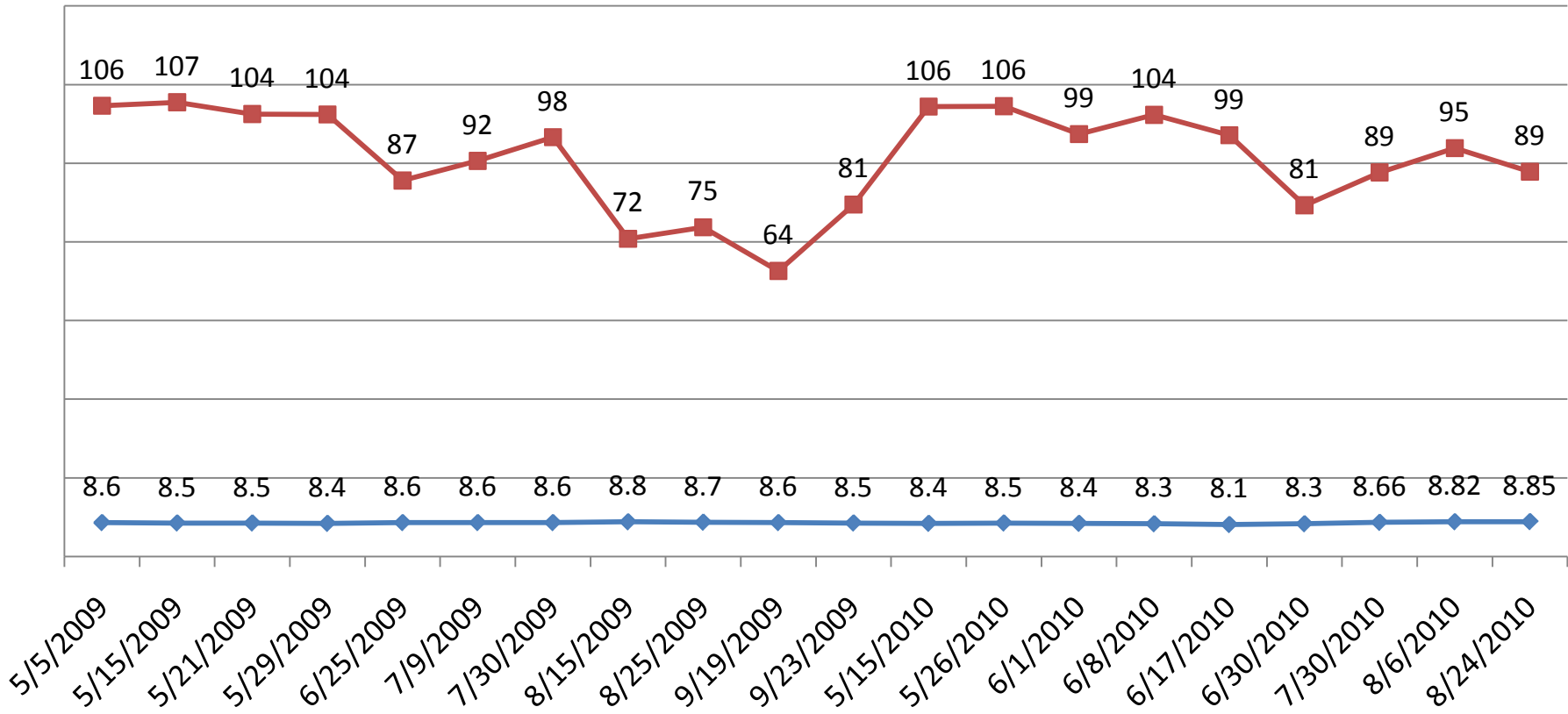
# Briarwood Bay – Alkalinity & pH 1 of 2 2007 - 2008



Top red line – Alkalinity in parts per million (ppm)

Bottom blue line – pH reading

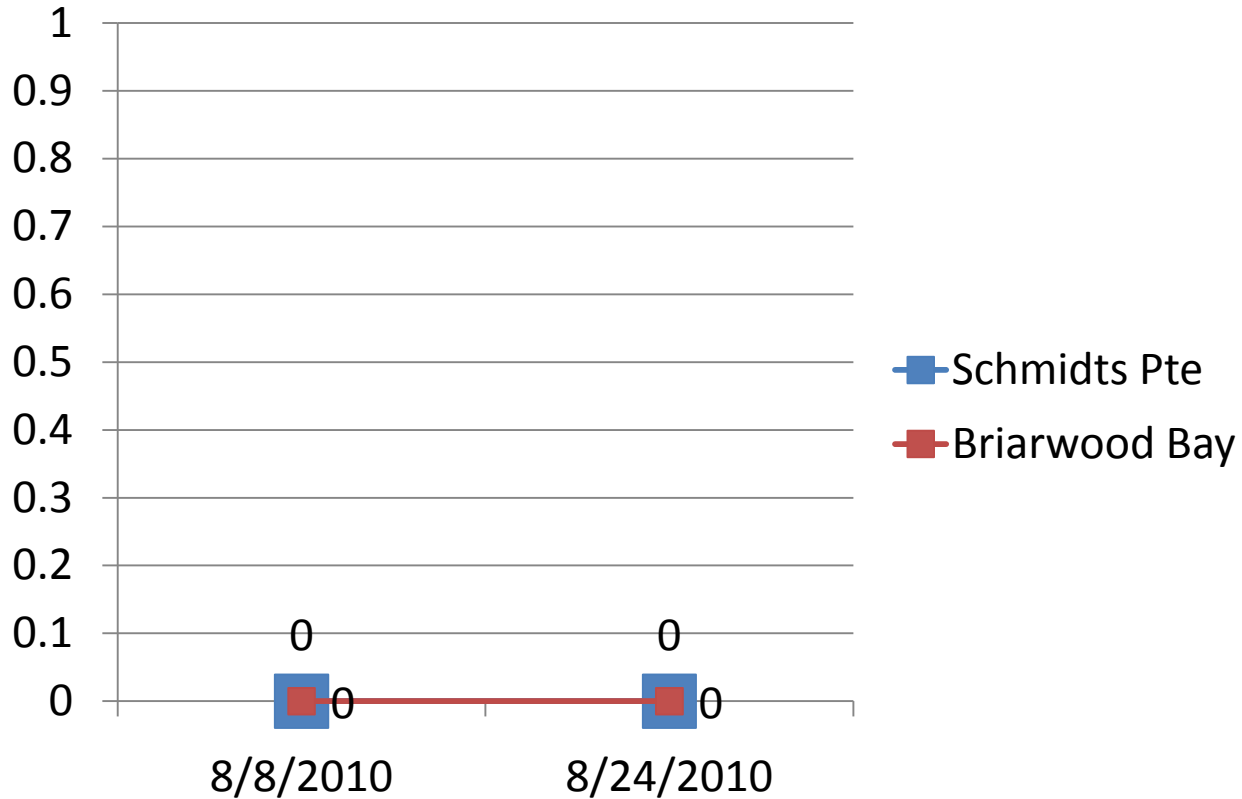
# Briarwood Bay – Alkalinity & pH 2 of 2 2009 - 2010



Top red line – Alkalinity in parts per million (ppm)

Bottom blue line – pH reading

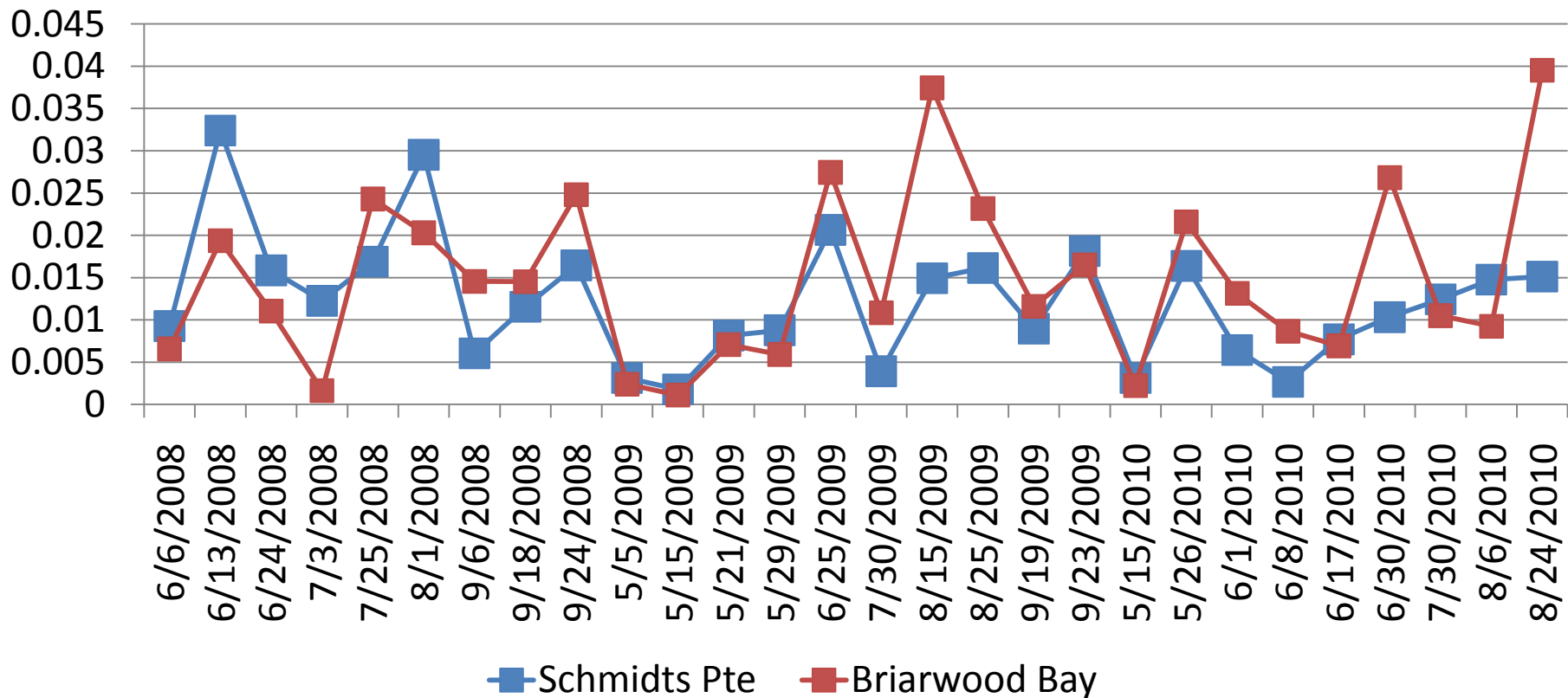
# Carbon Dioxide in the Water – 2010



Free Carbon Dioxide (CO<sub>2</sub>) in water exists in varying degrees naturally. It can exist in waters with pH values from 3.6 to 8.4, but we have read that it will never be present in waters having a pH of 8.5 or higher. Cedar Lake pH values at both sampling locations are very near or higher than 8.4 on most sampling occasions. However, because there is a relationship between pH, alkalinity and free Carbon Dioxide, we tested for CO<sub>2</sub> in 2010. There are no traceable amounts of CO<sub>2</sub> on our waters.

# Toxic Unionized Ammonia 2008 – 2010

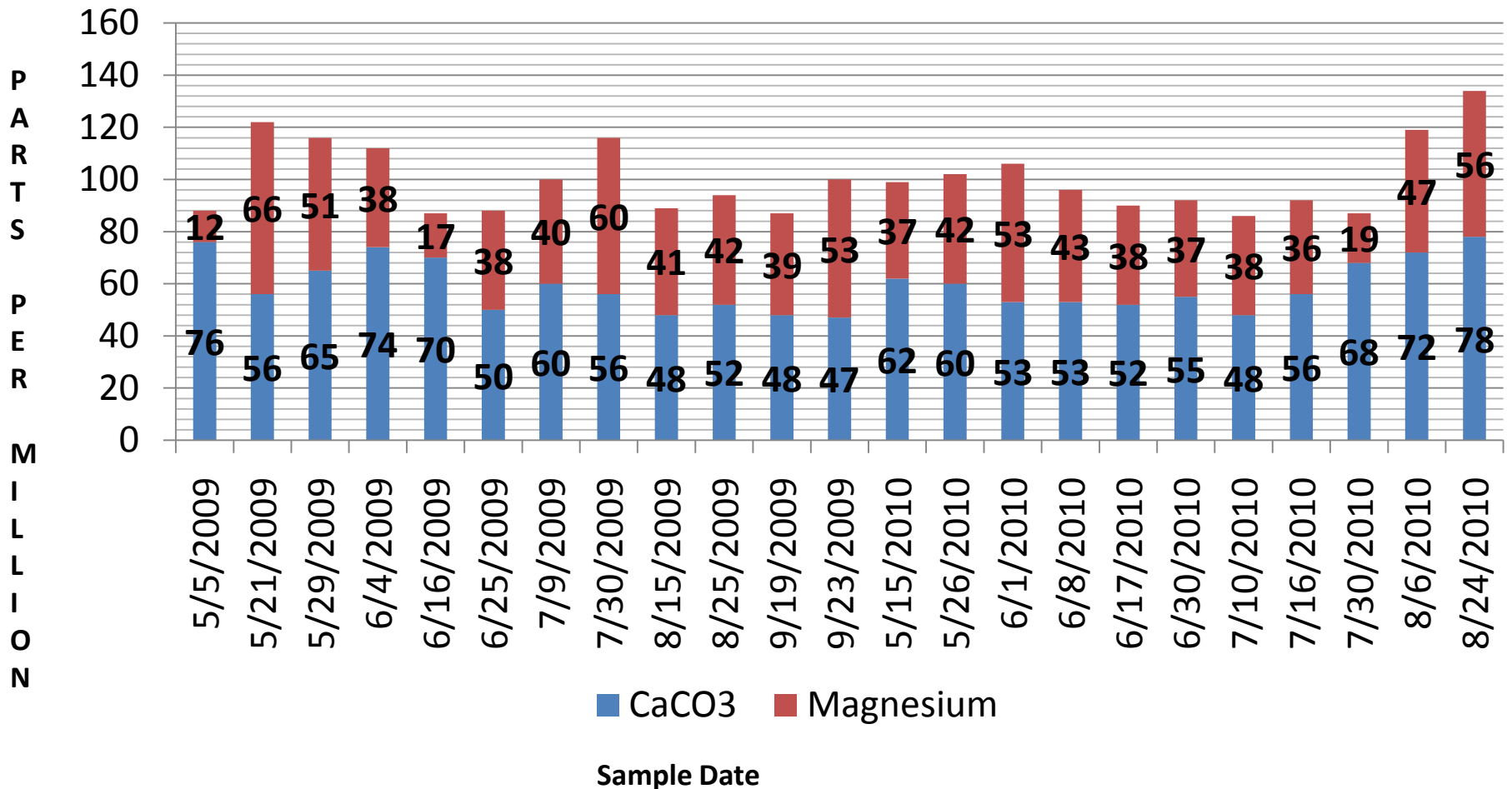
## Parts Per Million (PPM)



Readings Above .02 indicate Toxic Unionized Ammonia (NH<sub>3</sub>) is nearing the danger zone

Readings above .03 indicate Toxic Unionized Ammonia (NH<sub>3</sub>) is in the danger zone

# Water Hardness at Schmidt's Pte 2009 - 2010



Total Hardness = CaCO<sub>3</sub> + Magnesium.

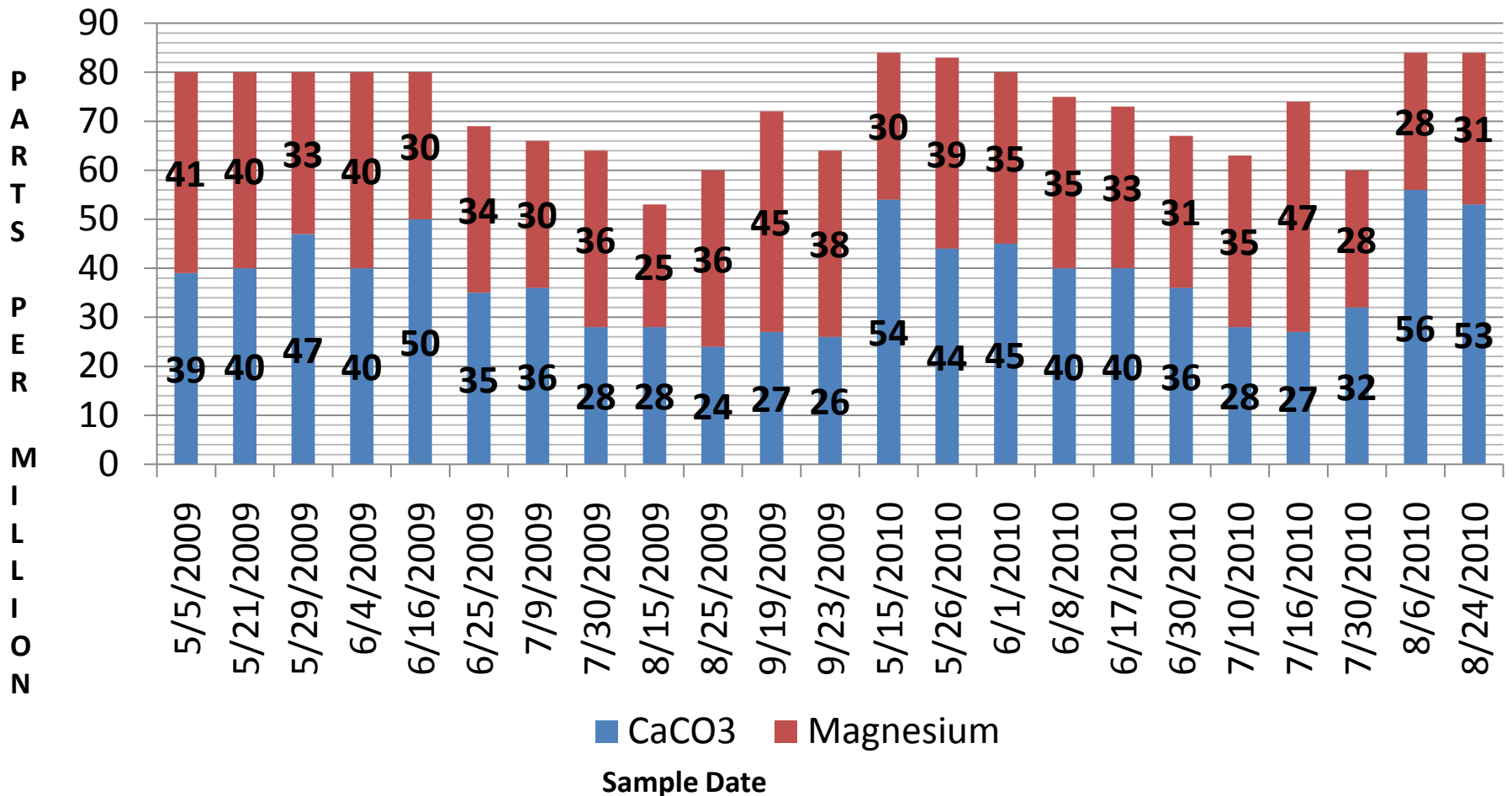
Soft - Total Hardness 0 – 60

Moderately Hard – Total Hardness 61 – 120

Hard – Total Hardness 121 - 180

Very Hard - >180

# Water Hardness at Briarwood Bay 2009 - 2010



Total Hardness = CaCO3 + Magnesium.

