

Walloon Lake Greenbelt Survey 2011

*By Tip of the Mitt Watershed Council and
Little Traverse Bay Bands of Odawa*

Report written by:
Kevin L. Cronk

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SUMMARY

Shoreline property development often has negative impacts on the lake ecosystem, including the loss of shoreline vegetation, also known as greenbelts. Greenbelts are essential for maintaining a healthy, diverse aquatic ecosystem because they provide habitat, food, and shade in near-shore areas. They also protect water quality by encouraging infiltration of stormwater runoff and filtration of pollutants, and by stabilizing the shoreline against waves, wind and ice. Recognizing the importance and ecological value of greenbelts, the Little Traverse Bay Bands of Odawa Indians (LTBB) acquired funding from the United States Environmental Protection Agency's Great Lakes Restoration Initiative (GLRI) to work collaboratively with Tip of the Mitt Watershed Council (TOMWC) and the Walloon Lake Association (Association) to conduct a comprehensive survey of shoreline greenbelts on Walloon Lake.

During the summer of 2011, staff from LTBB and TOMWC assessed greenbelt health for every shoreline property on Walloon Lake. Survey results show that Walloon Lake shoreline greenbelts are in good shape; approximately 58% of parcels scored in the "good" or "excellent" categories. Over 90% of properties had a greenbelt on a portion of the shoreline frontage and over half had greenbelts along more than 75% of the shoreline. The majority of parcels had deep greenbelts that extend, on average, more than 10 feet from the shoreline landward and nearly one-third of the greenbelts were found to exceed 40 feet in average depth. In addition, 51% of properties had complex vertical structure, 43% had high species diversity, and 36% had dense vegetation.

Despite the prevalence of healthy greenbelts on Walloon Lake, there is room for improvement. Turf grass documented on over half of shoreline properties undoubtedly has negative impacts on the Walloon Lake ecosystem because: 1) turf grass has short roots compared with extensive root networks of diverse mixes of native vegetation (including woody shrubs and trees) which results in a lesser capacity to filter out pollutants from stormwater runoff before they get to the lake as well as a severely reduced ability to stabilize the shoreline against erosion, 2) maintaining turf grass often involves the addition of fertilizers and herbicides that can wash into the lake causing nutrient pollution that results in undesirable algae and aquatic plant blooms, and 3) turf grass does not contribute valuable habitat structure for fish and other aquatic organisms (e.g. large woody debris such as branches and fallen trees) or food energy (e.g. leaves) to the lake ecosystem. Survey results show that over 25% of parcels have turf grass along 75% or more of the shoreline and that another ~15% have

turf grass along 25-75% of the shoreline.

Erosion control structures documented on Walloon Lake shoreline properties also have negative impacts on the lake ecosystem. The complex root structures of greenbelts and fallen woody debris (e.g. tree trunks and branches) in near-shore areas help to prevent shoreline erosion. Conversely, when natural shorelines are developed and vegetation/debris is removed, shorelines experience more erosion. Seawalls, groins, and other hardened structures exacerbate erosion of adjacent shorelines as they do not absorb wave and ice energy, but rather deflect it to other areas. They can also degrade valuable habitat. Extra large riprap, or oversized rock, provides slightly more habitat than seawalls, but erosion can still occur through the large gaps between rocks. Neither type of structure provides habitat or provides water quality protection as natural vegetation. Additionally, hardened structures such as sea walls can cause increased erosion on neighboring properties. Over 50% of properties had riprap along the shoreline and 15% had seawalls.

Regulation can be an effective approach for protecting shoreline greenbelts. Bay, Evangeline, Melrose, and Resort Townships have adequate ordinances in place to protect greenbelts on Walloon Lake. However, Bear Creek Township falls under Emmet County zoning, which does not require, but rather recommends that a vegetated buffer strip be maintained on the lake shoreline. Survey results show that Bear Creek Township had the highest percentage of shoreline properties with poor greenbelts and lowest percentage with good greenbelts.

Follow-up activities are recommended to get the maximum value out of the greenbelt survey. LTBB, TOMWC, and the Association are working together to get survey results out to Walloon Lake property owners, local governments, and the general public. This outreach effort is intended to increase understanding of the ecological value of shoreline vegetation, provide information for improving greenbelts, and highlight the effectiveness of greenbelt ordinances. Project partners are also plan to conduct a greenbelt workshop to provide more in-depth information about greenbelts and greenbelt installation. The goal of these follow-up activities is to improve the health of greenbelts on Walloon Lake, which will help protect the lake ecosystem and improve water quality.

INTRODUCTION

Background:

During the summer of 2011, a survey was conducted by Tip of the Mitt Watershed Council (TOMWC) and the Little Traverse Bay Bands of Odawa Indians (LTBB) to evaluate the health of greenbelts along the Walloon Lake shoreline. The greenbelts of all lakefront properties were assessed based on seven criteria. Additionally, eroded shoreline areas, emergent vegetation, and invasive species were also noted. Funding for the survey was provided by a grant from the U.S. Environmental Protection Agency's Great Lakes Restoration Initiative (GLRI). The Walloon Lake Association (Association) is also a project partner and will assist with follow-up activities.

Greenbelts refer to the vegetated areas along the shoreline of lakes, ponds, rivers and streams. Greenbelt may have a natural look with a mix of different species and plant types, or may have a more landscaped or formal appearance consisting of a few select species.

