A Nutrient Pollution Shoreline Survey on Black Lake, 2005

By Tip of the Mitt Watershed Council

INTRODUCTION

A shoreline survey to identify locations of potential nutrient pollution was conducted on Black Lake by the Tip of the Mitt Watershed Council during the summer of 2005. The shoreline was surveyed for *Cladophora* growth and for areas of high conductivity. The survey was funded by the Black Lake Association.

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, nutrients, and other factors. 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 high water quality, such as Black 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 that 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, malfunctioning septic systems, poor agricultural practices, soil erosion, and wetland destruction. These nutrients can contribute to an overall decline in lake water quality. Additionally, malfunctioning septic systems pose a potential health risk due to bacterial and viral contamination.

Although the size of the growth on an individual basis is important in helping to interpret the cause of the growth, growth features of *Cladophora* are greatly influenced

by such factors as current patterns, shoreline topography, size and distribution of substrate, and the amount of wave action the shoreline is subject to. Therefore, the description has limited value when making year to year comparisons at a single location or estimating the relative amount of shoreline nutrient input. Rather, the presence or absence of any significant growth at a single site over several years is the most valuable comparison. It can reveal the existence of chronic nutrient loading problems, and help interpret the cause of the problems and assess the effectiveness of any remedial actions. Comparisons of the total number of algal growths can reveal trends in nutrient input due to changing land use.

In lakeshore areas not suitable for *Cladophora* growth due to lack of appropriate habitat, another technique is employed to locate areas where failing septic systems are contaminating the surface water. If a septic system is malfunctioning due to mechanical problems or if a drainfield's capacity has been exhausted due to age, septic leachate often contaminates shallow ground water and migrates into shoreline surface water. Generally, septic leachate has high ion content due to dissolved substances in the waste water, such as salts. The conductivity of water, which is the water's ability to carry an electric current, is largely determined by the ionic content and thus, provides a parameter that can be monitored along the shoreline that identifies septic leachate pollution.

The Watershed Council developed a system called the "septic leachate detector" (SLD), which allows shoreline areas to be surveyed by examining conductivity levels. This system works well for locating shoreline areas that are being polluted from septic leachate, but there are naturally occurring phenomena that can confuse the signal. For example, streams often have higher conductivity levels than lakes and therefore, strong differences in conductivity may be due to stream inlets on the lake shore. SLD surveys are conducted in the fall as septic contamination in shoreline areas is typically at its peak due to heavy seasonal use.

A shoreline survey can be a valuable lake management tool. Coupled with follow-up on-site visits and questionnaires, controllable sources of nutrients to the lake

can be identified. Subsequently, a reduction in nutrient loading can often be achieved by working with homeowners to solve problems. 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.

Shoreline surveys were conducted on Black Lake in 1991 and, along limited shoreline areas, again in 2001. Periodic repetition of shoreline surveys are important for identifying chronic problem sites as well as recent occurrences. They are also valuable for determining long-term trends of nearshore nutrient inputs associated with land use changes, and for assessing the success of remedial actions.

METHODS

The presence of *Cladophora* and other shoreline features were surveyed using kayaks on June 22-23, 2005. The entire shoreline was closely inspected for *Cladophora* growths by traveling as close to the shoreline as possible (usually within 20 feet). When a *Cladophora* growth was observed, it was described according to criteria used during past surveys and recorded on a field data sheet. The description included both an estimation of the length (feet) of shoreline it covered and the density of growth. Categories for growth density used are as follows:

- Very Light (VL)
- Light (L)
- Light to Moderate (L/M)
- Moderate (M)
- Moderate to Heavy (M/H)
- Heavy (H)
- Very Heavy (VH)

Although *Cladophora* density and shoreline length are subjective estimates, shoreline surveys of this nature have been very effective in locating areas where nutrient pollution is occurring.

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*, although 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 survey maps and described the same as those of *Cladophora*.

Among other things, the distribution and size of each *Cladophora* growth is dependant 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. The presence or absence of suitable *Cladophora* growth substrate was recorded during the survey. In the database, properties with habitat throughout the shoreline were listed as "yes," without any habitat listed as "no," and those parcels possessing areas with habitat and without habitat were listed as "partial".

