



Larks Lake Watershed Management Plan

January 2022

Tip of the Mitt Watershed Council

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Chapter 1: Watershed Characterization

Introduction

Larks Lake is a valuable resource that has been important to many people for several generations of families and visitors. This management plan provides the framework in which to protect, restore, and enhance the waters of Larks Lake for generations to come.

In recent years, Tip of the Mitt Watershed Council has undertaken efforts to create approved watershed management plans throughout their service area. In 2018, a watershed management plan was developed for the Burt Lake Watershed, in which Larks Lake resides, and approved by the Michigan Department of Environment, Great Lakes, and Energy. This management plan, provided to the Larks Lake Association, is an abridged version of the Burt Lake Watershed approved plan.

Watershed Description

Larks Lake is a small, shallow lake located in Center Township in northern Emmet County (Figure 1) with a population of around 600 people. Larks Lake is fed by spring outlets. It is the headwaters of Brush Creek; a tributary flowing into the west branch of the Maple River, and also what is known as the Pleasantview Swamp. Larks Lake is considered an important recreation resource for county residents with access provided at the Center Township Park and boat access at the end of Kaz Road. The Larks Lake Watershed land surface area is 4,640 acres. The Larks Lake Watershed is a small subwatershed of the larger Cheboygan River Watershed, which covers 1,461 square miles (935,000 acres) in Cheboygan, Otsego, Emmet, Presque Isle, Montmorency, and Charlevoix Counties. The Larks Lake Watershed land area makes up 0.5% of the Cheboygan River Watershed.

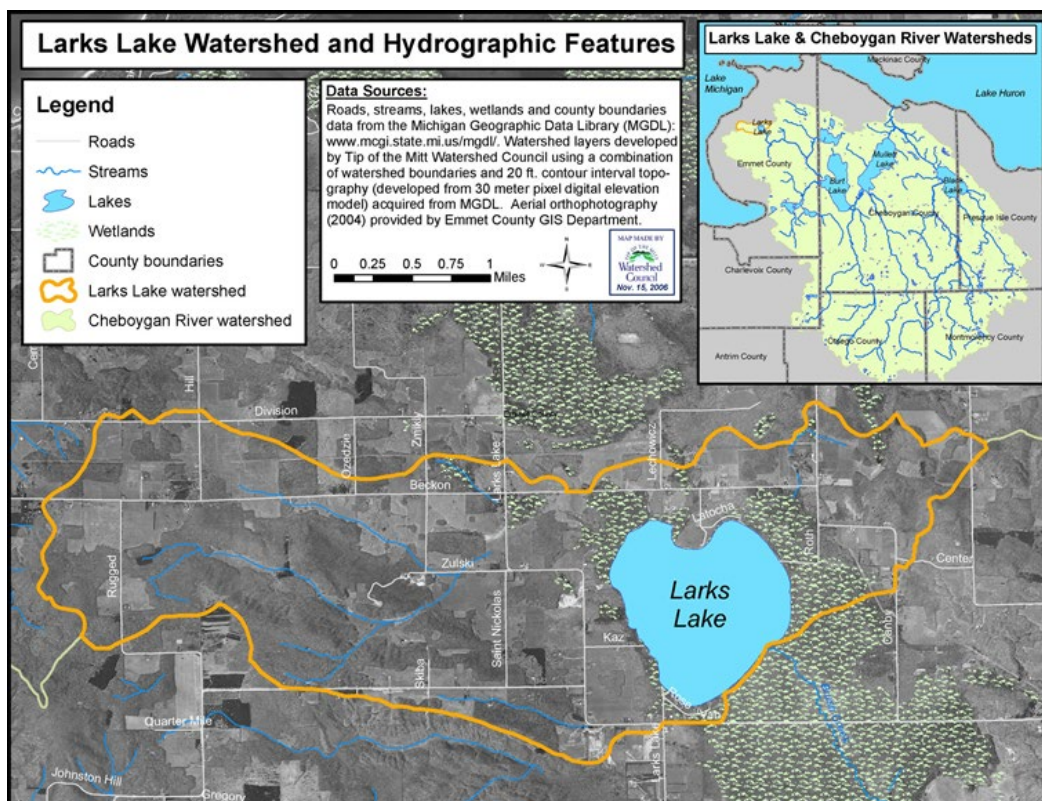


FIGURE 1. LARKS LAKE WATERSHED

Local Government

The Larks Lake Watershed lies within the jurisdiction of the Emmet County government and Center Township. Emmet County administers the zoning for Center Township.

Geology and Soils

Soils are an important watershed feature for many aspects of water resource management, including groundwater recharge, septic system performance, and erosion/sedimentation potential. Soil is the unconsolidated material within six feet of the surface that has been modified from the “parent” glacial deposits by climate, biological processes, and other environmental factors.

In the United States, soils are assigned to four hydrologic soil groups, A, B, C, and D. This describes their rate of water infiltration when the soils are not protected from vegetation, are thoroughly wet, and receive precipitation from long-duration storms. The hydrologic soil groups in the Burt Lake Watershed include mostly A groups, followed by C and D. Group A consists of soils that have high infiltration rates even when thoroughly wet, because of sandy or gravelly, well-draining soils. Groups C and D have respectively slower infiltration rates when thoroughly wet, due to fine texture or clay-rich soils.

The quaternary geology surrounding Larks Lake is glacial outwash sand and gravel and postglacial alluvium; and coarse textured glacial till. Geology in areas adjacent to Larks Lake also include peat and muck (Farrand, 1982). Substrate types within the lake basin include marl, organic silt, coarse and medium sand with pebbles distributed throughout, and fine sand. Organic sediments and silt occur most heavily in the northwest end of the lake, which is adjacent to forested wetland.

Groundwater

Groundwater is critically important for water quality and ecosystem integrity of lakes, streams, and wetlands. Rain, melting snow, and other forms of precipitation move quickly into and through the ground throughout much of the Watershed due to highly permeable (sandy) soils. Gravity causes vertical migration of groundwater through soils until it reaches a depth where the ground is filled, or saturated, with water. This saturated zone in the ground is called the water table and can vary greatly in depth. Figure 6 illustrates groundwater recharges areas throughout the Watershed based on their respective infiltration rates.

In watershed areas with steep slopes, hillsides intersect the water table, resulting in groundwater expulsion at the land surface. The exposed water table causes horizontal groundwater movement, which releases to create seeps and springs that then form or contribute water to streams and wetlands.

The surface waters of the Larks Lake Watershed are dependent upon groundwater inputs. This dependency makes it is extremely important to protect and conserve groundwater resources in the Watershed. The prevailing sandy soils that facilitate groundwater recharge and expedite groundwater transport to surface waters also present a danger to the aquifers, streams, lakes, and wetlands in the Larks Lake Watershed. Although soils are a natural filtration medium, pollutants associated with agricultural activity (e.g., pesticides, herbicides, nutrients) and the urban or residential environment (e.g., metals, automotive fluids, nutrients) can be transported through the ground and contaminate either drinking water supplies or local surface waters fed by groundwater. Furthermore, expanding development, such as road and house construction, alters the hydrologic cycle by replacing natural land cover with impervious surfaces, which impedes infiltration and groundwater recharge. Therefore, protecting groundwater resources must address both the potential for pollutants to reach and contaminate groundwater and the reduction of groundwater recharge due to development.

Water Resources

Larks Lake

Morphometric features of Larks Lake and its watershed are shown in *Table 1*. Larks Lake has a low shoreline development factor. This limits the amount of shoreline influence on water quality. Larks Lake has a watershed to lake size ratio of 7.9:1, which is considered a small ratio. Lakes that have a large watershed relative to lake size are generally more susceptible to nutrient enrichment from nonpoint source than lakes with proportionally smaller watersheds. Fortunately, much of the watershed is currently in land uses that characteristically don't export excessive levels of nutrients.

TABLE 1. LARKS LAKE MORPHOMETRIC FEATURES

Larks Lake Morphometric Features	
Lake Surface Area	591 acres
Watershed Area	4,640 acres
Maximum Depth	7.87 feet
Mean depth	2.62 feet
Maximum length	1.21 miles
Maximum width	1.17 miles
Volume	1,866,543 cubic meters
Shoreline Development Factor	1.13
Shoreline length of Lake	4.0 miles
Watershed Area: Lake Size	7.9:1

Larks Lake is a shallow marl lake, and is naturally shallower than most typical marl lakes. Marl sediments are a mixture of clay, sand, and calcium carbonate from limestone that tends to be soft in texture, which is deposited on firm substrates and aquatic macrophytes. All the major lakes of the Cheboygan River Watershed have moderately “hard” water, in reference to the levels of dissolved calcium and magnesium carbonates originating from the limestone bedrock geology of the Watershed and conveyed via groundwater to surface waters (Fuller, 2006). Marl lake deposits are rich in calcium carbonate that precipitates during the photosynthetic processes of aquatic plants, such as Chara (McDonough, 2002).

Sediment in the northwest cove of the lake is organic muck, and muck deposits are deep in this area. Observational depths vary from about six inches to over five feet in depth, as measured with a paddle at various locations. This section of the lake is adjacent to forested wetlands with peat soils. Locally produced organic matter in peat soils will accumulate and bury underlying mineral substrates (Keddy, 2002). In the northwest cove there is an area with wood fragments below two to three feet of muck soils. This may be due to the presence of the Carbondale soil series, in which wood fragments are a common component below 12 inches of depth (NRCS, 2004).

Pleasantview Swamp

Covering 6,544 acres, this is one of the biggest, uninterrupted expanses of organic soils in northern Lower Michigan. There are areas of forested swamp, shrub swamp, and emergent marshes. Within the Pleasantview Swamp are four “spring ponds” (called The Four Lakes) that form the headwaters of the Maple River. The swamp has more than 30 miles of shoreline on the Maple River, Brush Creek, Larks Lake, and The Four Lakes. It is home to most of Michigan's large reclusive mammals, including bobcat, black bear, and river otter. Bald eagles and ospreys nest in the swamp. Soils consist of Carbondale and Tawas mucks (Hydrologic Soil Groups D

and D/A) with Roscommon mucky sand (Hydrologic Soil Group D) along the margins. Fifty-four percent of the swamp is publicly owned by the State of Michigan (Fuller, 2006).

West Branch of the Maple River

The Maple River is a tributary to Burt Lake. The West Branch of the Maple River originates in a large wetland called the Pleasantview Swamp, and is supplemented by the inflow of Brush Creek which drains from Larks Lake.

Cultural Resources

Native American History

Long before the arrival of Europeans, the northern portion of Michigan's Lower Peninsula was most recently home to the Ottawa (Odawa) Nation. The total population of the Odawa in this region at that time is not known, although the summer population has been estimated to range somewhere between 30,000 and 100,000.

The Odawa made their home here for hundreds of years, maintaining villages along the Lake Michigan shoreline, and along the Inland Waterway. These northern villages were primarily occupied with the tribes traveling to rivers along the southern coast of Lake Michigan during winter. After the spring maple syrup season was completed, the tribes returned north to the Little Traverse Bay, Cross Village, and the Inland Waterway. These villages were connected by a series of footpaths which allowed natives to travel overland (many of today's roads and highways roughly follow these paths). More important than footpaths for travel were the waterways, because large distances could be covered quickly. Native Americans utilized the Inland Waterway, in part, as a means of traveling from Lake Huron to Little Traverse Bay, avoiding the perilous journey through the Straits of Mackinac and around Waugoshance Point. Not surprisingly, the name Cheboygan is Algonquin meaning "place for going through". Using birch bark canoes well adapted for rough waters and light enough to carry on portages, Native Americans could quickly travel from Little Traverse Bay to hunting grounds, seasonal fishing spots, and neighboring villages along the Crooked River, Burt Lake, Indian River, Mullett Lake, and the Cheboygan River.

The marshes, bogs, and swamps along the Inland Waterway are rich in plants that were utilized by the Odawa for fiber, medicines, and foodstuffs. Bulrushes, grasses, cattails, and sedges found in today's marshes were extensively harvested for baskets, shelter, fish nets, and clothing. Sphagnum moss, a common plant of many wetland environments, was stuffed into boots and clothing for insulation and wetland shrubs such as red-osier dogwood and some common mosses were used for dyes. Numerous wetland plant species were used for their medicinal properties: Labrador tea for the treatment of ulcers, willow for indigestion, balsam fir for headaches, and tamarack for burns.

Waterfowl, which were attracted to the vast wetlands in the area, gathered in great numbers during both the spring and fall migratory seasons and were a primary source of food. Freshwater mussels and clams were harvested from shallow waters and numerous types of fish, from whitefish to lake sturgeon were netted or speared throughout the warm months.