Soft - Total Hardness 0 – 60

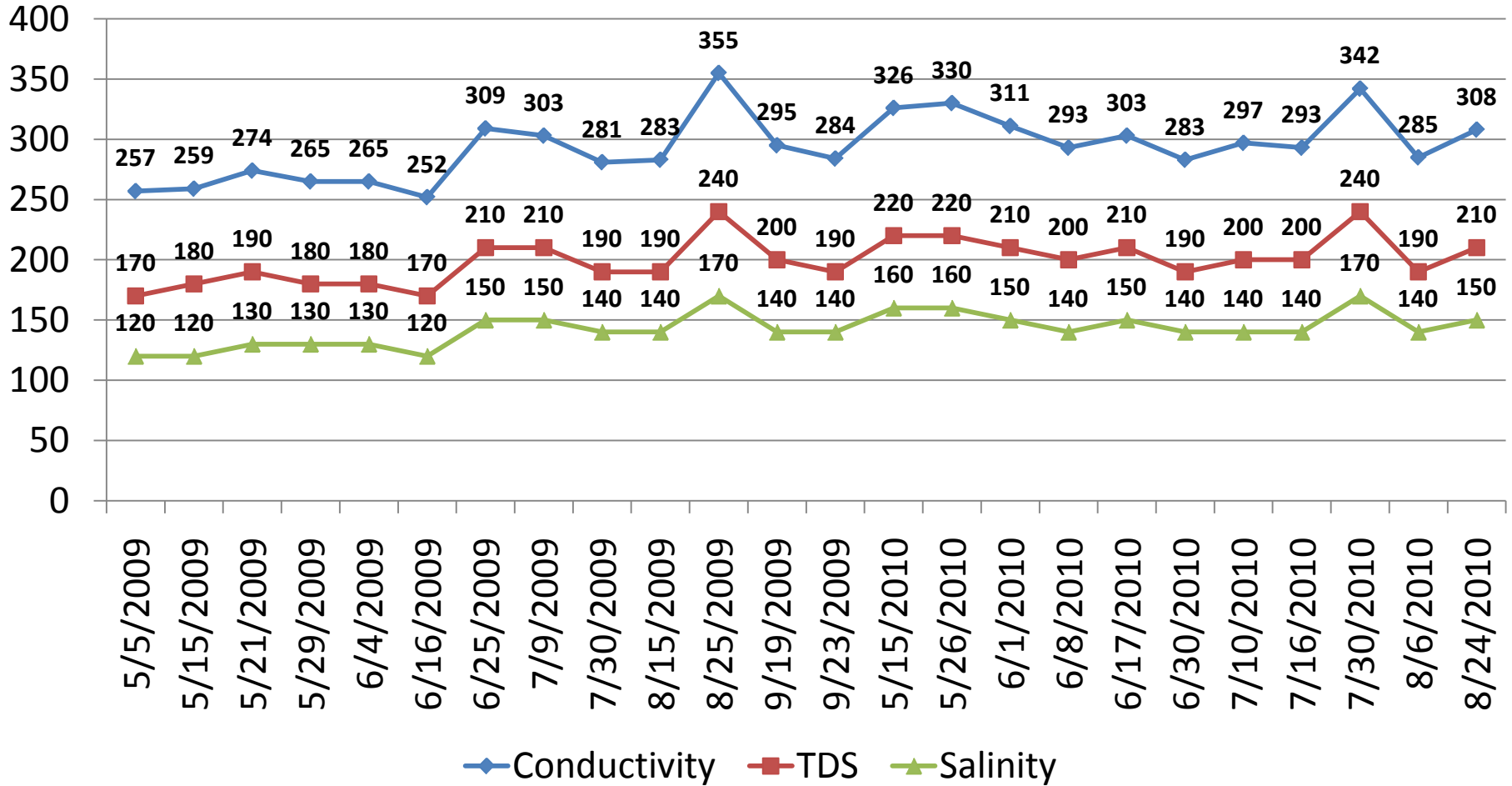
Moderately Hard – Total Hardness 61 – 120

Hard – Total Hardness 121 - 180

Very Hard - >180

# Schmidt's Pte

## Conductivity/Total Dissolved Solids (TDS)/ Salinity – 2009 & 2010

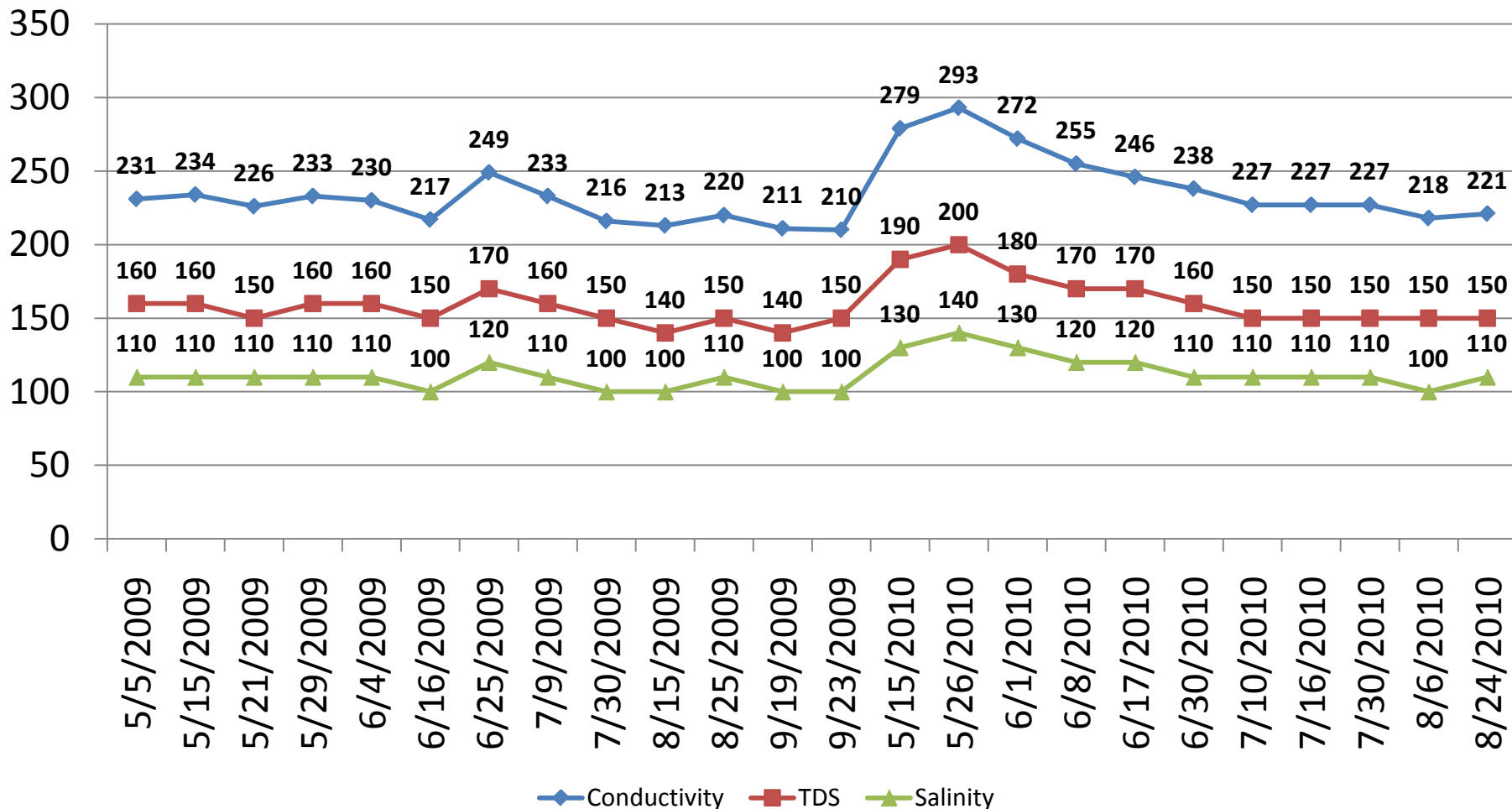


Conductivity measured in microSiemens per centimeter (uS/cm)  
 Total Dissolved Solids (TDS) measured in parts per million (ppm)  
 Salinity measured in parts per million (ppm)



# Briarwood Bay

## Conductivity/Total Dissolved Solids (TDS)/ Salinity – 2009 & 2010



Conductivity measured in microSiemens per centimeter (µS/cm)  
 Total Dissolved Solids (TDS) measured in parts per million (ppm)  
 Salinity measured in parts per million (ppm)

# ATTACHMENT B

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Preliminary Invasive Species List

## Michigan Invasive Aquatic Plant Species

		Present in Cedar Lake?	Native	Exotic	Selective Management Potential	Comments
<b>EMERGENT PLANT SPECIES</b>						
Flowering Rush	<i>Butomus umbellatus</i>			√	p	
Japanese Knowtweed	<i>Fallopia japonica</i>			√	?	
Yellow Flag Iris	<i>Iris pseudacorus</i>			√	p	
Purple Loosestrife	<i>Lythrum salicaria</i>	Y		√	f	
Aquatic Forget-Me-Not	<i>Myosotis scorpioides</i>			√	f	
Watercress	<i>Nasturtium officinale</i>				f	
Reed Canary Grass	<i>Phalaris arundinacea</i>		?	?	p	
Common Reed	<i>Phragmites australis</i>	?		√	p	
Great Water Cress	<i>Rorippa amphibia</i>				?	
Cattail	<i>Typha</i> species and hybrids	Y	√	√	p	
Garden Heliotrope	<i>Valeriana officinalis</i>			√	?	
<b>FLOATING PLANT SPECIES</b>						
Water Fern	<i>Azolla sp.</i>			√	p	Very common contaminant in water garden plants.
Duckweed	<i>Lemma and Wolffia</i>	Y	√	?	p	Very common; however, it can be a serious nuisance.
Giant Salvinia	<i>Salvinia molesta, auriculata, biloba, herzogii</i>			√	p	Very common contaminant in water garden plants.
<b>FLOATING LEAF PLANT SPECIES</b>						
Frog's Bit	<i>Hydrocharis morsus-ranae</i>			√	g	Nuisance in Lake St. Clair drainage area.
Yellow Floating Heart	<i>Nymphoides peltata</i>			√	g	Water garden plant, probably in State
Water Chestnut	<i>Trapa natans</i>			√	g	New England, not found in MI yet.
<b>SUBMERSED PLANT SPECIES</b>						
Flowering Rush	<i>Butomus umbellatus</i>			√	p	Minor nuisance in some SE Michigan Lakes
Fanwort	<i>Cabomba caroliniana</i>	Y		√	?	Major problem in Kalamazoo area, found in Oakland Co. in 2007
Coontail	<i>Ceratophyllum demersum</i>			√	g	Very common but occasionally a terrible nuisance.
Brazilian Elodea	<i>Egeria densa</i>			√	?	Found in Indiana
Elodea	<i>Elodea canadensis</i>	Y		√	g	Problem in Lake St. Clair in 1994, occasionally a nuisance.
Hydrilla	<i>Hydrilla verticillata</i>			√	?	Found in Indiana
East Indian Hygrophila	<i>Hygrophila polysperma</i>			√	?	Common aquarium plant, problem in SE US
African Elodea	<i>Largarosiphon major</i>			√	?	Not reported in US. Major nuisance in New Zealand.
Red Ludwigia	<i>Ludwigia repens</i>	Y		√		Common aquarium plant found in Wayne Co. pond in 2007/
Parrot's Feather	<i>Myriophyllum aquaticum</i>			√	?	Found in Indiana
Variable-Leaved Watermilfoil	<i>Myriophyllum heterophyllum</i>	Y		√	f	Occasionally a nuisance.
Variable Watermilfoil Hybrid	<i>Myriophyllum sp.</i>	Y		√	p to e?	New England, not found in MI yet.
Eurasian Watermilfoil Hybrid	<i>Myriophyllum sp.</i>	Y		√	f	Found throughout MI
Eurasian Watermilfoil	<i>Myriophyllum spicatum</i>	Y		√	e	Found throughout MI
Slender-Leaved Naiad	<i>Najas minor</i>	Y		√	g	Found throughout MI
Variable Leaf Pondweed hybrid	<i>Potamogeton</i>	Y		√	p	Nuisance growth is probably an emerging pondweed hybrid.
Broad Leaf Pondweed hybrid	<i>Potamogeton amplifolius</i>	Y		√	p	Nuisance growth is probably an emerging pondweed hybrid.
Curly Leaf Pondweed	<i>Potamogeton crispus</i>	Y		√	e	Found throughout MI
Wild Celery	<i>Vallisneria americana</i>	Y		√	p	Nuisance growth is probably a genetic strain introduced from AK in the mid 60's.
<b>MACRO ALGAE</b>						
Chara	<i>Chara sp.</i>	Y		√	p	
Starry Stonewort	<i>Nitellopsis obtusa</i>	Y		√	g	
<b>FILAMENTOUS ALGAE</b>						
Cladophora	<i>Cladophora sp.</i>			√	?	p
Water Net	<i>Hydrodictyon sp.</i>			√		p
Pithophora	<i>Pithophora sp.</i>			√		p
Rhizoclonium	<i>Rhizoclonium sp.</i>			√	?	p
<b>"GELATINOUS" ALGAE</b>						
Lyngbya	<i>Lyngbya ?</i>			?		p
Oscillatoria	<i>Oscillatoria sp.</i>			?		p
<b>PLANKTONIC ALGAE</b>						
(Toxic) Blue Greens,		Y		?		g
	<i>Cylindrospermopsis raciborskii</i>			√		g
Diatoms, Dinoflagellates				?		?
	<i>Didymosphenia geminata</i>			√		p

**PRESENT IN CEDAR LAKE?:** Confirmed sighting of species

**NATIVE:** Plant is endemic to the upper Great Lakes Region

**EXOTIC:** Plant is not endemic to the upper Great Lakes Region

**MANAGEMENT POTENTIAL:** Refers to the potential for selective species management with any plant or algae management strategy, device, technique, or product.

e = excellent potential for target specific management

g = good potential for target specific management

f = far potential for target specific management, current technologies may result in significant non-target damage

p = poor or little potential for target specific management, considerable and significant non-target damage is likely to be encountered.

## Michigan Invasive Fish & Aquatic Wildlife

		Present in Cedar Lake?	Native / Naturalized	Exotic	Management Potential	Comments
<b>FISH SPECIES</b>						
Round Goby	<i>Neogobius melanostomus</i>	Y		√	p	Displace native species
Tubenose Goby	<i>Proterorhinus marmoratus</i>			√	p	Compete with other small benthic fish species for food
Common Carp	<i>Cyprinus carpio</i>	Y	√			Can elevate turbidity and decrease water clarity, known to overpopulate in absence of predators
Asian Carp						
Bighead Carp	<i>Hypophthalmichthys nobilis</i>			√	p	Entering Great Lakes Region from Mississippi River, found in Lake Erie in 1995, 2000
Black Carp	<i>Mylopharyngodon piceus</i>			√	p	Entering Great Lakes Region from Mississippi River
Silver Carp	<i>Hypophthalmichthys molotrix</i>			√	p	Entering Great Lakes Region from Mississippi River, eDNA found in Lake Michigan in 2010
Grass Carp	<i>Ctenopharyngodon idella</i>			√	p	Stocked in many inland lakes, found in Michigan waters of Lake Huron in 2000
Eurasian Ruffe	<i>Gymnocephalus cernuus</i>			√	p	Exotic perch-like species, potential prey of Northern Pike
White perch	<i>Morone americana</i>			√	p	Decrease native walleye populations, found in Lake Huron since 1997
Alewife	<i>Alosa pseudoharengus</i>			√	p	Compete with other small fish species for food
Northern Snakehead	<i>Channa sp.</i>			√	p	Voracious predator capable of short over land migrations, specimen found in Lake Michigan in 2004
Rainbow Smelt	<i>Osmerus mordax</i>			√	p	Decrease native walleye populations
<b>MUSSEL SPECIES</b>						
Zebra Mussels	<i>Dreissena polymorpha</i>	Y		√	p	Present throughout Great Lakes Region
Quagga Mussels	<i>Dreissena bugensis</i>			√	p	Present throughout Great Lakes Region
<b>INVERTEBRATE SPECIES</b>						
Spiny Water Flea	<i>Bythotrephes cederstroemi</i>			√	p	Eat zooplankton that is normally consumed by juvenile fish
Rusty Crayfish	<i>Orconectes rusticus</i>	Y		√	p	Can severely reduce lake and stream vegetation
Bloody Red Shrimp	<i>Hemimysis anomala</i>			√	p	Found in Lake Erie and Lake Huron in 2009
Parasitic Copepod	<i>Neogergasilus japonicus</i>			√	g	Goldfish and common carp are primary hosts, parasitizes gills and skin causing secondary infections
New Zealand Mud Snail	<i>Potamopyrgus antipodarum</i>			√	g	One snail can produce 40 million offspring in one growing season, susceptible to copper sulfate
Exotic Zooplankton	<i>Cercopagis pengoi</i> , <i>Bythotrephes cederstroemi</i>			√	p	Primarily suited to Great Lakes as they prefer cool temperatures
<b>VIRUSES/DISEASES</b>						
VHS	<i>Novirhabdovirus sp.</i>		-	-	p	Many freshwater fish species susceptible Optimum replication conditions Ph=7.4-7.8 and Temp=14-15 C
Early Mortality Syndrome	<i>Thiamine Deficiency Complex</i>		-	-	p	Caused by Invasive fish or food-web disruption

**PRESENT IN CEDAR LAKE?:** Confirmed sighting of species

**NATIVE:** Plant is endemic to the upper Great Lakes Region

**EXOTIC:** Plant is not endemic to the upper Great Lakes Region

**MANAGEMENT POTENTIAL:** Refers to the potential for selective species management with any fish or aquatic wildlife management strategy, device, technique, or product.

Once existent, most invasive fish species cannot be eliminated without harming the entire lake population

e = excellent potential for management

g = good potential for management

p = poor or little potential for management (prevention is only known effective strategy)

# ATTACHMENT C

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Septic System Loading Calculations Document

## Cedar Lake Septic System Survey and Loading Model Results

A written septic system survey was prepared by K&A and distributed by the Alcona-Iosco Cedar Lake Association (AICLA) to Cedar Lake shoreline property owners in May 2008. The surveys were returned to K&A in June 2008 for analysis. A copy of the survey is included in this document. Respondents provided information on the number of residents (both year-round and seasonal); age of home; age of septic system; septic maintenance schedule; and distance of drain field from the lake. This survey was completed by 190 lakeshore residents, of which 68 were residents located on the northwest side of Cedar Lake.

Previous hydrologic studies of Cedar Lake indicated that only groundwater from the northwest side of the lake feeds into Cedar Lake (K&A, 2006). The remaining area surrounding the lakeshore appears to drain water away from the lake. A total of 68 surveys were completed by residents from the northwest side of the lake (properties located north of Kings Corner Road and on the west Cedar Lake shoreline). Greenbush township plat maps and information from the AICLA indicate that a total of 189 plats border the lake on the northwest side, so approximately 121 residences did not complete a survey. To best account for these incomplete data, the survey results that were available were calculated to obtain averages for: capita years, septic system age, maintenance schedule, and distance of the drain field from the lake. The average capita year was 1.02 and multiplied by the 121 residents to obtain the estimated number of capita years for those residents not accounted for in the survey. This number was then added to the 69.02 capita years obtained from the returned surveys, yielding an estimated total of 192.44 capita years for the northwest side of Cedar Lake.

This number was used in the following equation (Reckhow, et al., 1980).

$$W_s = EC_{st} * C_t * AV \quad \text{Equation 3}$$

Where:  $W_s$  = Total phosphorus load to the lake from septic systems (pounds/year)  
 $EC_{st}$  = Export coefficient to septic tank (pounds/(capita-year)/year)  
 $C_t$  = Total number of capita-years/residence  
 $AV$  = Sum of all variables influencing delivery of phosphorus to lake (dimensionless)

$$AV = EV + SSV \quad \text{Equation 4}$$

$$EV = 0.143[(1-SP) + (1-PA) + (1-DR) + (1-S)] \quad \text{Equation 5}$$

$$SSV = 0.143 [(1-A) + (1-DS) + (1-M)] \quad \text{Equation 6}$$

Where:  $EV$  = environmental variables (dimensionless)  
 $SSV$  = septic system variables (dimensionless)  
 $SP$  = soil permeability factor (dimensionless)  
 $PA$  = phosphorus adsorption capacity factor (dimensionless)  
 $DR$  = drainage factor (dimensionless)  
 $S$  = slope factor (dimensionless)  
 $A$  = age factor (dimensionless)  
 $DS$  = distance factor (dimensionless)  
 $M$  = maintenance factor (dimensionless)

The same calculations were applied to survey results from the entire lake. A total of 190 surveys were returned regarding septic systems and their maintenance. Greenbush and Oscoda township maps and information from the AICLA indicate that a total of 706 plats border the lake in total, so approximately 516 residences did not complete a survey. To best account for these incomplete data, the survey results that were available were calculated to obtain averages for: capita years, septic system age, maintenance schedule, and distance of the drain field from the lake. Average capita year was 1.14 and multiplied by the 516 residents to obtain the estimated number of capita years for those residents not accounted for in the survey. This number was then added to the 216.89 capita years obtained from the returned surveys, yielding an estimated total of 805.13 capita years for the entire lake. This information was used in the equations above to estimate the approximate phosphorus loads resulting from septic systems.

Septic system variables (SSV) were obtained from survey averages and used in equation 5, above. Using these averages, the assigned factors for SSV could be determined for use in equation 6.

Environmental variables (EV) were determined from soils information obtained from the USDA Soil Surveys of Alcona and Iosco Counties, Michigan ([websoilsurvey.nrcs.usda.gov](http://websoilsurvey.nrcs.usda.gov)). The soils within the Cedar Lake watershed are listed in Table 1. The soil survey provides specific information on soil permeability, drainage, and other soil properties for each soil type. These parameters were then used to determine EV factor ratings for the above equations. The mid-range of phosphorus adsorption capacity from Table 2 (1300-1600 pounds/acre per top 3 feet of soil) was used for the PA parameter.