Most Northern Michigan lakes possess undeveloped shoreline sections where healthy, natural greenbelts predominate. However, lakeshore development pressure has increased over time, resulting in fewer shoreline properties with healthy greenbelts. The Association has supported and promoted the idea of a lake-wide intensive greenbelt assessment for several years because they recognize the importance of greenbelts in protecting and preserving the lake's high quality waters, particularly in the face of ever-increasing development pressure.

A total of ten shoreline surveys have been performed on Walloon Lake during the last 30 years. All but one of the prior surveys were not specific to greenbelts, but rather comprehensive; the shoreline surveyed for a variety of factors that potentially affect water quality ranging from nutrient pollution to shoreline alterations. The only prior greenbelt-specific survey on Walloon Lake was carried out in 2005 and limited to the shoreline area falling within the

boundaries of Resort Township. This survey of 403 properties found that nearly 60% of parcels had greenbelts that were rated in “good” to “excellent” condition.

The 2011 greenbelt survey consisted of a comprehensive assessment of all shoreline properties, providing consistent data for the entire lake. This valuable dataset has immediate utility as a lake management tool and, in the future, for determining and assessing trends. Through follow-up activities, such as distributing educational brochures, offering on-site consultations, holding educational workshops, and providing training to landscapers, greenbelt health can be improved. Establishing or fortifying a greenbelt can be simple and low cost; no-mow zones can be established and augmented with a variety of native herbaceous and woody plant species. However, preserving native vegetation is the most cost-effective approach to protecting and improving the lake’s greenbelts. Regularly updating (repeating) the greenbelt survey will provide the necessary information to determine long-term trends and identify shoreline areas that require remedial action.

Study area:

Walloon Lake is located in the northwest Lower Peninsula of Michigan; in Bear Creek and Resort Townships of Emmet County and Bay, Evangeline, and Melrose Townships of Charlevoix County. Based on digitization of 2005 aerial orthophotography from the Michigan Geographic Data Library, the shoreline of Walloon Lake measures 30.5 miles and lake surface area totals 4,586 acres. Walloon Lake extends approximately 9.5 miles in a southeast to northwest direction and is generally less than one mile wide throughout its length. A number of prominent land points project out into the lake and define the boundaries of the lake’s five distinct basins. The five basins in Walloon Lake include (from northwest to southeast): Mud Lake, the West Arm, the Wildwood Basin, the Foot Basin, and the North Arm (Figure 1).

Bathymetry maps from the Michigan Department of Natural Resources show the deepest location to be near the center of the West Arm, with a

maximum depth of 100 feet. Maximum depths in the other basins are as follows: 94' in the Foot Basin, 80' in the Wildwood Basin, 52' in the North Arm, and 14' in Mud Lake. Broad shallow areas are found between the various basins and throughout Mud Lake.

Walloon Lake is a drainage lake with water flowing into and out of the lake. The primary inlets include the Schoof's Creek in the north end of the North Arm and South Arm Creek (AKA, Fineout Creek) in the south end of the Foot Basin (USGS, 1990). The only outlet is the Bear River, which flows out the east end of the Foot Basin at Walloon Lake Village. Extensive wetland areas are found in the lower ends of the Schoof's and South Arm Creeks' watersheds, as the perimeter of the Mud Lake basin.

A Walloon Lake Watershed boundary map layer was developed by the Watershed Council in a GIS (Geographical Information System) using data from the Michigan Geographic Data Library. Based on this GIS map layer, the Walloon Lake Watershed encompasses approximately 26,500 acres of land and water (Figure 1). A watershed ratio of 4.75 was calculated by dividing the lake surface area into the watershed area (not including the lake), indicating that there are under five acres of land in the watershed for each acre of Walloon Lake's water surface. This ratio provides a statistic for gauging susceptibility of lake water quality to changes in watershed land cover. Relative to other lakes in Northern Michigan, Walloon Lake has a low watershed ratio and therefore, a small buffer that protects the lake from impacts associated with watershed development.

Land cover statistics were generated for the watershed using remote sensing data from the Coastal Great Lakes Land Cover project (Table 1). Based on 2006 data, the majority of the watershed's landcover is natural; consisting primarily of forest, wetlands, and grassland. There is a moderate amount of agricultural landcover in the watershed (~22%), but little urban (~3.5%). Both agricultural and urban landcover increased by roughly one percent between 2000 and 2006.

Figure 1. Map of Walloon Lake features and watershed.



Table 1. Walloon Lake Watershed land-cover statistics*.