Fish and Wildlife

Fish

Larks Lake is used as a recreational warm water fishery. Angler reports in recent years have indicated a decline in populations of sport fish. A variety of fish species (bluegill, yellow perch, smallmouth bass, largemouth bass, and northern pike) were stocked by the MDNR in the early 1930's until 1959. The Michigan Department of

Natural Resources Fisheries Division states that the fish community at present is typical for a shallow lake with limited nutrient availability as a result of lake morphology (i.e. low vegetation levels and marl substrate) (MDNR, 2005). An additional study has cited the inability of Larks Lake to support a healthy game fish population due to the lack of lake productivity (Anderson and Ridley, 1993).

While Larks Lake has a limited ability to support a larger fishery, the warm water fishery is potentially threatened by an increase in sediment and inadequate habitat. There may also have been an increase in angling pressure in recent years, though evidence of hooking sores on a number of largemouth bass collected in a recent survey indicates that many fish are caught and released (MDNR, 2005). Throughout the watershed, the warm water fishery is impaired due to the occurrence of mercury, which has resulted in fish consumption advisories. The primary source of mercury is atmospheric fallout.

Wildlife

Larks Lake has an abundance of wildlife that can be seen throughout the year. Most notably, a pair of nesting loons, bald eagles, and sandhill cranes.

An abundance of native freshwater mussels have been observed on Larks Lake. High-density mollusk populations are common in marl lakes (McDonough, 2002). Freshwater mussels are one of the most endangered groups of animals in North America, and Michigan supports globally significant populations for several freshwater mussel species that are federally listed as endangered or candidates for federal listing (MNFI, 2020).

Wild Rice

Wild rice (*Zizania palustris*) is an annual plant that is thought to have once been abundant through Michigan but has all but been nearly extirpated in northern Michigan. Reasons for this is due to shoreline development, increased recreation, predation, herbicide application, and climate change. Wild rice prefers shallow water with mucky or muddy bottom where there is a slight current.

Wild rice, also called manoomin (meaning “the good berry”), is a culturally significant species to the Anishinaabe people.

Aquatic Invasive Species

Aquatic invasive species are non-native species introduced to an aquatic ecosystem that causes environmental and/or economic harm. Aquatic invasive species have come to the forefront of issues impacting our lakes, streams, and wetlands.

The Larks Lake Watershed has few known aquatic invasive species. Some invasive species are on the verge of entering the Watershed as they expand their respective ranges. These species tend to be well established in the southern United States and are advancing northward. The Great Lakes also remain a potential source of invasives for inland lakes as many species spread via connecting waterways. The only two known aquatic invasive plants found in the watershed are phragmites and purple loosestrife.

Phragmites

Phragmites (*Phragmites australis*), also known as the common reed, is an aggressive wetland invader that grows along the shorelines of water bodies or in water several feet deep. It is characterized by its towering height of up to 14 feet and its stiff wide leaves and hollow stem. Its feathery and drooping inflorescences (clusters of tiny flowers) are purplish when flowering and turn whitish, grayish, or brownish in fruit. Eventually, Phragmites become the sole dominant plant in many of these wetlands at the expense of native plants and animals that depend on these native habitats. There are several known occurrences of Phragmites within the

Watershed. These stands are concentrated in the Sturgeon River Watershed (upper Watershed) and near the mouth of the Maple River. More stands elsewhere within the Watershed have not been documented.

Purple loosestrife

Purple loosestrife (*Lythrum salicaria*) is an invasive wetland plant. Imported in the 1800s for ornamental and medicinal uses, purple loosestrife poses a serious threat to wetlands because of its prolific reproduction. Native to Europe and Asia, purple loosestrife can be identified by its purple flowers which bloom from June to September. Purple loosestrife produces square woody stalks 4 to 7 feet high. Leaves are heart or lance shaped and flowers have 5 to 7 petals. Due to the long flowering season, purple loosestrife plants have the ability to produce millions of seeds each year. In addition to seeds, purple loosestrife can also produce vegetatively by sending up shoots from the root systems. The underground stems can grow up to a foot each growing season. Purple loosestrife is widely distributed throughout the Watershed, particularly within the Crooked River Watershed. Efforts to manage it have helped to curtail its spread. Most stands tend to be patchy and are located in roadside ditches.

Land Use

Pre-settlement land cover (or vegetation present in about 1800) in the Larks Lake watershed was primarily Beech-Sugar Maple-Hemlock forest in the upland areas and cedar swamp in wetland areas (Fuller, 2006). Present day land cover within the watershed consists largely of forest, grassland, and agriculture, with minor areas of agricultural and residential land (Table 2). A land use map can be seen in Figure 2.

TABLE 2. LAND USE

Land cover type	Acreage	Percentage
Forest	1856.37	35.54%
Grassland	1262.17	24.16%
Agriculture	825.06	15.80%
Wetland	400.62	7.67%
Scrub/Shrub	165.32	3.16%
Urban/residential	102.71	1.97%
Barren	9.30	0.18%

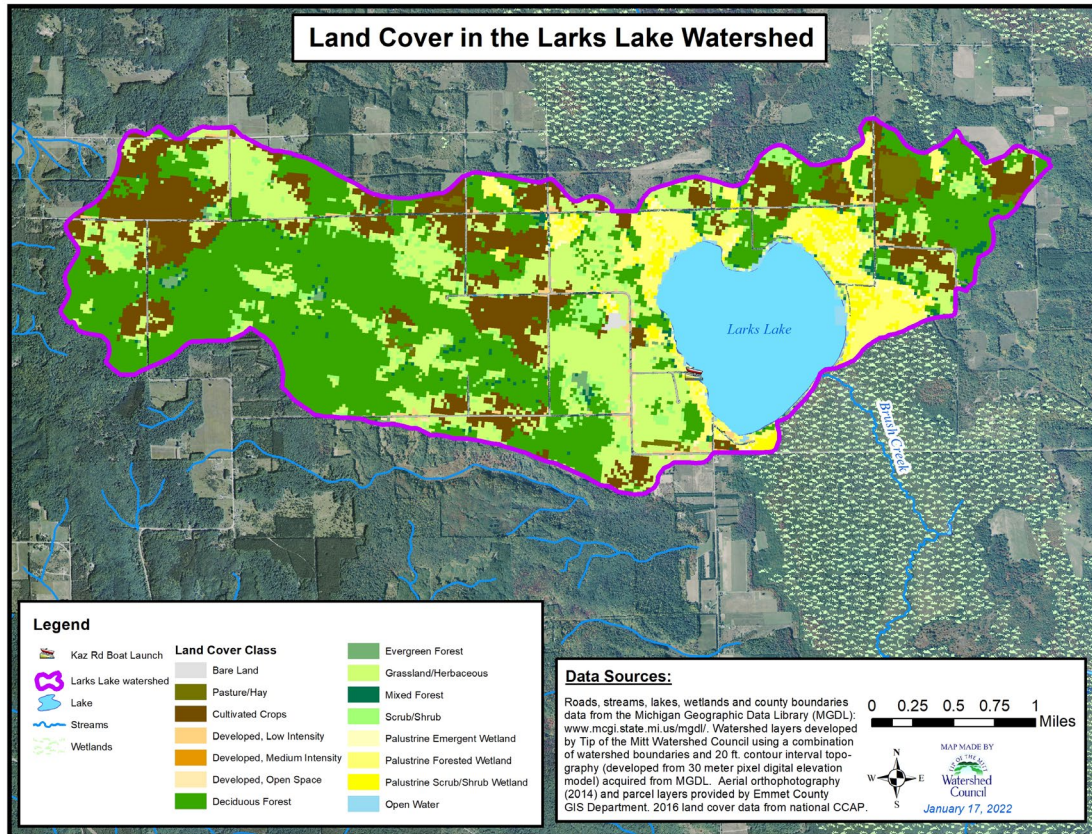


FIGURE 2. LARKS LAKE WATERSHED LAND USE

Chapter 2: Water Quality, Standards, Designated & Desired Uses

Water Quality

Since 1987, the Watershed Council has tracked the health of Northern Michigan's waters, monitoring on a three-year schedule. 2019 marked the eleventh round of comprehensive water quality monitoring for many water bodies in Northern Michigan, and the eighth for Larks Lake. This important collection of data allows us to not only understand the lake's current conditions, but to also identify any deviations from long-term trends.

Dissolved Oxygen, pH, Temperature, and Conductivity

The results of a variety of parameters captured with a multi-parameter probe show good water quality on Larks Lake in 2019. Dissolved oxygen, which is the amount of oxygen dissolved in the water, is an important characteristic for fish habitat. The State of Michigan requires at least 5 mg/L (milligrams per liter) of dissolved oxygen in warm water lakes, and Larks Lake averaged well above that threshold at 10.35 mg/L. A test for pH measures the concentration of hydrogen ions—the lower the pH, the more hydrogen ions a substance contains. The pH range of 0 -14 represents acidic (from 0-7) and basic (7-14) conditions. For examples, battery acid has a pH of 0 and bleach has a pH of 13. The pH, which should be between 6.5 and 9.0 in surface water, was 8.52 for Larks Lake in 2019. Conductivity, a measure of how well water can conduct electricity through dissolved minerals and chemicals, averaged 221.13 $\mu\text{S}/\text{cm}$ (microSiemens per centimeter), which is well below the normal range of Northern Michigan's waters from 300-600 $\mu\text{S}/\text{cm}$. Temperature was appropriate for inland lakes as well at 13.80°C.

Chloride

Chloride (Cl^-) is likely on your kitchen table, in water softener salts, some fertilizers, and used in the wintertime to de-ice roadways. Chloride in Larks Lake is well below the U.S. Environmental Protection Agency's (EPA) chronic toxicity threshold of 230 mg/L. While chloride in Larks Lake increased from 2001 to 2013, since 2016 it has decreased. The low chloride in Larks Lake shows minimal impact from humans on water quality and could be due to the lake's relatively small watershed.

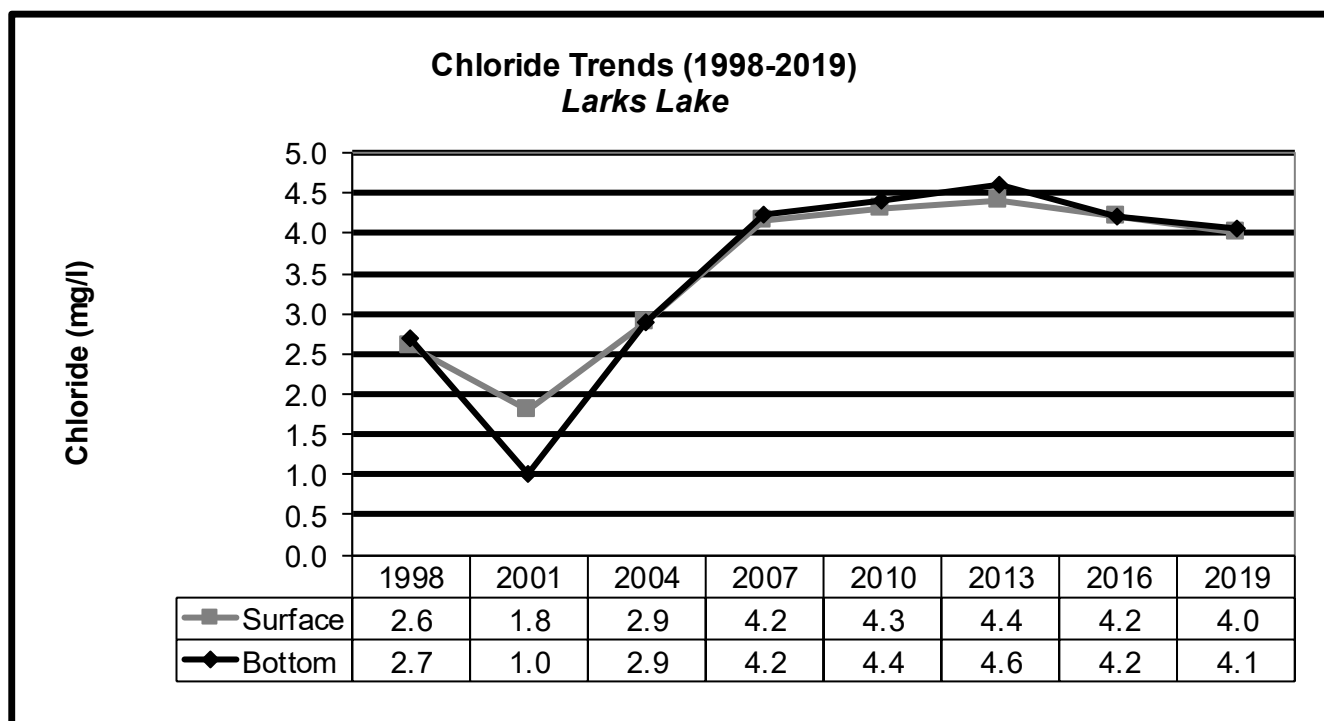


FIGURE 3. CHLORIDE TRENDS

Total Nitrogen and Phosphorus

Phosphorus and nitrogen are two important nutrients for plant and algal growth. However, too much of either can have a negative impact on Larks Lake's water quality. Both nutrients are found in fertilizers and can leach from failing septic systems or surface runoff after rainfall. Most lakes in Northern Michigan are phosphorus limited, meaning the biological productivity (i.e. algal growth) is limited by the amount of phosphorus available. Minimizing external phosphorus inputs to Larks Lake from septic systems and fertilizers is vital to managing nuisance algal blooms and maintaining high water quality. Phosphorus in 2019 was about the same as 2016, and nitrogen increased slightly. Phosphorus and nitrogen are well-below EPA's standards of 9.69 ug/L and 400 µg/L, respectively.