**Table 1. Soil classification from northwest Cedar Lake lakeshore. [Source: SSURGO soils map and web soil survey map ([websoilsurvey.nrcs.usda.gov](http://websoilsurvey.nrcs.usda.gov))]**

Soil Types	Code	Estimated % at Shore
Battlefiled Sand	29A	4
Tawas Muck	71	5
Croswell Sand	17B	15
Au Gres Sand	18A	76

The  $EC_{st}$  parameter was estimated at 1.3 pounds/capita-year based on estimates used in Reckhow, et al., 1980. This is considered a best estimate based on the number of survey respondents with dishwashers (52.9%). It is unlike that laundry detergents and dishwasher detergents contain substantial amounts of phosphorus, and therefore, would not be contributing substantially to drain field loads.

The estimate for phosphorus loading from the entire shoreline of Cedar Lake was approximately 489 lbs of phosphorus/year. From research and modeling performed by K&A in 2006, results indicate that only the properties on the northwest side of the lake have groundwater contribution to Cedar Lake. For this reason, the surveys from residents on the northwest side of the lake were used to calculate a “contributing load” of phosphorus from septic systems. The results from this model run estimate the loading to Cedar Lake from these septic systems is approximately 115 lbs of phosphorus/year.

Table 2. Variables considered in calculating AV and assigned factors. (Source: Limno-Tech, 1989)

Parameter	Range	Assigned Factors
<b>Soil Permeability</b>	>10	0.75
(in/hr)	1-10	0.5
	0-1	0.25
<b>Phosphorus Adsorption Capacity</b>	1600-2000	.75
(lbs/ac/top 3 feet of soil)	1300-1600	.5
	1000-1300	.25
<b>Soil Drainage</b>	6	.75
(depth to water table)	0.5-1.8	.15
	0	.05
<b>Slope</b>	0	1
(%)	>0-6	1
	>6-12	.75
	>12-18	.75
	>18-25	.5
	>25	.25
<b>Age</b>	0-2.5	1
(years)	>2.5-5	.75
	>5-8	.5
	>8-11	.25
	>11	.05
<b>Maintenance Frequency</b>	0-2	1
(years)	>2-5	.75
	>5-8	.5
	>8-11	.25
	>11	.05
<b>Distance to Lake</b>	<50	.05
(ft)	>50-75	.25
	>75-100	.5
	>100-200	.75
	>200	1



## References

Kieser & Associates, LLC. 2006. Phase II Final Report for Additional Hydrologic Evaluation of Cedar Lake with Reference to Lake Levels. Prepared September 18, 2006 for AICLA.

Limno-Tech, Inc. 1989. Variables for Modeling Phosphorus Loading from Septic Systems to Lakeshore.

Reckhow, K. H., Beaulac, M. N., and J. T. Simpson. 1980. Modeling Phosphorus Loading and Lake Response Under Uncertainty: A Manual and Compilation of Export Coefficients. USEPA 440/5-80-011. Washington, DC.

## **Septic System Survey Form and Cover Letter**

May 16, 2008

Dear Cedar Lake Resident:

The AICLA and Lake Board contracted the environmental engineering firm of Kieser & Associates, LLC (K&A) to assess current water quality conditions in Cedar Lake, facilitate the watershed planning process, and formulate lake improvement options to protect this water body.

In addition to addressing water level issues, our watershed planning efforts focus on phosphorus as a pollutant that can degrade water quality if added to the lake in large quantities. Phosphorus is a naturally occurring element that is found in soil, plants, food, human and animal wastes and used in fertilizers and many soaps. In order to determine the impact of phosphorus on Cedar Lake water quality, we are estimating phosphorus inputs from various sources including its shoreline. One potential source of phosphorus to Cedar Lake from these shoreline areas is septic systems.

We are asking for your help in estimating phosphorus contributions from shoreline septic systems. The AICLA has enclosed a voluntary septic system survey form to be completed by Cedar Lake shoreline residents. All requested information is valuable in assessing septic system contributions to Cedar Lake. We would greatly appreciate your time to provide the most accurate and complete information that you can.

Please assist us in assessing lake water quality. When you complete your survey form, return it to Russ Anton by July 4, 2008.

Thank you for your cooperation. Your responses will be kept confidential. Please direct any questions you may have to Russ Anton of AICLA.

# Cedar Lake Shoreline Septic Systems

## A Survey for Lake Residents

***Optional Information:***

Date you completed this form: \_\_\_\_\_

Resident of Cedar Lake home: \_\_\_\_\_

Owner of home (if different than above): \_\_\_\_\_

Address: \_\_\_\_\_

***Necessary Information:***

**IF YOU ARE PERMANENT YEAR-ROUND RESIDENT**, number of permanent residents at the home: \_\_\_\_\_.

**-OR-**

**IF YOU ARE SEASONAL RESIDENT**, number of seasonal residents: \_\_\_\_\_, approximate length of stay \_\_\_\_\_ days

If you are seasonal residents, how many people plan to become permanent residents? \_\_\_\_\_ people in \_\_\_\_\_ years?

**OTHER INFORMATION:**

Typical number of annual guests: \_\_\_\_\_, approximate length of stay \_\_\_\_\_ days

Age of home: \_\_\_\_\_ years

Age of septic system: \_\_\_\_\_ years

Distance of drain field from the lake: \_\_\_\_\_ feet

Is the septic tank routinely pumped (circle)? Yes or No.  
How often? Every \_\_\_\_\_ years

***Additional Optional Information:***

\_\_\_\_\_ years since septic tank last pumped. Reason for pumping (for example, routine maintenance, system filled to capacity, system backed up, etc.) \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_ years since major septic system repairs. (Describe the repair.) \_\_\_\_\_

\_\_\_\_\_

Please enter the number of each water-using fixture (Please note "w.c." if designed to conserve water):

___ Shower head	___ Kitchen sink	___ Laundry machine
___ Bathtubs	___ Garbage disposal	___ Water softener
___ Bathroom sink	___ Dishwasher	___ Utility sink
___ Toilets	___ Other kitchen	___ Other utilities

Are there any plans for changes to the household water fixtures? \_\_\_\_\_

\_\_\_\_\_

Are there any known problems with the septic system? \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

Are there any plans to replace your septic system and if so, when?

\_\_\_\_\_

Thank you for your cooperation. Please return completed surveys to Russ Anton, AICLA President.

# ATTACHMENT D

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Preliminary Roles of a Lake Manager

## **Preliminary Proposed Role of the Lake Manager**

The Cedar Lake Improvement Lake Board requires a professional resource trained in limnology and conversant at a detailed technical level in freshwater lake management matters. The professional or firm selected for this position will be required to familiarize themselves with the history of Cedar Lake management efforts and initiatives, becoming conversant on all of the major studies and plans developed in the last decade.

This advisory position will be responsible for developing and offering the lake board guidance on:

- **An annual aquatic plant management plan** – In that regard they will analyze the plant environment on Cedar Lake, working with the LB and the treatment applicator, recommend treatment where needed, and annually update the Cedar Lake Aquatic Plant Management Plan.
- **A fishery management plan** – This will require a regular evaluation of the spawning, nursery, and overall habitat for the fishery, and in an annual Fishery Management Plan make recommendations for the management and improvement of the fishery.
- **A Cedar Lake project management plan** – Offer and assist with lake management/improvement tasks and guidance to the Lake Board by coordinating the recommended projects, tasks, and approached outlined in the WMP, the Hydrological Evaluation of Cedar Lake, the Aquatic Plant Management Plan, the Fishery Management Plan, and the currently, in progress, augmentation pilot. These actions need to be integrated together in a project management strategy that considers the impact of each action, priority to the lake, and impacts on the lake. This position will require the profession to recommend updates to the WMP in an adaptive approach. Rather than a report, the professional would be responsible for producing a true project management and tracking system, identifying relevant dates and resource requirement, bringing to light conflicts and resource bottleneck issues. The professional will assist the Lake Board in envisioning, planning and approving the work of Cedar Lake in a holistic manner.

Thereafter, the professional in this position will be a resource to the lake board in their decision making process as they consider new work. They will be available, as a technical resource, for public hearings and other meetings where the technical issues related to LB work might arise. They will maintain an awareness of work in-progress sufficient to allow them to be an advisory resource to the lake board on an as-needed basis. In this regard, the lake manager will function as a non-voting member/resource to the Lake Board.

A major responsibility will be to advice the Lake Board of issues which they become aware of that impact the management of Cedar Lake, recommending necessary action, and guidance in determining the priority and impact of lake matters that come up. In this role, the lake manager will fulfill the WMP requirement to track and report on the work identified in the WMP and its implementation on a regular basis.

# ATTACHMENT E

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Implementation Strategy Table

**Cedar Lake Implementation Strategy Table**

Implementation Project (Task, Process, or BMP)	Key Steps/Process	Priority	Output/Outcome	Lake/Watershed Benefit	Key Organizations	Technical Assistance	Cost Range	Funding Source	
Objective I: Protect critical wetlands identified along the NW side of Cedar Lake from drainage or diversion (and loss of wetland function)									
I-1	Support and work to implement wetland and zoning ordinance to protect wetland function	1. Develop model language for ordinance 2. Township planning board and legal review 3. Public notice ordinance process 4. Develop/approve wetland map 5. Approval by township to pass ordinance	1	Wetland ordinance in Oscoda & Greenbush Twps	-Protect wetland habitat -Protect spawning habitat -Filtration of runoff -Protect source water to lake/enhance lake levels -In-lake habitat protection	Oscoda Twp/ Greenbush Twp Planning Comm., AICLA, Twp Legal Counsel	Twp Legal Counsel, Land Planning/ Wetland Consultant	\$5,000-20,000	Townships
I-2	<u>Re-engineer hydrology of NW wetlands:</u> (Examples) Store water in wetlands & slowly release through streams Raise culvert at Kings Corner to slow water diversion Augment wetland water levels through groundwater pumping into wetland (may require land acquisition)	1. Determine feasibility of re-engineering options 2. Confirm/secure funding commitments 3. Draft engineering plans 4. Construct/implement selected solution	1	Restoration/recharge solution in NW wetlands	-Protect wetland habitat -Protect spawning habitat -Filtration of runoff -Protect source water to lake/enhance lake levels -In-lake habitat protection	Engineering Firm (K&A), Lake Board Alcona Co RC, Iosco Co RC, DNRE, Property Owners	Engineering Consultant, Fisheries Consultant	\$102,820 (augmentation pilot) \$150,000-500,000+ implementation	Tax Assessment
I-3	<u>Acquisition of property in NW for wetland restoration/public viewing area:</u> (Examples) Direct purchase of land Donation of conservation easements Purchase of development rights	1. Partner with Land Conservancy or county/township agency 2. Review property information to determine potential landowners and engage them to acquire land 3. Develop funding/tax strategy 4. Design wetland restoration/ viewing deck and signage	1	Protected parcels of land in the NW with restored wetland hydrology/ function	-Protect wetland habitat -Protect spawning habitat -Filtration of runoff -Protect source water to lake/enhance lake levels	Alcona County Land Division, AICLA, Land Conservancy, Road Commission, MDOT	Engineering Consultant, Legal Services	Purchase of land: \$2,500-3,500/acre Purchase Devel. Rights: \$1,000-2,500/ acre (depending on land value) [Restoration costs vary on acreage/ condition]	Tax Assessment, State Grants, MDOT Funds (wetland mitigation)
Objective II: Prevent additional groundwater loss from the lake on the SE side of the lake due to storm sewer infrastructure									
II-1	Support and work to implement ordinance (wetland or zoning overlay) to prevent building in wetlands/low-lying areas	See I-1	1						
II-2	Set up coordination procedures with DNRE & building inspector to ensure building codes are followed and DNRE is notified	1. Set up meetings between county building inspector, DNRE, and LSPOA 2. Determine what procedure can be put in place to avoid flooding of homes	2	Meetings to establish/confirm building permits and requirements	Less water loss to shallow aquifer on SE side of lake	Iosco Co. Bldg Inspector, LSPOA, Iosco Drain Comm.	DNRE Wetlands Div.	In-kind	County Building Dept., LSPOA, Drain Comm.

Priority Code: 1 = 1-3 years, 2 = 4-5 years, 3 = >5 years



Implementation Project (Task, Process, or BMP)	Key Steps/Process	Priority	Output/Outcome	Lake/Watershed Benefit	Key Organizations	Technical Assistance	Cost Range	Funding Source
II-3	Partner with LSPOA to determine if Architectural Standards could be modified or other informational/educational materials would be effective	1	Specific homeowner education/ brochures	Reduce pressure to drain SE side of lake and prevent homeowners from getting flooded	LSPOA, losco Drain Comm.	Building/ Flood Specialists	\$1,000-5,000 for I&E (if paired other I&E priorities)	LSPOA, Private/Comm. Foundations
II-4	Hold workshops to educate homeowners on building practices or measures that will reduce flooding	1	Adoption of site-specific alternatives	Less water loss to shallow aquifer on SE side of lake	Sub-committee, DNRE Wetlands Division, LSPOA, Local Builders	DNRE	\$1,000-3,000/ workshop	Sponsorship from builders, Private/Comm. Foundations, AICLA Membership
II-5	Conservation Easements on parcels in Lakewood Shores (potentially on "grouped" parcels)	3	Conservation/ protection of wetland parcels where building is not ideal	Less water loss to shallow aquifer on SE side of lake	Sub-committee, DNRE Wetlands Division, Land Conservancy	Legal Services, Land Planning Consultant, Environmental Consultant	\$500-1,500 /parcel + legal fees	Donations from private property owners, State Grants, Private Foundations
Objective III: Pursue augmentation feasibility study to choose suite of lake level management options for implementation								
III-1	Conduct public hearings and informational session to gain taxpayer support and pass assessment to fund lake level management (completed in 2009)	1	Funding for augmentation feasibility study and lake level management recommendations	Reduction in low lake levels during dry summer months	Lake Board, Lakefront Property Owners, Alcona/Iosco RC, Other Property Owners/Lake	Engineering Consultant (K&A)	Portion of the \$102,820 for augmentation feasibility study (See I-2)	Tax Assessment

Priority Code: 1 = 1-3 years, 2 = 4-5 years, 3 = >5 years

Implementation Project (Task, Process, or BMP)	Key Steps/Process	Priority	Output/Outcome	Lake/Watershed Benefit	Key Organizations	Technical Assistance	Cost Range	Funding Source
III-2	Implement lake level management projects to augment summer lake levels	1	Functioning lake level and management projects	Increased volume of water to lake in order to sustain suitable lake levels	Lake Board, Lakefront Property Owners, Alcona/Iosco RC, Other Lake Stakeholders	DNRE, Engineering Consultant	Determined through Augumentation Feasibility <b>\$150,000 - \$500,000+</b> (depending on projects selected)	Tax Assessment
Objective IV: Manage and improve sport fishery in Cedar Lake through enhanced lake levels, creek levels, and wetland protection								
IV-1	Re-engineer hydrology of NW wetlands							
IV-2	Wetlands protection through policy and/or conservation easements							
IV-3	Continue aquatic plant management and control of nuisance aquatic species to avoid potential condition that could stunt growth of pan fish							
IV-4	Continue relationship with Michigan DNRE to continue walleye fingerling stocking on an "as needed" basis in Cedar Lake	1	Stocking of walleye fingerlings approximately every other year	Improved sport fishery	Michigan DNRE Lake Board	DNRE	<b>\$100</b>	Tax Assessment

Priority Code: 1 = 1-3 years, 2 = 4-5 years, 3 = >5 years

	Implementation Project (Task, Process, or BMP)	Key Steps/Process	Priority	Output/Outcome	Lake/Watershed Benefit	Key Organizations	Technical Assistance	Cost Range	Funding Source
IV-5	<u>Recommendations from Aquest Corp and SEAS, LLC 2008 Creel Census Report (June 29, 2009):</u>								
	Conduct a fish population assessment	1. Conduct fish population assessment using gill nets, trap nets, seines and electro fishing units to characterize fish population 2. Conduct analysis of fish scales and spines to assess age and growth	2	Fish population survey and report of findings	Improved sport fishery	Lake Board	Fisheries Consultant	\$5,500-7,500	Tax Assessment
	Conduct critical fish habitat assessment	Assess changes in fish habitat usage as a result of aquatic vegetation management activities on an annual basis and provide findings to stakeholders	1	Annual written report	Improved sport fishery/ adaptive management approach	Lake Board	Fisheries Consultant	\$2,500	Tax Assessment
	Provide habitat enhancement for walleye and channel catfish and document use	1. Assess potential walleye spawning area at Sherman Creek 2. If viable, enhance/increase walleye spawning habitat by providing fallen logs	1	Use by (or capture of) young of year and juveniles/ increased angling success	Increase in fish size	AICLA, Lake Board	Fisheries and Aquatic Veg. Consultant	1) \$2,500 2) \$3,750-5,000	Tax Assessment
	Maintain or increase size and number of adult bass	1. Develop creel limit language (limit of 3 fish over 14 inches and release of all bass over 18 inches and discourage angling for bass on nests) 2. Implement limit and educate fisherman on new limits	1	Increase in angler perception and respect of adult bass population/ increased catch rate of Master Angler Award sized bass	Increase in fish size	Lake Board	Fisheries Consultant	\$1,000-1,5000	Tax Assessment
	Re-assess angling benefits and potential for stocking Redear sunfish to establish an increased fishery/increase bluegill spawning habitat	1. Research success of established Redear sunfish populations north of Bay City (other lakes) 2. Conduct angler interviews or voluntary mailings to determine catch rates, fishing pressure and angler use 3. Increase the size of spawning habitat in documented critical spawning areas to increase recruitment 4. Plant Redear sunfish, if suitable	1	Habitat suitability report and recommendations for/against planting Redear sunfish. Increase bluegill spawning habitat in historic spawning areas by 50% in 5 years.	Improved sport fishery	Lake Board	Fisheries Consultant	1) \$750 2) \$1,500 3) \$2,000 4) \$890/year for 3 years	Tax Assessment

Priority Code: 1 = 1-3 years, 2 = 4-5 years, 3 = >5 years

Implementation Project (Task, Process, or BMP)	Key Steps/Process	Priority	Output/Outcome	Lake/Watershed Benefit	Key Organizations	Technical Assistance	Cost Range	Funding Source	
Objective V: Work to control and/or stop the spread of invasive species and nuisance aquatic plant growth									
V-1	Education on best practices to reduce transmission of invasives	1. Form subcommittee to consult experts and research other sources for information 2. Develop educational materials and guidelines for lake users 3. Disseminate information through mailings, outreach and signage	1	Recognition by lake users of best practices to reduce the spread of invasives and general knowledge of invasive species	Improved/protected lake ecosystem	AICLA, DNRE, Lake Board	\$1,000-5,000 for educational campaign (if paired with other I&E priorities)	Private/Comm. Foundation	
V-2	Create boat cleaning station with signage informing lake users about invasive risks and best practices to reduce the risk of spread	1. Determine areas where signage would be most effective 2. Pursue funding opportunities to build cleaning station	1 3	Signage at strategic locations around the lake to promote best practices to reduce invasives	Improved/protected lake ecosystem	AICLA, DNRE, Lake Board DNRE, Consultant	\$800-1,500 educational signage \$60K+ boat cleaning station (\$60K Higgins Lake; \$150K Holland, MI)	Private/Comm. Foundation, State Funding, Conservation Grants	
V-3	Develop Cedar Lake Property Owners Guide to promote WMP and educate on invasive species, lakescaping, lawn practices, fertilizers/nutrients, and other priorities (see Attachment I)	Develop lake "guidelines" and design Property Owners Guide with WMP summary information & guidelines	1	Distribute Cedar Lake Property Owners Guide	Protection of Cedar Lake water quality and aquatic ecosystem	Lake Board, AICLA	Consultant, MSUE	\$5,000-15,000 (consulting, design & printing)	AICLA Membership, Private/Comm Foundation
V-4	Develop full Lake Manager contract through the Lake Board to continue adaptive management strategy for lake and recommended future actions/implementation of WMP strategies	Annual recommendations to Lake Board and progress toward WMP goals, objectives, and approaches/projects	1	Completed implementation projects	Control of excessive nuisance aquatic plant growth for a balanced aquatic community	Lake Board	Lake Management Consultant	\$50,000-100,000	Tax Assessment
V-5	Continue lake treatments for noxious weeds and algae growth	Treat problem areas around the lake with landowner consent	1	Reduction in noxious weed growth	Balanced aquatic plant community	Lake Board, AICLA	Fisheries and Aquatic Veg. Consultant	\$50,000/yr	Tax Assessment

