Scotts and Beals Lakes Shoreline Survey 2016

By Tip of the Mitt Watershed Council

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SUMMARY

During the late spring and early summer of 2016, the Tip of the Mitt Watershed Council conducted a shoreline survey on Scotts and Beals Lakes as part of a comprehensive shoreline survey for the entire Elk River Chain of Lakes. Watershed Council staff and interns surveyed the upper Elk River Chain (Beals Lake through Intermediate Lake) in 2016 and the lower Elk River Chain (Lake Bellaire through Elk Lake) in 2017. Surveys were designed to document conditions that can potentially impact water quality, including the three biggest threats to inland lakes: nutrient pollution, habitat loss, and shoreline erosion.

Survey results indicate that the shorelines of Scotts and Beals Lakes are largely in their natural state, although some impacts from development were documented. For the two lakes combined, 20% of all shoreline properties lack adequate shoreline vegetation, and 4% have altered shorelines. Nearly all problem areas are located along the western shore of each lake, where development is most concentrated. Compared to other Northern Michigan lakes, Scotts and Beals Lakes have excellent shoreline habitat and relatively few alterations. Shoreline erosion areas were very limited, with only three Scotts Lake parcels and one Beals Lake parcel having erosion issues. Most were small areas of light erosion. *Cladophora* algae was not present in either lake. The lakes lacked habitat suitable for supporting *Cladophora* growth, making this form of nutrient pollution detection less useful for Scotts or Beals Lakes.

INTRODUCTION

Background:

During the late spring and early summer of 2016, a shoreline survey was conducted on Scotts and Beals Lakes by the Tip of the Mitt Watershed Council (Watershed Council) to document shoreline conditions that potentially impact water quality. The entire shoreline was surveyed to document the following: algae as a nutrient pollution indicator, erosion, shoreline alterations, greenbelts, and tributary inlets and outlets. This survey was funded by a grant from the Michigan Department of Environmental Quality as part of a larger Elk River Watershed protection initiative. This was the first shoreline survey to be performed on Scotts and Beals Lakes.

The 2016 survey provides a comprehensive data set documenting shoreline conditions on Scotts and Beals Lakes; a valuable data set that can be used as a lake management tool. Combined with follow-up activities, such as questionnaires and on-site visits, problems in shoreline areas that threaten the lake's water quality can be identified and corrected. These solutions are often simple and low cost, such as regular septic system maintenance, proper lawn care practices, and wise land use along the shoreline. Prevention of problem situations can also be achieved through the publicity and education associated with the survey. Periodic repetition of shoreline surveys is important for identifying new and chronic problem sites, determining long-term trends of near-shore nutrient inputs and shoreline alterations associated with land-use changes, and for assessing the success of remedial actions. For maximum benefits, the shoreline survey should be repeated every 5 – 10 years.

Shoreline Development Impacts:

Lake shorelines are the critical interface between land and water; where human activity has the greatest potential for degrading water quality. Traditional development of shoreline properties for residential, commercial, or other uses invariably leads to negative impacts on the lake ecosystem. During the development process, the natural landscape is altered in a variety of ways: vegetation is removed, the terrain is graded, utilities are installed, structures are built, and areas are paved. These changes to the landscape and subsequent human activity in the shoreline area have consequences on the aquatic ecosystem. Nutrients from organic wastes, contaminants from cars and roads, and soils from eroded areas are among some of the pollutants that end up in and negatively impact the lake following shoreline development.

Nutrient pollution can have adverse impacts on aquatic ecosystems and pose a danger to human health. While nutrients are necessary to sustain a healthy aquatic ecosystem, excess nutrients will stimulate nuisance aquatic plant growth of both macrophytes (aquatic plants that grow in or near water and are either emergent, submergent, or floating) and algae. Additionally, algal blooms pose a public health risk as some species (i.e. blue green algae) produce toxins, including hepatotoxins (toxins that cause liver damage) and neurotoxins (toxins that affect the nervous system). Excess plant and algae growth can also degrade water quality by depleting the ecosystem's dissolved oxygen stores. During nighttime respiration, plants compete with other organisms for a limited oxygen supply. Furthermore, the decomposition of algae and plants has the potential to deplete dissolved oxygen supplies due to the aerobic activity of decomposers, particularly in the deeper waters of stratified lakes.

In general, small and shallow lakes, such as Scotts and Beals, are more sensitive to nutrient pollution. Because larger lakes have a greater water volume and dissolved oxygen stores, they tend to be less susceptible to nutrient pollution. By contrast, small lakes generally have smaller stores of dissolved oxygen and a lesser ability to dilute nutrients, making them more susceptible to the indirect impacts of nutrient pollution. Furthermore, nutrient pollution can be more problematic in small lakes due to extensive shallow areas that can support aquatic plant growth.