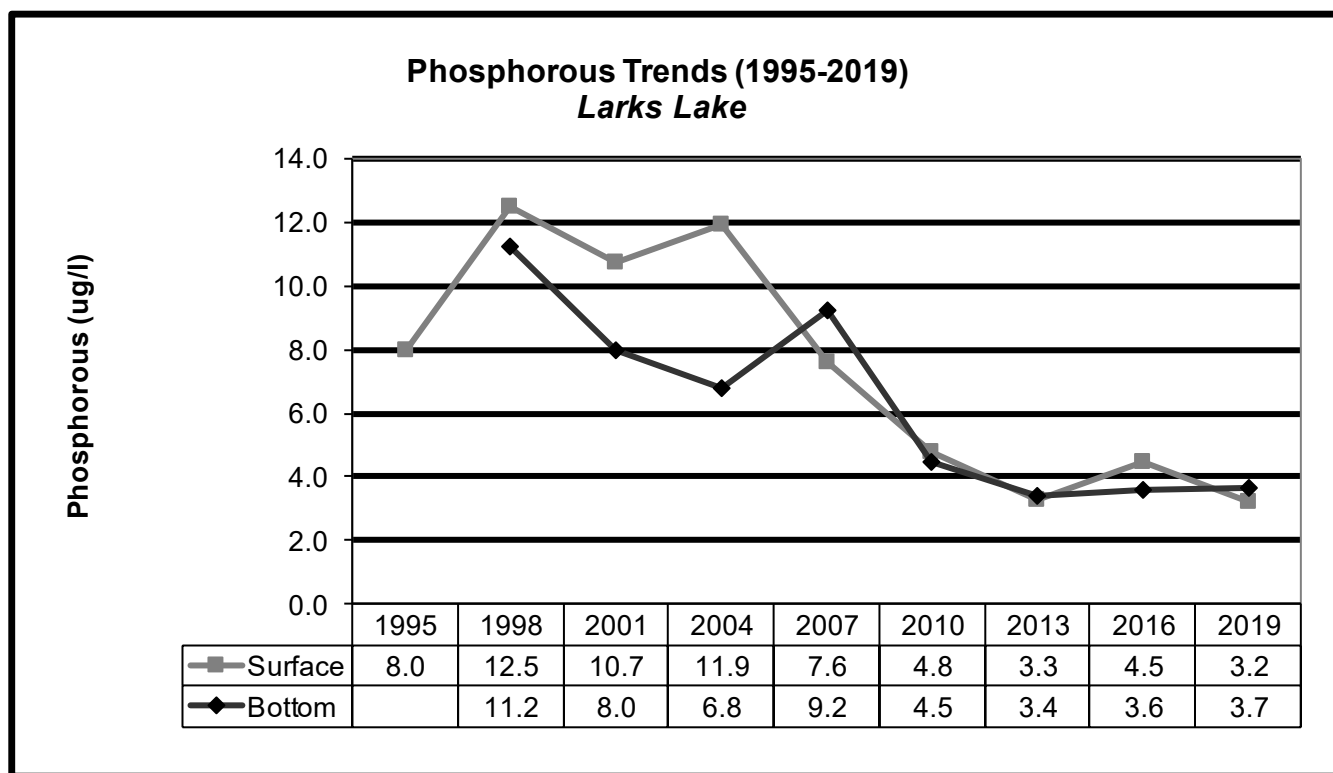


FIGURE 4. PHOSPHORUS TRENDS

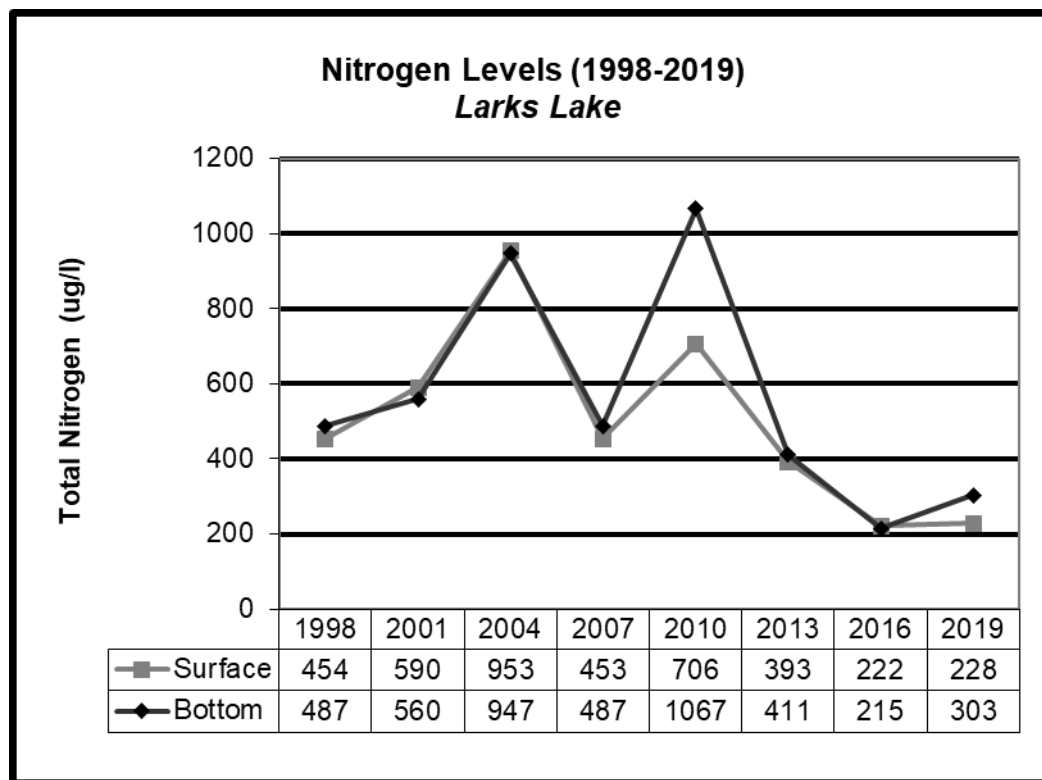


FIGURE 5. NITROGEN TRENDS

Designated Uses

The Michigan Department of Environment, Great Lakes, and Energy (EGLE) monitors the waters of the State on a five-year rotating watershed cycle to facilitate effective watershed management. Michigan has 57 major watersheds based on the USGS's 8-digit Hydrologic Unit Codes (HUC). Water quality assessment efforts focus on a subset (approximately 20%) of these major watersheds each year. The Larks Lake Watershed, included in the Cheboygan Watershed (HUC#04070004), was last assessed by EGLE in 2020, and is scheduled to be assessed every 5 years. The next assessment will be in 2025.

The State of Michigan has developed water quality standards (WQS) under Part 4 of the Administrative Rules issued pursuant to Part 31 of the Natural Resources and Environmental Protection Act (1994 PA451, as amended). These standards can be found in Table 3. The State uses quantitative water quality standards to help determine if designated uses are impaired.

TABLE 3: MICHIGAN WATER QUALITY STANDARDS

Parameter	Water Quality Standards	Designated Uses Affected
Dissolved Solids	Not to exceed 500 mg/L monthly average or 750 mg/L at any time as a result of controllable point sources	All
pH	Between 6.5 to 9.0	All
Taste or odor producing substances	The surface waters of the state shall contain no taste-producing or odor-producing substances in concentrations which impair or many impair their use for a public, industrial, or agricultural water supply source or which impair the palatability of fish as measured by test procedures approved by the department.	Public Water Supply* Industrial Water Supply Agricultural Water Supply Fish Consumption
Toxic substances (selected shown here; see rule for complete listing)	DDT and metabolites: below 0.00011 µg/L Mercury, including methylmercury: below 0.0013 µg/L PCBs (class): below 0.00012 µg/L 2,3,7,8 - TCDD: below 0.0000000031 µg/L	All but navigation
Radioactive substances	Pursuant to U.S nuclear regulatory commission and EPA standards	All but navigation
Plant nutrients	Phosphorus: 1 mg/L maximum monthly average for permitted point source discharges. Regulation for surface waters is limited to the following narrative standard from Rule 60 (323.1060): "nutrients shall be limited to the extent necessary to prevent stimulation of growth of aquatic rooted, attached, suspended, and floating plants, fungi or bacteria which are or may become injurious to the designated uses of the waters of the state."	All
Microorganisms	30-Day Geometric Mean: below 130 <i>E. coli</i> per 100 ml Daily Maximum Geometric Mean: 300 <i>E. coli</i> per 100 ml Daily Maximum Geometric Mean: below 1,000 <i>E. coli</i> per 100 ml Human sewage discharges (treated or untreated) below 200 fecal coliform per 100 ml 30-day mean or 400 fecal coliform per 100 ml in 7 days or less	Total body contact Total body contact Partial body contact Total body contact
Dissolved oxygen	Minimum 7 mg/L for coldwater designated streams, inland lakes, and Great Lakes/connecting waters; minimum 5 mg/L for all other waters Minimum 5 mg/L daily average	Cold water fishery Warm water fishery
Temperature	Natural daily and seasonal temperature fluctuations shall be preserved: Maximum monthly averages for inland lakes: J F M A M J J A P O N D 45 45 50 60 70 75 80 85 80 70 60 50	Cold water fishery Other indigenous aquatic life and wildlife

Maximum monthly averages for warm water streams in this watershed:												Warm water fishery
J	F	M	A	M	J	J	A	P	O	N	D	
38	38	41	56	70	80	83	81	74	64	49	39	
Maximum monthly averages for cold water streams in this watershed:												Cold water fishery
J	F	M	A	M	J	J	A	P	O	N	D	
38	38	43	54	65	68	68	68	63	56	48	40	

**All surface waters of the state that are identified in the publication "Public Water Supply Intakes in Michigan," dated December 9, 1999, are designated and protected as public water supply sources at the point of water intake and in such contiguous areas as the department may determine necessary for assured protection.*

Designated Uses

The State of Michigan has established a set of designated uses that can be measured for impairment based on the water quality standards described in the previous section. Rule 100 (R323.1100) of the water quality standards states that all surface waters of the State are designated for, and shall be protected for, eight particular uses (Table 4).

TABLE 4: SURFACE WATER DESIGNATED USES OF THE STATE

Designated Use	General Definition
Agriculture	Livestock watering, irrigation, and crop spraying
Navigation	Navigation of inland waters
Warmwater fishery	Supports warmwater species
Coldwater fishery	Support coldwater species
Other Indigenous aquatic life and wildlife	Supports other indigenous animals, plants, and macroinvertebrates
Partial body contact recreation	Supports boating, wading, and fishing activities
Total body contact recreation	Supports swimming activities between May 1 to October 31
Public water supply*	Surface waters meet human cancer and non-cancer values set for drinking water
Industrial water supply	Water utilized in industrial or commercial applications
Fish Consumption	There is a statewide, mercury-based fish consumption advisory that applies to all of Michigan's inland lakes, including those within the Burt Lake Watershed.

**All surface waters of the state that are identified in the publication "Public Water Supply Intakes in Michigan," dated December 9, 1999, are designated and protected as public water supply sources at the point of water intake and in such contiguous areas as the department may determine necessary for assured protection.*

Chapter 3: Resource Inventories

The inventories conducted to document nonpoint source pollution included field data collecting inventories to identify current sources and causes of pollution as well as potential sources. Below are the summaries of the inventories conducted and their results.

Larks Lake Shoreline Inventory

A shoreline survey to identify locations of nutrient pollution (using *Cladophora* as an indicator), shoreline erosion, bottom sediment type, and shoreline development characteristics was performed by Tip of the Mitt Watershed Council (Watershed Council) during the summer of 2006 (Figure 4).

Cladophora survey

Cladophora is a branched, filamentous, green algae that occurs naturally in small amounts in Northern Michigan lakes. Its occurrence is governed by specific environmental requirements for temperature, substrate, and nutrients. It is found most commonly in the wave splash zone and shallow shoreline areas of lakes, and can also be found in streams. It grows best on stable substrates such as rocks and logs. Artificial substrates such as concrete or wood seawalls are also suitable. The preferred water temperature is 50 to 70 degrees Fahrenheit. This means that late May to early July, and September and October are the best times for its growth in Northern Michigan lakes.