Priority Code: 1 = 1-3 years, 2 = 4-5 years, 3 = >5 years

Implementation Project (Task, Process, or BMP)	Key Steps/Process	Priority	Output/Outcome	Lake/Watershed Benefit	Key Organizations	Technical Assistance	Cost Range	Funding Source	
Objective VI: Seek ways to improve composition of lake bottom sediments (determine if muck reduction is feasible)									
VI-1	Pursue option of dredging lake bottom to remove existing sediments/muck from Cedar Lake	1. Sediment thickness study and mapping & ecological impact study	1	Reduction in muck sediments in Cedar Lake	Improved lake aesthetic	Lake Board, Lakefront Property Owners, AICLA, Lake Stakeholders	Engineering Consultant, Lake Management Consultant	\$10,000-30,000 for sediment testing \$500K-\$1M+ for partial dredging (see objective text)	Tax Assessment
		2. Dredging plan (including disposal)	2						
		3. Dredging implementation	3						
VI-2	Conduct educational workshop and distribute information during the summer regarding best lawn care practices	1. Recruit local organizations or experts to speak at workshop 2. Organize and plan meetings/workshops	1	Reduction in the number of residents dumping lawn materials in the lake/over fertilizing lawns	Improved water quality and lake aesthetic	AICLA, MSUE	MSUE, Conservation Districts, Consultant	\$1,000-3,000/workshop	Private/Comm. Foundations, AICLA Membership
VI-3	Start a "Lake Stewards" program promoting lakeshore/water quality stewardship	1. Form sub-committee to develop program framework 2. Develop components of the program using other lake programs as a model 3. Develop an informational brochure that explains program 4. Work with first homeowners to showcase the program and sponsor a "lake tour" of stewards	2	Functioning program with homeowner participation	Lake protected from excessive runoff and pollutant loads	AICLA, LSPOA, MSUE	Other lake associations with programs	\$2,500 brochure printing/design \$1,000 for flags	AICLA Membership, Private/Comm. Foundations
VI-4	Cedar Lake Property Owners Guide	See V-4							
Objective VII: Educate lakeshore residents about natural lakescaping methods / green buffers and their benefits									
VII-1	Educate residents on lakescaping benefits and techniques (workshops held in 2009)	Organize and hold workshops to educate lakefront property owners	1	Increase in native veg. near lakeshore to serve as buffer	Reduced runoff and pollutant loads to lake	AICLA, MSUE	MSUE	\$1,000-3,000/workshop with advertising and printing	WMP
VII-2	Partner with LSPOA and lakefront property owners to implement a native vegetation buffer demonstration site in highly visible area around lake	1. Develop partnership to find highly visible area 2. Design buffer/native plants 3. Determine funding sources and management plan 4. Plant buffer	1	Demonstration of buffer strip in highly visible area to promote native lakescaping	Reduced runoff and pollutant loads	AICLA, LSPOA, Townships, MSU Master Gardeners	Environmental Consultant	\$1.20-2.50/sq ft of plants \$1,500-2,500 for design Volunteer labor (in-kind)	AICLA Membership, Private/Comm. Foundations
VII-3	Incorporate natural lakescaping and buffers into "Lake Stewards" program	See VI-3							
VII-4	Hold "Lake Stewards" event each year with: 1) a tour to showcase lakescaping sites, 2) native plant exchange or sale, and 3) educational event/workshop	Partner with lakeshore residents interested in native buffers to develop tour and organize sale	2	Increased interest in native lakescaping/buffers; increased lakescaping	Reduced runoff and pollutant loads	Lake Board, AICLA, LSPOA	MSUE	\$300-500/event (advertising, transportation, printing, etc.)	AICLA Membership, Private/Comm Foundation, State Grants
VII-5	Cedar Lake Property Owners Guide	See V-3							

Priority Code: 1 = 1-3 years, 2 = 4-5 years, 3 = >5 years

	Implementation Project (Task, Process, or BMP)	Key Steps/Process	Priority	Output/Outcome	Lake/Watershed Benefit	Key Organizations	Technical Assistance	Cost Range	Funding Source
Objective VIII: Protect water quality through continued monitoring indicators ( <i>E. coli</i> and nutrients)									
VIII-1	Continue involvement with Michigan Lake & Stream Association to maintain knowledge on lake management and legal strategies/practices	AICLA involvement in ML&SA annual meeting	1	Obtain information	Adaptive management of watershed resources	AICLA	ML&SA	\$350-450/year (varies on AICLA membership) Travel Costs (\$200-400)	AICLA Membership
VIII-2	Educate residents on proper septic system maintenance, clean out, and repair and incorporate into "Lake Stewards" program	Determine guidelines for septic maintenance and criteria to meet obligations of "Lake Steward" program	1	Improvement in septic system maintenance on lakefront properties	Reduction in <i>E. coli</i> counts and nutrient loading to lake	Lake Board, AICLA, LSPOA	MSUE, Conservation Districts, Consultant	\$1,000-3,000/workshop & printing	AICLA Membership
VIII-3	Document and track persistent water quality problems and pursue site-specific water quality sampling	1. Continue detailed observations and tracking of persistent problems; site-specific sampling were problems exist  2. Further develop sampling needs in response to annual data and seek funding for sampling program	1	Sampling program that can address site-specific problems	Decreased nutrient loading, decreased <i>E. coli</i> levels and threats to human health	AICLA, District Health Dept. No. 2	Lake Management Consultant	\$1,000-\$5,000/yr depending on sampling needs	MiCorps Grant, AICLA, State Grants
Objective IX: Utilize conservation options with the local land conservancy as a habitat protection tool									
IX-1	Engage with land conservancies to provide technical resources and information to obtain conservation easements from private property owners	1. Obtain criteria necessary for conservation easements and tax benefits 2. Determine feasibility of conservation easements 3. Develop Cedar Lake watershed guidelines to screen parcels where property owners are interested in conservation easements 4. Develop strategy for outreach to potential properties owners regarding conservation easements	2	Protected wetland parcels/ hydrology in NW area of watershed	Lake recharge and wetland habitat benefits	Lake Board, AICLA	Land Conservancy	Purchase of Development Rights: \$1,000-2,500/ acre (depending on land value)  Donated easements: legal fees only	Private Foundations, Federal and State Grants
IX-2	Explore the option of purchasing and managing important parcels of land in the NW area	See I-3							

Priority Code: 1 = 1-3 years, 2 = 4-5 years, 3 = >5 years

# ATTACHMENT F

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## Wetland Protection Materials:

- 1) Sample Ordinance Language
- 2) Policy Options for Cedar Lake Table
- 3) Information on Legal Challenges to Wetland Ordinances

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**APPENDIX E: SAMPLE DEQ WETLAND ORDINANCE**

PROVIDED BY: MICHIGAN DEPARTMENT OF ENVIRONMENTAL QUALITY and  
HURON RIVER WATERSHED INITIATIVE

DATE: MARCH 2003

To find out if a wetlands inventory has been conducted by DEQ for your county, go to [www.michigan.gov/deq](http://www.michigan.gov/deq) and click on Water, then Wetlands Protection, the Preliminary Wetland Inventories, or call DEQ for more information at 517-241-8169 in Lansing or 1-800-662-9278.

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**WETLANDS PROTECTION**

**[COMMUNITY], MICHIGAN**

Ord. No \_\_ effective \_\_

An Ordinance for the control and preservation of wetlands within the [community] and to protect the wetlands of the [community] from sedimentation, destruction, and misuse; to prescribe the powers, duties and functions of the [community] enforcing agency; to establish permits and a fee schedule; to establish design standards, specifications, and bond requirements; to provide for variance and exceptions; to provide for inspections and enforcement; to provide for violations, remedies and penalties thereof; and to provide for severability and effective date of the Ordinance.

**THE [COMMUNITY] HEREBY ORDAINS:**

**SECTION 1. GENERAL**

**Section 1.1 - Findings**

The Board of the [community] finds that wetlands are indispensable and fragile resources that provide many public benefits, including maintenance of water quality through nutrient cycling and sediment trapping as well as flood and storm water runoff control through temporary water storage, slow release, and groundwater recharge. In addition, wetlands provide open space; passive outdoor recreation opportunities; fish and wildlife habitat for many forms of wildlife, including migratory waterfowl, and rare, threatened or endangered wildlife and plant species; and pollution treatment by serving as biological and chemical oxidation basins.

Preservation of the remaining [community] wetlands is necessary to maintain hydrological, economic, recreational, and aesthetic natural resource values for existing and future residents of the [community], and therefore the [community] Board declares a policy of no net loss of wetlands. Furthermore, the [community] Board declares a long term goal of net gain of wetlands to be accomplished through review of degraded or destroyed wetlands in the [community], and through cooperative work with landowners, using incentives and voluntary agreements to restore wetlands.

To achieve these goals, and with authority from Section 30307(4) of Part 303, Wetlands Protection, of the Natural Resources and Environmental Protection Act, 1994 PA 451, as amended MCL 324.30307(4) (hereinafter the Wetlands Protection Act), the [community] Board finds that local regulation of wetlands is necessary in [community]. Pursuant to Article 4, Section 52 of the Constitution of the State of Michigan, the conservation and development of



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natural resources of the state is a matter of paramount public concern in the interest of the health, safety, and general welfare of the people. The [community] Board therefore finds that this Ordinance is essential to the long term health, safety, and general welfare of the people of the [community], and to the furtherance of the policies set forth in Part 17, Michigan Environmental Protection Act, of the Natural Resources and Environmental Protection Act, 1994 PA 451, as amended MCL 324.1701 et. seq. (hereinafter the Michigan Environmental Protection Act ) and the Wetlands Protection Act.

### **Section 1.2 - Purpose**

The purposes of this Ordinance are to provide for:

- A.** The protection, preservation, replacement, proper maintenance, restoration, and use in accordance with the character, adaptability, and stability of the [community]'s wetlands, in order to prevent their pollution or contamination; minimize their disturbance and disturbance to the natural habitat therein; and prevent damage from erosion, siltation, and flooding.
- B.** The coordination of and support for the enforcement of applicable federal, state, and county statutes, ordinances and regulations including but not limited to the Wetlands Protection Act, enforced by the Michigan Department of Environmental Quality which is hereinafter referred to as the MDEQ.
- C.** Compliance with the Michigan Environmental Protection Act which imposes a duty on government agencies and private individuals and organizations to prevent or minimize degradation of the environment which is likely to be caused by their activities.
- D.** The establishment of standards and procedures for the review and regulation of the use of wetlands.
- E.** A procedure for appealing decisions.
- F.** The establishment of enforcement procedures and penalties for the violation of this Ordinance.
- G.** Creation of a board to assist in the protection of wetlands and to build public support for the values of wetlands.

### **Section 1.3 - Construction and Application.**

The following rules of construction apply in the interpretation and application of this Section:

- A.** In the case of a difference of meaning or implication between the text of this Section and any caption or illustration, the text shall control.
- B.** Particulars provided by way of illustration or enumeration shall not control general language.

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- C. It is the intent of this ordinance to allow reasonable use of private property.
- D. Any ambiguities perceived in this ordinance are to be resolved by the entity administering the ordinance, in accordance with Section 7.

**Section 1.4 - Applicability to Private and Public Agency Activities and Operations.**

The provisions of this Ordinance, including wetlands use permit requirements and criteria for wetlands use permit approval, shall apply to activities and operations proposed by federal, state, local and other public agencies as well as private and public organizations and individuals except as may be exempt by law.

**SECTION 2 - DEFINITIONS**

**Section 2.1 - Definition of Terms**

Terms not specifically defined shall have the meaning customarily assigned to them:

**CONTIGUOUS** means any of the following:

1. A permanent surface water connection or any other direct physical contact with an inland lake or pond, a river or stream, one of the Great Lakes, or Lakes St. Clair.
2. A seasonal or intermittent direct surface water connection to an inland lake or pond, a river or stream, one of the Great Lakes, or Lakes St. Clair.
3. A wetland is partially or entirely located within five hundred (500') feet of the ordinary high water mark of an inland lake or pond or a river or stream or is within 1,000 feet of the ordinary high watermark of one of the Great Lakes or Lake St. Clair, unless it is determined by the MDEQ, pursuant to R. 281.924 of the administrative rules promulgated under the Wetlands Protection Act (hereinafter Wetlands Administrative Rules), that there is no surface water or groundwater connection to these waters.
4. Two (2) or more areas of wetlands separated only by barriers, such as dikes, roads, berms, or other similar features, but with any of the wetland areas contiguous under the criteria described in Subsections (1)(2) or (3) of this definition.

**ELECTRIC DISTRIBUTION LINE:** means underground lines below 30 kilovolts and lines supported by wood poles.

**ELECTRIC TRANSMISSION LINE:** means those conductors and their necessary supporting or containing structures located outside of buildings that are used for transmitting a supply of electric energy, except those lines defined as a electric distribution line.

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**FILL MATERIAL** means soil, rocks, sand, waste of any kind, or any other material that displaces soil or water or reduces water retention potential.

**LOT:** means a designated parcel, tract, building site or other interest in land established by plat, subdivision, conveyance, condominium master deed, or as otherwise permitted by law, to be used, developed or built upon as a unit.

**MINOR DRAINAGE:** includes ditching and tiling for the removal of excess soil moisture incidental to the planting, cultivating, protecting, or harvesting of crops or improving the productivity of land in established use for agriculture, horticulture, silviculture, or lumbering.

**MITIGATION** shall mean: (1) methods for eliminating or reducing potential impact to regulated wetlands; or (2) creation of new wetlands to offset unavoidable and permitted loss of existing wetlands.

**PERSON** means an individual, sole proprietorship, partnership, corporation, association, municipality, this state, and instrumentality or agency of this state, the federal government, or an instrumentality or agency of the federal government, or other legal entity.

**PIPELINES HAVING A DIAMETER OF 6 INCHES OR LESS:** means a pipe which is equal to or less than what is commonly referred to as a 6-inch pipe and which has an actual measured outside diameter of less than 6.75 inches.

**[COMMUNITY] BOARD** shall mean the legislative body of [community].

**WETLAND** means land characterized by the presence of water at a frequency and duration sufficient to support, and that under normal circumstances does support, wetland vegetation or aquatic life and is commonly referred to as a bog, swamp or marsh and which is any of the following:

1. All wetlands subject to regulation by the MDEQ including wetlands:
  - (a) Contiguous to the Great Lakes or Lake St. Clair, an inland lake or pond, or a river or a stream.
  - (b) Not contiguous to the Great Lakes, an inland lake or pond, or a river or stream; and more than 5 acres in size; except this subparagraph shall not be of effect, except for the purpose of inventorying, in counties of less than 100,000 population until the MDEQ certifies to the commission it has substantially completed its inventory of wetlands in that county.
  - (c) Not contiguous to the Great Lakes, an inland lake or pond, or a river or stream; and 5 acres or less in size if the MDEQ determines that protection of the area is essential to the preservation of the natural resources of the state from pollution, impairment, or destruction and the department has so notified the owner; except this subparagraph may be utilized regardless of wetland size in a county in

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which subparagraph (ii) is of no effect; except for the purpose of inventorying, at the time.

**2. Other wetlands subject to regulation by the [community] including:**

- (a) Wetlands two (2) acres or greater in size, whether partially or entirely contained within the project site, which are not contiguous to the Great Lakes or Lake St. Clair, an inland lake or pond, or a river or a stream.
- (b) Wetlands smaller than two (2) acres in size which are not contiguous to the Great Lakes or Lake St. Clair, an lake or pond, or a river or a stream, and are determined to be essential to the preservation of the natural resources of the [community] as provided for in Section 7.6 of this Ordinance.

**WETLAND CONSULTANT** shall mean a person or persons knowledgeable in wetland protection and delineation who is identified by the [community] to make wetlands determinations, to delineate wetlands, and to advise the [community] on wetland resource policy, education, and restoration. Any firm or individual appointed on a contractual basis.

**WETLAND VEGETATION** means plants that exhibit adaptations to allow, under normal conditions, germination or propagation and to allow growth with at least their root systems in water or saturated soil.

**WETLANDS ADMINISTRATOR** shall mean a person(s) knowledgeable in wetlands protection, appointed by the [community] legislative body to administer this Ordinance and to carry out certain duties hereunder. Any firm or individual appointed on a contract basis.

**WETLANDS BOARD** shall mean the body of the [community] which makes decisions on wetlands use permit appeals and advises the [community] on wetlands resource policy, education and restoration.

**WETLANDS MAP** refers to the [community] wetlands inventory map, based on the National Wetlands Inventory Map of the U.S. Fish and Wildlife Service; the Michigan Resource Information System Mapping (MIRIS) of the State of Michigan ; the soils maps of the Soil Conservation Service, aerial photography, and onsite inspections. *[community would explain here the sources of its map.]*

**WETLANDS USE PERMIT** shall mean the [community] approval required for activities in wetlands described in Section 7 of this Ordinance.

**SECTION 3 - RELATIONSHIP TO STATE AND FEDERAL PERMIT REQUIREMENTS**

Whenever persons requesting a wetlands use permit are also subject to state and/or federal permit requirements, the following shall apply:

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- A.** The [community] shall have jurisdiction for the regulation of wetlands under this Ordinance concurrent with the jurisdiction of the Michigan Department of Environmental Quality.
- B.** Approvals under this Ordinance shall not relieve a person of the need to obtain a permit from the MDEQ and/or the U.S. Army Corps of Engineers, if required.
- C.** Issuance of a permit by the MDEQ and/or the U.S. Army Corps of Engineers shall not relieve a person of the need to obtain approval under this Ordinance, if applicable.

## **SECTION 4. ADMINISTRATION**

### **Section 4.1 - [community] Wetlands Map**

The [community] Wetlands Map is a guide to the location of wetlands in [community]. The Wetlands Map shall be used in the administration of this Ordinance.

The Wetlands Map, together with all explanatory matter thereon and attached thereto, as may be amended through the Wetlands Verification and Delineation process, is hereby adopted by reference and declared to be a part of this Ordinance. The Wetlands Map shall be on file in the office of the [community] Clerk.

The Wetlands Map shall serve as a general guide for the location of wetlands. The Wetlands Map does not create any legally enforceable presumptions regarding whether property that is or is not included on the Wetlands Map is or is not a wetland.

The Wetlands Verification Process, as set forth herein, shall be used to verify wetlands on properties where wetlands are shown on the Wetlands Map or on properties where wetlands exist as defined in Section 2.1 herein. The Wetlands Delineation Process, as set forth herein, shall be used to establish the actual boundaries of wetlands in the [community]. The identification of the precise boundaries of wetlands on a project site shall be the responsibility of the applicant subject to review and approval by the [community] Wetland Consultant. Verification and delineation under this ordinance does not constitute a federal or state wetland jurisdiction or boundary decision.

- A.** Wetlands Verification Process
  - 1.** The [community] or property owners of wetlands may initiate a verification of the areas shown on the Wetlands Map as wetlands or on properties where wetlands exist as defined in Section 2.1 herein. The verification shall be limited to a finding of wetlands or no wetlands by the Wetlands Administrator. The finding shall be based on, but not limited to, aerial photography, topographical maps, site plans, and field verification.
  - 2.** In the event that there is a finding of no wetlands on the property, then no further determination would be required.

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- 3.** The applicant shall pay fees for the Wetlands Verification Process as established in Section 9.1.

### **B.** Wetlands Delineation Process

Prior to the issuance of any permit or land development approval for a property which is shown to include wetlands on the Wetlands Map, the applicant may be required to provide a wetlands delineation to the [community]. The Wetlands Administrator, in consultation with the Wetland Consultant, shall determine whether a delineation is required, based on the proximity and relationship of the project to the wetlands. A delineation shall be required when a wetlands use permit is requested.

- 1.** To establish actual wetlands boundaries on a property, the applicant shall provide a survey or dimensional site plan, drawn at the scale required by [community]'s site plan review requirements, showing property lines, buildings and any points of reference along with the wetlands boundaries, according to one of the following:
  - (a)** Wetlands delineation by the Michigan Department of Environmental Quality (MDEQ).
  - (b)** Wetlands delineation by the applicant's wetlands consultant subject to review and approval by the Wetland Consultant.
- 2.** Where a wetlands delineation is required by this Section, the Wetland Consultant shall establish wetlands boundaries following receipt of the above required information and after conducting a field investigation.
- 3.** The applicant shall pay fees for the Wetlands Delineation Process as established in Section 9.1.

### **C.** Map Amendment

- 1.** The Planning Commission shall make recommendations to the [community] Board for revisions to the Wetlands Map whenever new and substantial data for wetlands become available.
- 2.** The [community] shall insure that each record owner of property on the property tax roll shall be notified of any amendment to the Wetlands Map. The notice shall include the following information:
  - (a)** the [community] Wetlands Map has been amended;
  - (b)** the location to review the map;
  - (c)** the owner's property may be designated as wetlands on the map;
  - (d)** the [community] has an Ordinance regulating wetlands;

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- (e) the map does not necessarily include all of the wetlands within the [community] that may be subject to the Wetlands Ordinance.