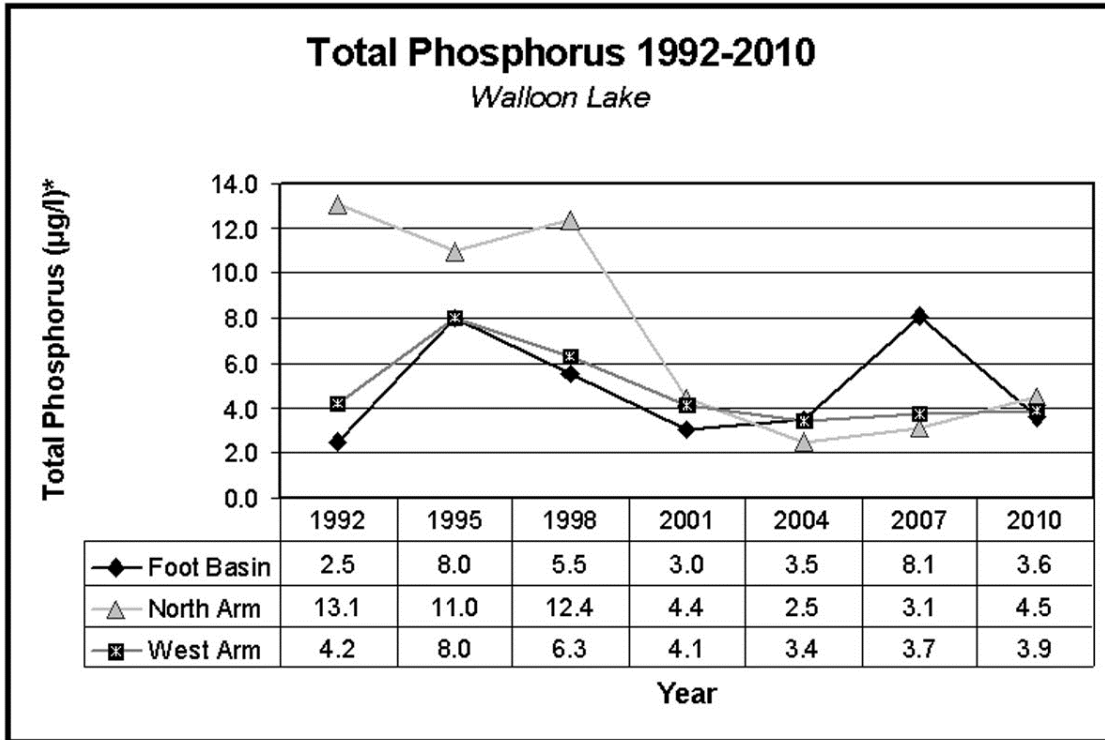
Land Cover Type	Acres (2000)	Percent (2000)	Acres (2006)	Percent (2006)	Change, Acres (2000-2006)	Change, Percent (2000-2006)
Agriculture	5499.14	20.74	5835.38	21.99	336.24	1.25
Barren	34.71	0.13	47.73	0.18	13.01	0.05
Forested	10100.97	38.10	10468.19	39.46	367.21	1.35
Grassland	3162.54	11.93	1974.97	7.44	-1187.57	-4.49
Scrub/Shrub	521.03	1.97	619.82	2.34	98.79	0.37
Urban/residential	691.33	2.61	927.45	3.50	236.12	0.89
Wetland	1788.91	6.75	1958.49	7.38	169.58	0.63
Water	4711.44	17.77	4699.15	17.71	-12.29	-0.06
TOTAL	26510.07	100.00	26531.17	53062.35	NA	NA

*land cover data from the NOAA Coastal Change Analysis Program.

The water quality of Walloon Lake has been monitored through TOMWC programs for more than two decades. Walloon Lake is monitored by TOWMC staff as part of the Comprehensive Water Quality Monitoring program (CWQM) and by volunteers as part of the Volunteer Lake Monitoring program (VLM). Water quality from the VLM and CWQM programs date back to 1989 and 1992 respectively.

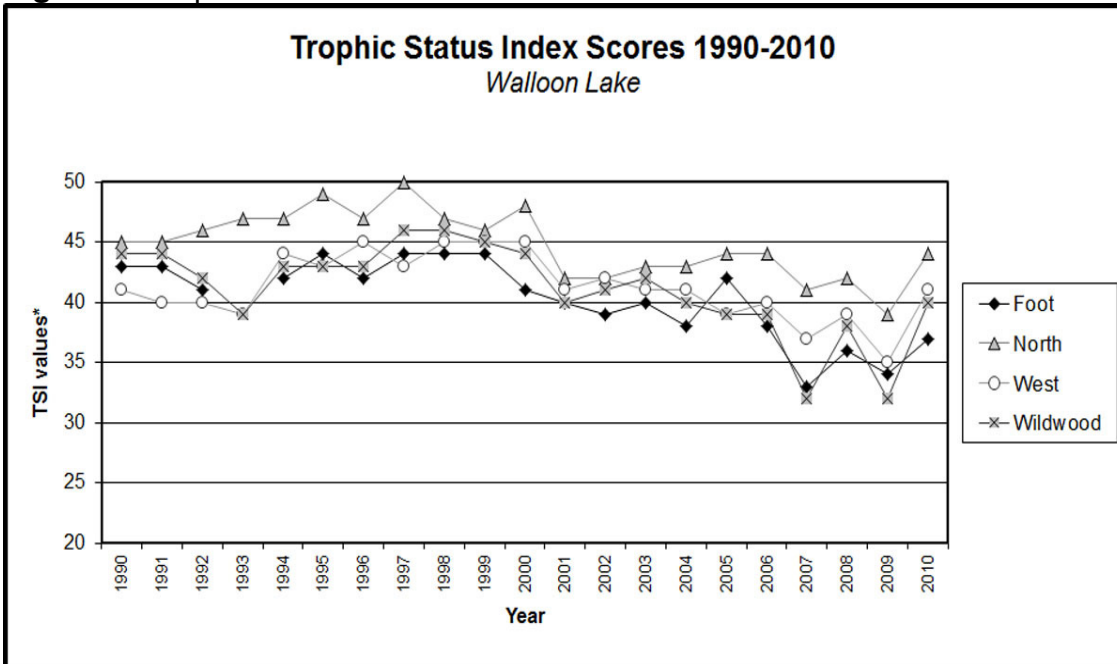
Data from these programs indicate that Walloon Lake consistently has high quality water. Total phosphorus data collected in the CWQM program show that levels dropped considerably in the last 20 years and are usually below 10 parts per billion (PPB), which is typical for high quality lakes of Northern Michigan (Figure 2). VLM data indicate that biological productivity has decreased in Walloon Lake, which is probably a result of the introduction of invasive zebra mussels. Trophic status index scores (measure of biological productivity) for three of the four basins monitored by volunteers now generally fall into the oligotrophic category (Figure 3). Oligotrophic lakes are characteristically large, deep, and nutrient poor, but have ample stores of dissolved oxygen and, in general, high water quality.