The nutrient requirements for *Cladophora* to achieve large, dense growths are greater than the nutrient availability in lakes with good water quality, such as Larks Lake. Therefore, the presence of *Cladophora* can indicate locations where relatively high concentrations of nutrients, particularly phosphorus, are entering a lake. Sources of these nutrients can be due to natural conditions, including springs, streams, and artesian wells that are naturally high in nutrients due to the geologic strata they encounter; as well as wetland seepages which may discharge nutrients at certain times of the year. However, the majority of *Cladophora* growths can be traced to cultural sources such as lawn fertilization, septic systems, poor agricultural practices, soil erosion, and wetland destruction. These nutrients can contribute to an overall decline in lake water quality. Additionally, failing septic systems can pose a potential health risk due to bacterial and viral contamination.

A database containing numerous information fields (tax identification number, description of the property or development as viewed from the water, and names and addresses of property owners) was developed by the Watershed Council. The database and maps were intended to facilitate repeat shoreline surveys. When used in conjunction with the parcel maps, the location of *Cladophora* growths are revealed.

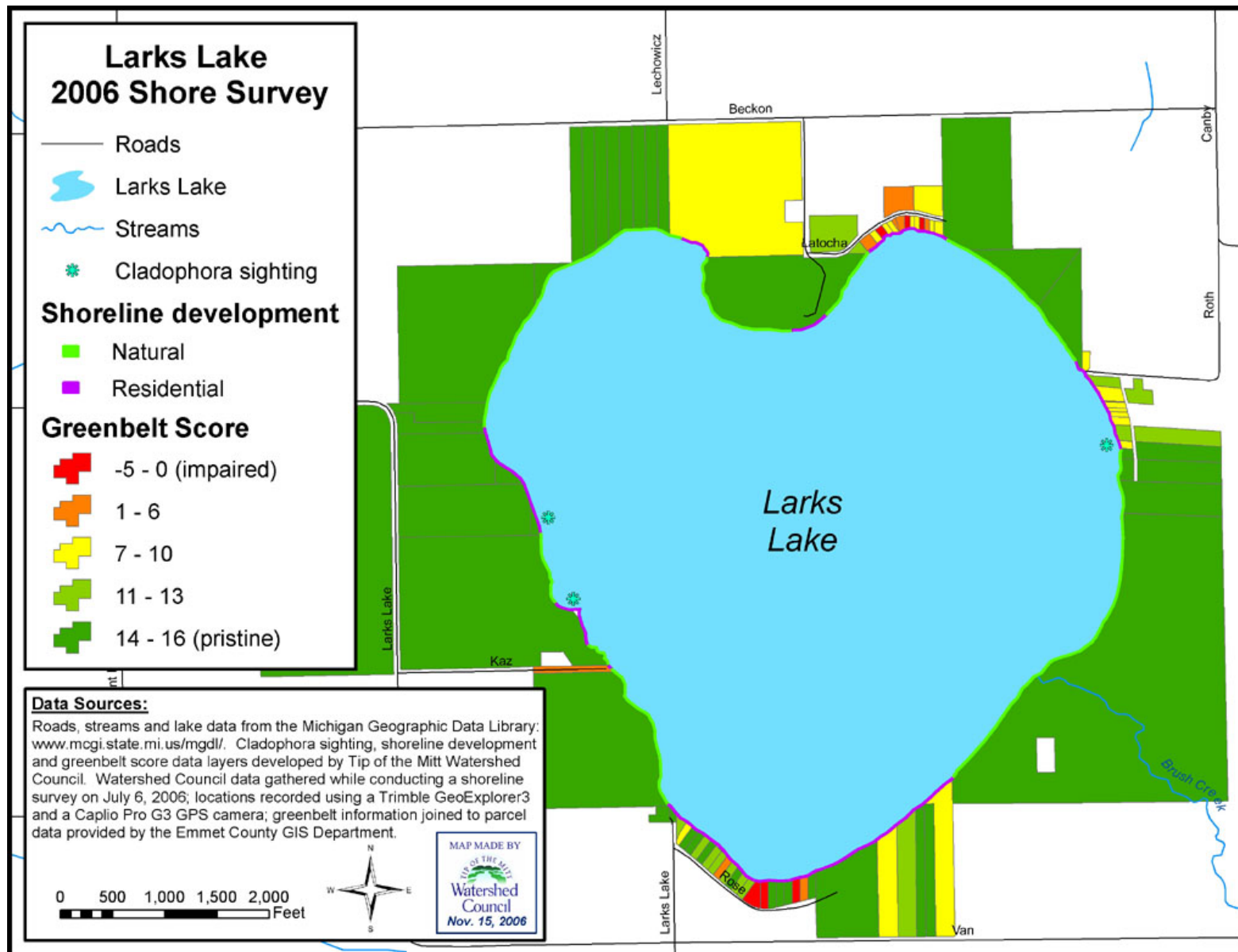


FIGURE 6. LARKS LAKE 2006 SHORE SURVEY

The shoreline was visually surveyed by traveling in a small boat (mostly by kayak) as close to the shoreline as possible (usually 5 to 20 feet). The locations of significant *Cladophora* growths, sites of erosion concern, bottom substrate, and property description were recorded.

When *Cladophora* growth was observed, it was described by estimating the length (feet) of shoreline it covered and the density or amount of available substrate that was utilized. The density description was divided into three categories, Light (L) 0-25%, Medium (M) 25-75%, or Heavy (H) 75-100%. When an algal growth occurred between two houses and could not be affirmatively associated with either one, the growth was indicated as occurring at both locations on the shoreline database.

The bottom substrate (or sediment) survey was conducted in that area of the lake where the bottom was visible. Where a wide, shallow nearshore area was present, the focus of the data collection was generally within about 50 feet of shore. Sediments were assessed visually, by probing with a paddle to judge texture, or by closer examination in a few cases.

Approximately 57 property parcels were identified along the Larks Lake shoreline. The number is approximate because property boundaries were not always evident. Of the 57 parcels, nine were recorded as having substrate that *Cladophora* requires. *Cladophora* growths were associated with four property parcels (Table 5).

TABLE 5. CLADOPHORA GROWTH ON LARKS LAKE

Number of Parcels	
Total Shoreline Properties	57
Parcels with suitable habitat	9
Parcels with <i>Cladophora</i> Growth	4
Heavy	0
Medium	1
Light	3

Shoreline erosion

Erosion, the wearing away of the land surface by physical forces, is a natural, although slow, process along shorelines. However, erosion can be accelerated (often by human activities) and result in environmental problems and property damage. Oftentimes, erosion control projects are not based on current best management practices, and they can be ineffective or even result in more water quality impacts or habitat loss. This survey noted areas of visible, accelerated erosion, including gullies or rills on the land surface, undercut, slumping, or receding banks or shorelines, or bare soil on slopes or steep banks. In addition, ill-conceived or ineffective erosion control projects were noted, as was the widespread (and often illegal and environmentally damaging) practice of beach sanding.

No parcels were identified as having lakeshore erosion problems. However, many parcels had sand beaches rather than shoreline vegetation greenbelts. This could have impacts on the water quality of Larks Lake. In locations where sand does not naturally occur, sand rarely stays in place and requires a lot of plant control through hand pulling and herbicide use (Henderson et al., 1999). Once a sand beach

has been created, wave action and surface runoff may erode the sand, or if the lake bottom is soft, then the sand will sink through the muck, requiring additional loads of sand to be deposited on the beach. When the sand washes into the water, it may also cover aquatic plant beds and degrade fish and wildlife habitat (Henderson et al., 1999).

Greenbelt Survey

The current condition of greenbelts, or shoreline vegetation, was assessed and documented during the shoreline survey performed during the summer of 2006 (Figure 4). A greenbelt provides a natural strip of vegetation between the shoreline and lawn or structures to help prevent erosion and remove pollution from runoff.

Greenbelt status was documented for 83 property parcels (Table 6). The number of parcels is approximate because survey observations were made from watercraft and exact property boundaries were not always evident. 54 property parcels are developed lots and 29 are considered undeveloped.

TABLE 6. GREENBELT STATUS

	Total count (2006)	% of Total
Shoreline Property Parcels	83	100
Greenbelt length (>75% length of shoreline)	53	64
Greenbelt width (>40 ft wide)	39	47
Turf (>75% of shore mowed to edge)	15	18

Of the 83 parcels surveyed, 53 parcels (64%) had a greenbelt that extended 75% or greater of the length of the shoreline (Table 6). This includes the 29 undeveloped parcels. When considering developed parcels only, then this changes to 30% (25 parcels). 20% (17 parcels) had a greenbelt 25-75% the length of the shoreline. 4% (3 parcels) had a greenbelt 10-25% the length of the shoreline, and 5% (4 parcels) had a greenbelt less than 10% of the shoreline. Six of the 83 parcels (7%) were documented as having no shoreline greenbelt. All parcels documented as having no shoreline greenbelt were developed property parcels.

Greenbelt depth (or width) was also documented, with 64% having greenbelts that are 40 feet wide or more. 40 feet is the desired greenbelt width for best surface runoff buffering. 19% (16 parcels) had greenbelt widths of 10-40 feet, and 27% (22 parcels) had greenbelts less than 10 feet wide. Additionally, 18% of property parcels surveyed had turf mowed to the water's edge on greater than 75% of their shoreline.

While over half of the shoreline property parcels on Larks Lake do have a greenbelt along most of the shoreline, it is important that information and education continue regarding the importance of greenbelts. Maintaining, enhancing, or restoring shoreline greenbelts is a critical way to protect lake water quality by filtering sediments or other pollutants before they reach the lake via surface runoff.

Aquatic Plant Survey

Larks Lake was comprehensively surveyed to document current aquatic plant species and communities, with a particular emphasis on documenting the presence of Eurasian watermilfoil, *Phragmites*, or other invasive aquatic plant species.

24 different plant taxa were found in Larks Lake. The most commonly found plant was naiad (*Najas spp.*), found at nearly 40% of sites (Table 7). Muskgrass and variable-leaf pondweed were also commonly found at 25% and 23% of sites respectively. Wild rice (*Zizania palustris* or manoomin in the Odawa language Anishinaabemowin) is a culturally significant food for the Little Traverse Bay Bands of Odawa Indians (LTBB). It was found at 20 sites in Larks Lake. Previous surveys by the Watershed Council did not mention wild rice and there could be multiple reasons. Wild rice may have been scarce in Larks Lake prior to LTBB planting efforts throughout the 2000s. Surveyors may not have been familiar with the species also.

No invasive plants were found besides invasive cattail and invasive *Phragmites*. Invasive cattail is fairly common in Northern Michigan and hard to eradicate. Once invasive *Phragmites* was found, efforts were made by Larks Lake Association and the Watershed Council to treat with herbicides. Herbicides were applied by Wildlife and Wetland Solutions in 2020 and will likely have to be applied in future years. Purple loosestrife was not documented in the survey, however it's presence along the eastern shore is well known and currently being mechanically removed and treated with the biological control *Galerucella* beetles. Low water levels prevented watercraft from reaching known purple loosestrife areas.

TABLE 7. PLANT TAXA FREQUENCY FOUND IN LARKS LAKE 2020

Latin Name	Common Name	Sites Found	Percent of Sites Found
<i>Najas spp.</i>	Naiad	43	38.39
<i>Chara spp.</i>	Muskgrass	28	25.00
<i>Potamogeton gramineus</i>	Variable-leaf pondweed	26	23.21
<i>Zizania palustris</i>	Wild rice	20	17.86
<i>Schoenoplectus spp.</i>	Soft/hardstem bulrush	13	11.61
<i>Myriophyllum sibiricum</i>	Common watermilfoil	11	9.82
<i>Stuckenia pectinata</i>	Sago pondweed	9	8.04
<i>Potamogeton amplifolius</i>	Large-leaved pondweed	8	7.14
<i>Potamogeton illinoensis</i>	Illinois pondweed	8	7.14
<i>Typha latifolia</i>	Invasive cattail	6	5.36
<i>Schoenoplectus pungens</i>	Common threesquare	6	5.36
<i>Phragmites australis ssp. americanus</i>	Native <i>Phragmites</i>	4	3.57
<i>Juncus balticus</i>	Baltic rush	4	3.57
<i>Valisneria spiralis</i>	Eel grass	3	2.68
<i>Equisetum fluviatile</i>	Horsetail	3	2.68
<i>Typha angustifolia</i>	Native cattail	2	1.79
<i>Asclepias incarnata</i>	Swamp milkweed	2	1.79

<i>Nuphar variegata</i>	Yellow pond lily	2	1.79
<i>Lycopus americanus</i>	Bugleweed	2	1.79
<i>Phragmites australis</i> ssp. <i>Australis</i>	Invasive <i>Phragmites</i>	1	0.89
<i>Sagittaria latifolia</i>	Arrowhead	1	0.89
<i>Sparganium</i> spp.	Burr-reed	1	0.89
<i>Myrica gale</i>	Sweetgale	1	0.89
	Total		112

The majority of sites had moderate plant density (Table 8). Few sites had very heavy or heavy density.