Shoreline structures were also noted during the field survey and included as a separate column in the database. Shoreline structures were noted in an "alteration" column with the following abbreviated descriptions:

SB = steel bulkhead (a.k.a seawall)
CB = Concrete bulkhead
WB = wood bulkhead
BB = boulder bulkhead
RR = rock rip-rap (see substrate categories for boulder vs rock sizes)
G = groin
BH= permanent boathouse
DR = dredged area
DP = discharge pipe

Sometimes abbreviations were mixed or vary from what is listed above.

The Black Lake shoreline was surveyed a second time using the septic leachate detector (SLD), starting September 16, 2005 and finishing on October 20, 2005. Similar to the *Cladophora* survey, the SLD was employed by traveling as close to the shoreline as possible in a kayak. Shoreline conductivity levels were compared with open water levels and increases were noted on data sheets. Increased conductivity levels (i.e., difference between open water and shore) were labeled "SLD signals" and grouped as follows:

- 0 = no signal
- 1-10 = weak signal
- 11-20 = moderate signal
- 21 and up = strong signal

The SLD portion of the survey was not performed on the entire shoreline, but rather focused on shoreline areas that did not have suitable habitat for *Cladophora* growth.

Locations of *Cladophora* growth and septic leachate signals were documented by using Global Positioning Systems (GPS) and by noting property features. Two different GPS units were employed in the field: a Trimble GeoExplorer3 mapping grade GPS unit and a Ricoh Caplio Pro G3 Digital GPS camera. Photographs accompany GPS locations where the Ricoh GPS camera was used. Property features and their description (as viewed from the water) were recorded on field data sheets. All information was recorded in a database developed for this project.

After performing field work, GPS data were transferred to computer at the Watershed Council office and processed for use. GPS data were imported into a Geographical Information System (GIS) and joined to the field datasheet records to produce maps and perform spatial analyses.

Property features included developed platted lots, undeveloped (vacant) lots, large undeveloped parcels, parks, preserves, public access sites, and county road endings. However, it was not possible to identify every distinct parcel in this manner. The database field containing the property description contains a sometimes cryptic descriptive phrase due to character space limits. 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. Wherever known, names of property owners and shoreline address of properties were included in the database.

Developed parcels were noted on field data sheets during the survey 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, relatively large parcels that may have development 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.

Tributaries are one of the primary conduits through which water is delivered to a lake or river from throughout its watershed. Tributaries also carry and deliver a variety of materials from throughout the watershed to the receiving water. This can include pollutants such as sediment, nutrients, bacteria, and toxins from human activities far removed from a lake or river. *Cladophora* growths and elevated conductivity levels often occur at the mouth of tributaries and therefore, tributary streams were documented during the survey and included in the database.

Additional information written on field data sheets was also inputted into the database. This information was added to a column entitled "comments".

RESULTS

This survey documented shoreline conditions at 829 locations (perceived as separate properties) on Black Lake. The shoreline was developed at approximately 737 of these locations (89%). Habitat generally considered suitable for *Cladophora* growth was present along at least part of the shoreline of 491 properties (59%). Noticeable growths of *Cladophora* or other filamentous green algae were found at 165 locations. The septic leachate detector revealed elevated conductivity levels at 176 locations.

Cladophora growth was documented at 33% of properties with suitable habitat. The number of locations where the different categories of *Cladophora* growth were observed are as follows:

Very Light	13
Light	54
Light to Moderate	25
Moderate	19
Moderate to Heavy	19
Heavy	25
Very Heavy	10

Although the greatest number of observed *Cladophora* growths fell in the Light category (54), the Light and Very Light categories accounted for only 41% of the total. Approximately one third of observed growths were in the Moderate to Heavy through Very Heavy categories. Most of the *Cladophora* growths were associated with developed shoreline properties (~97%).

Elevated conductivity was documented at ~29% of surveyed properties that did not have suitable habitat for *Cladophora* growth. The number of locations where the different categories of SLD signals were observed are as follows:

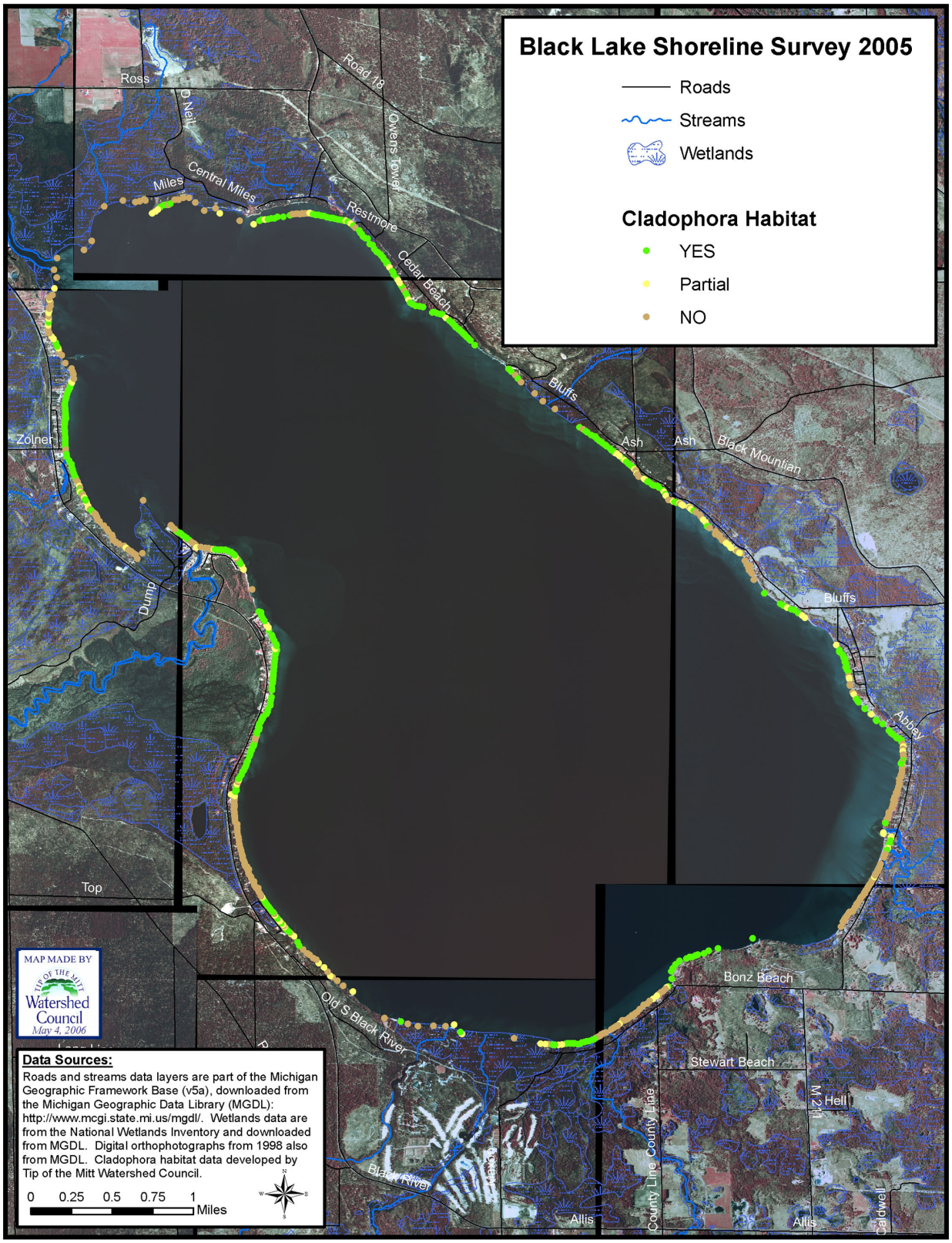
Weak 96
Moderate 37
Strong 43

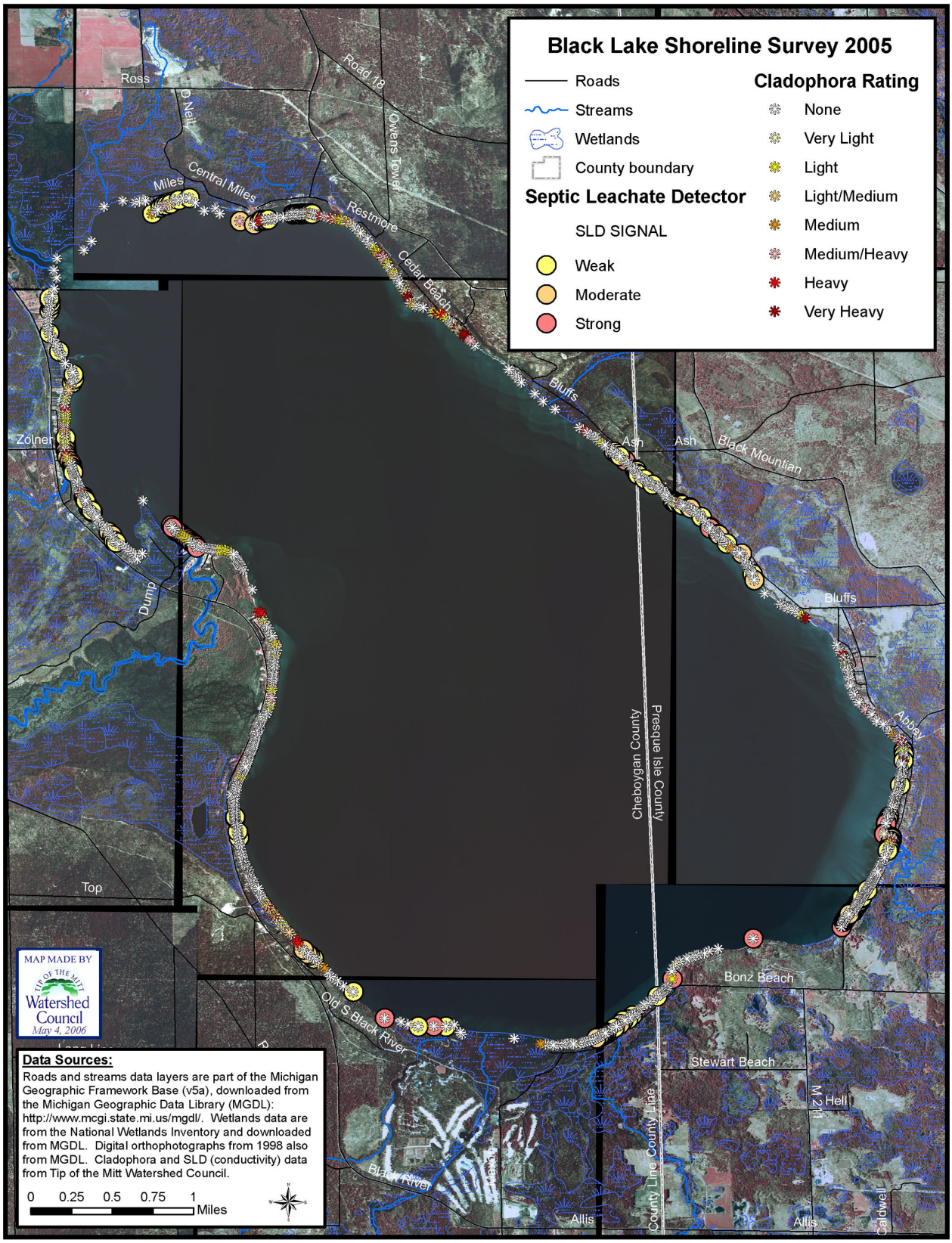
The majority of SLD signals were in the weak category (~55%). However, there were strong signals at 24% of sites where elevated conductivity levels were observed. Only 34 locations surveyed had both *Cladophora* and elevated conductivity levels, which is not surprising as the SLD survey was focused on areas without *Cladophora* habitat.

A few patterns in the occurrence of *Cladophora* growth and elevated conductivity levels were discerned after reviewing maps made using GPS data and GIS software. Most of the heavy and very heavy *Cladophora* growth occurred in the northwest near Zolner Road, in the northeast between North Shore Drive and Cedar Beach Lane, in the southeast from Abbey Lane to Silver Beach Drive, and in the southwest near Corbat Road. High SLD readings occurred in concentrated groups in the northwest near Zolner Road and the Black River inlet and in the southeast from the Rainy River inlet down to Onaway State Park, but were also scattered in the east along Bluffs Highway near Ash Road and along much of the southern shore. The two criteria surveyed in this study occurred together in the north side of the lake along North Shore and Miles Drive, in the northwest near Zolner Road and the Black River inlet, in the east near Ash Road, in the southeast near the Rainy River inlet and in a few other scattered areas along the south shore.

Thirty-seven of the locations/properties surveyed were documented as having tributary streams. In addition, numerous drain pipes along the shoreline with continual flow were observed, indicating that a substantial amount of ground water discharge is occurring in some areas.

The shoreline survey database, which is included on a compact disc, contains a sequential listing of properties beginning at Zolner Road and traveling clockwise around the entire perimeter of the lake. The database contains all data collected in the field and identification numbers correspond to those on the large map.