Surface waters receive nutrients through a variety of natural and cultural (human) sources. Natural sources of nutrients include stream inflows, groundwater inputs, surface runoff, organic inputs from riparian (shoreline) areas, and atmospheric deposition. Springs and seeps, streams, and artesian wells are often naturally high in nutrients due to the geologic strata they encounter. Nearby wetland seepages may also discharge nutrients at certain times of the year. Cultural sources include septic systems, fertilizers, and stormwater runoff from roads, driveways, parking lots, roofs, and other impervious surfaces. Poor agricultural and forestry practices, which oftentimes result in soil erosion, and wetland destruction also contribute to nutrient pollution. Additionally, some cultural sources (e.g., malfunctioning septic systems) pose a potential health risk due to bacterial and viral contamination.

Severe nutrient pollution is detectable through chemical analyses of water samples, physical water measurements, and the utilization of biological indicators (a.k.a., bio-indicators). Although chemical analyses of water samples to check for nutrient pollution can be effective, they are oftentimes more labor intensive and costlier than other methods. Typically, water samples are analyzed to determine nutrient concentrations (usually forms of phosphorus and nitrogen), but other chemical constituents, such as chloride, can be measured. Physical measurements, such as water temperature and conductivity (i.e., the water's ability to conduct an electric current), are primarily used to detect malfunctioning septic systems. Biologically, nutrient pollution can be detected along the lake shore by noting the presence of *Cladophora* algae, a bio-indicator.

Cladophora is a branched, filamentous green algal species that occurs naturally in small amounts in Northern Michigan lakes. Its occurrence is governed by specific environmental requirements for temperature, substrate, nutrients, and other factors. It is found most commonly in the wave splash zone and shallow shoreline areas of lakes, as well as streams. It grows best on stable substrates such as rocks and logs, though artificial substrates such as concrete or wood seawalls are also suitable. *Cladophora* prefers water temperatures in a range of 50 to 70 degrees Fahrenheit, which means that the optimal time for its growth and detection in Northern Michigan lakes is from mid-May to early July, and September to October.

The nutrients required for *Cladophora* to achieve large, dense growths are typically greater than the nutrient availability in the lakes of Northern Michigan. Therefore, shoreline locations where relatively high concentrations of nutrients, particularly phosphorus, are entering a lake can be identified by noting the presence of *Cladophora*. Although the growth features of *Cladophora* can be influenced by factors such as current patterns, shoreline topography, substrate composition, and wave action, the presence or absence of any significant growth is a powerful lake-wide screening tool. It can reveal the existence of chronic nutrient loading problems and assess the effectiveness of any remedial actions. Comparisons of the total number of algal growths can reveal trends in nutrient inputs due to changing land use.

Erosion along the shoreline has the potential to degrade the lake's water quality. Stormwater runoff through eroded areas carries sediments into the lake and impacts the lake ecosystem in a variety of ways. Sediments clog the gills of fish, aquatic insects, and other aquatic organisms. Excessive sediments smother fish spawning beds and fill interstitial spaces that provide habitat for a variety of aquatic organisms. Suspended sediments absorb sunlight energy and increase water temperatures. In addition, nutrients adhere to sediments that wash in from eroded areas, which can lead to nuisance aquatic plant growth and algal blooms.

Shoreline greenbelts (vegetative buffers) are essential for maintaining a healthy aquatic ecosystem. A greenbelt consisting of a variety of native woody and herbaceous plant species provides habitat for near-shore aquatic organisms as well as other shoreline-dependent wildlife. They also help to stabilize shorelines against wave and ice action with their extensive network of deep, fibrous roots. Greenbelts also provide shade to nearshore areas, which is particularly important for lakes with cold water fisheries. In addition, greenbelts provide a mechanism to filter pollutants carried by stormwater from rain events and snowmelt.

Tributaries have a significant potential for influencing a lake's water quality as they are one of the primary conduits through which water is delivered to a lake from its watershed. Inlet streams may provide exceptionally high quality waters that benefit the lake ecosystem. Conversely, they have the potential to deliver polluted waters that degrade the lake's water quality. Outlet streams flush water out of the lake, providing the means to remove contaminants that have accumulated in the lake ecosystem.   With regard to shore surveys, noting the location of inlet tributaries is very helpful when evaluating shoreline algae conditions because nutrient concentrations are generally higher in streams than in lakes. The relatively higher nutrient levels delivered from streams often lead to naturally heavier *Cladophora* and other algal growth in nearby shoreline areas.

Lake-friendly shoreline property management is paramount for protecting water quality and sustaining a healthy, thriving lake ecosystem. Septic system maintenance, stormwater management, erosion control, and the elimination of fertilizers, herbicides, and pesticides are among the many low-cost best management practices that minimize the impact of shoreline properties on water quality.