TABLE 8. PLANT DENSITY AT SAMPLE SITES IN LARKS LAKE 2020

None	3
Very Light	17
Light to Moderate	14
Moderate	35
Moderate to Heavy	15
Heavy	10
Very Heavy	1
Total	112

Plant Communities and Density

Plants covered 36% of the lake in this survey, which is an increase from 34% in 2009 (Table 9). Naiad was the most dominant plant community. It accounted for 120.11 acres in areas where it was the sole dominant species. An additional 9 acres of the lake was covered by naiad mixed with other plant species. Naiad accounts for 60% of the lake's vegetated areas, which is a decrease from 70% in 2009. The next most dominant plant species were muskgrass and pondweed. Of the lake area with vegetation, 36% was covered in very heavy to heavy vegetation, the same amounts as 2009 (Table 10). The densest vegetation was concentrated to the southeast of Pioneer Park and mostly consisted of large populations of naiad (Figure 2 and 3).

TABLE 9. PLANT TAXA DISTRIBUTION IN LARKS LAKE 2020.

Common Name	Acres	Percentage of Total Plant Acreage	Percentage of Total Lake Area
Naiad	120.11	54.92	20.02
Muskgrass	57.64	26.35	9.61
Naiad and Pondweed	11.31	5.17	1.89
Pondweed	11.44	5.23	1.91
Common threesquare	6.26	2.86	1.04
Bulrush Mix	4.98	2.28	0.83
Muskgrass and Pondweed	2.29	1.05	0.38
Wild rice and naiad	1.03	0.47	0.17
Bulrush and muskgrass	0.96	0.44	0.16

Muskgrass and Bulrush	0.78	0.36	0.13
Bulrush and naiad	0.51	0.23	0.08
Milfoil and Pondweed	0.22	0.10	0.04
Muskgrass and Bladderwort	0.22	0.10	0.04
Wild rice	0.21	0.09	0.03
Yellow Pond Lily and Pondweed	0.18	0.08	0.03
Bulrush Mix and Pondweed	0.14	0.06	0.02
Invasive Cattail	0.13	0.06	0.02
Native Cattail	0.11	0.05	0.02
Native <i>Phragmites</i>	0.07	0.03	0.01
Horsetail	0.04	0.02	0.01
Wild rice and pondweed	0.03	0.01	0.00
Invasive <i>Phragmites</i>	0.02	0.01	0.00
Swamp Milkweed	0.02	0.01	0.00
Arrowhead	0.01	0.00	0.00
Yellow Pond Lily	0.01	0.00	0.00
Total	218.7	0.00	36.45

TABLE 10. DENSITY OF PLANT COMMUNITIES IN LARKS LAKE 2020.

Density Category	Acres	Percentage of Total
Very Light	57.44323	26.26466
Light	22.06848	10.09033
Light to Moderate	30.44574	13.92065
Moderate	27.68685	12.6592
Moderate to Heavy	38.05783	17.40111
Heavy	32.83133	15.0114
Very Heavy	10.17578	4.652653
Total	218.7093	100

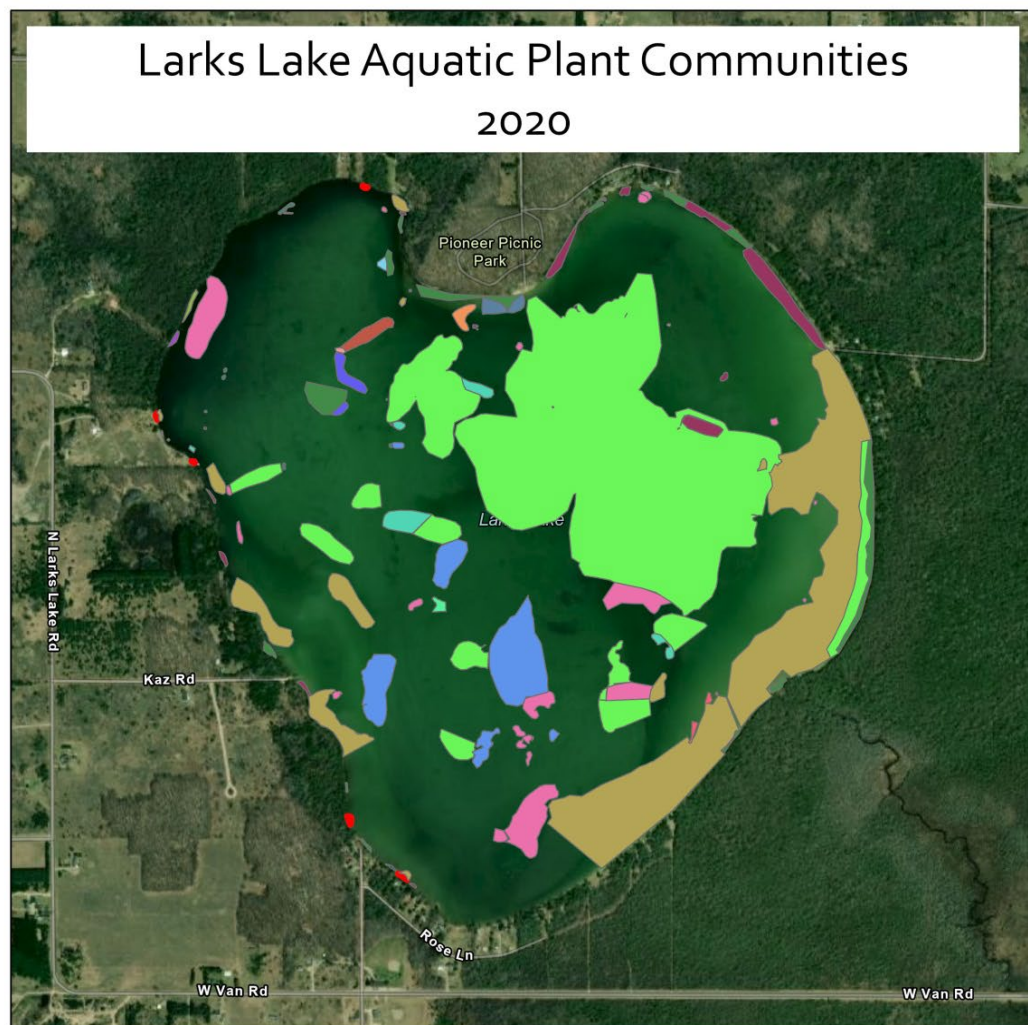


FIGURE 7. PLANT COMMUNITY DISTRIBUTION IN LARKS LAKE 2020.

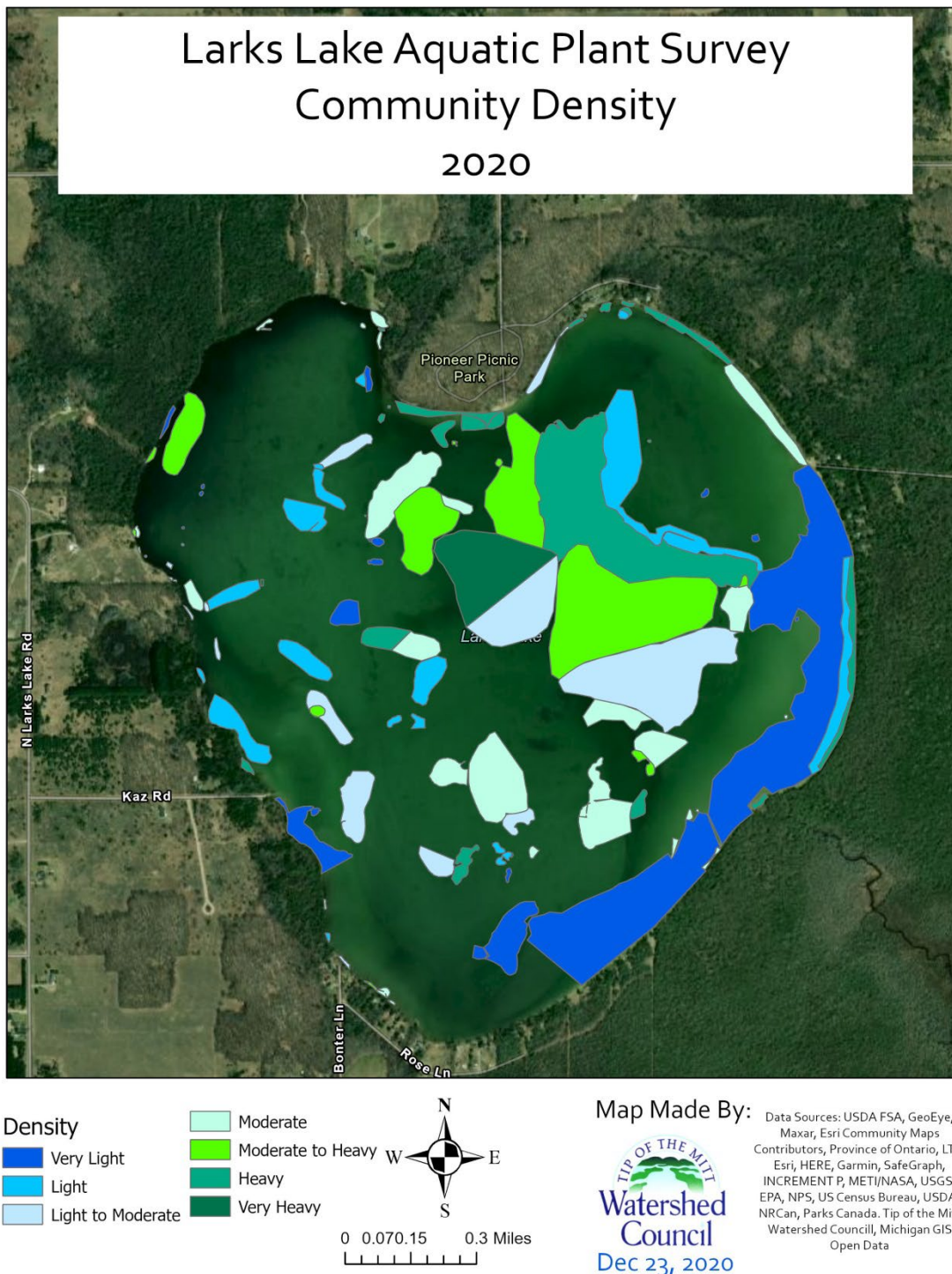


FIGURE 8. PLANT COMMUNITY DENSITY IN LARKS LAKE 2020.

Priority Parcel Analysis

Tip of the Mitt Watershed Council's Priority Parcel Analysis comprehensively ranks individual land parcels using a quantitative scoring system that reflects each parcel's ecological value. While the process is a holistic

approach to ecological evaluation, special emphasis is placed on the protection of water resources. Anthropogenic variables pertaining to development are also used in the criteria to frame the rankings from a land acquisition and preservation standpoint. The Analysis is done entirely in a Geographic Information System (GIS), using commonly available spatial data. Many of the data layers used in the analysis were obtained from the Michigan Geographic Data Library. A portion of the data is supplied by partner organizations and government agencies, including parcel datasets from county GIS or equalization departments, and protected lands from local conservancies.

Properly managing high-quality water resources requires addressing known sources of pollution and reducing future sources. Although effective regulation and strong stewardship ethics reduce the adverse impacts of development and land management to our surface waters, the permanent protection of sensitive lands is potentially the most effective tool for long-term water quality and aquatic ecosystem protection. Permanent protection of sensitive areas helps maintain the ecological integrity of our lakes, streams, and wetlands, and arguably provides the most positive impact per conservation effort. Permanent protection is best achieved through purchase, donation, or conservation easement.

Parcels within the Larks Lake Watershed were analyzed and ranked based on variables considered important for protecting and improving the quality and ecology integrity of the Watershed's aquatic ecosystems. Descriptions of scoring criteria and the point system used to assign priority rankings to parcels are described below. The scores for each criterion were summed to produce a total score for each land parcel.

Parcel Size: Larger blocks of contiguous land typically have higher ecological value due to their potential to harbor a greater diversity of species and habitat types. Permanent protection of large parcels is also more time and cost effective than protecting small parcels. The selection threshold for parcel size criteria during this process was 10 acres. The larger the parcel, the more points it received.

Groundwater Recharge Potential: Groundwater discharge is essential for the maintenance of the cold-water fisheries that prevail in watersheds of the Northern Lower Peninsula. Land with highly permeable soils allows precipitation to percolate through the soils and recharge groundwater supplies. Predominant soil type and associated permeability were determined for each parcel using the physical properties found in county soil surveys (Natural Resource Conservation Service, Emmet and Charlevoix Counties). Parcels were scored based on the extent (acreage) of soils conducive to groundwater recharge.

Wetlands: Wetlands provide a variety of important functions that contribute to the health of the Watershed, including fish and wildlife habitat, water quality protection, flood and erosion control, and recreational opportunities. National Wetlands Inventory data were utilized to determine the acreage of wetlands on individual properties and assign scores.

Lake and Stream Riparian Ecosystems: Activities on land immediately adjacent to a waterbody are critically important to maintaining water quality and ecological health. Properties with lake or stream shorelines were given scores based on total shoreline distance contained within the parcel.