Figure 2. Phosphorus data from Walloon Lake.



*Total phosphorus measured in ug/l, which is milligrams per liter or parts per billion.

Figure 3. Trophic status index data from Walloon Lake.



*Trophic Status Index values based on annual averaged Secchi disc depth data and represent the trophic status (biological productivity) of the lake: 0-38 = oligotrophic (low productive system), 39-49 = mesotrophic (moderately productive system), and 50+ = eutrophic (highly productive system).

METHODS

The Walloon Lake shoreline was comprehensively surveyed during the summer of 2011 to document the status of shoreline greenbelts on individual properties. Although eroded areas and the presence of invasive species were also noted, this report only includes data from the greenbelt assessments. Greenbelts and other shoreline features were assessed and documented while paddling near the shore in kayaks. Information for each property was recorded on field datasheets and subsequently inputted into a database. In addition, a GPS camera was used for photographic documentation of all shoreline properties. Property descriptions from field datasheets and GPS information were used to link field data and photographs with property owner data from county equalization records. The following are descriptions of shoreline attributes that were recorded on field datasheets.

Field Survey Parameters:

Property description: Properties were described in terms of whether they were developed or undeveloped, physical characteristics of any buildings on the property, and any other unique identifying features (e.g., flagpoles, statues, etc.). Properties were considered developed if they had 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, relatively large parcels with healthy vegetation and no structures near the lake, but with development in an area far from the water's edge (1000'+) were not considered developed. Due to data sheet space limits, building descriptions were recorded in an abbreviated cryptic 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.

Greenbelt length: The percentage of the length of shoreline for a given property that has a greenbelt (of any size/depth) extending landward from the water's edge. Greenbelt length did not include areas where turf grass was present. The greenbelt length rating system used in the field was **0**: no greenbelt, **1**: 1-10%, **2**: 10-25%, **3**: 25-75%, **4**: >75%.

Greenbelt average depth: The average distance that the greenbelt extends landward from the water's edge. This parameter can vary widely within a single parcel and is one of the most difficult to accurately assess. For example, shoreline parcels often have greenbelts at property boundaries that extend far into the property, but little else in terms of greenbelts, such that assigning an average greenbelt depth value can be challenging. The greenbelt depth rating system used in the field was **0**: no greenbelt, **1**: 1-10', **2**: 10-40', **3**: 40'+.

Vertical Structure: The different types of plants in terms of (maximum) vertical growth contained within the property's greenbelt. Vertical structure was documented in the field by noting the presence of 1) ground cover, 2) understory, and 3) overstory. Ground cover refers to herbaceous plant species, such as sedges and goldenrods. Understory refers to woody shrub species or small trees, such as ground juniper, dogwoods and alders. Overstory refers to large trees, such as willows, maples and pines.

Density: Describes the vegetation within a greenbelt in terms of how thick and tightly grown together it is. This parameter was noted in terms of the overall or average greenbelt density because it often varies greatly over the length and depth of the property. Density for a given property was noted as 1) sparse, 2) moderate, or 3) dense. Sparse growth would be easy to see and walk through, whereas walking through dense growth would be difficult.

Species diversity: The diversity of plant species within a greenbelt. Species diversity was recorded in the field as 1) uniform, 2) several species, or 3) many species. Uniform means a greenbelt with just one or two plant species, per given area of greenbelt (i.e., 50% of greenbelt could be planted with juniper only and the other 50% with only maple trees and day lilies). Several species would indicate approximately 3-5 species mixed together within the greenbelt. Many species refers to 6 or more species mixed together.

Turf: The percentage of the length of shoreline on a property with mowed turf grass that extends to the shoreline. Tall un-mowed grasses are considered part of the greenbelt. The turf rating system used in the field was **0**: none, **1**: <10%, **2**: 10-25%, **3**: 25-75%, **4**: >75%.

Alterations: Human-made structures and other shoreline alterations, which are typically installed to stabilize shorelines and prevent erosion caused by waves, currents, and ice. Alteration types noted in the field include 1) seawalls, 2) riprap, 3) boat ramps, 4) boat houses, 5) groins, 6) beach sand and 7) biotechnical or bioengineering. Seawalls are constructed primarily of concrete, wood, metal, or a mix of these materials. Riprap is a shoreline fortification technique using rocks that range in size from cobble to boulders (boulder riprap was noted separately). Boat ramps are typically constructed of concrete, though sometimes made of wood. Boat houses are usually built upon concrete bulkheads that extend from the water's edge into the lake. Groins are made of rock or other hard materials and extend from the shoreline into the lake to encourage sand deposition and reduce incoming wave energy. Beach sand refers to shoreline areas where sand has been introduced (dumped) or vegetation removed to expose underlying sand layers. Biotechnical are semi-permanent structures that provide a softer, more natural approach to shoreline stabilization using biodegradable materials

including coir (coconut fiber) logs, rounded fieldstone of varying sizes and plantings.