Study Area:

Scotts and Beals Lakes are located in Echo Township of Antrim County of the northwest Lower Peninsula of Michigan. Based on digitization of aerial orthophotography, the shoreline of Scotts Lake measures 1.6 miles and Beals Lake measures 1.2 miles. The Lakes have surface areas of 63 and 39 acres, respectively. Bathymetry maps of Scotts Lake indicate the deepest location to be near southeast side of the Lake, with a maximum depth of 21 feet. Bathymetry maps of Beals Lake indicate maximum depths of 16 feet, near the center (MI DNR, 1949).

Scotts and Beals Lakes are drainage lakes with water flowing into and out of the Lakes. Beals Lake, primarily fed by the Intermediate River, is the uppermost lake within the Elk River Chain. A small channel connects Scotts and Beals Lakes, accounting for the primary inflow to Scotts Lake. The outlet from Scotts Lake is called the Dingman River, which flows north roughly two miles to Six Mile Lake.

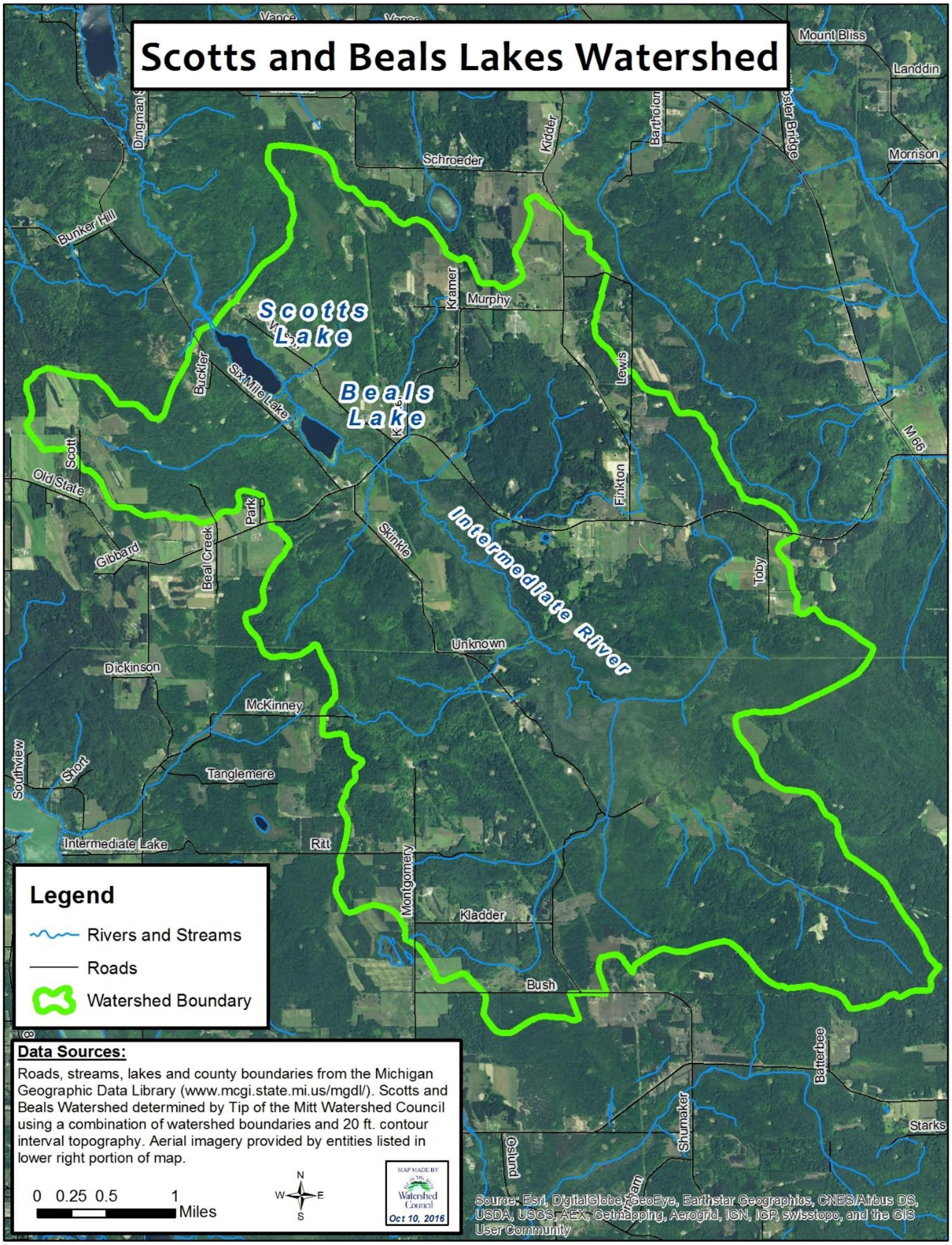

Figure 1. Map of Scotts and Beals Lakes and Watershed.