Steep Slopes: Steep, highly erodible slopes are particularly vulnerable to improper use. Large amounts of erosion can degrade terrestrial habitat and impact water quality through sedimentation. Parcels with slopes greater than 20% scored points in this category.

Protected Land Adjacency: Properties adjacent to protected lands, such as state forests or conservancy preserves, have a high ecological value because they provide a buffer to preexisting protected lands. They also increase the contiguous protected area, which essentially expands the biological corridor for species migration

and interaction. Parcels bordering local or state government land and conservancy properties were identified and scored based upon the number of sides on the parcel adjacent to protected lands. Properties that linked two separate protected land parcels, or doubled the size of an existing parcel, received additional points.

Threatened or Endangered Species (state or federally listed): The protection of threatened and endangered species is important because many species are indicators of environmental quality and other dependent species could be affected. The Biological Rarity (Biorarity) Index model, developed by the Michigan Natural Features Inventory, provides an estimate of occurrence based on known sightings of threatened, endangered, or special concern species and high quality natural communities. Priority scores were based on model predictions for occurrence of threatened and endangered species or habitat types on the parcel.

Proximity to Development: Properties near urban areas have a high conservation value due to the imminent threat of development. Because these properties are near population centers, they have the greatest potential for public use and provide the most gain in terms of ecosystem preservation. NOAA CCAP (Coastal Change Analysis Program) land cover data and MGD municipal boundary data were used to identify urban areas and growth corridors. Parcels were scored based on proximity to these areas.

Natural Land Cover Types: Land in its natural state is more ecologically valuable than altered land because natural land cover tends to contain a greater diversity of habitat and species, and is more resilient to invasion by non-native species. NOAA's CCAP land-cover dataset was used to determine a percent coverage of natural land cover types for each parcel. Parcels with greater than 50% natural land cover received points.

Drinking Water Protection Areas: Wellhead protection areas are critical recharge zones that maintain aquifer water supplies and sustain local municipal drinking water systems. Development within these areas can jeopardize water sources by contaminating water supplies or inhibiting the infiltration of rainwater. Points were assigned to parcels that lie within wellhead protection areas and based on the percentage of the parcel within the area.

Exceptional Resources: This criterion provides a fixed, two point score increase to any parcel adjacent to an exceptional resource. Exceptional resources are locally occurring conditions that are rare, vulnerable to degradation, and have high intrinsic value. The following were identified as critical resources for this analysis: critical dunes, blue-ribbon trout streams, and undeveloped lakes.

Parcels scored between 0 and 42, with a maximum possible score of 50. These parcels were divided into categories to simplify analysis. Land protection is often most efficient when large parcels are protected, maximizing the benefits of protecting continuous riparian corridors, significant amounts of aquatic habitat, or large areas of hydrologically sensitive lands (i.e. wetlands, headwaters, or groundwater recharge areas).

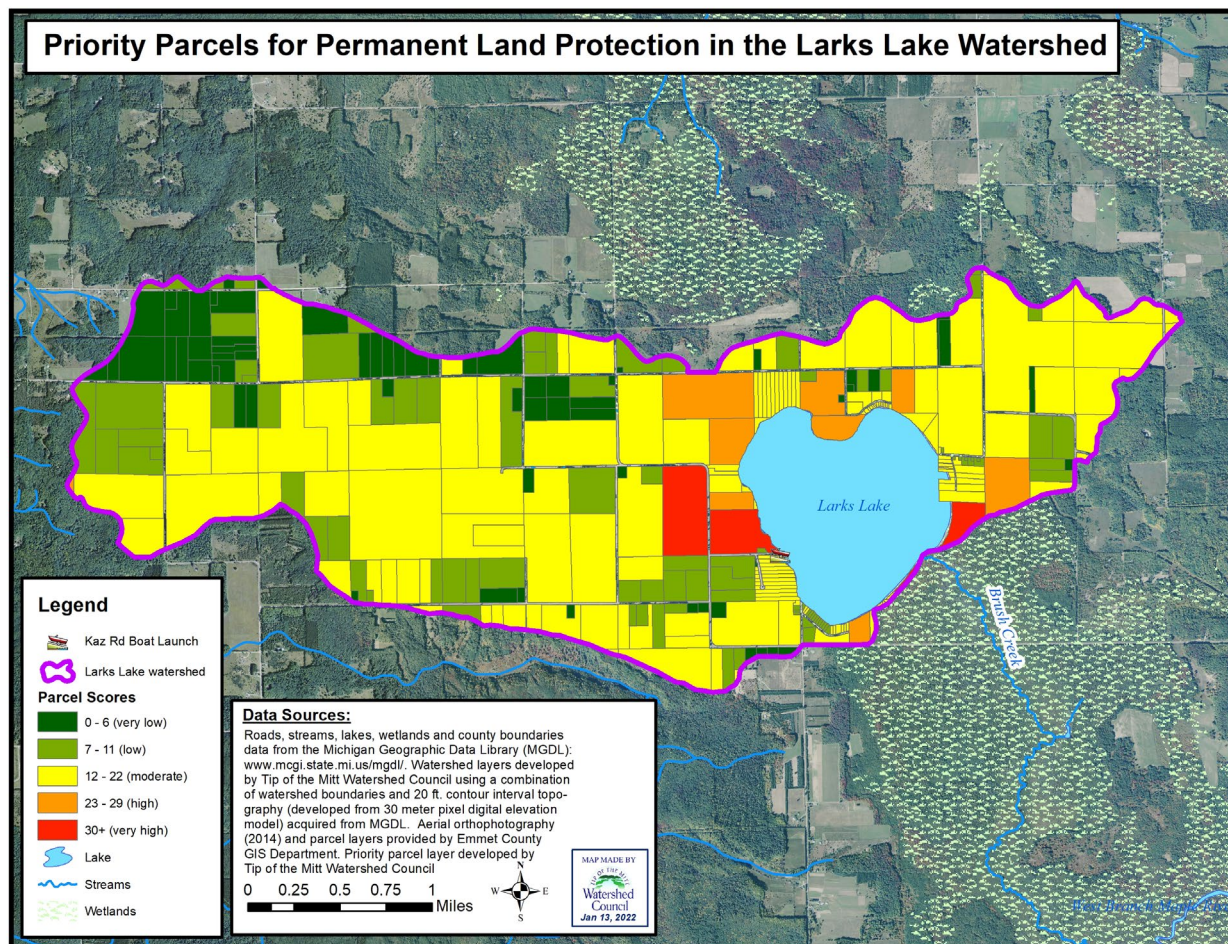


FIGURE 9. PRIORITY PARCELS FOR PERMANENT LAND PROTECTION

Chapter 4: Water Quality Threats

Different land uses (sources) and activities (causes) have the potential to impact water quality, and subsequently, threaten the designated uses of a water body. It is critical to identify and understand the link between the source of nonpoint source pollutants and the potential cause. It is this understanding that forms the framework for developing the goals, objectives, and implementation steps of the Watershed Management Plan.

Sediment Sources and Causes

Sediment pollution comes from a variety of sources and causes.

Sources of sediment can include lakeshores and streambanks, road/stream crossings, agricultural practices, construction, logging, and others.

Causes of sediment pollution range as well and oftentimes include:

- Lakeshore and streambank erosion is often a result of the removal of shoreline vegetation.
- Improperly sized culverts and lack of runoff diversions are the main reason for erosion and sedimentation associated with road/stream crossings.
- Livestock access to streams for a watering source can destroy the bank and cause erosion and sedimentation.
- New construction in the shoreline area can also contribute sediment, particularly if inadequate erosion controls are used.
- Not maintaining buffer strips during logging can also contribute to erosion and sedimentation.
- Motorboats travelling at excessive speeds in no-wake areas causes erosion and sedimentation.

Nutrient Sources and Causes

Nutrient pollution may also be derived from a variety of sources, and oftentimes is linked with sediment pollution because nutrients attach to sediment particles.

Sources of nutrient pollution include shoreline and streambank erosion, road crossings, turf management, failing septic systems, agricultural practices, stormwater discharges in urban areas, manure application and management, golf course management, and new construction.

Consequently, shoreline, streambank, and road/stream crossing erosion contribute sediment and nutrient pollution.

Causes of nutrient pollution oftentimes mirror that of sediment pollution. They may include:

- Lakeshore and streambank erosion is often a result of the removal of shoreline vegetation.
- Improperly sized culverts and lack of runoff diversions are the main reason for erosion and sedimentation associated with road/stream crossings.
- Livestock access to streams for a watering source can destroy the bank and cause erosion and sedimentation. In addition, manure may be directly entering stream.

- Outdated, poorly maintained, and improperly designed septic systems discharge nutrients.
- Improper (overuse, wrong formulation, etc.) application of fertilizers on agricultural fields, golf courses, and residential lawns.

Urban stormwater carries pet waste and other nutrient sources and is discharged to a lake or stream without treatment.

Sources and Causes of Other Pollutants

Sources of oils, grease, and heavy metals include stormwater discharges in urban areas and road/stream crossings.

Sources of pesticides include agricultural fields and residential, commercial, and municipal turf management.

Sources of bacteria include stormwater discharges in urban areas, manure application and storage, and livestock access to streams.

Causes may include:

- Outdated, poorly maintained, and improperly designed septic systems discharge bacteria and other pathogens.
- Urban stormwater carries bacteria, oils, grease, and heavy metals and is then discharged to a lake or stream without treatment.
- Unrestricted livestock access to a stream allows waste to enter the stream directly.
- Over application of pesticides on residential, commercial, and municipal properties, as well as agricultural fields.

Reducing and preventing nonpoint source pollutants relies upon addressing the priority pollutants' sources and causes, which have been identified and ranked for the Burt Lake Watershed (Table 11). The pollutants are ranked according to their potential impact on water quality. Sources are ranked for each pollutant according to their prevalence. Causes are ranked according to their priority by source.

Other Environmental Stressors

Habitat Degradation

The disruption of a water body's hydrology can cause systemic problems that affect water quality and habitat. The most common sources of these disruptions are road/stream crossings and dams. Road/stream crossings, if designed or installed improperly, can restrict flow and create upstream flooding and downstream erosion. Downstream reaches can become sediment starved due to the interference of sediment transport. Water temperatures can increase from upstream impounding. Excess sediments and nutrients can enter a stream more readily due to localized erosion. Road/stream crossing can also create physical barriers to upstream passage of aquatic organisms due to perched culverts or accelerated velocity of water through the structure. Dams can result in many of the same conditions stated above, including disturbance of sediment transport, increased water temperatures, downstream erosion, and as barriers to aquatic organism passage.

Invasive Species

Invasive species can have a profound impact of water resources. Whether fully aquatic species, such as Eurasian watermilfoil (*Myriophyllum spicatum*), or semi-aquatic species, such as common reed (*Phragmites*

australis), once a noxious invasive species becomes established within or around a waterbody, the impacts are far-reaching. Native plant communities can become outcompeted by more aggressive invasive species thereby limiting the availability of food and shelter to local wildlife. Local hydrology can change and lead to flooding and erosion. Recreation can become impaired from excess growth of plants that limit swimming, boating, etc. Decomposition of dead and decaying plant matter can deplete dissolved oxygen, which then affects fish and other aquatic organisms.

Thermal Pollution

Thermal pollution is caused when surface waters are unnaturally warmed from either a warm water discharge, such is the case when stormwater flows directly into a lake or stream, or when sunlight is allowed to penetrate deeper into the water column due to increased water clarity or impounding of water. Increased water temperatures can affect aquatic life as some species have limited tolerance for even very small increases in water temperature due to less dissolved oxygen and other factors.

Climate Change

Although climate change is not a nonpoint source pollutant, cause, or source of nonpoint source pollution, it does factor into watershed protection. Climate change predictions indicate that the Earth's average temperature will increase, which will subsequently influence the patterns and amounts of global precipitation. Sea levels will rise, ice and snow cover will be reduced, and there will be more frequent and extreme weather events. Given these predictions, it is critical that high-quality water resources are protected to maintain their resilience in the face of climate change. As described earlier, the Burt Lake Watershed includes some of the most pristine lakes, streams, and wetlands within Michigan. Protecting them now will help to mitigate not only the local effects of climate change, but also on a regional scale.