Emergent vegetation: Emergent vegetation includes aquatic plants that live in near-shore environments, such as cattails or bulrush. This parameter is noted simply as either present or absent and is not included in the total greenbelt score because the occurrence of emergent vegetation varies naturally along lake shorelines. However, emergent vegetation is important to note because of the benefits it provides to the lake ecosystem (e.g., provides habitat and helps reduce wave energy and thereby, shoreline erosion) and, similar to greenbelts, it is often removed or reduced when shoreline properties are developed.

Erosion: 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. 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.

Invasive Species: Invasive species discovered on a shoreline property were noted, as well as descriptive information about the infestation, such as areal extent and density. In particular, surveyors focused on the following invasive species that are current threats in riparian areas of Northern Michigan: *Phragmites australis* (Phragmites), *Lythrum salicaria* (purple loosestrife), *Fallopia japonica* (Japanese knotweed), and *Cynanchum louiseae* (Black swallow-wort).

Notes: Any other notes regarding the parameters listed above or other relevant information regarding the property and its greenbelt. For example, a parcel with a greenbelt that was recently cut and removed would be appropriately noted here.

Data Processing

Field data were inputted into an existing database containing historical shoreline survey data for Walloon Lake. New attribute columns were added for all parameters surveyed in the field and subsequently populated with information recorded on field data sheets. The shoreline survey database contains a sequential listing of properties beginning at the Gruler Road end boat launch and traveling counter-clockwise around the entire perimeter of the lake. Due to changes in shoreline parcels since the last survey (e.g., property splits), the sequential numbering system for shoreline parcels was modified and included as a new attribute: "TOMWC_ID11".

Digital GPS photographs taken during the survey were uploaded to a computer and processed to facilitate review of shoreline conditions. The photos were renamed to correspond to the sequential numbering system used for shoreline parcels. GPS-Photo Link® software was used to produce tagged photos that include watermarked text with location and survey information. In addition, the software produced a GIS data layer that included points for the locations where photographs were taken, as well as relevant attribute information (e.g., latitude, longitude, date, and time).

Field data and equalization information were combined to allow shoreline conditions documented during the survey to be referenced by TOMWC_ID11 number, parcel identification number, or property owner name. Shoreline properties were selected from GIS map layers with equalization information provided by Emmet and Charlevoix Counties, and exported to create a new GIS map layer. An attribute column was added to the new layer and all shoreline parcels were assigned unique identification numbers based on the TOMWC_ID11 sequential numbering system. The shoreline survey database was joined to the equalization data layer and exported to create a new GIS map layer of shoreline parcels that includes both property (equalization) information and field data.

In order to better display survey results, another map layer was developed

that consists of a 100-meter band along the outside of the lake perimeter. A buffer layer was created for the area extending from the lake shoreline 100 meters landward and then, intersected with the GIS data layer containing both equalization and survey data. The resultant 100-meter shoreline buffer layer contains a polygon representing each shoreline parcel and includes all equalization and field data. This data layer was overlaid with other GIS data from the State of Michigan to produce a poster-size map to display survey results.

Final products include a comprehensive database, a complete set of GPS digital photographs, a GIS data layer with GPS photo locations, GIS data layers of shoreline parcels that include both county equalization and shore survey data, and a map displaying results. The database contains all field data from the 2011 survey, historical shoreline survey going back to 2001, and unique parcel identification numbers that correspond to those in GIS data layers and on hard-copy maps.

Greenbelt Scoring System:

Individual parcels were given a rating for each of seven greenbelt attributes: length, depth, turf, vertical structure, density, species diversity, and alterations. After all field data were inputted into a database, scores were calculated for the each criterion and then, summed to produce a total greenbelt score. Scores for length, depth, vertical structure, density, and species diversity ranged from zero to four while scores for turf and structures ranged from zero to negative four. Table 2 summarizes the scoring system used.

Table 2. Scoring system used to rate shoreline greenbelts.

Score	Length	Depth	Vertical Structure	Density	Diversity	Score	Turf Grass	Alterations
0	none	none	none	none	none	0	none	none, biotechnical
1	<10%	<10'	1 type	Sparse	Uniform	-1	<10%	ramp, groin, sand
2	10-25%	10-40'	2 types	Medium	Several spp	-2	10-25%	riprap
3	25-75%	40'+	3 types	Dense	Many spp	-3	25-75%	seawall, boathouse
4	>75%	NA	NA	NA	NA	-4	>75%	NA

RESULTS

This survey documented greenbelt status, erosion, and invasive species at 1020 shoreline parcels on Walloon Lake. However, only the results of the greenbelt assessment are included in this report. The length of shoreline per parcel varied from less than 20 feet to more than a mile. Approximately 85% (865) of shoreline properties were considered to be developed.

The majority of Walloon Lake shoreline properties ranked in the top two (best) tiers of the five greenbelt survey parameters that are considered to be positive attributes. A total of 940 properties (~92%) had greenbelts along some portion of the shoreline; the majority of these with vegetation along more than 75% of the shoreline (Table 3). The average greenbelt depth exceeded 10 feet at 57% of shoreline properties. Over 50% of properties had all levels of vertical structure (groundcover, understory, and overstory) in their greenbelts and nearly 80% had two or more levels. Plant density within greenbelts was moderate to dense at nearly 70% of parcels and species diversity included several to many species at ~78% of parcels.

Table 3. Survey results for six greenbelt survey parameters.