Using elevation data acquired from the State of Michigan, Watershed Council staff developed watershed boundary files for Scotts and Beals Lakes in a GIS (Geographical Information System). Based on these data, the Scotts and Beals Lake Watershed encompasses approximately 12,800 acres of land and water (Figure 1). A watershed ratio of 125.4 was calculated by dividing the Lake surface area into the watershed area (not including the Lake), indicating that there are roughly 125 acres of land in the Watershed for each acre of Scotts and Beals Lakes' water surface. This ratio provides a statistic for gauging susceptibility of lake water quality to changes in watershed landcover. Relative to other lakes in Northern Michigan, Scotts and Beals Lakes have a high watershed ratio and therefore, greater dependence on overland flow produced by the Lakes' Watershed, making it more susceptible to impacts related to watershed degradation.

According to landcover data from the National Oceanic and Atmospheric Administration's Costal Change Analysis Program, the watershed of Scotts and Beals Lakes is primarily forested. Watersheds in their natural state (as opposed to agricultural or urban) generally support higher water quality and greater biodiversity. Tributaries flowing through wetland complexes upstream from Beals Lake are buffered from polluted runoff by the filtering capacity of riparian wetlands.

The water quality of Scotts and Beals Lakes has rarely been monitored. They were monitored as part of the Watershed Council's Comprehensive Water Quality Monitoring program in 1995 and 1998. Water quality can be characterized, in the late 90's, as minimally impacted mesotrophic conditions. Dissolved oxygen was high in most of the water column, but dwindled to near-zero at the bottom of both lakes in 1998, a condition common in smaller, more productive lakes. Average total phosphorus concentrations of 16.3 ug/L for Beals Lake and 17.4 ug/L for Scotts Lake are within the normal range for a mesotrophic lake, and are considered to be indicative of a healthy level of nutrients. Chloride, a common pollutant in Northern Michigan, was in low concentration, at an average of roughly 5 mg/L for both Lakes, and pH readings indicate the Lakes are mildly basic, averaging 7.6 in both Lakes.

METHODS

The Scotts and Beals Lakes shoreline was comprehensively surveyed in mid-June of 2016 to document shoreline conditions that can potentially impact water quality. Shoreline conditions were surveyed by traveling in kayak as close to the shoreline as possible (usually within 20 feet) and noting *Cladophora* growth, substrate type, erosion, greenbelt health, shoreline alterations, and tributaries. A GPS camera was used to photograph all shoreline properties. Information for each property was recorded on field data sheets, subsequently inputted into a database, and used in conjunction with GPS data to link field data and photographs with property owner data from county equalization records.

Field Survey Parameters

Shoreline property features were documented by photographing and noting physical features on a data sheet, such as building descriptions, public access sites, and county road endings. Due to data sheet space limits, building descriptions were recorded in an abbreviated style. For example, *Red 2 sty, brn rf, wht trm, fldstn chim, lg pine* means that the property has a red two-story house with a brown roof, white trim, fieldstone chimney, and a large pine tree in the yard. Whenever possible, names of property owners and addresses were included.

Developed parcels were noted on field data sheets and included as a separate column in the database. Properties described as developed indicate the presence of buildings or other significant permanent structures, including roadways, boat launching sites, and recreational properties (such as parks with pavilions and parking lots). Properties with only mowed or cleared areas, seasonal structures (such as docks or travel trailers), or unpaved pathways were not considered developed. Additionally, large parcels that had structures in an area far from the water's edge were not considered developed. The length and area of developed versus undeveloped shoreline was not calculated.

Many species of filamentous green algae are commonly found growing in the nearshore regions of lakes. Positive identification of these species usually requires the aid of a microscope. However, *Cladophora* usually has an appearance and texture that is quite distinct to a trained surveyor, and these were the sole criteria upon which identification was based. Other species of filamentous green algae can respond to an external nutrient source in much the same way as *Cladophora*, though their value as an indicator species is not thought to be as reliable. When other species occurred in especially noticeable, large, dense growths, they were recorded on the data sheets and described the same as those of *Cladophora*.

When *Cladophora* was observed, it was described in terms of the length of shoreline with growth, the relative growth density, and any observed shoreline features potentially contributing to the growth. For example, "MHx30 – seeps" denotes a moderate to heavy growth that covered 30' of the shoreline and with groundwater seeps in the area that may have been contributing to the growth. Both shoreline length and growth density are subjective estimates. Growth density is determined by estimating the percentage of substrate covered with *Cladophora* using the following categorization system:

Table 1. Categorization system for *Cladophora* density.