**Section 4.2. Wetlands Board**

There is hereby created a Wetlands Board:

- A. The Wetlands Board shall consist of five (5) residents of the [community] appointed by the [community] Board upon recommendation of the Planning Commission; four of whom shall have knowledge and experience in the areas of botany, soils, geology, hydrology, or natural resources. One member of the Wetlands Board shall be a member of the [community] Board. The initial terms of appointment shall be as follows: 2 individuals for 3 years, 2 individuals for 2 years, and 1 individual for 1 year. Thereafter, appointments shall be for a term of three years. The term of the [community] Board representative to the Wetlands Board shall be concurrent with the term of office.
- B. The Wetlands Board shall establish rules of procedure.
- C. The Wetlands Board is authorized to undertake activities to protect wetlands including the following:
  - 1. Conduct public hearings and review appeals of wetlands use permit, mitigation, and/or restoration decisions made by the Wetlands Administrator, the Planning Commission or the [community] Board.
  - 2. Serve in an advisory role in setting policy guidelines on wetlands issues in the [community].
  - 3. Identify conflicts between wetlands protection and present [community] ordinances, [community] operating procedures, and [community] activities.
  - 4. Provide recommendations and assist in map administration.
  - 5. Coordinate with the Michigan Department of Environmental Quality in keeping up-to-date on issues affecting wetlands protection.
  - 6. Recommend a program to protect and acquire important wetlands through tax incentives, donation, development rights, easements, land exchange, purchase, and other means.
  - 7. Develop education programs for the public and for [community] schools. The program should promote the values of wetlands and awareness of the hazards and threats to wetlands. The program should be particularly targeted to landowners with wetlands and emphasize how best to protect wetlands values on their property.

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- 8. Develop an adopt-a-wetlands program for interested citizens to participate more directly in preservation of specific wetlands.
- 9. Review degraded or destroyed wetlands in the [community] for possibility of rehabilitation or restoration.
- D. Members of the Wetlands Board shall receive a stipend as determined from time to time by resolution of the [community] Board.
- E. The [community] Board has sole and exclusive discretion for removal of members of the Wetlands Board with or without a hearing.

**SECTION 5 - ACTIVITIES IN WETLAND**

**Section 5.1 - Activities Prohibited Without First Obtaining A Wetlands Use Permit**

Except as otherwise provided by Section 5.2, it shall be unlawful for any person to do any of the following in a wetland unless and until a wetlands use permit is obtained from the [community] pursuant to this Ordinance.

- A. Deposit or permit the placing of fill material in a wetland.
- B. Dredge, remove or permit the removal of soil or minerals from a wetland.
- C. Construct, operate or maintain any use or development in a wetland.
- D. Drain surface water from a wetland.

**Section 5.2 - Activities Not Requiring A Permit**

Notwithstanding the prohibitions of Section 5.1, the following uses are allowed in a wetland without a wetlands use permit, unless otherwise prohibited by statute, ordinance or regulation:

- A. Fishing, trapping, or hunting.
- B. Swimming or boating.
- C. Hiking.
- D. Grazing of animals.
- E. Farming, horticulture, silviculture, lumbering, and ranching activities, including plowing, irrigation, irrigation ditching, seeding, cultivating, minor drainage, harvesting for the production of food, fiber, and forest products, or upland soil and water conservation practices. Wetlands altered under this subsection shall not be used for a purpose other than a purpose described in this subsection without a permit from [community].



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- F.** Maintenance or operation of serviceable structures in existence on October 1, 1980 or constructed pursuant to the Wetlands Protection Act or former Act No. 203 of the Public Acts of 1979.
- G.** Construction or maintenance of farm or stock ponds.
- H.** Maintenance, operation, or improvement which includes straightening, widening, or deepening of the following which is necessary for the production or harvesting of agricultural products:
  - 1. An existing private agricultural drain.
  - 2. That portion of a drain legally established pursuant to the drain code of 1956, Act No. 40 of the Public Acts of 1956, being sections 280.1 to 280.630 of the Michigan Compiled Laws, which has been constructed or improved for drainage purposes.
  - 3. A drain constructed pursuant to other provisions of the Wetlands Protection Act or former Act No. 203 of the Public Acts of 1979.
- I.** Construction or maintenance of farm roads, forest roads, or temporary roads for moving mining or forestry equipment, if the roads are constructed and maintained in a manner to assure that any adverse effect on the wetland will be otherwise minimized.
- J.** Drainage necessary for the production and harvesting of agricultural products if the wetland is owned by a person who is engaged in commercial farming and the land is to be used for the production and harvesting of agricultural products. Except as otherwise provided in the Wetlands Protection Act, wetland improved under this subdivision after October 1, 1980 shall not be used for nonfarming purposes without a permit from [community]. This subdivision shall not apply to a wetland which is contiguous to a lake or stream, or to a tributary of a lake or stream, or to a wetland that the MDEQ has determined by clear and convincing evidence to be a wetland that is necessary to be preserved for the public interest, in which case a permit is required.
- K.** Maintenance or improvement of public streets, highways, or roads, within the right-of-way and in such a manner as to assure that any adverse effect on the wetland will be otherwise minimized. Maintenance or improvement does not include adding extra lanes, increasing the right-of-way, or deviating from the existing location of the street, highway, or road.
- L.** Maintenance, repair, or operation of gas or oil pipelines and construction of gas or oil pipelines having a diameter of 6 inches or less, if the pipelines are constructed, maintained, or repaired in a manner to assure that any adverse effect on the wetland will be otherwise minimized.
- M.** Maintenance, repair, or operation of electric transmission and distribution power lines and construction of distribution power lines, if the distribution power lines are

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constructed, maintained, or repaired in a manner to assure that any adverse effect on the wetland will be otherwise minimized.

- N.** Operation or maintenance, including reconstruction of recently damaged parts, of serviceable dikes and levees in existence on October 1, 1980 or constructed pursuant to the Wetlands Protection Act former Act No. 203 of the Public Acts of 1979 .
- O.** Construction of iron and copper mining tailings basins and water storage areas.
- P.** An activity in a wetland that was effectively drained for farming before October 1, 1980 and that on and after October 1, 1980 has continued to be effectively drained as part of an ongoing farming operation is not subject to regulation under this ordinance.
- Q.** A wetland that is incidentally created as a result of one or more of the following activities is not subject to regulation under this ordinance:
  - 1.** Excavation for mineral or sand mining, if the area was not a wetland before excavation. This exemption does not include a wetland on or adjacent to a water body of 1 acre or more in size.
  - 2.** Construction and operation of a water treatment pond or lagoon in compliance with the requirements of state or federal water pollution control regulations.
  - 3.** A diked area associated with a landfill if the landfill complies with the terms of the landfill construction permit and if the diked area was not a wetland before diking.

## **SECTION 6 - APPLICATION**

Application for approval, appeal, and issuance of wetlands use permits shall be concurrent with the application for approval, appeal, and issuance of other necessary [community] approvals. The applicant for a wetlands use permit shall submit four copies of the following to the [community]:

- A.** An application completed in full, on a form supplied by the Michigan Department of Environmental Quality, together with any supplemental information necessary relative to isolated wetlands under 2 acres.
- B.** A wetlands delineation including, but not limited to the following information: dominant tree, sapling, shrub and herb vegetation; presence or lack of accepted wetland hydrology indicators; analysis of soil including a description of the soil profile to at least 20 inches and comparison to [county] County Soil Survey, and plan views of the wetland(s) delineated. Plan views shall be represented in a manner that allows comparison to the Wetlands Map.
- C.** Soil drainage and stormwater management plans.

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- D.** A mitigation plan, if the proposed activity will result in the loss of wetland resources. In order to adequately review a proposed mitigation plan, the following information shall be provided to the [community]:
1. A brief overview of the plan including the short-range and long-range objectives for vegetation, hydrology, grading, and monitoring.
  2. A schedule of all mitigation activities, including coordination with other local and state agencies, if applicable.
  3. A planting plan and plant list for the area(s) to be established. The use of native plants characteristic of local conditions is encouraged. Species should be selected based on the need for wildlife, restoration, landscaping, and recovery. The [community] Building Department shall, in consultation with knowledgeable persons, maintain and update a list of botanical species that are considered invasive. Mitigation activities shall be performed without the use of invasive species.
  4. A grading and soil erosion control plan including existing and proposed conditions.
  5. A description of all soils and materials to be used including their approximate volumes and origin.
  6. Hydro-geological information sufficient to determine the site's suitability for the mitigation.
  7. Construction detail drawings for planting, soil erosion control, stabilization, water conveyance, and all other items necessary to facilitate the review.
- E.** A cover letter signed by the applicant including the following information:
1. Name, address, and phone number of applicant.
  2. Name of project and brief description (one sentence).
  3. Date upon which the activity is proposed to commence.
  4. Explanation of why the project meets the wetlands use permit standards and criteria contained in this Ordinance.
  5. List of all federal, state, county or other local government permits or approvals required for the proposed project including permit approvals or denials already received. In the event of denials, the reasons for denials shall be given. Attach copies of all permits that have been issued.
  6. Identification of any present litigation involving the property.
  7. Size of total wetland, size of affected wetland and cubic yards of fill.

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- F.** For a wetlands use permit approval required in conjunction with a site plan, plat or other proposed land use, the applicant shall at the time of application elect to have the application processed under either Subsection (1) or (2) below:
- 1.** The wetlands use permit application shall be reviewed either prior to or concurrent with the review of the site plan, plat or other proposed land use submitted by the applicant. [Community] will need to complete the review within the 90-day review period limitation pursuant to the Wetlands Protection Act. However, the land use review may not be completed at the time the decision is rendered on the wetlands use permit application. Therefore, election of this alternative may require a reopening of the wetlands use permit application if the land use approval is inconsistent with the wetlands use permit approval; or,
  - 2.** The wetlands use permit application shall be reviewed and acted upon concurrent with the review of the site plan, plat or other proposed land use submitted by the applicant, and the 90-day review period limitation specified in the Wetlands Protection act shall thereby be extended accordingly.
- G.** Copies of wetland permit applications filed with the MDEQ and forwarded to the [community] in accordance with Section 30307(6) of Wetlands Protection Act shall become part of the application for a [community] wetlands use permit.
- H.** An Application shall not be considered properly received by the [community], nor shall the 90-day review period limitation specified in the Wetlands Protection Act commence until all information required by this section has been submitted.

## **SECTION 7 - REVIEW**

### **SECTION 7.1 - Method of Review of Wetlands Use Permit Application**

- A.** Whenever a wetlands use permit is required, applicant may request an administrative meeting with the Wetlands Administrator to review the proposed activity in light of the purposes of this Ordinance.
- B.** Upon receipt of an application, the [community] shall insure that all required information including a wetlands delineation has been submitted. The receipt of the application shall constitute permission from the owner to complete an on-site investigation. Applicant will pay fees as established in Section 9.1.
- C.** The [community] Clerk shall transmit one copy of the application and supporting materials to the [community] Wetland Consultant to confirm the boundaries of the wetland and to review the proposal in light of the purpose and review standards of Section 7 and other applicable sections of this Ordinance.
- D.** The Wetland Consultant shall prepare and transmit a report and recommendation to the Wetlands Administrator documenting the review required by Section 7.1 D.

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- E.** Upon receipt of an application, the [community] Clerk shall:
- 1.** Transmit one copy of the application, along with any state fees received, to the MDEQ.
  - 2.** Cause to be published a notice of the application and the date and time for submission of written public comments in a newspaper of general circulation in the [community], except for activities proposed on a single family lot.
  - 3.** Advise the applicant of his/her obligation to post the subject property with a sign that shall be no less than ten (10) square feet in size. The sign shall be clearly visible from the abutting street(s) and shall state that an application has been filed for a wetlands use permit on the property.

### **Section 7.2 - Wetlands Use Permit Decisions by the Wetlands Administrator**

The following process shall apply to wetlands use permit decision by the Wetlands Administrator:

- A.** For wetlands use permit applications submitted in conjunction with activities that do not require approval by the Planning Commission and/or [community] Board, the Wetlands Administrator shall approve, approve with modifications, or deny the application within 90 days after receipt of an application. If the Wetlands Administrator does not make a final determination on the application within ninety (90) days after receipt of a complete application, then the permit application shall be considered approved, except where the 90-day limit has been extended pursuant to Section 6.F.2
- B.** Persons wishing to comment on the application must submit their comments in writing to the Wetlands Administrator prior to the date and time set in the notice. Persons wishing to receive notice of the Wetlands Administrator's decision must submit a written request to the Wetlands Administrator.
- C.** After completing the review and reviewing the written comments, the Wetlands Administrator shall approve, approve with modifications or conditions, or deny the wetlands use permit application in accordance with the standards of this Ordinance. The denial of a permit shall be accompanied by a written statement of all reasons for the denial. The Wetlands Administrator shall report the decision to the Wetlands Board, [community] Planning Commission and [community] Board, and the MDEQ.
- D.** When a wetlands use permit is approved, approved with modifications, or denied, written notice shall be sent to the applicant and to all persons who have requested notice of the Wetlands Administrator's decision.

### **Section 7.3 - Wetlands Use Permit Decisions by Planning Commission or the [community] Board**

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The following process shall apply to wetlands use permit decisions by the [community] Planning Commission or by the [community] Board:

- A.** Wetlands use permit applications submitted in conjunction with a related land development activity shall be decided by the same entity that decides the related land development activity. The Wetlands Administrator shall transmit application materials and the report and recommendation prepared by the Wetland Consultant to the Planning Commission or [community] Board as applicable.
- B.** After review and study of the application materials, the Wetland Consultant's report and recommendation, the [community] Planning Commission or [community] Board as applicable may hold one public hearing after publication in a newspaper of general circulation in the [community] not less than ten (10) days nor more than sixty (60) days prior to the date of the hearing. Such notice shall indicate the place, time and subject of the hearing and the place and time the proposed wetlands use permit may be examined. The wetlands use permit hearing may be held in conjunction with a review of the related land use requests.
- C.** In the event of a public hearing, notice shall be sent by mail or personal delivery to the owners of property for which approval is being considered, and to all owners of property, as listed on the most recent tax roll, within 600 feet of the boundary of the property in question. Notification need not be given to more than one (1) occupant of a structure, except that if a structure contains more than one (1) dwelling unit or spatial area owned or leased by different persons, one (1) occupant of each unit shall receive notice. In the case of a single structure containing more than four (4) dwelling units, notice may be given to the manager or owner of the structure who shall be requested to post the notice at the primary entrance to the structure. A notice containing the time, date, place and purpose of the hearing shall be posted on the subject property at least eight (8) days prior to the hearing. The posting sign shall be no less than ten (10) square feet in size, shall be clearly visible from the abutting street(s), and shall state that an application has been filed for a wetlands use permit.
- D.** After completing the review, the Planning Commission or [community] Board, as applicable, shall approve, approve with modifications, or deny the application within ninety (90) days after receipt of a complete application, in accordance with this Ordinance. If the [community] Planning Commission or the [community] Board, as applicable, does not make a final determination on the application within ninety (90) days after receipt of a complete application, then the permit application shall be considered approved, except where the 90-day limit has been extended pursuant to Section 6.F.2.
- E.** Written notice shall be sent to the applicant and the MDEQ upon approval, approval with modifications, or denial of a wetlands use permit by the [community]. The denial of a permit shall be accompanied by a written statement of all reason for denial.

### **Section 7.4 - Appeals Of Decisions Of The Wetlands Administrator, Planning Commission, or Board**

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The following process shall apply to appeals of decisions made by the Wetlands Administrator, the Planning Commission, or the [community] Board as applicable:

- A.** Any person who is aggrieved by the approval, approval with modifications, or denial of a wetlands use permit by the Wetlands Administrator, the Planning Commission, or by the [community] Board, may appeal the decision to the Wetlands Board. A written letter containing the specific reasons for appeal shall be filed with the [community] Clerk within ten (10) calendar days after the date of the decision to be appealed. Timely filing of an appeal shall have the effect of suspending the effect of the permit pending the outcome of the appeal. In the event that the person(s) filing the appeal do not own property within 600 feet of the wetland affected, the Planning Commission shall determine whether the person(s) are aggrieved.
- B.** Standard of Review. Based upon the record, in considering the appeal, the Wetlands Board shall affirm the original decision unless it finds an abuse of discretion by the entity deciding the wetlands use permit.
- C.** After a hearing, the Wetlands Board shall determine that the decision of the Wetlands Administrator, Planning Commission, or [community] Board be affirmed, affirmed with modification, or reversed. The Wetlands Board's decision shall be based on written findings.

### **Section 7.5 - Wetlands Use Permit Conditions**

- A.** The Wetlands Administrator, the Planning Commission, or the [community] Board, as applicable, shall attach any reasonable conditions considered necessary to ensure that the intent of this Section will be fulfilled, to minimize or mitigate damage or impairment to, encroachment in or interference with nature resources and processes within the wetlands, or to otherwise improve or maintain the water quality. Any conditions related to wetland mitigation shall follow the provisions of Section 8 of this Ordinance.
- B.** The Wetlands Administrator, the Planning Commission, or the [community] Board, as applicable, shall fix a reasonable time to complete the proposed activities.
- C.** If the Wetlands Administrator, the Planning Commission, or the [community] Board, as applicable determines that there is a potential for adverse impacts to wetlands not authorized by the wetlands use permit or off-site property, they will require the applicant to file with the [community] a cash bond or irrevocable bank letter of credit in an amount, estimated by the Wetland Consultant to be required to address those impacts.
- D.** A wetlands use permit shall be conditioned upon compliance with all other requirements of ordinance and law, including site plan, plat or land use approval as applicable, and issuance of a permit by the MDEQ, if required under the Wetlands Protection Act. In cases where a MDEQ permit allows activities not permitted by the wetlands use permit approval granted under this Section, the restrictions of the approval granted under this Section shall govern.

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- E.** Wetlands use permits for seasonal operations need not be renewed annually unless otherwise stated in the permit.
- F.** Any change that materially increases the size or scope of the operation and that affects the criteria considered in approving the permit as determined by the Wetlands Administrator, the Planning Commission, or the [community] Board, as applicable, shall require the filing of a new wetlands use permit application.
- G.** Any temporary, seasonal, or permanent operation that is discontinued for two (2) years or two (2) seasons shall be presumed to have been abandoned and the wetlands use permit automatically voided.
- H.** Any permit granted under this Ordinance may be revoked or suspended by the Planning Commission or [community] Board ,as applicable, after notice and an opportunity for a hearing, for any of the following causes:
  - 1.** A violation of a condition of the permit.
  - 2.** Misrepresentation or failure to fully disclose relevant facts in the application.
  - 3.** A change in a condition that requires a temporary or permanent change in the activity.
- I.** An applicant who has received a wetlands use permit under this Ordinance shall comply with the following in connection with any construction or other activity on the property for which the wetlands use permit has been issued:
  - 1.** Maintain soil erosion control structures and measures, including but not limited to, silt fences, straw bale berms, and sediment traps. The permittee shall provide for periodic inspections throughout the duration of the project.
  - 2.** Maintain clear delineation of the wetlands (so marked by the Wetlands Administrator or Wetland Consultant during the on-site inspection) so that such locations are visible to all construction workers.
  - 3.** Post on the site, prior to commencement of work on the site and continuing throughout the duration of the project, a copy of the approved wetlands use permit containing the conditions of issuance, in a conspicuous manner such that the wording of said permit is available for public inspection.
- J.** The wetlands use permit shall remain effective for a time period coincidental with any other land use permit reviewed and approved concurrent with the wetlands use permit. If applied for prior to the expiration date and concurrent with the expiring land use permit, the applicant may be granted an extension that corresponds to additional time granted for the underlying land use permit. Extensions shall be approved by the same person or body that made the original decision. The maximum number of extensions shall coincide with the maximum number allowed for the underlying land use permit.



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- K.** When there is no other activity or permit involved, the wetlands use permit shall remain effective for one (1) year. A maximum of a one (1) year extension may be approved.

**Section 7.6 - Regulation Criteria For Non-Contiguous Wetlands Less Than (2) Two Acres In Area.**

- A.** A wetlands use permit shall be approved with respect to a non-contiguous wetland less than two (2) acres in area unless the Planning Commission or [community] Board determines that the wetland is essential to the preservation of the natural resources of the [community]. It shall not be the burden of the property owner to prove that the wetland is not essential to the preservation of the natural resources of the community.
- B.** All non-contiguous wetland areas of less than two (2) acres which appear on the Wetlands Map, or which are otherwise identified during a field inspection by the [community], shall be analyzed for the purpose of determining whether such areas are essential to the preservation of the natural resources of the [community]. If there is to be a denial of a wetlands use permit in a non-contiguous wetland area of less than two (2) acres, then, on the basis of data gathered by or on behalf of the [community], findings shall be made in writing and given to the applicant stating the basis for the determination that such wetland is essential to preservation of the natural resources of the [community]. In order to make such a determination, there shall be a finding that one (1) or more of the following exist within such wetland:
1. The site supports state or federal endangered or threatened plants, fish, or wildlife appearing on a list specified in Section 36505 of Part 365, Endangered Species Protection, of the Natural Resources and Environmental Protection Act, 1994 PA 451, as amended.
  2. The site represents what is identified as a locally rare or unique ecosystem.
  3. The site supports plants or animals of an identified local importance.
  4. The site provides groundwater recharge documented by a public agency.
  5. The site provides flood and storm control by the hydrologic absorption and storage capacity of the wetland.
  6. The site provides wildlife habitat by providing breeding, nesting, or feeding grounds or cover for forms of wildlife, waterfowl, including migratory waterfowl, and rare, threatened, or endangered wildlife species.
  7. The site provides protection of subsurface water resources and provision of valuable watersheds and recharging groundwater supplies.
  8. The site provides pollution treatment by serving as a biological and chemical oxidation basin.