Greenbelt Length (% of shore)	Percent of parcels	Greenbelt Depth (Average)	Percent of parcels	Vertical Structure	Percent of parcels
0%	7.84	0 ft*	14.61	NA [†]	7.84
<10%	13.63	<10 ft	28.04	1 level	13.73
10-25%	5.98	10-40 ft	26.76	2 levels	27.16
25-75%	21.76	>40 ft	30.59	3 levels	51.27
>75%	50.78				
Plant Density	Percent of parcels	Species Diversity	Percent of parcels	Turf Grass (% of shore)	Percent of parcels
NA [†]	7.84	NA [†]	7.84	0%	43.24
Sparse	24.31	Uniform	14.51	<10%	8.53
Moderate	31.67	Several spp	33.92	10-25%	7.75
Dense	36.18	Many spp.	43.73	25-75%	14.80
				>75%	25.69

*The percentage of greenbelt average “depth = 0 ft” varies from the percentage of greenbelt “length = 0%” because parcels with solitary trees on the shoreline were considered to have a greenbelt length < 10%, but an average depth of 0 ft.

[†]NA=not applicable because this percentage of properties did not have a greenbelt.

Despite seemingly healthy greenbelts throughout most of the Walloon Lake shoreline, over 25% of properties were found to have turf grass along more than 75% of the shoreline (Table 3). Some type of shoreline alteration was documented at 832 shoreline properties (~82%). Riprap was the most common type of shoreline alteration, present at 55% of properties (Table 4). Seawalls were the next most common alteration type at 15%, followed by beach sand at 14% of properties.

Table 4. Survey results for shoreline alterations by type.

Alteration Type*	Seawalls	Riprap (large)[†]	Riprap (small)	Boathouses
Number of properties	154	144	414	23
Percentage of properties	15.10	14.12	40.59	2.25
Alteration Type*	Groins	Boat ramps	Beach sand	None
Number of properties	55	23	142	188
Percentage of properties	5.39	2.25	13.92	18.43

*Shoreline alterations on individual properties sometimes a mix of the various categories; one property may be included in the count for more than one type.

[†]Large riprap refers to boulder size, which is defined as greater than 10” in diameter.

Greenbelt scores for individual parcels ranged from -7 (worst) to 16 (best). Approximately 23% of shoreline property greenbelts fell into the lowest tiers: poor and very poor (Table 5). Greenbelts on 58% of parcels scored in the top two tiers: good and excellent, indicating that a majority of the shoreline possessed high-quality greenbelts. At the township scale, Bay Township had the highest percentage of properties with greenbelts in the good and excellent categories (Tiers 4 and 5), while Bear Creek had the lowest (Table 6).

Table 5. Greenbelt scores and ratings for Walloon Lake.

Greenbelt Score	Rating	No. of parcels	% of parcels
Tier 1 (-7 to -3)	Very poor	86	8.43
Tier 2 (-2 to 2)	Poor	144	14.12
Tier 3 (3 to 7)	Moderate	194	19.02
Tier 4 (8 to 12)	Good	296	29.02
Tier 5 (13 to 16)	Excellent	300	29.41

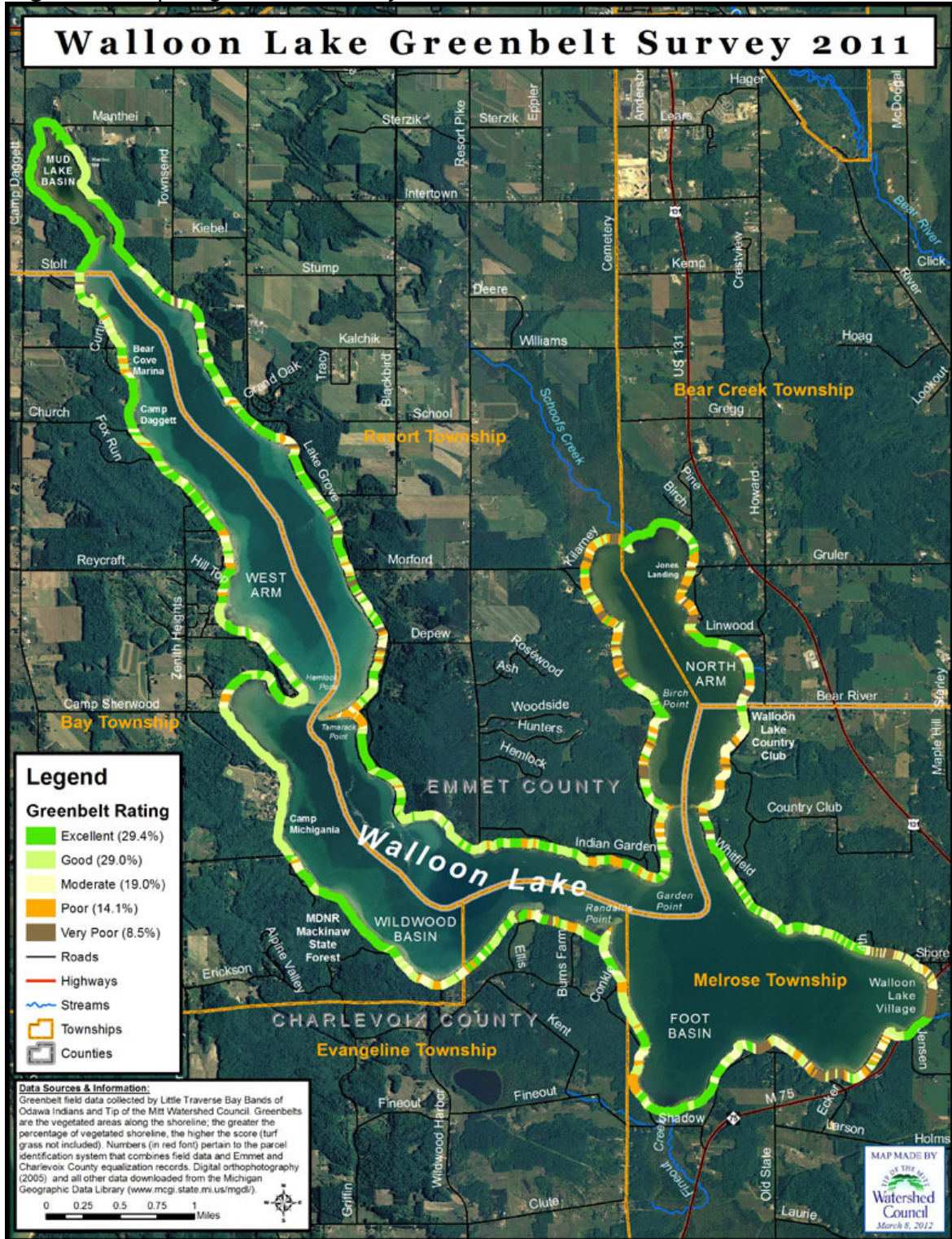
Table 6. Greenbelt scores by township.