Density Category	**Field Notation**	**Substrate Coverage**
Very Light	(VL)	0% *
Light	(L)	1- 20%
Light to Moderate	(LM)	21-40%
Moderate	(M)	41-60%
Moderate to Heavy	(MH)	61-80%
Heavy	(H)	81-99%
Very Heavy	(VH)	90-100% *

**Very Light is noted when a green shimmer is noticed on hard substrate, but no filamentous growth present. Very Heavy overlaps with heavy and is distinguished by both high percentage of substrate coverage and long filamentous growth.*

Among other things, the distribution and size of each *Cladophora* growth is dependent on the amount of suitable substrate present. The extent of suitable substrate should therefore be taken into account when interpreting the occurrence of individual growths, and assessing the overall distribution of *Cladophora* along a particular stretch of shoreline. Substrate types were noted during the survey using the following abbreviations: m = soft muck or marl, s = sand, g = gravel (0.1” to 2.5” diameter), r = rock (2.5” to 10” diameter), b = boulder (>10” diameter), and w = woody debris. Substrate suitable for *Cladophora* growth include the g, r, b, and w types. The extent of suitable substrate along a shoreline parcel in terms of distance was not documented.

Erosion was noted based on shoreline areas that exhibited areas of bare soil, leaning or downed trees, exposed tree roots, undercut banks, slumping hunks of sod, or excessive deposits of sediments. Similar to *Cladophora*, shoreline erosion was recorded on field data sheets with estimates of its extent and relative severity (minor, moderate, or severe). For example “Mx20” indicated 20 feet of shoreline with moderate erosion. Additional information about the nature of the erosion, such as potential causes, was also noted.

Greenbelts (i.e., shoreline vegetation) were rated based on the length of shoreline with a greenbelt and the average depth of the greenbelt from the water’s edge landward. Ratings for length ranged from 0 to 4, while ratings for depth ranged from 0 to 3. Ratings were based on the following:

Length... 0: None, 1: 1-10%, 2: 10-25%, 3: 25-75%, 4: >75%
Depth.. 0: None, 1: <10 ft, 2: 10-40 ft, 3: >40 ft

Greenbelt ratings for length and depth were summed to produce an overall greenbelt score. Greenbelt scores ranged from 0 to 7, representing the greenbelt status or health. Scores of 0 were considered very poor, 1-2=poor, 3-4=moderate, 5-6=good, and 7=excellent.

Shoreline alterations were surveyed and noted with the following abbreviated descriptions: SB = steel bulkhead (i.e., seawall), BB = boulder bulkhead, CB = concrete bulkhead, RR = rock riprap, WB = wood bulkhead, BS = beach sand, BH = permanent boathouse, DP = discharge pipe. Abbreviations were sometimes mixed or vary from what is listed above.

Tributaries (i.e., rivers and streams) were noted on the field data sheets and included in a separate column in the database. Additional information regarding shoreline property features or shoreline conditions recorded on field data sheets was included in the database in a “comments” column.

Data Processing

Upon completing fieldwork, all field data were transferred to computer. Information from field data sheets was inputted into a Microsoft Excel® workbook. Digital photographs and GPS data were uploaded to a computer at the Watershed Council office and processed for use.

Linking field and equalization data allows shoreline conditions documented during the survey to be referenced by parcel identification number or parcel owner name. Field data were linked to Antrim County parcel data in a GIS with the aid of GPS and photographs. Occasionally, errors occur wherein field data are not linked to the appropriate parcel.

In order to display survey results without pinpointing specific parcels, a new map layer was developed using the parcel map data layer acquired from the county equalization department and a Scotts and Beals Lakes shoreline layer. The new map layer consists of a narrow band following the shoreline, split into polygons that contain field and equalization data. This data layer was overlaid with other GIS data from the State of Michigan to produce a map to display survey results.

Final products include a comprehensive database, a complete set of GPS digital photographs, GIS data layers of shoreline parcels that include both county equalization and shore survey data, and a map displaying results. The database contains all data collected in the field and identification numbers correspond to those in the GIS data layer and on hard-copy maps.

RESULTS

This survey documented shoreline conditions at 45 parcels on Scotts Lake and 24 parcels on Beals Lake. Approximately 67% of properties on Scotts Lake were considered to be developed, and 46% of shoreline properties on Beals Lake were considered to be developed. This level of development is much lower than the average for Northern Michigan lakes.

Habitat generally considered suitable for *Cladophora* growth was not present along the shoreline of Scotts and Beals Lakes. Noticeable growths of *Cladophora* or other filamentous green algae were not found along the shoreline at any of the 69 properties.