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9. The site provides erosion control by serving as a sedimentation area and filtering basin, absorbing silt and organic matter.
  10. The site provides sources of nutrients in water food cycles and nursery grounds and sanctuaries for fish.
- C. In connection with the determination whether the wetland is essential to the preservation of the natural resources of the [community], the property owner shall make an election and response under Subsection 1 or 2 below, relative to each non-contiguous wetland area less than two (2) acres.
1. In lieu of having the [community] or its Wetland Consultant proceed with the analysis and determination, the property owner may acknowledge that one (1) or more of the criteria in Subsections (B-1) through (B-10) above, exist on the wetland in question, including a specification of the one or more criteria which do exist; or
  2. An election to have the [community] or its Wetland Consultant proceed with the analysis of whether each of the criterion in Subsections (B-1) through (B-10) exist or do not exist in the wetland in question, including specific reasons for the conclusion in respect to each criteria
- D. If the [community] determines that the wetland is not essential to the preservation of the natural resources of the [community], the [community]'s decision shall be so noted on the Wetland Map, at the time it is amended. The requested activity shall be approved subject to all other applicable laws and regulations.
- E. If the [community] determines that the wetland is essential to the preservation of the natural resources of the [community], and the [community] has found that one or more of the criteria set forth exist at the site, the [community] shall notify the applicant in writing stating the reasons for determining the wetland to be essential to the preservation of the natural resources.

After determining that a wetland less than two (2) acres in size is essential to the preservation of the natural resources of the [community], the wetland use permit application shall be reviewed according to the standards in Section 7.7.

### **Section 7.7 - Review Standards for Wetlands Use Permits**

The criteria to evaluate wetlands use permits under this Ordinance and to determine whether a permit is granted are as follows:

- A. A permit for any activity listed in Section 5.1 shall not be approved unless the [community] determines that the issuance of a permit is in the public interest, that the permit is necessary to realize the benefits derived from the activity, and that the activity is otherwise lawful.

In determining whether the activity is in the public interest, the benefit that reasonably may be expected to accrue from the proposal shall be balanced against the reasonably

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foreseeable detriments of the activity. The decision shall reflect the national, state, and local concern for the protection of natural resources from pollution, impairment, and destruction. The following general criteria shall be considered:

1. The relative extent of the public and private need for the proposed activity.
  2. The availability of feasible and prudent alternative locations and methods to accomplish the expected benefits from the activity.
  3. The extent and permanence of the beneficial or detrimental effects that the proposed activity may have on the public and private uses to which the area is suited, including the benefits the wetlands provide.
  4. The probable impact of each proposal in relation to the cumulative effect created by other existing and anticipated activities in the watershed.
  5. The probable impact on recognized historic, cultural, scenic, ecological, or recreational values and on the public health or fish or wildlife.
  6. The size of the wetland being considered.
  7. The amount of remaining wetland in the general area.
  8. Proximity to any waterway.
  9. Economic value, both public and private, of the proposed land change to the general area.
  10. Findings of necessity for the proposed project that have been made by federal or state agencies.
- B.** A wetlands use permit shall not be issued unless it is shown that an unacceptable disruption will not result to the aquatic resources . In determining whether a disruption to the aquatic resources is unacceptable, the criteria set forth in Section 30302 of the Wetlands Protection Act and Subsection A of this section shall be considered. A permit shall not be issued unless the applicant also shows either of the following:
1. The proposed activity is primarily dependent upon being located in the wetland.
  2. A feasible and prudent alternative does not exist.

## **SECTION 8 - WETLAND MITIGATION**

### **Section 8.1 - Findings That Wetland Loss Is Unavoidable**

Mitigation shall not be considered a substitute for making all prudent attempts to avoid wetland impacts.

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- A.** Prior to considering a proposal for wetland mitigation, the Wetlands Administrator, the Planning Commission or the [community] Board, as applicable shall make all of the following findings:
  - 1.** That all feasible and prudent efforts have been made to avoid the loss of wetland.
  - 2.** That all practical means have been considered to minimize wetland impacts.
  - 3.** That it is practical to replace the wetland which will be unavoidably eliminated.
  - 4.** That all alternatives for preserving wetlands have been evaluated and found to be impractical, inappropriate, or ineffective.
- B.** To ensure no net loss of wetlands in the [community], mitigation shall be required in instances where there are losses of wetland resources and where the Wetlands Administrator, the Planning Commission or the [community] Board, as applicable have made the findings required in Section 8.1.A.

### **Section 8.2 - Criteria For Approving Proposals For Wetland Mitigation.**

If the Wetlands Administrator, Planning Commission or the [community] Board, as applicable, determines that it is practical to replace the wetlands that will be impacted, mitigation plans shall be approved only if all of the following criteria are met:

- A.** That the mitigation plan provides for the substantial replacement of the predominant functional values of the wetland to be lost. Mitigated wetlands shall be replaced at a minimum of 1.5 new acres of wetland to 1 lost acre. A larger replacement ratio may be required if the lost wetlands are deemed to have exceptional value.
- B.** That the mitigation plan provides for no net loss of wetland resources unless the Wetlands Administrator, the Planning Commission or the [community] Board, as applicable determines that the net loss will result in a minimum negative impact upon wetlands, and attendant natural resources under all of the circumstances.
- C.** Mitigation shall be provided on-site where practical and beneficial to the wetland resources. If mitigation on-site is not practical and beneficial, then mitigation in the immediate vicinity, within the same watershed, of the permitted activity may be considered. Only if all of these options are impractical shall mitigation be considered elsewhere.
- D.** The mitigation plan will comply with all applicable federal, state, and local laws.
- E.** A plan to monitor preserved and replacement wetlands over a minimum of five years has been specified. The plan shall include the following information:
  - 1.** Schedule and list of activities to be contracted and conducted related to the site's hydrology, including sub-surface and surface water for a period of at least five years.

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A report and recommendation on the hydrologic conditions of the site should be submitted to the [community] annually.

2. Schedule and list of activities to be contracted and conducted related to the site's plant establishment and control of invasive exotic species for a period of at least five years. A report and recommendation on the plant establishment of the site should be submitted to the [community] annually.
3. To assure that the objectives established in the mitigation plan are successful, the monitoring plan should indicate the mechanisms necessary to execute the recommendations from the annual reports and provide for additional monitoring after the five-year period.

### **Section 8.3 - Other Mitigation Requirements**

- A. Wetland mitigation and monitoring plans shall become conditions to the wetlands use permit and shall be the responsibility of the applicant.
- B. Financial assurances that mitigation is accomplished as specified by the permit condition may be required by Wetlands Administrator, Planning Commission or [community] Board, as applicable.
- C. Any mitigation activity shall be completed before initiation of other permitted activities, unless a phased concurrent schedule can be agreed upon between the Wetlands Administrator, Planning Commission or [community] Board, as applicable, and the applicant.
- D. Wetland mitigation plans that create less than two (2) acre wetlands shall be designed and constructed to meet one of the conditions listed in Section 7.6 B.1-10.

## **SECTION 9 - FEES, PENALTIES AND ENFORCEMENT**

### **Section 9.1 - Fees**

Applications for a wetlands use permit under this Section shall be accompanied by a non-refundable administrative application fee in an amount specified from time to time by resolution of the [community]. In addition an applicant shall pay an escrow fee in an amount determined from time to time by resolution of the [community] Board for the estimated cost of outside consultant(s) who may be retained by the [community] in connection with the review of the application. In the event the cost of the services of the consultant(s) is less than the escrow fee, the applicant shall be refunded the balance. In the event the cost of the services of the consultant(s) exceeds the amount of the escrow fee, the applicant shall provide to the [community] and additional escrow amount equivalent to no less than one-half (1/2) the original escrow amount. All review of the wetlands use permit application shall cease until such additional escrow amount is deposited with the [community], and the number of days during which all review of the wetlands use permit application is ceased shall be deducted from the time limits within which the [community] would otherwise act upon the application. In the event the

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cost of the services of the consultant(s) is less than the subsequent escrow fee(s), the applicant shall be refunded the balance. A denial of an application for a wetlands use permit shall not affect the applicant's obligation to pay the fees provided for in this Section.

### Section 9.2 - Penalties And Enforcement

#### A. Penalties

1. If, on the basis of information available to the [community], the [community] finds that a person is in violation of this Ordinance or of a condition set forth in a permit, the [community] shall issue an order requiring the person to comply with the prohibitions or conditions, or the [community] shall take such enforcement action as it deems appropriate.
  - (a) If a person acts in violation of this ordinance [community] may issue a stop work order on construction or shall refuse a certificate of occupancy or other construction permits related to the project whenever there is a failure to comply with the provisions of this Ordinance.
  - (b) An order issued under subsection (1) shall state with reasonable specificity the nature of the violation and shall specify a time for compliance, not to exceed 30 days, which the [community] determines is reasonable, taking into account the seriousness of the violation and good faith efforts to comply with acceptable requirements.
2. A person who violates any provision of this Ordinance shall be responsible for a civil infraction for which the court may impose a civil fine of not less than \$100.00 nor no more than \$10,000 per day of violation plus all costs, direct or indirect, which the [community] has incurred in connection with the violation.
3. In addition to the penalties provided in subsection (3), the court may order a person who violates this Ordinance to restore as nearly as possible the wetland affected by the violation to its original condition immediately before the violation, and may issue any other orders permitted by law. The restoration may include the removal of fill material deposited in a wetland or the replacement of soil, sand, minerals, or plants.

#### B. Injunction

Any activity conducted in violation of this section is declared to be a nuisance *per se*, and the [community] may commence a civil suit in any court of competent jurisdiction for an order abating or enjoining the violation, and/or requiring restoration of the wetland as nearly as possible to its condition before the violation.

### Section 9.3 Reporting and Record Keeping

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- A.** Any citizen observing what he or she believes or suspects may be an instance of noncompliance with the provisions of this Ordinance may report the observation to any official or employee of the [community].
- B.** Any report received pursuant to Subsection A of this Section shall be forwarded immediately to the [community] Ordinance Officer and the [community] Clerk.
- C.** [community] Ordinance Officer Duties
  - 1.** The [community] Ordinance Officer shall inspect the site of the suspected noncompliance as soon as is reasonably practical, but in no case later than the close of business five (5) business days after receiving the report.
  - 2.** The [community] Ordinance Officer shall complete an entry for the report into the Compliance Docket.
  - 3.** The [community] Ordinance Officer may enlist the expertise of the Wetlands Administrator if necessary to determine whether a violation of this Ordinance has occurred.
  - 4.** The [community] Ordinance Officer shall take any actions within his or her authority necessary to ensure this Ordinance is enforced.

## **D.** Compliance Docket

The [community] Ordinance Officer shall maintain a Compliance Docket at the [community] Office. The Docket shall be used to identify all properties or uses of properties which have been evaluated for compliance with this Ordinance. The Docket shall be available to the public upon demand during normal business hours. The Docket shall contain the following information:

- 1.** Date: the date the Docket entry was initiated.
- 2.** Address/Location of Property: the street address, if available, or descriptive text or vicinity map sufficient to enable citizens to identify the property in question
- 3.** Permit or Docket Number: If it has been determined that the use being made of the property does not require a wetlands use permit from [community], a Docket number shall be assigned. Otherwise, the Permit number shall be maintained.
- 4.** Compliance Status: A record shall be made of whether the use being made of the property is in compliance with the provisions of this Ordinance, the date the determination was made, and the name(s) of the [community] official and/or consultant who made the determination.
- 5.** Sidwell property number.

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### **E. Violation Docket**

The [community] Ordinance Officer shall maintain a Violation Docket at the [community] Office. The Docket shall be used to track the status of violations of this Ordinance. The Violation Docket shall contain the following information, as it becomes available:

1. Date: the date the Docket entry was initiated
2. The permit or Docket number: This number shall be the same number as is used to identify the property in the Compliance Docket.
3. Address/Location of property: The street address, if available, or descriptive text or vicinity map sufficient to enable citizens to identify the property in question.
4. Nature of violation.
5. Date violation confirmed.
6. Name of person confirming the violation.
7. Enforcement action taken.
8. Date of enforcement action taken.
9. Outcome of enforcement action: If outcomes are appealed by the property owner or any other party, each appeal shall be noted, and its outcome shall also be noted under this heading.

## **SECTION 10 - STATE NOTIFICATION**

### **Section 10.1 - Notice to the Michigan Department of Environmental Quality**

The [community] shall notify the MDEQ of the adoption of this Ordinance. The [community] shall cooperate with the MDEQ in the enforcement of the Wetlands Protection Act as to wetlands under the MDEQ's jurisdiction as defined under this Ordinance.

## **SECTION 11 - ORDINANCE CONFLICT**

### **Section 11.1 - Abrogation and Conflict of Authority**

Nothing in this Ordinance shall be interpreted to conflict with present or future state statutes in the same subject matter; conflicting provisions of this Ordinance shall be abrogated to, but only to, the extent of the conflict. Moreover, the provisions of this Ordinance shall be construed, if possible, to be consistent with and in addition to relevant state regulations and statutes. If any part of this Ordinance is found to be invalid or unconstitutional by any court of competent



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jurisdiction, such portion shall be deemed a separate, distinct and independent provision. Such finding shall not affect the validity of the remaining portions thereof, and the remainder of the Ordinance shall remain in force. Rights and duties that have matured, penalties which have been incurred, proceedings which have begun and prosecutions for violations of law occurring before the effective date of this Ordinance are not affected or abated by this Ordinance.

**SECTION 12 - PROPERTY TAX ASSESSMENT**

If a wetlands use permit is denied by the [community], a landowner may appear at the annual Board of Review for the purpose of seeking a re-valuation of the affected property for assessment purposes to determine its fair market value under the use restriction.

**SECTION 13 - EFFECTIVE DATE**

This Ordinance shall take full force and effect upon [date], following final publication of said Ordinance.

**SECTION 14 - CERTIFICATION**

I, \_\_\_\_\_, Clerk of the [community], do hereby certify that the foregoing is a true and correct copy of an Ordinance adopted at first reading by the [community] Board at a regular meeting on \_\_\_\_\_ and adopted at second and final reading by said Board at a regular meeting of said Board on \_\_\_\_\_.

**To:** Cedar Lake Steering Committee

**Date:** 05/22/2009

**From:** Jamie McCarthy, K&A

**Enclosure:** Policy Options Table

**Re: Cedar Lake Watershed Management Planning Policy Options**

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A major component of any watershed management plan is an implementation plan and schedule detailing the proposed best management practices, projects, and education plans that will be implemented in the watershed after the planning process is complete. As part of the Cedar Lake watershed management planning process, policy and ordinance options will be discussed in order to propose the best means of protecting wetland habitat and groundwater recharge (i.e., groundwater and surface water inputs to the lake) and minimizing lake level impacts from future development in wetlands (lake drainage).

At the upcoming Steering Committee (SC) meeting scheduled on June 9, K&A will lead the SC through a discussion and decision-making process on potential ordinances and policies related to wetland protection. The attached document outlines the potential policy options using information from other Michigan townships that have implemented similar policies. During the SC meeting, the committee will discuss and select the most appropriate and feasible policy option(s) (with the ability to add or delete language, as needed). In order to work through these materials in an efficient manner, please read through and become familiar with the attached policy options prior to the June 9 meeting.

After the SC discusses and selects the policy option(s) best suited for Cedar Lake and the surrounding townships/counties, K&A will recommend a series of "next steps" and an estimate for the potential "level of effort" involved in implementing such a policy. This document, along with all of the policy options, will be included in the watershed management plan and be incorporated into the implementation schedule. If the selected policy is taken from an existing Michigan township ordinance example, model ordinance language can be provided as an appendix to the watershed management plan. To be clear, the plan will identify what should be pursued; future implementation efforts beyond the plan will be needed to institute the recommendations.

**Attachment I.1**

**Example Ordinance and Policy Components**

GENERAL PARTS OF AN ORDINANCE	WETLAND ORDINANCE	ZONING ORDINANCE	MODIFY BUILDING CODE	TASKS
Statement of the purpose of the ordinance/policy	<p><b>Purpose:</b>                      1) Provide protection and appropriate use of wetlands within the township in order to minimize disturbance of these vital natural features.                      2) Coordinate the provisions of this ordinance with state law, as well as to provide for coordinated enforcement of wetland protection laws and requirements by responsible township, county and state officials.                      3) To establish procedures for the processing of applications for permits involved in the permitted use of wetlands in the township.</p> <p align="right">(A)</p>	<p><b>Purpose:</b>                      1) To provide for the protection and preservation of wetlands, environmentally sensitive areas, groundwater, and fish and wildlife habitat, and the functions and services they provide to the township and its residents.                      2) To uniformly apply an additional set of regulations to established zoning districts related to the protection of environmental areas due to development.                      (The benefits of an overlay policy include the ability to respond to land use issues that affect multiple zoning districts/areas, preserve natural features, and enhance public awareness)</p> <p align="right">(B)</p>	<p><b>Purpose:</b> to add an additional set of building code requirements for homes being built in floodplain or flood-prone areas to protect property values, to alleviate future flooding and public health issues associated with flooded homes, and to eliminate or reduce costs to taxpayers caused by flooding.</p>	<ul style="list-style-type: none"> <li>• Determine overall goal or purpose of an ordinance or policy</li> <li>• Determine what model would work best in your township or wetland/natural areas in your township</li> </ul> <p><b>GOALS:</b>                      1) Protect wetlands (to preserve gw recharge to Lake and protect fish spawning)                      2) Minimize lake elevation impacts and flooding issues</p>
Area covered under the ordinance/policy	<p><b>Wetlands:</b> as defined by Public Act 451 (Wetlands Protection Regulation, Part 303: "Land characterized by presence of water at a frequency and duration sufficient to support, and that under normal circumstances does support, wetland vegetation and aquatic life; commonly referred to as bog, swamp or marsh."  <b>Drainageways, greenbelt/buffers, floodplains</b>  <b>State Regulated:</b> contiguous to or within 1000 ft of Great Lakes; 500 ft of stream, lake or pond but are greater than 5 acres and in counties with 100,000 pop.; not contiguous and less than 5 acres in size if DEQ has determined the wetlands are essential to the preservation of state's natural resources and has so notified the property owner(s).</p> <p align="right">(C)</p>	<p><b>Overlay:</b> options include                      1) Floodplains, watersheds, lake shore lands, river corridors, environmentally sensitive areas, high risk erosion areas, and wetlands                      2) Other areas identified by the county or township that are ecologically important or sensitive to development or affects thereof</p>	<p><b>Coverage Area:</b>                      1) Lands located in the 100-year floodplain                      2) Areas identified on the wetland map as part of the township's master plan                      3) Other flood-prone areas identified by the township (and mapped) or environmentally sensitive areas</p>	<ul style="list-style-type: none"> <li>• Review wetlands maps of the township and county soils maps</li> <li>• Overlay wetlands information onto township zoning map(s) [<i>counties or townships provide overlays of parcel lines</i>]</li> <li>• Determine what critical areas the ordinance will cover (Wetlands and floodplains? What size wetland? Only those not regulated by State or Feds?)</li> </ul>
Wetland inventory map, overlay map, or coverage area	<p>1) Review of the USFWS National Wetlands Inventory and other relevant data layers. The delineated areas will require special use permits and/or site plan reviews when development is</p>	<p>1) An overlay map will be created and incorporated into the townships master planning map. The overlay will include environmentally sensitive areas determined by the township and a</p>	<p>Additional building codes will not likely be implemented for all building/development projects in the township, so an area must be delineated or criteria selected where</p>	<ul style="list-style-type: none"> <li>• Decide what information would be used to develop a map -- will it be a wetlands map, natural resources</li> </ul>