Greenbelt Score	Resort Twp (#)	Resort Twp (%)	Bear Creek Twp (#)	Bear Creek Twp (%)	Melrose Twp (#)	Melrose Twp (%)
Tier 1 (-7 to -3)	32	8	6	10	45	16
Tier 2 (-2 to 2)	73	18	20	32	28	10
Tier 3 (3 to 7)	59	14	10	16	72	26
Tier 4 (8 to 12)	120	29	10	16	72	26
Tier 5 (13 to 16)	131	32	17	27	60	22
TOTAL	415	100	63	100	277	100
Greenbelt Score	Evangeline Twp (#)	Evangeline Twp (%)	Bay Twp (#)	Bay Twp (%)		
Tier 1 (-7 to -3)	2	4	1	0		
Tier 2 (-2 to 2)	10	19	13	6		
Tier 3 (3 to 7)	8	15	45	21		
Tier 4 (8 to 12)	16	31	78	37		
Tier 5 (13 to 16)	16	31	76	36		
TOTAL	52	100	213	100		

Spatial variation and patterns in greenbelt scoring tiers in Walloon Lake are presented graphically in Figure 4. Properties with greenbelts in the poor categories were most prevalent in the North Arm, particularly in the northern half of the basin. Other concentrations of properties with poor greenbelts were found along the eastern shore of the Foot Basin, near Walloon Lake Village, and in the southeast corner of the West Arm. Excellent greenbelts were found on properties throughout all basins of Walloon Lake, the greatest concentrations occurring in the West Arm and Mud Lake.

Final products of the survey include a shoreline parcel map labeled using the Watershed Council identification system, corresponding digital photographs, a database containing all information gathered on field datasheets, and GIS map data layers. Greenbelt conditions for the summer of 2011 can be reviewed by locating the parcel on the labeled map and then searching for corresponding photographs and database entries using the Watershed Council's identification system. Additionally, survey data and photographs for each property can be viewed in a GIS using map data layers developed as part of this project.

Figure 4. Map of greenbelt survey scores.



DISCUSSION

The 2011 survey results show that shoreline greenbelts on Walloon Lake were generally in good shape. Therefore, measures should be taken to protect them. Education is among the most effective tools for protecting and improving greenbelts. The Association and TOMWC have worked together for years to educate Walloon Lake lakeshore property owners about the importance of maintaining a healthy greenbelt on their shorelines, but such efforts must be continual as property ownership is ever in flux. In addition, local governments and other organizations and agencies should be engaged and encouraged to assist with greenbelt education efforts.

Regulation is another effective approach for protecting shoreline greenbelts. According to the Charlevoix County Local Ordinance Gaps Analysis (TOMWC, 2011), Bay, Evangeline, and Melrose Townships have adequate ordinances in place to protect greenbelts on Walloon Lake. There is also a comprehensive greenbelt ordinance in place in Resort Township in Emmet County, but Bear Creek Township falls under Emmet County zoning, which does not require, but rather recommend that a vegetated buffer strip be maintained on the lake shoreline. Survey results show that Bear Creek Township had the highest percentage of shoreline properties with poor greenbelts and lowest percentage with good greenbelts. Thus, in terms of regulation, Walloon Lake greenbelts would benefit most from passage of a stronger greenbelt ordinance in Emmet County.

Despite the prevalence of healthy greenbelts on Walloon Lake, there is room for improvement. Results of the survey show that over 25% of parcels have turf grass along over 75% of the shoreline and that another ~15% have turf grass along 25-75% of the shoreline. Although turf does constitute vegetation along the shoreline, it does not provide the same benefits as a diverse, dense greenbelt. Turf grass has short roots compared with the extensive root system of native plants, shrubs, and trees, which results in a lesser capacity to filter contaminants

from stormwater runoff and stabilize the shoreline against erosion. Maintaining turf grass often requires the addition of fertilizers and herbicides, which invariably wash into the lake. In addition, turf grass does not contribute habitat structure (e.g. branches) and food energy (e.g. leaves) to the lake ecosystem. Therefore, the turf grass documented on more than half of shoreline parcels undoubtedly has negative impacts on the Walloon Lake ecosystem.