Greenbelt scores ranged from 0 (little to no greenbelt) to 7 (exemplary greenbelt). More than half of greenbelts (64%) along the Scotts Lake shoreline were found to be in good or excellent condition (Table 2). The vast majority (83%) of parcels on Beals Lake had a good to excellent greenbelt. Very few parcels received a rating in the poor or very poor categories. The majority of poor greenbelts were located on the west shore of each lake (Figure 2).

Table 2. Greenbelt rating results.

		Scotts Lake		Beals Lake	
Greenbelt Rating		**Number of Parcels**	**Percent of Parcels**	**Number of Parcels**	**Percent of Parcels**
0	Very Poor (absent)	1	2%	3	13%
1-2	Poor	7	16%	1	4%
3-4	Moderate	8	18%	0	0%
5-6	Good	14	31%	2	8%
7	Excellent	15	33%	18	75%

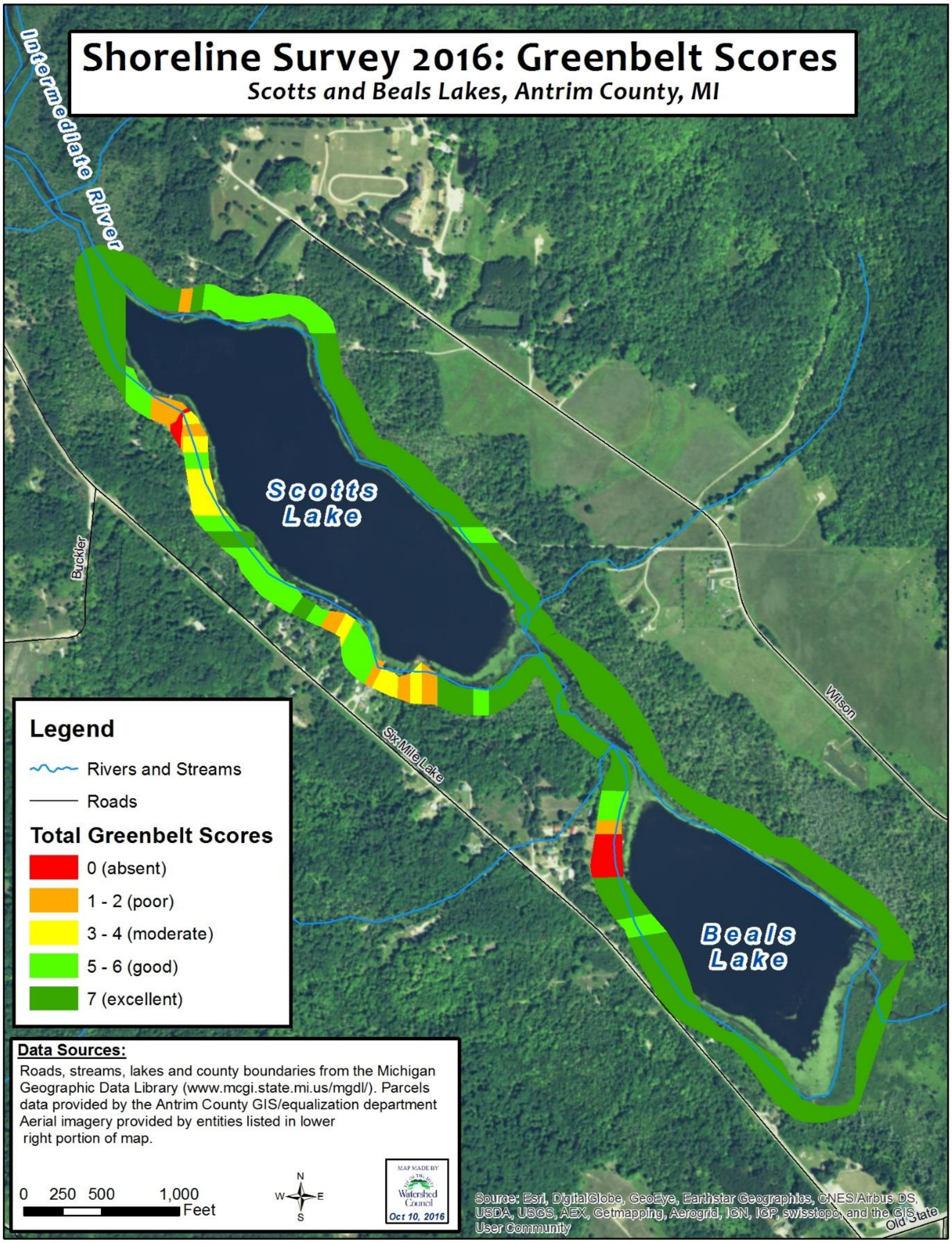

Figure 2. Greenbelt score results for Scotts and Beals Lakes.