	<p>proposed. A GIS map will be created and incorporated into the township general development master plan. It will be used by township boards and officials to identify areas which may be subject to federal, state or local regulation.</p> <p>2) Delineation of wetland boundaries on individual parcels or sites shall be the responsibility of the township but chargeable to the property owner. The wetland map shall not be considered a substitute for on-site field inspection. The applicant for a use approval shall be responsible for identifying boundaries of protected wetlands located on the project site. The landowner is responsible for having the locations of protected wetlands on the project site identified and marked by qualified personnel of either the MDEQ or consulting firm competent in this field. (A)</p>	<p>public notice will be issued regarding the new map and how a copy can be obtained.</p> <p>2) The overlay map will include environmentally sensitive areas in the township where specific building codes, setbacks, impervious surface limits, increased vegetation removal limits and other codes exists; options:</p> <ul style="list-style-type: none"> <li>• Floodplain (100 year) or flood-prone areas</li> <li>• Wetlands identified through USFWS National Wetlands Inventory and DEQ MIRIS layer</li> <li>• Stream corridors</li> <li>• Greenbelt areas</li> <li>• All surface waterbodies</li> <li>• Unique wildlife/fish habitat</li> <li>• Groundwater recharge/protection areas</li> </ul>	<p>these building codes will be required. This could be a zoning overlay district, general wetlands map, environmentally sensitive areas, etc.</p>	<p>protection area map, a zoning overlay map, etc?</p> <ul style="list-style-type: none"> <li>• Determine what select areas (floodplains, buffers, drainageways) or critical wetlands need protection</li> </ul>
<p>Information about the permit/development process</p>	<p>1) Application must be submitted to the zoning board to request land use in delineated wetland areas.</p> <p>2) The application will include drawings of the proposed activities.</p> <p>3) Use application shall be submitted to the township for a preliminary review of subdivision plats, site plans, lot splits, grading approvals or building permits.</p> <p>4) Applications will also be forwarded to the DEQ and approval may need to be issued from state wetland's program as well. (D)</p>	<p>For development in the overlay zone, regardless of zoning (and when a special use permit is not required), a site plan review will be required. The site plan review will have an environmental component to protect resources outlined in the zoning ordinance.</p> <p>The site plan will be reviewed by a township administrator or Zoning Board and approved if all of the conditions are met for development (outlined below). One copy of approval will be sent to building inspector to issue building permit and confirm site plan, one copy to property owner, and one copy for township records. (B)</p>	<p>Additional building codes will be added for development in select areas. The code will stipulate building foundation requirements in terms of elevation and design. Impervious cover from driveways, house footprint, patios, and other out buildings will be limited. Vegetation should remain insofar as practical aside from clearing for initial building and "regular" mowing and pruning or for agricultural purposes.</p>	<ul style="list-style-type: none"> <li>• After selecting a type of policy (wetland or zoning ordinance or building code addition), determine what elements need to be incorporated to meet purpose/goal of policy</li> <li>• Use options here to discuss/select components</li> </ul>
<p>Standards of the ordinance or policy</p>	<p>1) The review board or administrator will determine whether the activity is in the public interest, the benefit which would reasonably be expected to accrue from the proposal shall be</p>	<p><b>Preservation or all natural vegetation</b>, insofar as practical (or greater percent in this area than is required elsewhere)</p> <ul style="list-style-type: none"> <li>• Sites 1 acre or larger will require</li> </ul>	<p>1) <b>Removal of vegetation:</b> a certain percent of clearing will be allowed for initial building/development. Natural vegetation should be</p>	<ul style="list-style-type: none"> <li>• Further develop/discuss the specific regulations or requirements that the selected policy will require</li> </ul>

	<p>balanced against the reasonably foreseeable detriments of the activity, taking into consideration the local, state and national concern for the protection and preservation of natural resources from pollution, impairment and/or destruction. [A list of general criteria that will be applied in undertaking this balancing test is listed below the table.]</p> <p>2) An approval shall not be granted unless it is shown that an unacceptable disruption will not result to the aquatic resources. An approval shall not be granted unless the applicant also shows either of the following:</p> <ul style="list-style-type: none"> <li>• The proposed activity is primarily dependent upon being located in the wetlands or,</li> <li>• A feasible and prudent alternative does not exist.</li> </ul> <p>3) Upon application for a wetland use permit, approval shall be granted unless the Township Board determines that the wetland is essential to the preservation of the natural resources of the township. A list of criteria that shall be considered in making this determination is listed below the table. (A)</p>	<p><b>stormwater management practices</b> to prevent flooding and protect natural resources</p> <ul style="list-style-type: none"> <li>• <b>Natural areas</b> (swales, creeks, ponds, wetlands, etc.) shall be protected/preserved insofar as practical in their natural state</li> <li>• <b>Elevation of buildings</b> above 100 year floodplain (or greater in certain areas)</li> <li>• <b>Other building codes</b> related to foundations to be applied in this area to avoid flooding issues</li> <li>• <b>Limited impervious surface</b> area of driveway, patios, house footprint, other out buildings, etc.</li> <li>• <b>Limit filling or wetland areas</b> insofar as practical for the specific site plan</li> </ul> <p>(B)</p>	<p>protected/undisturbed insofar is practical (a building code may require specific guidance on this criteria/standard).</p> <p>2) <b>Impervious cover:</b> the footprint of driveways, concrete patios, house footprint, and other out buildings or impervious surfaces will be limited to a practical ratio of house:driveway:lot size (or other standard).</p> <p>3) <b>Foundations:</b> building foundations in wetland areas or flood-prone areas will need specific building/structural solutions to protect a home from flooding; including elevation requirements (1 - 3 ft above 100 year floodplain), sump options, or undergrade drainage structures.</p> <p>4) <b>Site filling:</b> filling of wetland areas (no regulated by state or federal law) will be limited to a ratio or percent of the lot for building foundations.</p>	<ul style="list-style-type: none"> <li>• Decide what resource will need to be consulted to fully develop the ordinance or policy</li> <li>• Assign tasks for the group members</li> </ul>								
<p>Penalties for violating the ordinance/policy</p>	<p>A civil infraction and fine schedule may be necessary for (re)development on property already grandfathered under this ordinance:</p> <table border="0"> <tr> <td>1<sup>st</sup> offense</td> <td>\$75.00</td> </tr> <tr> <td>2<sup>nd</sup> offense</td> <td>\$150.00</td> </tr> <tr> <td>3<sup>rd</sup> offense</td> <td>\$325.00</td> </tr> <tr> <td>4<sup>th</sup> offense (or more)</td> <td>\$500.00</td> </tr> </table> <p><b>Or:</b> require developer to obtain wetlands permit before issuing building permit. (A)</p>	1 <sup>st</sup> offense	\$75.00	2 <sup>nd</sup> offense	\$150.00	3 <sup>rd</sup> offense	\$325.00	4 <sup>th</sup> offense (or more)	\$500.00	<p>Denial of land use permit, and therefore building permit. Persons building without necessary permits are subject to established fines and/or prosecution.</p>	<p>Denial of building permit or not passing final building inspection for occupancy (or interim inspections). Person building without necessary permits are subject to established fines and/or prosecution.</p>	<ul style="list-style-type: none"> <li>• Determine what penalties or deterrents are necessary to maximize compliance with a new ordinance/policy and result in the best protection of wetlands, floodplain areas, property values, public health and safety, etc.</li> </ul>
1 <sup>st</sup> offense	\$75.00											
2 <sup>nd</sup> offense	\$150.00											
3 <sup>rd</sup> offense	\$325.00											
4 <sup>th</sup> offense (or more)	\$500.00											

- (A) Fabius Township Compliation of the Wetlands Protection Ordinance. Ordinance Number 70, as Amended by Ordinance Number 90, 93, and 120. Effective April 21, 1999. Fabius Township, St. Joseph County, Michigan.
- (B) LSA, Associates, LLC. Four Townships Water Resources Council's Site Plan Review for Water Quality Protection.
- (C) State of Michigan Natural Resources and Environmental Protection Act, Part 303 of Public Act 451, as Amended (1994).
- (D) Cannon Township Wetlands Protection Ordinance. Ordinance Number 2005-1. Cannon Township, Kent County, Michigan.

Criteria to determine whether a project is in the public interest:

- (1) The relative extent of the public and private need for the proposed activity.
- (2) The availability of feasible and prudent alternative locations and methods to accomplish the expected benefits from the activity, including alternatives which are off-site or on other commercially available properties.
- (3) The extent and permanence of the beneficial or detrimental effects which the proposed activity may have on the public and private use to which the area is suited, including the benefits the wetland provides.
- (4) The probable impact on the proposal in relation to the cumulative effect created by other existing and anticipated activities in the watershed.
- (5) The probable impact on recognized historic, cultural, scenic, ecological, or recreational values and on the public health or fish or wildlife.
- (6) The size and quality of the wetland being considered.
- (7) The amount and quality of the wetland being considered.
- (8) Proximity to any waterway.
- (9) Extent to which upland soil erosion adjacent to protected wetlands or drainageways is controlled.
- (10) Economic value, both public and private, of the proposed land change to the general area.
- (11) Findings of necessity for the proposed project which have been made by other state or local agencies.

Criteria to determine if the wetland is essential to the protection of a natural resource:

- (1) The site supports state or federal endangered or threatened plants, fish or wildlife appearing on a list specified in Section 36060 of the Act.
- (2) The site represents what is identified as a locally rare or unique ecosystem.
- (3) The site supports plants or animals of an identified local importance.
- (4) The site provides groundwater recharge documented by a public agency.
- (5) The site provides flood and storm control by the hydrologic absorption and storage capacity of the wetland.
- (6) The site provides wildlife habitat by providing breeding, nesting or feeding grounds or cover for forms of wildlife, waterfowl, including migratory waterfowl, and rare, threatened or endangered wildlife species.
- (7) The site provides protection of subsurface water resources and provision of valuable watersheds and recharging underground supplies.
- (8) The site provides pollution treatment by serving as a biological and chemical oxidation basin.
- (9) The site provides erosion control by serving as a sedimentation area and filtering basin, absorbing silt and organic matter.
- (10) The site provides sources of nutrients in water food cycles and nursery grounds and sanctuaries for fish.



## Legal Cases Related to Wetlands in Michigan

*Submitted as part of the Model Wetlands Ordinance Project  
to the MDEQ Coastal Management Program  
by the Huron River Watershed Council  
March 31, 2002*

### **Overview**

As part of its project to develop a model wetlands ordinance, the Huron River Watershed Council (HRWC) conducted a literature search for case histories involving legal challenges to wetland regulations. HRWC searched through the legal summaries section of the last 20 years of the *Planning and Zoning News* publication, contacted every community in Michigan on record with the MDEQ as having a wetlands ordinance, and conducted several internet-based searches through newspaper and legal databases.

### **Conclusions**

The first conclusion to draw from this initial survey of legal cases regarding wetlands laws is that very little information is readily available describing local courts, where most of the wetlands-related cases occur. In order to obtain a more complete picture of the legal environment, much more time is needed to travel to each community to meet with its attorney and search through its legal files. Phone surveying was helpful, but often the government representative with whom we spoke (whether they were the clerk, planner, or building official) was not able (or willing) to conduct what they said would be an extensive file search. Indeed, even when we were able to obtain a written decision on a particular case, key information was often missing. Apparently, decisions made in the district and circuit courts are not organized or summarized in any particular way, as State Court records are.

The second conclusion to draw is that most lawsuits that we were able to find were settled in some way before a definitive decision needed to be made by a judge. Out of seven wetlands related cases about which we were able to find information, only two resulted in a decision regarding the wetlands ordinance. In the Superior Township case, the Judge decided for the developer, agreeing that the building of a farm road is a “permitted activity” not requiring a permit from the wetlands ordinance. The Judge did cite the provision of the ordinance that requires farm roads, even though they are exempt, to be “constructed and maintained in a manner to assure that any adverse effect on the wetlands will be otherwise minimized.” So, the township can still prosecute the developer if he fails to minimize the road’s effects on wetlands. In the Master Key Northern v. Ann Arbor case, the judge categorically sided with the City, saying that their wetlands ordinance is indeed constitutional.

**Cases decided out of court (i.e. before a judge could make a final decision about an ordinance):**

Cisne vs. City of Orchard Lake Village

The Cisne's owned 3.79 acres on Orchard Lake. They proposed to build a 22' wide, 140' long home on 7' stilts in a wetlands. They applied for and received a permit from MDEQ (after two years of negotiations), but were denied a local permit. They filed litigation. The MDEQ approval was appealed by Orchard Lake Shore Property Owners Association. That appeal was dismissed by the administrative law judge, but the Association is appealing that decision.

The City and the Cisne's agreed to a consent judgement that granted the wetlands permit with many conditions. Conditions include: installation of erosion controls during construction, removal of invasive species from the wetland, a restrictive covenant prohibiting removal of any native vegetation, acknowledgement that sewer and water may not be available (which would then void the permit altogether), planting of new shrubs in wetland, that the boardwalk be constructed by hand and not cause removal of any vegetation, and that vegetation must continue to grow under house and boardwalk. The house has never been built.

*Final decision:* The DEQ's approval of a permit pressured the local community into reaching a consent agreement, so the legal process never reached the point where a court really ruled anything regarding the legality of their wetlands. However, the consent judgement did give the community the power to condition a permit on a number of stringent conditions on building in the wetland.

Wixom Wetland Case

The Land and Water Management Division of the MDEQ is currently in a lawsuit regarding a parcel of land in Wixom, Oakland County. Part of the plaintiff's argument is that the local wetland law supercedes the States. The case is still pending.

Waterford Township v. Kurtz

In 1990, property owner Kurtz applied to the MDNR for permission to fill a wetland to install a seawall. The MDNR denied the permit. The Township also informed him he needed to apply for a Township permit. Kurtz began the work anyway in 1991. He refused to cease until the police were called and a cease and desist order was issued. Kurtz continued to work in the area, and the Township obtained a temporary restraining order. .

The Township cited Kurtz for violating their wetlands ordinance. In Oakland County Circuit Court, the Township tried to prove him negligent for damaging the wetland behind his house and sought a permanent injunction to keep him from landscaping the yard, and asked for several thousand dollars in attorney fees. In turn, the property owners filed a counter suit that charged that their constitutional rights had been violated.

All of those conditions were dropped in an out of court settlement, where the court dismissed both suits, saying it was no longer possible to determine the original wetland boundary and therefore whether a violation had occurred. The court also ordered that protection of the remaining wetlands occur.

*Final decision:* Dismissal of case and each party agrees to drop all legal actions. Wetland will be delineated, soil erosion fencing will be placed along wetland boundary, and landscaping will occur up to the wetland boundary.

#### Genoa Township:

Property owners were denied a building permit to build within the 25 foot setback from a wetlands. They appealed to the zoning board of appeals and were denied. They filed a suit claiming the denial of their appeal was improper, because a variance was necessary for reasonable use of the property, and since the property owners' consultant determined wetland boundaries that were different from those determined by the Township. They claimed that the zoning restrictions on their property rendered it unusable, and that is a takings. An official determination was never made, but it appears the Court sided with the property owners, who revised their original application for a land use permit and it was approved.

#### Charter Township of Independence

A property owner obtained a wetlands permit from the State, but the Township denied the project under the local ordinance. The property owner brought a lawsuit against the township in court. The DEQ's approval of a permit pressured the local community into agreeing to allow him to build a scaled back version of the original.

#### West Bloomfield:

They have had several cases. According to sources familiar with those cases, none of the challenges resulted in anything being struck down in court that is in the model ordinance.

#### **Cases where a court did make a final decision regarding a local ordinance:**

##### Court of Appeals: Frericks v. Highland Township, March 13, 1998

Frericks purchased property zoned A1 (10 acre lots) and requested rezoning to R1B (1.5 acre lots). The Township Board approved rezoning to R1A (3 acre lots). Frericks sued, saying R1A was a taking. The trial court ruled this density was unreasonable and arbitrary, since this lot size is not necessary to protect legitimate interests about pollution, septic systems, increased traffic, threat of inadequate fire protection, or conformance to master plan.

Frericks then appealed to the Court of Appeals, charging that the way the ordinance calculated allowable buildable area (it didn't include wetlands and floodplains) was invalid since regulations of wetlands was under the purview of the State. The Court disagreed.

*Conclusion:* While this decision was not directly involving a wetland ordinance, it has important implications for local ordinances. Local communities can remove environmentally sensitive areas when calculating allowable buildable area on development parcels.

Superior Twp vs. Patrick Sieloff

Superior brought charges against property owner Sieloff in 1998. Sieloff was engaged in farming activities – constructing a farm road and planting trees. The court ruled that while the building of a farm road is an activity permitted without a wetlands permit, the ordinance does reference a standard the defendant has to meet in the building and maintenance of the road. He can put in the farm road as long as the road is constructed and maintained in a manner to assure that any adverse effect on the wetlands will be otherwise minimized.

*Conclusion:* The charges against the property owner by Superior Township are premature, because the building of a farm road is a permitted activity under the ordinance. But the township can prosecute if the road fails to minimize effects on wetlands.

Zealy v. City of Waukesha, 548 NW2d 528 (1996) *Note: this case occurred in Wisconsin, not Michigan, but the final decision is an important one regarding takings law.*

The property at issue was a 10.4 acre plot of land that had been zoned, at different times, for agricultural uses, for residential uses, and for business uses. By 1985, 8.2 acres of Zealy's property were zoned as a conservancy district, because of wetlands on that part of the property. Of the remaining portion of Zealy's property, 1.57 acres were zoned for residential use, and .57 acres were zoned for business. Under the rezoning, the property classified as a conservancy district could not be used for residential purposes. Zealy claimed that the reclassification of the 8.2 acres of his land from residential to a conservancy district decreased the value of that part of his property from \$200,000 to \$4,000. The trial court dismissed Zealy's claim, holding that the parcel should be considered as a whole.

The appeals court reversed, on the rationale that the property should be viewed with respect to its different segments, and not as a whole. The Wisconsin Supreme Court reversed the appeals court and affirmed the decision of the lower court. The facts of Zealy's case showed that the conservancy zoning only applied to part of his property, not all of it. The zoning only reduced (rather than destroyed) the value of Zealy's property, viewed as a whole. According to the Supreme Court of Wisconsin, there was no taking.

Master Key Northern v. City of Ann Arbor

In 1998, Master Key Northern applied for site plan approval and a wetland use permit for a development in the City of Ann Arbor. The planning commission denied the site plan and the permit. Master Key Northern filed a lawsuit alleging that the Wetland Protection and Natural Features chapters of the City Ordinance violated due process and were beyond the power of a local community. The Court disagreed, saying that the plaintiff

was not without legal remedy since he did not file an appeal. The Court also wrote that the City does have the discretion to approve or deny site plans, and it is done duty-bound to approve them, as the plaintiff claimed. The Court also wrote that the case is not “ripe” for a consideration of takings because all the appeals had not yet been exhausted. The Court also ruled that the wetlands ordinance is constitutionally valid in that it is not vague.

*Final decision:* the City of Ann Arbor Wetland Protection Section, which is part of its zoning ordinance, is constitutionally valid, and provides the proper process.

# ATTACHMENT G

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A Primer on Muck (Dr. Douglas Pullman)

## About Muck: A Primer

G. Douglas Pullman, Ph.D.  
Aquest Corporation  
Flint, MI  
2008

Statement:

Aquatic plant control leads to the build up of muck on the bottom of the lake!

Response:

Muck, the dark, smelly, loosely compacted “goo” that accumulates on the bottoms of most lakes, is generally thought to be undesirable and a sign that “things have gone wrong”. It is a commonly held belief among lakeside property owners, that aquatic plants are a prime contributor to the build up of muck. This belief is sometimes used to steer lake management programs away from the use of aquatic herbicides. However, sometimes the argument is used to support the position that weed control must be implemented to save the lake from being filled in with muck. But it doesn't matter what the arguments are, muck is a complicated matter and simple inferences, such as those made to support or influence lake management programs usually fail to acknowledge the complex processes involved in the creation and accumulation of muck. So, what is muck and where does it come from?

First, muck is essentially a complex blend of organic matter that contains varying amounts of some inorganic substances. Books have been written about the processing of organic matter in aqueous environments, so this will provide only a brief overview of the key processes. The organic matter in muck enters lakes from outside sources, such as terrestrial plants, trees, etc. as well as many internal sources such as aquatic plants and algae. Organic matter is changed and consumed very rapidly in aquatic environments. Microbes are the primary operators in the processing of organic matter particles in aquatic environments, but they do receive an “assist” from other organisms. Macroinvertebrates chew on particulate organic matter, shred it, and break it up as they use the organic content and the bacteria that grow on the organic matter as a primary food source (similar to the way we enjoy yogurt or cheese). This breaks the organic matter down into particle sizes that are easier for the microbes to use and digest. Approximately 2/3 of the organic matter in tree leaves and other terrestrial plants is broken down in less than a few days. What is left is a very resilient type of organic matter that is very slow to be broken down by microbial communities. This resilient or refractory organic matter is dominated by compounds such as lignin and other “structural” materials that are used to give terrestrial plants shape and rigidity. Wetland plants contain a lot of this kind of organic matter and even though the more labile (break-down-able) organic matter is broken down quickly within the wetland, a lot the more refractory organic matter flows out into lakes where it becomes a major component of

muck. Once the muck is buried or becomes only a few millimeters thick, a bottleneck in the breakdown process is created. The lack of oxygen, nitrate, sulfate, or even carbon dioxide, which is needed by the microbes, can arrest the breakdown process or impede the rate of break down so that the “muck” begins to accumulate in the bottom of the lake. Once the bottleneck is created, it is virtually impossible to overcome and the organic matter will just continue to accumulate. Interestingly, that’s how oil is formed. Studies have demonstrated that aeration or even nitrate additions do little to break the bottleneck and “jump start” the break down process, even though consumers spend thousands of dollars on all sorts of products and devices that claim to “break down muck”. The only way to get rid of muck is to remove or displace it.