TABLE 11: BURT LAKE WATERSHED POLLUTANT SOURCES AND CAUSES AND ENVIRONMENTAL STRESSORS

Rank	Pollutant/Stressor	Source ((k)nown, (s)uspected)	Rank	Cause (listed in priority order by source)
1	Nutrients: Phosphorus and Nitrogen	Stormwater (k)	1	Inadequate treatment of stormwater (k)
		Shoreline/streambank development & property management (k)	1	Fertilizers (s)
				Removal of native shoreline vegetation (k)
		Septic systems (s)	2	Outdated, poorly maintained, and improperly designed systems (s)
		Road/stream crossings (k)	3	Inadequate infrastructure (k)
				Lack of runoff diversions (k)
	Sediment	Agriculture and Forestry (s)		Lack of vegetation (k)
			4	Limited use of BMPs (s)
		Road/stream crossings (k)	1	Inadequate infrastructure (k)
				Lack of runoff diversions (k)
				Inadequate fill on road surface (k)
				Lack of vegetation (k)
		Shoreline/streambank development & property management (k)	2	Removal of native shoreline vegetation (k)
		Stormwater (k)	3	Inadequate treatment of stormwater (s)
		Agriculture and Forestry	3	Limited use of BMPs (s)

		(s)		
		New development and construction (s)	4	Lack of proper erosion control and stormwater management measures (s) Removal of native shoreline vegetation (k)
3	Habitat Degradation	Shoreline/streambank development & property management (k)	1	Removal of native shoreline and nearshore habitat (k) Shoreline alterations (beach sanding, seawall construction, etc.)(k)
		Road/stream crossings (k)	2	Hydrologic disruption, barrier for aquatic organisms (k)
		Small dams (k)	3	Hydrologic disruption, barrier for aquatic organisms (k)
4	Invasive Species	Recreation (k)	1	Lack of clean boating practices and other BMPs
		New development and construction (s)	2	Lack of BMPs
5	Thermal Pollution	Stormwater (k)	1	Warmer stormwater discharged to lakes and streams (s)
		Small dams and RSXs (k)	2	Warmed water from impounded streams
	Oils, grease, heavy metals	Urban stormwater (k)	1	Inadequate treatment of stormwater that may contain oils, grease, heavy metals (s)
	Pesticides	Shoreline/streambank development & property management (k)	1	Misuse and over use of pesticides (s)
	Pathogens	Urban stormwater (k)	1	Pet waste, wildlife (k)
		Septic systems (s)	2	Outdated, poorly maintained, and improperly designed systems (s)

Chapter 5: Goals and Objectives

Goals and objectives have been identified as part of the Burt Lake Watershed Management Plan. Goals and objectives are based upon both the Watershed's natural resources needs, including protection and restoration, as well as the health, livelihoods, recreational needs, and industries of the people that live and visit the Watershed.

Goal 1: Protect water quality of the Watershed's lakes and streams.	
Objectives:	
1.1	Reduce nutrient and sediment inputs through restoration of natural shorelines and streambanks where shore surveys and erosion inventories indicate greenbelts are "poor," erosion is moderate or severe, hardened shoreline structures are present, as well as where road/stream crossings are contributing sediment.
1.2	Reduce nutrient inputs through maintenance or replacement of nonfunctioning septic systems.
1.3	Balance the management of lake levels, where applicable, to reduce the risk of erosion due to widely fluctuating water levels.
1.4	Reduce agricultural and forestry impacts to water quality through increased implementation of best management practices.
1.5	Manage stormwater in developed areas.
1.6	Conduct resource inventories and monitor water quality on a regular basis to assess conditions that may be affecting water quality.
1.7	Identify potential water quality threats through expanded monitoring and research.
1.8	Adopt and enforce water quality protection zoning ordinances.

Goal 2: Protect and restore aquatic and riparian habitats.	
Objectives:	
2.1	Protect natural and restore degraded shorelines and streambanks along with riparian and instream habitat improvements.
2.2	Manage priority invasive species throughout the Watershed.
2.3	Protect water resources from future development by incorporating green infrastructure.
2.4	Adopt and enforce water quality protection zoning ordinances.
2.5	Implement permanent land protection strategies in priority areas and on priority parcels.
2.6	Conduct resource inventories and monitor water quality on a regular basis to assess conditions that may be affecting water quality.
2.7	Support efforts to protect or restore critical habitat for native species.

Goal 3: Sustain tourism, recreational opportunities, and industry in a manner consistent with water quality protection.	
Objectives:	
3.1	Support and expand low-impact recreational opportunities.
3.2	Incorporate watershed protection into recreational planning efforts.
3.3	Limit impacts from forestry and agriculture.
3.4	Limit impacts from recreational activities.
3.5	Support measures that minimize the risk of exposure to pathogens, bacteria, heavy metals, and other contaminants.
Goal 4: Protect regional and local hydrology.	
Objectives:	
4.1	Limit impacts to wetlands and groundwater recharge areas.
4.2	Manage stormwater throughout the Watershed.
4.3	Restore hydrology where impacted.
4.4	Protect drinking water sources.
4.5	Conduct resource inventories and monitor water quality on a regular basis to assess conditions that may be affecting water quality.
Goal 5: Protect the Larks Lake Watershed from future threats/emerging issues.	
Objectives:	
5.1	Advocate for short-term measures that will minimize risks of an oil leak from the Line 5 pipeline. Using information from the state Pipeline Advisory Board, educate partners and local citizens regarding potential long-term solutions, including decommissioning.
5.2	Mitigate climate change impacts, including more severe coastal storms in our area, by protecting and restoring vulnerable areas and implementing best management practices throughout the Watershed.
5.3	Be aware and responsive to any new threats or emerging issues that may impact the Watershed on a broad scale.

Chapter 6: Implementations Steps

Overview of Implementation Tasks and Actions

The Burt Lake Watershed Management Plan Advisory Committee seeks an integrative approach to reduce existing sources of nonpoint source pollution and prevent future contributions. Effective watershed management must rely upon an integrative approach that includes:

- 1) Best management practices (BMPs)
- 2) Partnerships, community consensus building, and work with local governments,
- 3) Information and education components

The recommended implementation tasks and actions represent the best management practices and initiatives identified by the Advisory Committee as being the most critical for water quality protection within the Watershed.

Proposed Best Management Practices (BMPs)

BMPs are techniques, measures, or structural controls designed to minimize or eliminate runoff and pollutants from entering surface and ground waters. Non-structural BMPs are preventative actions that involve management and source controls. These include policies and ordinances that provide requirements and standards to direct growth of identified areas, protection of sensitive areas such as wetlands and riparian areas, and maintaining and/or increasing open space. Other examples include providing buffers along sensitive water bodies, limiting impervious surfaces, and minimizing disturbance of soils and vegetation. Additional non-structural BMPs can be education programs for homeowners, students, businesses, developers, and local officials about everyday actions that protect water quality. Educational efforts are expounded upon in the Information and Education Strategy.

Structural BMPs are physical systems that are constructed to reduce the impact of development and stormwater on water quality. They can include stormwater facilities such as stormwater wetlands; filtration practices such as grassed swales and filter strips; and infiltration practices such as bioretention areas and infiltration trenches.

Structural and non-structural BMPs will be used in combination in the Watershed to obtain the maximum reduction or elimination NPS pollutants. BMPs should be selected according to their potential to reduce the targeted NPS pollutant, as well as budget, maintenance requirements, available space, and other factors. Some examples of possible BMPs for the most common sources of nonpoint source pollutants are listed in Table 12. Specific BMP recommendations for the Watershed are located in the Implementation Tasks (Table 15).

TABLE 12. STRUCTURAL BMPs

Structural Practices	Nonstructural Practices
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Agriculture	Contour buffer strips Grassed waterway Herbaceous wind barriers Mulching Live fascines Live staking Livestock exclusion fence Revetments Riprap Sediment basins Terraces Waste treatment lagoons	Brush management Conservation coverage Conservation tillage Educational materials Erosion and sediment control plan Nutrient management plan Pesticide management Prescribed grazing Residue management Requirement for minimum riparian buffer Rotational grazing Workshops/training for developing nutrient management plans
Forestry	Broad-based dips Culverts Establishment of riparian buffer Mulching Revegetation of firelines with adapted herbaceous species Temporary cover crops Windrows	Education campaign on forestry-related NPS control Erosion and sediment control plans Forest chemical management Fire management Operation of planting machines along the contour to avoid ditch formation Planning and proper road layout and design Preharvest planning Training loggers and landowners about forest management practices, forest ecology, etc.
Urban	Bioretention cells Breakwaters Brush layering Infiltration basins Green roofs Live fascines Marsh creation/restoration Establishment of riparian buffers Riprap Stormwater ponds Sand filters Sediment basins Tree revetments Vegetated gabions Water quality swales	Planning for disconnection of impervious surface (e.g., eliminating or reducing curb and gutter) Educational materials Erosion and sediment control plan Fertilizer management Ordinances Pet waste programs Pollution prevention plans No-wake zones Setbacks Workshops on proper installation of structural BMPs Zoning overlay districts

Note: Practices listed under one land use category can be applied in other land use settings.

BMP Effectiveness

The actual effectiveness or efficiency of a BMP is determined by the size of the BMP implemented (e.g., feet of vegetated buffer or acres of stormwater detention ponds), and how much pollution was initially coming from the source. Table 13 (Huron River Watershed Council, 2003) lists estimates of pollutant removal efficiencies for stormwater BMPs that may be used in the Watershed.

Information regarding pollutant removal efficiency, designs of BMPs, and costs are continually evolving and improving. As a result, it is critical to research the latest technologies, design, and methodologies before implementing BMPs within the Watershed.

TABLE 13. POLLUTANT REMOVAL EFFICIENCIES

Pollutant Removal Efficiencies

Management Practice	Total Phosphorus	Total Nitrogen	TSS	Metals	Bacteria	Oil & Grease
High-powered street sweeping	30-90%		45-90%			
Riparian buffers Forested: 20-40 m width Grass: 4-9 m width	Forested: 23-42%; Grass: 39-78%	Forested: 85%; Grass: 17-99%	Grass: 63-89%			
Vegetated roofs	70-100% runoff reduction, 40-50% of snow/rainfall. 60% temperature reduction. Structural addition of plants over a traditional roof system.					
Vegetated filter strips 7.5 m length 45 m width	40-80%	20-80%	40-90%			
Bioretention	65-98%	49%	81%	51-71%	90%	
Wet extended detention pond	48-90%	31-90%	50-99%	29-73%	38-100%	66%
Constructed wetland	39-83%	56%	69%	(-80)-63%	76%	
Infiltration trench	50-100%	42-100%	50-100%			
Infiltration basin	60-100%	50-100%	50-100%	85-90%	90%	
Grassed swales	15-77%	15-45%	65-95%	14-71%	(-50)-(-25)%	
Catch basin inlet devices		30-40% sand filter	30-90%			
Sand and organic filter	41-84%	22-54%	63-109%	26-100%	(-23)-98%	
Soil stabilization on construction sites			80-90%			
Sediment basins or traps at construction sites			65%			
Porous pavement	65%	80-85%	82-95%	98-99%		

Implementation Steps

The following implementation steps (Table 15) includes a comprehensive list of proposed tasks and actions that, if implemented, will result in water quality protection or improvements. Tasks and actions are organized by category to facilitate easy reference. The recommendations are based on a 10-year timeline (2017-2026), a standard duration of time for a watershed management plan. Each task and action identifies the following:

Priority Level: Each task and action has been assigned a priority level based on one or more of the following factors:

- Urgency to correct or reduce an existing problem
- Need to enact a specific task or action before a problem develops
- Availability of funds, partner(s), or program(s) ready to implement
- Overall need to balance low, medium, and high priorities over the course of ten years

Unit Cost/Total Cost estimate: An estimated unit cost is provided when applicable. An estimated total cost is provided when applicable and calculable.

Milestones: Milestone(s) are identified, when possible, to establish an interim, measurable benchmark for determining progress of a specific task or action.

Timeline: Based on the ten-year span of the Watershed Management Plan, steps fall into short-term (1-2 years), mid-term (3-5 years), and long-term (5-10 years). When a task or action is ongoing, it is noted as spanning the ten years.

Potential Partners: The potential partners specified are those who have the interest or capacity to implement the task or action. They are not obligated to fulfill the task or action. It is expected that they will consider pursuing funds to implement the task or action, work with other identified potential partners, and communicate any progress with the Burt Lake Watershed Advisory Committee.

TABLE 14. PARTNER LIST

Partner	Abbreviation
Little Traverse Bay Bands of Odawa Indians	LTBB
Michigan Department of Environment, Great Lakes, and Energy	EGLE
Michigan Department of Natural Resources	MDNR
Tip of the Mitt Watershed Council	TOMWC

Potential Funding Sources: Potential funding sources for each task or action include, but are not limited to:

- Private foundation (PF)
- State grant (SG)
- Federal grant (FG)
- Local government (LG)
- Partner organization (PO)
- Revenue generated (RG)
- Private cost-share (CS)
- Local businesses (LB)

Objectives Addressed: Each task and action supports one or more of the objectives in Chapter 5. Steps shown in **bold** are actions that should be prioritized.