Shoreline alterations such as seawalls, rip-rap, or beach sanding were virtually absent from Scotts and Beals Lakes. No shoreline alterations were documented on Beals Lake. Surveyors documented two instances of beach sanding on Scotts Lake. Another Scotts Lake parcel had riprap and a 3” drainpipe outlet at the shoreline. A total of three parcels with alterations, or 4% of the 69 total, speaks to the exceptionally natural condition of shorelines on both Scotts and Beals Lakes.

Erosion was also very limited on both Scotts and Beals Lakes. Only one parcel on Beals Lake exhibited erosion, and was limited to light-moderate severity along 10’ of shoreline. Scotts Lake had slightly more erosion, totaling three parcels, most of which was light and limited to small areas of sand. One parcel was documented as having moderate erosion along 40 feet of shoreline. A total of four parcels showing signs of erosion, or 6% of the total number of parcels on both lakes, indicates that erosion is not an issue for most lakeshore properties.

DISCUSSION

Development of shoreline parcels negatively impacts a lake’s water quality due to a multitude of factors. Among the most serious impacts are: 1) loss of vegetation that would otherwise absorb and filter pollutants in stormwater runoff as well as stabilize shoreline areas and prevent erosion, 2) increased impervious surface area such as roofs, driveways, and roads, which leads to greater inputs of stormwater runoff and associated pollutants, and 3) waste and byproducts of human activity such as septic leachate, fertilizers, and decomposing yard waste that potentially reach and contaminate the lake water. Clearly, there are many problems associated with development, but there are also many solutions for reducing or even entirely eliminating impacts.

Numerous best management practices have been developed that help minimize negative impacts to water quality and which can be utilized during, or retroactively after, the development of shoreline parcels. A buffer of diverse, native plants can be maintained along the shoreline to filter pollutants and reduce erosion. Impacts from stormwater generated from roofs, roads, and driveways can be reduced using rain barrels, rain gardens, grassy swales, and many other techniques. Leachate reaching the lake from septic systems can be minimized by pumping the septic tank regularly, having all components of the septic system inspected regularly and replacing the septic system when necessary. Mulch can be composted far from the shoreline and fertilizers applied sparingly, if at all.

Results from the 2016 shoreline survey indicate that shoreline development is limited on Scotts and Beals Lakes. Less than half of Beals Lake parcels are developed, and about two-thirds of Scotts Lake parcels are developed. The rural location of the lakes plays a role in keeping development sparse, as does the large wetland complex flanking much of the lakes. Many of the properties that are developed have very few structures or other alterations close to water's edge. This type of development is the best-case scenario, when considering ecosystem health.

Cladophora algae growth was absent from Scotts and Beals Lakes. This is largely due to a lack of suitable substrate for *Cladophora* growth. Suitable substrates include hard surfaces such as rocks, boulders, riprap, submerged wood, and metal seawalls. This limits the usefulness of *Cladophora* as an indicator of nutrient pollution. With no supporting habitat for *Cladophora*, it is difficult to make any assertions about the level of nutrient pollution occurring along Scotts or Beals Lake shorelines using the methods at hand.

Results from the greenbelt assessment portion of the survey on Scotts and Beals Lakes indicate that shoreline vegetation removal is the exception, not the norm. This is great news for all aspects of the Scotts and Beals Lakes environment, including water quality, wildlife, and the fishery. Intact habitat provides cover and forage for young fish, amphibian, reptiles, aquatic mammals, and terrestrial animals that rely upon the lakes. While these natural areas may indicate a greater awareness of the importance of shoreline vegetation, more education and outreach is needed to convey the importance of greenbelts to lake residents.

Erosion sites were limited to four parcels on Scotts and Beals Lakes. Most of these were light to moderate in severity, and limited in areal extent. Erosion is less likely to be a problem on Scotts and Beals Lakes compared to larger lakes. Small lakes have less water surface width for wind to generate waves (fetch), resulting in smaller waves and less impact to the shoreline from wave energy. Likewise, winter ice-shove is also less impactful on smaller lakes. Without exposure to erosional forces commonly found on larger lakes, shorelines generally retain more vegetation and require less armoring. This is likely why Scotts and Beals lakes have the lowest amounts of shoreline alterations amongst Northern Michigan lakes surveyed under the same protocol (Table 3). Furthermore, repair of the current erosion sites should be relatively easy to accomplish with plantings, as the low-energy shoreline allows for establishment of new plants.

The Lake ecosystem would benefit from further improvements. Although problems are few and far between on Scotts and Beals Lakes, they still pose a threat to water and habitat quality. The small size of both Lakes makes them especially vulnerable to sediment inputs from erosion, or from removal of shoreline vegetation and habitat. Properties with healthy, intact greenbelts provide a model for improvement for other shoreline properties. Further improvement of the quality of greenbelts throughout the shoreline would invariably have positive impacts on the Lake’s water quality and ecosystem in general.