Erosion control structures documented on over half of Walloon Lake shoreline properties also have negative impacts on the lake ecosystem. The complex root structures of greenbelts and fallen woody debris (e.g. tree trunks and branches) in near-shore areas help to prevent shoreline erosion. Conversely, when natural shorelines are developed and vegetation/debris is removed, shorelines experience more erosion. Seawalls, groins, and other hardened structures exacerbate erosion of adjacent shorelines as they do not absorb wave and ice energy, but rather deflect it to other areas. They also degrade valuable habitat. Boulder-sized riprap provides slightly more habitat than seawalls, but erosion can still occur through the large gaps between rocks. Neither type of structure provides the stormwater filtration, habitat, and shading benefits of native vegetation. The extensive natural shorelines that remain on the lake merit protection and the lake ecosystem will further benefit from the conversion of seawalls and over-sized riprap to a more natural state using biotechnical erosion control techniques.

Spatially, clusters of properties with poor greenbelts were found in the West Arm and Foot Basin, though the most heavily affected areas were in the North Arm. Observations of patterns in the map displaying results suggest that poor greenbelts may be related to parcel size; shoreline areas with clusters of properties with poor greenbelts appear to be areas where smaller lots occur. Another factor thought to influence where poor greenbelts are clustered is the slope at the shoreline. During the survey, shoreline properties with steep slopes were observed to frequently have healthy greenbelts, which may be due to the impracticality of maintaining a turf-grass lawn in such areas.

Walloon Lake, like most lakes throughout the region, continues to face development pressure along its shoreline. As shorelines are developed and redeveloped, greenbelts are often impacted, reduced in size, or removed altogether. The few undeveloped shoreline parcels that remain on Walloon Lake merit protection, though there are many developed parcels with intact, healthy greenbelts that also need protection. Surrounding township governments have taken the lead by establishing a regulatory framework (i.e., passing ordinances) to protect shoreline vegetation. The information collected during this survey provides valuable baseline information for assessing the effectiveness of greenbelt protection ordinances, while also providing great insight into the status of greenbelts along the Walloon Lake shoreline. By sharing the lake's overall greenbelt status with the public and providing outreach and technical help to shoreline property owners, this survey has the potential to protect and improve greenbelts on Walloon Lake, as well as throughout the region.

Recommendations

The full value of this greenbelt survey will only be achieved when the information is used to educate riparian property owners about the importance of shoreline vegetation, and encourage them to preserve, maintain, establish, or enhance their greenbelts. The following are recommended follow-up actions:

1. **Disseminate results of the survey.** The results of this survey should be shared with the public and in particular, with Walloon Lake shoreline property owners. Publicizing the results will 1) raise the level of awareness of the overall condition of greenbelts on Walloon Lake; 2) increase public appreciation of the ecological value of shoreline vegetation and the need to protect it, thereby fostering greater stewardship of greenbelts, and the lake ecosystem in general; and 3) help riparian owners better understand the value of ordinances. A summary of survey results should be sent to all

shoreline property owners on Walloon Lake. Survey results can also be shared through other means, such as newspapers and the Internet.

2. **Reach out to property owners with poor greenbelts.** Inform owners of properties that received poor greenbelt scores of specific results for their property. Supply these property owners with information (e.g. printed brochures) regarding the benefits of greenbelts and guidance for improvements. Encourage property owners to establish or improve greenbelts using a variety of native plants. Inform property owners that TOMWC can assist with site assessments, as well as coordinate and implement greenbelt development or improvement projects.

3. **Educate and inform Walloon Lake riparians and the public.** Collaboratively plan and implement an information and education campaign to increase awareness of the importance of maintaining healthy shoreline greenbelts. The campaign should: 1) encourage shoreline property owners to preserve or create healthy greenbelts along as much shoreline as possible, to the greatest depth possible, with multiple levels of vertical structure, relatively tight plant density, and species diversity; 2) discourage shoreline alterations such as seawalls, over-sized riprap, and sand beaches, and promote natural shorelines and biotechnical erosion control techniques; and 3) discourage the use of turf grass on or near the shoreline and the removal of emergent aquatic vegetation. The campaign can be accomplished through a variety of means, including mailings, newsletters, newspapers, and the Internet, but should also include informational meetings and workshops. Workshops should provide information about greenbelts and survey results, as well as a hands-on component where participants learn how to create and enhance greenbelts.

4. **Utilize the Internet to share survey information.** A general summary of the greenbelt survey and the full report should be posted on the WLA, LTBB, and TOMWC web sites. Property-specific information can also be shared via these web pages by randomizing the shoreline survey database and providing property owners with a code number that refers specifically to survey results from their property. The Watershed Council is available to assist with this approach.
5. **Get other local governments on board.** Promote the apparent success of ordinances at protecting greenbelts with other local governments. In particular, Emmet County should be encouraged to adopt an adequate greenbelt protection ordinance. Survey results may encourage local governments beyond Walloon Lake to pass greenbelt ordinances and thereby, help protect surface waters throughout the region.
6. **Mine data to produce additional meaningful statistics.** Data collected and developed during the survey were presented with this report, but there remain opportunities to generate additional statistics. One such example is determining the shoreline distance with greenbelts, which was not determined during the survey, but could be computed using survey data in a GIS. Generating additional, meaningful statistics could be useful for reports, trend analyses, and comparisons with other areas.
7. **Repeat survey on a regular basis.** Lake shorelines change continually, both in terms of physical characteristics and land ownership. Therefore, some version of this survey should be repeated regularly (ideally every 3-5 years), coupled with follow-up activities to promote greenbelt awareness and good management practices on an ongoing basis. Repeating the survey periodically will also help detect ordinance violations and ensure that any information used for ordinance enforcement is current.

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