Black Lake Shoreline Survey 2005
Roads
Streams
Wetlands
Cladophora Habitat
YES
Partial
NO
Ross
O Neil
Road 18
Oxens Tower
Miles
Central Miles
Restmore
Cedar Beach
Bluffs
Zolner
Ash
Ash
Black Mountian
Dump
Bluffs
Abbey
Top
Bonz Beach
Old S Black River
Stewart Beach
M 12
Hell
Black River
Allis
County Line
Allis
Caldwell
MAP MADE BY
Tip of the Mitt Watershed Council
May 4, 2006
Data Sources:
Roads and streams data layers are part of the Michigan Geographic Framework Base (v5a), downloaded from the Michigan Geographic Data Library (MGDL): http://www.mcgi.state.mi.us/mgdl/. Wetlands data are from the National Wetlands Inventory and downloaded from MGDL. Digital orthophotographs from 1998 also from MGDL. Cladophora habitat data developed by Tip of the Mitt Watershed Council.
0 0.25 0.5 0.75 1
Miles


Black Lake Shoreline Survey 2005
Roads
Streams
Wetlands
County boundary
Septic Leachate Detector
SLD SIGNAL
Weak
Moderate
Strong
Cladophora Rating
None
Very Light
Light
Light/Medium
Medium
Medium/Heavy
Heavy
Very Heavy
Ross
O Neil
Road 18
Owens Tower
Miles
Central Miles
Restmore
Cedar Beach
Bluffs
Zolner
Ash
Ash
Black Mountian
Dump
Bluffs
Cheboygan County
Presque Isle County
Abbey
Top
Bonz Beach
Old S Black River
Stewart Beach
Mud Hell
Black River
Allis
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0 0.25 0.5 0.75 1
Miles

DISCUSSION

Many areas along the Black Lake shoreline show evidence of potential nutrient pollution. Although some of the algae growths and elevated conductivity levels are undoubtedly associated with septic system leachate or other factors associated with development and human activities, many are probably due to natural factors. There are numerous streams, springs and seeps flowing into Black Lake from virtually all sides that may be delivering nutrients and ions. However, there are a few areas that raised an alarm and should be further investigated.

There were two areas of primary concern on the Black Lake shoreline, where Watershed Council staff perceived that nutrient pollution was occurring. These include the shoreline areas along Corbat Road in the southwest and where County Road 489 turns south in the southeast corner of the lake. In addition, based on examination of compiled field data a third area of suspected nutrient pollution is the shoreline area near Zolner Road in the northwest.

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--in other words, do not publish a list of sites where filamentous algae or high conductivity readings were found.

2. Send a general summary of the survey results to all shoreline residents, along with a packet of informational brochures produced by the Watershed Council and others to provide information about practical, feasible, effective actions to protect water quality. This would cost approximately $5 to $25 per household, depending on complexity and type of materials distributed.

3. Inform those owners of properties with *Cladophora* growths or SLD signals of the specific results for their property, ask them to fill out a questionnaire in an attempt to interpret causes of the growth/signals, and offer individualized recommendations for water quality protection. Following the questionnaire survey, site visits coupled with ground water testing are sometimes preformed in an effort to gain more insight into the nature of the findings. Again, it should be stressed that all information regarding names, specific locations, and findings be kept confidential to encourage property owner participation in this project.

4. Repeat some version of the survey periodically (every 3-5 years), coupled with the follow-up mailings described previously, in order to promote water quality awareness and good management practices in an ongoing basis. During each subsequent survey, more information about shoreline features could be added to the database. The database will greatly facilitate future surveys, resulting in a reduction of staff hours needed for repeating the survey, and can be utilized for other water resource management applications.

5. Compile more accurate parcel and ownership information for the shoreline database from the Cheboygan and Presque Isle County Equalization Departments, or based on the knowledge of Association members or shoreline residents. When this information is added to the database, it will facilitate identifying the locations of *Cladophora* growths and SLD signals during future shoreline surveys and will help with contacting property owners. It will also be useful for empowering the lake association to monitor shoreline activities, recruit new members, and compile and manage other water resource information. This task could easily be accomplished by Lake Association volunteers or be completed by Watershed Council staff.

6. Improve the utility of the maps by showing property parcels in relation to *Cladophora* growth and SLD signal locations, and other resource information. Ideally, the shoreline database developed for this survey should be linked with the county equalization databases in a GIS. The database could also be expanded to include other shoreline features such as public access sites, shoreline erosion, greenbelts, wetlands, aquatic plants, and bottom substrate type.