So, what about aquatic plants? Aquatic plants simply do not have to make the structural materials that are made by terrestrial plants because they are not needed to maintain shape or rigidity in water. Submersed aquatic plants use air or gasses to stand up in the water column. Consequently, the amount of refractory organic material that is produced by aquatic plants is relatively small compared to terrestrial plants. That’s why terrestrial and wetland plants with above water leaves and stems, contribute far more to muck build up than do aquatic plants. In other words, the big culprits in the formation and accumulation of muck are the plants that surround lakes, not the ones that grow in the lakes. However, aquatic plants do play other roles in the creation and accumulation of muck. Inorganic substances accumulate on the outer surfaces of aquatic plants when they photosynthesize. Algae do the same thing, and these inorganic substances, which are usually pale in color, can contribute to the muck accumulation rate. The relative “blame” for this kind of deposition depends on water chemistry and the relative contribution of organic matter from terrestrial sources.

There are many fascinating things to consider about muck; however, most lake property owners consider muck to only be a nuisance. The most important thing that people can learn about muck is that most of it originates “outside” of the lake. Property owners need to do everything they can do to keep leaves, and soils from eroding or entering into lakes where they will accumulate on the bottom. This is part of good lake stewardship.



# ATTACHMENT H

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Preliminary Lake Stewards Program Information

## Preliminary Cedar Lake Stewards Program

The Cedar Lake Stewards Program recognizes lakefront residents who enact good shoreline practices that protect the water quality of Cedar Lake. These practices include native plant buffers and lakescaping, good septic system maintenance, phosphorus-free fertilizers and fertilizer buffers near the shore. Residents that complete the program checklist below qualify to become a Cedar Lake Steward and are recognized with a flag they can post in their yard and in the AICLA newsletter.

Options for program requirements:

- \_\_\_\_\_ **Installation of a native plant buffer near the shore** (Minimum 20 feet from the shoreline; turf grass does not qualify as native buffer. Native and other rooted plants that do not require fertilizing within the shoreline. Only native plants can be planted within the water zone and no more than 60% of the shoreline can be used as a developed, sandy beach.)
  
- \_\_\_\_\_ **Septic system clean-out every 3-5 years, depending on usage** (If clean-out is not needed within 5 years, the applicant must provide proof of a septic system inspection by a professional service as part of the Lake Stewards application/tracking.)
  
- \_\_\_\_\_ **No use of fertilizers for lawn and garden care, or at a minimum, use of phosphorus free fertilizers once per year**
  
- \_\_\_\_\_ **Maintain a buffer along the shoreline where no fertilizer is applied** (Minimum of 30 feet from the shoreline.)
  
- \_\_\_\_\_ **Limit the pumping of lake water for personal/irrigation uses<sup>1</sup>**
  
- \_\_\_\_\_ **Practice good fishing practices** (1) No disposal of live bait in Cedar Lake, 2) no fishing in areas where fish habitat has been enhanced, and 3) release of fish below a certain size [determined by fisheries management recommendations].)
  
- \_\_\_\_\_ **Disinfect boats and PWC when transferring from another lake into Cedar Lake**
  
- \_\_\_\_\_ **Removing leaves and grass clippings from the lawn and proper disposal or composting to avoid entry into lake** (In addition, note that residents must commit to no dumping of any kind into the lake.)

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<sup>1</sup> Exact criteria should be developed once augmentation pilot is complete (e.g., No pumping November-May; limit pumping to once/week for not more than 30 minutes from June-September; no pumping when lake level is greater than X inches below legal limit.)

Note: Break walls form a barrier between upland shoreline areas and the lake. They limit can limit native plant growth in this transitional areas, which serves as important habitat for both aquatic and upland wildlife species (such as insects, birds, and amphibians). Lake riparians are highly encouraged to leave or restore shoreline areas to a more natural state, although this will not likely be a requirement of the Lake Stewards program. In order to encourage participation in the program, it is recommended that properties owners with break walls still be able to become a lake steward by fulfilling other requirements and best practices. It is important to note that many residents have purchased homes where break walls already exist, have built break walls with DNRE permission/proper permits, and that removal of certain established break walls may be costly, dangerous, and/or risk further erosion/sediment deposition into Cedar Lake.

# ATTACHMENT I

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Education Program Priorities

# Educational Program Strategy

Topic	Priority
<b>Lakescaping</b>	<b>1</b>
[Lakescaping buffer demonstration project and educational signage project near the causeway with Lake Board and LSPOA partnership. The project should involve planning, designing and planting a native buffer strip on a portion of the causeway with a sign to educate residents and lake users how buffers can provide benefits to the lake, deter nuisance waterfowl, and create habitat. Partnering with a local plant nursery or MSU master gardener to bring in plants to educate lake residents on the aesthetic value of natives would help encourage lake residents to adopt the practice of lakescaping.]	
<b>Invasive Species Education (for Non-AICLA Members and emerging issues for everyone)</b>	<b>1</b>
[The AICLA provides education to members and non-members through regular meetings on invasives species in and around Cedar Lake. The WMP calls for additional educational opportunities for lake residents that do not attend these meetings. All lake residents can be updated on invasive species current issues through the AICLA newsletter, <i>Whispering Waters</i> . This avenue would be a low cost option for the Lake Board to disseminate important, up-to-date information on the status of invasives in the watershed.]	
<b>Benefits of Wetland Protection</b>	<b>1</b>
[Information on this topic could be disseminated via a newsletter or through the summer meetings, whereby residents are educated on how wetlands protection ordinances work, how conservation easements work, what on-the-ground work is involved in wetland restoration, and the benefits wetlands project will provide in the Cedar Lake watershed. The main educational objective would be to get support from lake residents on protecting the wetlands in the northwest and to provide them with specific information about a possible wetlands ordinance.]	
<b>Educational Material from LSPOA on Home Flood Protection</b>	<b>1</b>
[As part of the WMP, LSPOA will provide educational materials to their membership on home protection options to reduce the incidence of flooding during wet seasons. This educational material could be disseminated through literature or workshops put on by LSPOA with professionals in the flood protection industry to assist homeowners in retrofitting their homes to protect against flooding.]	
<b>Lawn Maintenance Practices</b>	<b>1</b>
[Include the specifications of buffer size, no-mow areas, and P-free fertilizer boundaries away from lake in the WMP brochure to educate homeowners on WMP recommendations and	

Priority Codes: 1 = 1-3 years  
2 = 3-5 years  
3 = 6-10 years

benefits of improving lake practices for lake protection. Other information can be disseminated through the lakescaping buffer project, newsletters, and meetings. The Lake Stewards program will also be a primary source of information to encourage and promote good practices and increase adoption.]

### **Septic System Maintenance**

**1**

[Septic system maintenance education was initiated during the WMP planning process with the help of the AICLA. This workshop series gave insight on how to best get participation at workshops and provided useful contacts with local health officials and MSU Extension. As an extension of this effort, additional information about proper septic system maintenance and how these systems can impact the lake should be given to the public through regular AICLA meetings or written materials initiated and distributed by the Lake Board via a local newsletter, newspaper or other avenue.]

### **Boats, Bait and Birds: Preventing the Spread of Aquatic Invasive Species**

**2**

[A workshop or newsletter series on ways in which invasive species spread from lake to lake. The series will identify widespread invasive species, those already found in Cedar Lake, and new threats. One of the main focuses will be on specific practices that homeowners and lake users should implement to stop the spread of unwanted invasive species.

### **Know Your Zoning Rules and Regulations**

**3**

[This workshop or written series would educate lake residents on all of the existing ordinances and zoning rules that are in place to protect water quality. It will work to inform them of rules on clearing lots for construction, building setback requirements, the need for wetlands permits in particular areas and sized properties, and any other rules or regulations that are not currently followed regularly, well-known, or require initiative by the property owner. This educational effort could also prepare the public for future rules, familiarize them with ordinances and regulations used on other lakes, or prompt a discussion for public feedback on regulations.]

### **Keeping Waste out of the Lake**

**3**

[This education objective could be presented at an AICLA meeting or other public forum. The relevant materials include reminding riparian homeowners about proper disposal of pet waste (keep it out of yards and lake), how to deter waterfowl from entering your yard (for nutrient and *E. coli* prevention), and touch on proper septic system maintenance and clean out. The workshop or meeting could introduce the idea of a waterfowl/geese feeding ordinance that would work to prevent attracting waterfowl to the lake. Excessive use of shoreline areas by waterfowl can cause problematic levels of *E. coli* and is a source of excess nutrients.]

*Priority Codes: 1 = 1-3 years  
2 = 3-5 years  
3 = 6-10 years*

# ATTACHMENT J

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## Land Protection Materials:

- 1) PA 446 Fact Sheet
- 2) Tax Benefits for Conservation Easements Brochure

# A Powerful New Incentive for Private Land Conservation

## Michigan Public Act 446 of 2006

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### What Does Public Act 446 Do?

Under current Michigan law, the taxable value of a parcel of property may not increase from one year to the next by more than 5% or the increase in the consumer price index, whichever is lower, until there is a transfer of ownership. When the property is sold or transferred, the assessment is “uncapped” and the parcel is taxed upon its state equalized value (SEV: 50% of its true cash value). This reassessment upon transfer creates a “pop-up” property tax.

P.A. 446, introduced as Senate Bill 1004, eliminates the “pop-up” property tax on the transfer of lands enrolled in a voluntary conservation agreement (also known as “conservation easement”).<sup>1</sup>

### How Does This Benefit Conservation?

Until the signing of Senate Bill 1004 on December 7, 2006, property taxes on conservation lands, like developed lands, jumped dramatically upon their sale or transfer. Property taxes on conservation lands rose significantly even though their development is permanently limited.

This provided a disincentive for landowners to enter into conservation agreements. To afford the higher taxes, new landowners needed the option of developing the land. The elimination of the pop-up tax on conservation lands means that both current and future landowners have a strong incentive to keep the affected lands intact with habitat, environmental and scenic benefits. This law gives protected conservation property the same tax treatment as protected farmland.

### How Does This Benefit Private Landowners?

The Act prevents the taxable value of conservation property from “popping-up” to the state equalized value when it is transferred. This means a potential direct tax savings of hundreds or thousands of dollars per year for new owners of the land.

### What’s an Example of How the New Law Works?

An 80-acre non-farm property with a current taxable value of \$43,000 and a state equalized value of \$252,000 would have been subject to \$4,395 in annual property tax payments after transfer. Under the new law, if the 80 acres are all enrolled in a conservation agreement, annual property taxes will remain at their current level after transfer -- \$750 per year. This means **an annual savings of \$3,645**. Over a 50-year span, the new landowner will realize an estimated \$149,131 in value from the change.

### How Do I Find Out More?

Contact your local land conservancy, accountant and tax advisor to learn how the new law could benefit you.

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<sup>1</sup> Residences and buildings on the lands are still subject to reassessment to the current SEV.





## USING THE CONSERVATION TAX INCENTIVE

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JULY 2008



Congress recently extended, through 2009, a Federal tax incentive for conservation easement donations that has helped thousands of landowners conserve their land.

If you own land with important natural or historic resources, donating a voluntary conservation easement (also called conservation agreement) can be one of the smartest ways to conserve the land you love, while maintaining your private property rights and possibly realizing significant federal tax benefits.

This brochure summarizes the conservation easement tax incentive and provides answers to some frequently asked questions. The incentive:

- Raises the deduction a donor can take for donating a conservation easement from 30 percent of his or her income in any year to 50 percent;
- Allows qualifying farmers and ranchers to deduct up to 100 percent of their income; and
- Extends the carry-forward period for a donor to take tax deductions for a voluntary conservation agreement from 5 to 15 years.

This is a powerful tool for allowing modest-income donors to receive greater credit for donating a very valuable conservation easement on property they own. For land trusts, this translates to the possibility of protecting much more land through the use of conservation easements.

It is important to note that the incentive *only applies to easements donated between 2006 and 2009*. The Land Trust Alliance will work to make this change permanent, but as it stands it will expire at the end of 2009.

Please check our website frequently for the latest information on this topic. Go to [www.lta.org/policy/tax-policy](http://www.lta.org/policy/tax-policy).





# FREQUENTLY ASKED QUESTIONS

## A. WHAT IS A CONSERVATION EASEMENT?

A conservation easement is a legal agreement between a landowner and a land trust or government agency, that permanently limits uses of the land in order to protect its conservation values. It allows landowners to continue to own and use their land, and they can also sell it or pass it on to heirs.

When you donate a conservation easement to a land trust, you give up some of the rights associated with the land. For example, you might give up the right to build additional structures, while retaining the right to grow crops. Future owners will also be bound by the easement's terms. The land trust is responsible for making sure the easement's terms are followed.

Conservation easements offer great flexibility. An easement on property containing rare wildlife habitat might prohibit any development, for example, while an easement on a farm might allow continued farming and the addition of agricultural structures. An easement may apply to all or a portion of the property, and need not require public access.

### Qualifying For A Tax Deduction

A landowner sometimes sells a conservation easement, but usually easements are donated to a land trust. If the donation benefits the public by permanently protecting important conservation resources, and meets other federal tax code requirements, it can qualify as a tax-deductible charitable donation. Easement values vary greatly; in general, the highest easement values result from very restrictive conservation easements on tracts of developable open space under intense development pressure. In some jurisdictions, placing an easement on your property may also result in property tax savings. To find a land trust near you to discuss your options, please visit [www.lta.org/community/](http://www.lta.org/community/).

## B. HOW DOES THE EXPANDED TAX INCENTIVE WORK?

### 1. Can you give me an example of the difference the new change makes?

Under the previous rules, a landowner earning \$50,000 a year who donated a \$1 million conservation easement could take a \$15,000 deduction for the year of the donation and for an additional 5 years—a total of \$90,000 in tax deductions.

The new rules allow that landowner to deduct \$25,000 for the year of the donation and then for an additional 15 years. That's a total of \$400,000 in deductions. If the landowner qualifies as a farmer or rancher, he could take a maximum of \$800,000 in deductions for his million dollar gift.

## 2. Can anyone deduct more than the value of his or her gift?

One can never deduct more than the fair market value of the gift. This change simply allows landowners who previously could not deduct the full value of their gift to deduct more of that value.

## 3. Who qualifies as a farmer or rancher?

The new law defines a farmer or rancher as someone who receives more than 50 percent of his or her gross income from “the trade or business of farming.” The law references an estate tax provision [Internal Revenue Code (IRC) 2032A(e)(5)] to define activities that count as farming. Specifically, those activities include:

- cultivating the soil or raising or harvesting any agricultural or horticultural commodity (including the raising, shearing, feeding, caring for, training, and management of animals) on a farm;
- handling, drying, packing, grading, or storing on a farm any agricultural or horticultural commodity in its unmanufactured state, but only if the owner, tenant, or operator of the farm regularly produces more than one-half of the commodity so treated; and
- the planting, cultivating, caring for, or cutting of trees, or the preparation (other than milling) of trees for market.

The qualified farmer or rancher provision also applies to farmers who are organized as C corporations. For an easement to qualify for the special treatment, it must contain a restriction requiring that the land remain “available for agriculture.”

IRS guidance on these parts of the law is available at [www.ita.org/policy/tax-policy/](http://www.ita.org/policy/tax-policy/).

## 4. Do these changes apply to gifts of land?

This expanded incentive does not apply to gifts of land in fee; it only applies to gifts that qualify under IRC 170(h)(2), such as conservation easements. A landowner considering donating their land should consult with an attorney to determine whether they should consider changing the structure of their gift to take advantage of this new incentive.

## 5. Does this incentive only apply to conservation easements?

The expanded incentive applies to all donations covered in IRC section 170(h)(2), which includes donations of the entire interest of the donor other than a qualified mineral interest; a remainder interest; or a permanent conservation or historic preservation easement.

## 6. What is the timeline for this expanded incentive?

The incentive applies to all easements donated between 2006 and 2009. The Alliance will work hard to make this change permanent, but as it stands it will expire at the end of 2009. If a donor qualifies under this provision, they can continue to apply its formulas to the amount of their contribution that they carry over into years beyond 2009.



## 7. What other restrictions apply?

Conservation easement donations are subject to the same restrictions as they were before. For example, easements must meet the “conservation purposes” test defined in the existing law; they cannot be donated as part of a “quid pro quo” agreement where the easement was given in exchange for something else, such as a building permit; and they must be donated to a qualified organization—a governmental unit or a publicly supported charity that has “a commitment to protect the conservation purposes of the donation, and...the resources to enforce the restrictions.”

See [www.ita.org/policy/tax-policy/](http://www.ita.org/policy/tax-policy/) for the Treasury Regulations on conservation easement donations.

## 8. Will donors who use this provision be audited?

Taking advantage of this new law will not necessarily affect one's likelihood of being audited. All donors should note, however, that the IRS has greatly increased the number of tax returns it audits. The IRS has also indicated that high value donations of property—including donations of conservation easements—will receive more attention from the IRS than most tax returns.

That makes it particularly important for a donor to know and follow the law; to utilize a reputable professional appraiser who has experience in the appraisal of conservation easements; and to donate to a well-established reputable land trust that has adopted and implemented *Land Trust Standards and Practices*.

## C. RECENT RULES AFFECTING EASEMENT DONORS

### 1. How do other new laws affect easement donations?

A 2006 law (PL109-280) redefines who is a “qualified appraiser,” and gives the IRS the power to issue new regulations on appraiser qualifications. This is important: appraisers need to show donors that they are qualified under the new law and any new Treasury Regulations or guidance that may follow from it. The law states that a qualified appraiser must “demonstrate verifiable education and experience in valuing the type of property subject to the appraisal.”

### 2. How does the law affect easements that protect both conservation and historic preservation values?

The 2006 law tightened the rules for easements on “certified historic structures.” If you are protecting a property that includes such a structure (e.g., a farm with a historic stone barn that is listed in the National Register) these new regulations may apply to you. Donors and donees of easements protecting historic structures need to understand the 2006 rules, which include a filing fee for donors and specific appraisal requirements.

### 3. Have there been other recent changes affecting easement donations?

Yes! The IRS has changed the instructions for Form 8283, and now asks for additional information from easement donors.

## D. WHAT IS THE LAND TRUST'S ROLE?

Potential easement donors should know that the donation of a permanent conservation easement is a big commitment. They should carefully consider their donation, and should consult with an attorney prior to donating a conservation easement.

Landowners need to understand that donating a conservation easement requires a working partnership with a land trust—and time. Donating an easement requires thought, careful drafting of documents and maps, baseline documentation and a professional appraisal. Land trusts can carefully explain their mission to potential donors, and landowners should understand that a land trust may decline to accept a donation that does not meet both the legal requirements and the land trust's own specific charitable mission and strategic plan.

## ACKNOWLEDGEMENTS

There are so many people to thank who were involved in this conservation tax-incentive victory, that one grand thank you from the Alliance goes out to all of you. We could not have done it without you.

The Alliance has been leading a team effort to achieve this since 2000, when we convened land trust leaders from across the country and a 53-member coalition of national conservation groups to build a consensus on what tax policies would best address the need to expand our conservation work. National land trust organizations, local and regional land trusts, wildlife conservation and sportsmen's groups, and representatives of the ranching and farming community all played important parts in that effort.

This legislation would not have happened without the leadership of Senator Max Baucus (D-MT)—who first introduced a version of it in 1999—and his colleague Senator Charles Grassley (R-IA). Many of their colleagues in the Senate and the House have helped. Land trusts in their states—including the Montana Land Reliance and the Iowa Natural Heritage Foundation—worked hard to show these leaders that the conservation work of land trusts was important to their communities and broadly supported by their constituents. That work provided the foundation for this new conservation tool.

Remember to visit [www.lta.org/policy/](http://www.lta.org/policy/) for the latest information.

*This information is for informational purposes only and should not be construed as legal advice.*

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## ABOUT THE ALLIANCE

The Land Trust Alliance is a national conservation organization representing over 1,600 Land Trusts, and works to save the places people love by strengthening land conservation throughout America. Please visit our website at [www.landtrustalliance.org](http://www.landtrustalliance.org) for more information on:

- Finding a local or regional land trust
- The latest federal tax laws concerning conservation easement donations
- Examples of how private landowners work with land trusts to protect their land
- Publications and resources for landowners

Cover photo: Harlen Persinger, photographer. Bottom cover image: Scott Bauer, USDA/ARS.

Previous panel: (clockwise from cattle image) Keith Weller, USDA/ARS; Tim McCabe USDA/NRCS; Teresa McCaffrey, courtesy of Montana Land Reliance; Scott Bauer, USDA/ARS.



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