TABLE 15. LARKS LAKE WATERSHED IMPLEMENTATION STEPS

Priority	Water Quality Monitoring			Est. Total Cost	Milestone 2022-2023	Milestone 2024-2026	Milestone 2027-2031	Potential Project Partners	Potential Funding Sources	Objectives Addressed	Information & Education Objectives Addressed
High	WQ.1	Continue implementing Tip of the Mitt Watershed Council's Volunteer Lake Monitoring (VLM) program	\$5,000	Monitor			TOMWC, lake associations	SG, FG, PO	1.6, 2.6, 4.5	IE.2.2, IE.2.4	
		Notes: Continue to monitor									
Medium	WQ.2	Monitor lake levels	\$100	Install gauge & monitor	Monitor		TOMWC, lake association	PF, PO	4.5		
		Notes: Report water levels									
Priority	Wetlands			Est. Total Cost	Milestone 2022-2023	Milestone 2024-2026	Milestone 2027-2031	Potential Project Partners	Potential Funding Sources	Objectives Addressed	Information & Education Objectives Addressed
High	WL.1	Continue to review DEQ Part 303 Wetland Permit Applications to evaluate proposed wetland impacts. Submit comments to DEQ regarding anticipated wetland impacts when appropriate and work with applicants to minimize impacts.	\$25,000	Ongoing			TOMWC, lake associations	PF, PO		IE.2.1	
		Notes: Respond to all permit applications when potential wetland impacts are high.									
Priority	Shoreline and Streambank Protection			Est. Total Cost	Milestone 2022-2023	Milestone 2024-2026	Milestone 2027-2031	Potential Project Partners	Potential Funding Sources	Objectives Addressed	Information & Education Objectives Addressed
High	SP.1	Repeat shoreline survey on Larks Lake	\$3,500	NA	Survey and Distribute	NA	TOMWC, lake associations	PF, SG, FG, LG PO	1.6, 2.6, 4.5	IE.2.2	
		Notes: Last survey was completed in 2006									
	SP.2	Promote the Michigan Shoreland Stewards program.	\$30,000	Mailing	Ongoing		TOMWC, lake associations	SG,FG,PO		IE.1.1, IE.2.2	
		Notes: Increase overall program enrollment and keep lake association info on the webpage current.									
	SP.3	Promote the use of Certified Natural Shoreline Professionals to riparians for bioengineering projects.	\$5,000	Ongoing			TOMWC, lake associations	SG,FG,PO		IE.1.1, IE.2.2	
		Notes: Education									
SP.4	SP.4	Provide riparian property owners with assistance and resources (publications, websites, workshops, and on-site assessments) as they relate to shoreline and streambank management.	\$30,000	Ongoing			TOMWC, lake associations	PF, SG, FG, PO		IE.1.1, IE.2.2	
		Notes: Ulitize different methods of outreach									

	SP.5	Continue to review DEQ Part 301 Inland Lakes and Streams Permit Applications to evaluate proposed wetland impacts. Submit comments to DEQ regarding anticipated impacts when appropriate and work with applicants to minimize impacts.	\$25,000	Ongoing			TOMWC, lake associations	PF, PO		IE.2.1
		Notes: Respond to all permit applications when potential impacts are high.								
Medium	SP.6	Implement best management practices (BMPs) on moderate and severe shoreline erosion sites in conjunction with property owner outreach.	\$25,000	NA	Funding and begin Installation	Continue Installation	TOMWC	PF, SG, FG, LG, PO, CS	1.1	
		Notes: Provide resources								
	SP.7	Develop and implement cost/share greenbelt program(s), including demonstration sites.	\$50,000	Adoption	Implementation		TOMWC, lake associations	PF, SG, FG, PO, CS	1.1, 2.1	IE.2.3
		Notes: Highlight an example of a greenbelt on the lake								
Priority	Stormwater Management		Est. Total Cost	Milestone 2022-2023	Milestone 2024-2026	Milestone 2027-2031	Potential Project Partners	Potential Funding Sources	Objectives Addressed	Information & Education Objectives Addressed
High	SW.1	Promote green infrastructure to watershed residents to increase stormwater awareness and implementation of best management practices.	\$15,000	Funding	Develop and Distribute		TOMWC, lake associations	PF, SG, PO, LB		IE.1.1, IE.1.2, IE.2.2
		Notes: Education								
Priority	Planning and Zoning		Est. Total Cost	Milestone 2022-2023	Milestone 2024-2026	Milestone 2027-2031	Potential Project Partners	Potential Funding Sources	Objectives Addressed	Information & Education Objectives Addressed
High	PZ.1	Utilize the recommendations of the Emmet County Gaps Analysis (2013) to encourage adoption of model standards in zoning ordinances to protect water quality.	\$60,000	Ongoing			Lake associations, local governments	PF, LG, PO	2.4	IE.2.2
		Notes: Encourage adoption								
	PZ.2	Work with Cheboygan County and Emmet County to adopt a wetland setback of at least 25', similar to shoreline setbacks.	\$3,000	NA	NA	Support and Implement	TOMWC, lake associations, local governments	PF, LG, PO	2.4	
		Notes: Encourage adoption								
Priority	Recreation, Safety and Human Health		Est. Total Cost	Milestone 2022-2023	Milestone 2024-2026	Milestone 2027-2031	Potential Project Partners	Potential Funding Sources	Objectives Addressed	Information & Education Objectives Addressed

Medium	RH.1	Implement stormwater and erosion BMPs at boat launches and other access points where water quality impacts are noted.	\$40,000	NA	Report and Implement		MDNR, TOMWC, lake associations, local governments	PF, LG, SG, FG, PO	3.4	
		Notes: Implement at Kaz Road launch								
	RH.2	Provide information and feedback to local and state governments regarding their recreational planning efforts that may impact the Watershed.	\$6,000	Ongoing			All	SG, LG, PO	3.2	
		Notes: Respond to planning efforts as projects are proposed.								
	RH.3	Promote clean boating practices and state boating regulations at marinas, boat launches, fishing tournaments, events and other public venues.	\$5,000	NA	Partner		TOMWC, lake association, local businesses	PF, PO, LB	3.4	
Notes: Partner with businesses or events to reduce recreational impacts.										
Priority	Threatened, Endangered, and Species of Concern		Est. Total Cost	Milestone 2022-2023	Milestone 2024-2026	Milestone 2027-2031	Potential Project Partners	Potential Funding Sources	Objectives Addressed	Information & Education Objectives Addressed
High	TE.1	Protect and restore wild rice habitat through education and research methods	\$30,000	Research & Restore			LTBB, lake association	PF, FG	2.7	
		Notes: Work with LTBB on education efforts on the lake								
Priority	Invasive Species		Est. Total Cost	Milestone 2022-2023	Milestone 2024-2026	Milestone 2027-2031	Potential Project Partners	Potential Funding Sources	Objectives Addressed	Information & Education Objectives Addressed
High	AI.1	Report introductions and spread of invasive species to at least one tracking database (USGS, MISIN, etc.).	\$20,000	Report			CAKE, TOMWC	PF, SG, FG, LG, PO	2.2	
		Notes: Report introductions annually beginning year 1.								
	AI.2	Implement on-the-ground management projects to stop the introduction, spread, and distribution of invasive species within the Watershed.	\$100,000	Implement			CAKE, TOMWC, local governments	SG, FG, LG, PO	2.2	
		Notes: Purple loosestrife, phragmites, and others as identified.								
	AI.3	Provide property owners with assistance and resources with invasive species management through site assessments, distribution of resources, and other outreach.	\$50,000	Implement			CAKE, TOMWC, local governments	PF, SG, FG, PO, CS	2.2	IE.2.1, IE.2.2
		Notes: Share AIS information via newsletters or other media.								
	AI.4	Install signage at public boat launch that highlight Clean Boats, Clean Waters program and message.	\$10,000	Locations and Funding	Install		MDNR, TOMWC, lake associations	PF, SG, PO, LB	2.2	IE.1.1
Notes: Install 1 sign										
AI.5	Repeat aquatic plant survey	\$4,000			Survey	TOMWC, lake associations	PF, SG, FG, PO	1.6, 2.6, 4.5	IE.2.2	

		Notes: Note any changes in plant community prior to survey								
	AI.6	Conduct volunteer-based boater education program through Clean Boats, Clean Waters program.	\$5,000		Recruit and Train		MI Sea Grant, TOMWC, lake associations	SG, FG, LG, PO	2.2	IE1.1, IE.2.1, IE.2.4
		Notes: Utilize mobile boat station for on the water events								
	AI.7	Recruit and coordinate multiple lake association-based volunteer teams to operate boat washing stations (AI.5).	\$30,000	Develop	Operate		TOMWC, lake associations	PF, PO	2.2	IE.2.4
		Notes: Develop and promote program, recruit volunteers, trainings and coordination.								
	AI.8	Monitor and manage purple loosestrife throughout the Watershed with biological control agent.	\$25,000	Ongoing			CAKE, TOMWC, lake associations		2.2	
		Notes: Release Galerucella beetles annually								
Priority	Septic Systems		Est. Total Cost	Milestone 2022-2023	Milestone 2024-2026	Milestone 2027-2031	Potential Project Partners	Potential Funding Sources	Objectives Addressed	Information & Education Objectives Addressed
High	SS.1	Develop septic system outreach campaign, including incentives such as a septic giveaway, free inspections.	\$75,000	NA	Develop and Funding	Implement	TOMWC, lake associations, local governments	PF, SG, FG, LG, PO, CS, LB		IE.1.1, IE.1.2, IE.2.1 IE.2.2, IE.2.3
		Notes: Distribute outreach materials								
Priority	Emerging Issues and Future Threats		Est. Total Cost	Milestone 2017-2018	Milestone 2019-2021	Milestone 2022-2026	Potential Project Partners	Potential Funding Sources	Objectives Addressed	Information & Education Objectives Addressed
High	EI.1	Conduct education and outreach to local government officials, lake associations, and other community groups and members about Line 5.	\$100,000	Ongoing			TOMWC, lake associations, local governments	PF, PO	5.1	IE.1.1, IE.2.2
		Notes: Share articles, press releases, and utilize social media to provide current and accurate information.								
	EI.2	Educate on climate-change strategies to protect most vulnerable aquatic resources.	\$100,000	Funding	Strategies		TOMWC, lake associations, local governments	PF, SG, FG, LG, PO	5.2	IE.1.1, IE.1.2, IE.2.2
		Notes: Disseminate strategies via climate change campaign.								

Chapter 7: Information and Education Strategy

Every watershed plan should include an Information and Education (I/E) component that involves the watershed community. Because many water quality problems result from individual actions and the solutions are often voluntary practices, effective public involvement and participation promote the adoption of management practices, help to ensure the sustainability of the watershed management plan, and perhaps most important, encourage changes in behavior that will help to achieve your overall watershed goals.

-EPA Handbook for Developing Watershed Plans to Restore and Protect Our Waters

Effective watershed protection is most successful when I/E efforts are incorporated into watershed management planning. In the previous chapter, I/E implementation steps were included in the overall Implementation Steps (Table 15), and to highlight the connection.

Goal 1: Develop and implement effective outreach and education efforts that address nonpoint source pollution within the Watershed, engage all Watershed constituents, and convey constituents' respective roles in watershed protection.

Objectives:

IE.1.1 Utilize the Internet, email, social media, podcasts, video, news media, surveys, print materials, advertising, workshops, presentations, and other innovative forms of communication.

IE.1.2 Apply concepts from the United States Environmental Protection Agency's Getting In Step: A Guide for Conducting Watershed Outreach Campaigns (3rd edition, November 2010) to improve communication efforts.

Goal 2: Enhance watershed protection capacity among Watershed stakeholders.

Objectives:

IE.2.1 Capitalize on the strengths and capacity of the Watershed stakeholders along with their respective programs and skill sets to implement the Watershed Management Plan.

IE.2.2 Provide resources, data, technical assistance to local governments, residents, businesses, organizations, and other entities

IE.2.3 Provide watershed protection incentives

IE.2.4 Provide watershed protection volunteer opportunities

The I/E Strategy reflects the various watershed audiences and the potential means of informing and educating. The following groups have been identified as the key audiences in which the I/E Strategy is based.

Component 1: General Watershed Community

General watershed protection and resource information should continue to be developed and disseminated through print and social media, websites, and educational events. Information should be general in nature with the following topic areas of focus:

- Water resources and water quality of the Watershed

- Stormwater: what is it, how it affects water quality, and how to manage it
- Cultivating the next generation of watershed stewards
- Boater education: clean boating practices

Component 2: Riparian Education

Riparians play an enormous role in watershed protection. Many riparians, however, remain unaware of the connection between water quality and riparian management. Focus areas should include what role riparians play in resource protection. The Michigan Shoreland Stewards program, an education and outreach component of the Michigan Natural Shoreline Partnership, is a valuable resource that applies to all lakes within the state. Promotion of this program, along with other local initiatives, is key in order to increase awareness of stewardship opportunities. In addition to shoreline management, efforts to increase awareness of aquatic invasive species should be emphasized among riparians. Riparians should have adequate access to current invasive species information, including identification, current range/distribution, modes of spread, and best management practices.

Component 3: Targeted Engagement

Efforts to identify, address, and engage with targeted groups should be at the forefront. Examples of these types of targeted groups include private property owners or homeowner associations known to have:

- A small dam
- A particularly threatening invasive species
- Suspected septic system issues

Other groups may include agricultural producers/farmers, local government officials, septic haulers, engineers, road commissions, and others to encourage best management practices where they are lacking.

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