Table 3. Shore survey statistics from Northern Michigan lakes.

Lake Name	Survey Date	*Cladophora**	Heavy Algae*	Erosion*	Poor Greenbelts*	Alterations*
Beals Lake	2016	0%	0%	0%	17%	0%
Ben-Way Lake	2016	3%	0%	84%	47%	40%
Burt Lake	2009	47%	29%	4%	36%	46%
Bellaire Lake	2017	35%	1%	27%	30%	55%
Charlevoix, Lake	2012	22%	19%	14%	34%	79%
Clam Lake	2017	48%	5%	30%	51%	55%
Crooked Lake	2012	29%	26%	14%	51%	65%
Douglas Lake	2015	27%	6%	17%	53%	60%
Elk Lake	2017	84%	2%	52%	30%	87%
Ellsworth Lake	2016	40%	14%	38%	24%	23%
Hanley Lake	2016	11%	0%	33%	19%	23%
Huffman Lake	2015	14%	0%	7%	57%	70%
Huron, Duncan Bay	2013	41%	2%	19%	45%	63%
Huron, Grass Bay	2013	0%	0%	4%	0%	8%
Intermediate Lake	2016	19%	9%	53%	63%	77%
Lance Lake	2014	19%	0%	12%	35%	31%
Larks Lake	2006	4%	0%	ND	12%	29%
Mullett Lake	2016	44%	6%	36%	59%	76%
Pickerel Lake	2012	27%	33%	15%	52%	64%
Round Lake	2014	21%	0%	27%	44%	44%
Scotts Lake	2016	0%	0%	2%	18%	7%
Silver Lake	2014	3%	0%	70%	53%	65%
Skegemog Lake	2017	52%	5%	40%	46%	76%
St. Clair Lake	2016	4%	0%	13%	34%	21%
Six Mile Lake	2016	10%	24%	13%	41%	37%
Thayer Lake	2017	11%	1%	32%	16%	22%
Thumb Lake	2007	4%	0%	ND	ND	39%
Torch Lake	2017	39%	5%	26%	20%	ND
Walloon Lake	2016	62%	2%	17%	39%	80%
Wildwood Lake	2014	5%	0%	22%	45%	50%
Wilson	2016	27%	5%	29%	11%	14%
AVERAGE	NA	24%	6%	26%	36%	47%

**Percentages are in relation to number of parcels on the lake shore, except for "heavy algae", which is the percent of only parcels that had Cladophora growth. Erosion is the percentage of parcels with moderate to severe erosion and poor greenbelts include those in the poor or very poor categories. ND=no data.*

RECOMMENDATIONS

The full value of a shoreline survey is only achieved when the information is used to educate riparian property owners about preserving water quality, and to help them rectify any problem situations. The following are recommended follow-up actions:

1. Keep the specific results of the survey confidential (e.g., do not publish a list of sites where *erosion was* found) as some property owners may be sensitive to publicizing information regarding their property.
2. Send a <u>general</u> summary of the survey results to all shoreline residents, along with a packet of informational brochures produced by the Watershed Council and other organizations to provide information about threats to the Lake's ecosystem and public health as a result of poor shoreline property management practices as well as practical, feasible, and effective actions to protect water quality.
3. Organize and sponsor an informational session to present findings of the survey to shoreline residents and provide ideas and options for improving shoreline management practices that would help protect and improve the Lake's water quality.
4. Devise methods for detection of near shore nutrient pollution (i.e. excessive fertilizer use or septic leachate) for lakes that lack hard substrate. C*ladophora* presence is a poor indicator of nutrient pollution in lakes such as Scotts and Beals that lack suitable habitat for its occurrence.
5. Inform owners of properties with poor greenbelt scores and those with eroded shorelines of specific results for their property. Supply these property owners with information (e.g., brochures) regarding the benefits of greenbelts and/or the problems associated with erosion. Encourage property owners to improve greenbelts using a mix of native plants and to correct erosion problems. Property owners can have the Watershed Council perform site assessments and carry out projects to improve

greenbelts and/or correct erosion problems.

6. Utilize the Internet to share survey information. A general summary report and this detailed report will be posted on the Watershed Council's website.
7. Repeat some version of the survey periodically (ideally every 5 - 10 years), coupled with the follow-up activities described previously, in order to promote water quality awareness and good management practices on an ongoing basis. During each subsequent survey, more details about shoreline features are added to the database, which can be utilized for other water resource management applications.
8. Regularly monitor the water quality of Scotts and Beals Lakes. The Watershed Council offers training, equipment, and other services for volunteers interested in monitoring their lake as part of the larger Volunteer Lake Monitoring Program. Incorporating Scotts and Beals Lakes into these programs would ensure that changes in water quality don't go unnoticed, and would enable action, should environmental problems surface.

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