10-2017

Survey of Lakeshore Property Owners to Understand Their Knowledge and Concerns about Water Quality and Best Management Practices on Little Birch Lake

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Survey of Lakeshore Property Owners to Understand Their Knowledge and Concerns about Water Quality and Best Management Practices on Little Birch Lake

by

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A Thesis

Submitted to the Graduate Faculty of

St. Cloud State University

in Partial Fulfillment of the Requirements

for the Degree

Master of Science

In Environmental and Technological Studies

October, 2017

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Abstract

Land use practices and the lack of knowledge of best management practices (BMPs) by lakeshore property owners often results in degradation of water quality. With the continual growth of structures around property adjacent to bodies of water, there is a decrease in native habitat that protects these waters from runoff containing pollution. There is a need for better understanding of what influences implementation of BMPs by property owners.

Many studies examine how BMPs improve water quality of lakes or streams by; decreasing the amount of runoff, decreasing nutrients entering the waterway, stabilizing banks, and/or decreasing the amount of sediment entering the water. BMPs also increase the amount and quality of natural habitat around the waterway, which ultimately leads to increasing populations of wildlife. Most BMPs can also be visually appealing to property owners. Over time, improvement through BMPs increases water quality and natural habitat around bodies of water such as Little Birch Lake, in central Minnesota. There needs to be a better understanding of how to get property owners to implement BMPs.

A letter along with a short survey was mailed out to each property owner on Little Birch Lake. The results of this survey will help better understand property owner's knowledge about BMPs and how their implemented BMPs can impact water quality.

Acknowledgments

I would like to thank everyone who helped me complete this thesis project, including my committee members (David Robinson and Chuck Rose), pre-survey takers and evaluators, the SCSU School of Graduate Studies, and Ann Anderson. I would also like to thank my family for their time and patience from the beginning of the project until the thesis was completed. A special thank you to Mitch Bender for all his work in helping me complete my Thesis to earn my Master's Degree in Environmental Studies.

Dedication

This paper is dedicated to my grandmother, who ingrained in me a love and a commitment to protect Little Birch Lake as she did for 97 years, so this lake can be used for future generations.

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Chapter I: Introduction

Many studies examine how best management practices (BMPs) improve water quality of lakes or streams by; decreasing the amount of runoff, decreasing nutrients entering the waterway, stabilizing banks, and/or decreasing the amount of sediment entering the water. BMPs also increase the amount and quality of natural habitat around the waterway, which should ultimately lead to increasing populations of wild/native animals (i.e., birds, frogs, turtles, etc.) and providing a better habitat for fish. Most BMPs can also be visually appealing to property owners and increase property values. The improvement of water quality and natural habitat over time that will result from implementation of BMPs will not only help Little Birch Lake, but will also be an example for other lakes in central Minnesota.

There are many organizations that focus on educating property owners and can be resourceful to lakeshore property owners to help them understand, fund, and/or implement BMPs on the lakeshore. Many Minnesota lakes, like Little Birch Lake, have a lake improvement association, which can be very helpful in helping property owners understand the importance of water quality and how the property owner can care for their own lakeshore environment. Another source of help comes from the watershed district and/or local counties for funding, and/or educational materials. Also websites like the Minnesota Department of Natural Resources (MNDNR) and Minnesota Pollution Control Agency (MPCA) can be valuable resources to learn about water quality. Understanding the relationship between how lakeshore property owners view water quality will help better understand how to best implement these BMPs around the lake.

Problem Statement

Land use practices and the lack of knowledge and implementation of BMPs by lakeshore property owners often results in degradation of water quality. There is a need for better understanding the relationship between lakeshore property owners and their caring and protection of water quality. We need to better understand how caring about clean water, will make property owners implement BMPs on the landscape that will help protect our water resources. There needs to be a better understanding of what will change a property owner's willingness to implement these practices: better/more educational resources or classes, funds to implement BMPs, or other resolves. By understanding the lakeshore property owner's knowledge and willingness to improve water quality will hopefully better influence their implementation of BMPs. Surveying these property owners to see if there are any relationships to their water quality ideals and how to get them to implement BMPs will help future restoration efforts.

Research Questions

1. Do lakeshore property owners understand how to protect the water quality of Little Birch Lake?
2. Is there a relationship between lakeshore property owners understanding of water quality and BMP implementation?
3. How does lakeshore property owner's conviction of water quality affect their land use practices?
4. Does previous environmental or lakeshore education affect property owner's willingness to implement BMPs?

5. If water quality is a concern to property owners why are they not implementing BMPs?
6. Does a person's demographics affect their understanding of water quality and/or BMP implementation?
7. Do lakeshore property owners understand what BMPs are and how they affect water quality?

Statement of Need and Contributions

The degradation of water quality by loss of natural habitat from increased human development needs to be changed through the implementation of BMPs to help not only restore native habitat, but also improve water quality. By implementing and using BMPs for restoration projects, lakeshore property owners will be helping to improve not only their property but also its value and eventually the water quality. Most of these BMPs are easy for an owner to implement; they just need to understand the importance of BMPs and how to implement them through lakeshore property owner education or personal contact. Adult environmental education is used as an outreach tool, to update property owners with current topics and research involving environmental issues, including water quality information.

Environmental education of lakeshore property owners needs to be improved (Eckman & Rivers, personal interview, 2009). The lack of knowledge or misunderstanding by lakeshore property owners with their subsequent use and/or misuse of their lakeshore property has led to a decrease in water quality throughout Minnesota, through a decrease of native habitat from urban sprawl and structures near shoreland and current agricultural practices (Minnesota Department of Natural Resources [MNDNR], 2009). Given the correct

information and understanding of proper lakeshore BMPs, implementation of these techniques will over time greatly improve the quality of our lakes and rivers.

Little Birch Lake, a 839 acre lake, is located in both Stearns and Todd counties in central Minnesota, in a mostly wooded area. Many parts of the lake are on a steep hillside adjacent to the water's edge especially on the southern end of the lake, along with some agricultural land around the northern part of the lake (MNDNR, 2007). Little Birch Lake is listed as a mesotrophic lake, a moderately clear lake, with no oxygen in the deepest part of the lake during summer months, according to the Minnesota Pollution Control Agency (MNPCA, 2017). A mesotrophic lake is the status most lakes in central Minnesota strive to have or try to protect for their water quality.

One way to evaluate how important the water quality is to the property owners is to develop a survey that will help answer the questions about water quality and the environment around their lake. It will also provide information on what is needed to convince people that the implementation of BMPs on their lakeshore will help restore native vegetation and habitat for animals, birds, and fish. The survey needs to be sent to all property owners on Little Birch Lake to receive responses from as many people as possible. A survey is a cost effective way to contact a large number of residents and receive pertinent information about the survey topic. There were 242 properties on Little Birch Lake, at the time of the survey. The survey results can ultimately help many other lake associations and watersheds evaluate what needs to be done on their lakes and how to educate lakeshore property owners on the proper use of BMPs to improve and increase water quality. Being able to duplicate this survey with other lake associations will also help in the formation of a more robust data set, make planning for

local units of government/associations, have more focused strategies, thus reducing costs to implement BMPs. Although surveys are a vital tool to understanding people's environmental knowledge, there needs to be better analysis of these surveys between water quality and BMPs implementation. This study will help with a better understanding of property owners' knowledge of BMPs and water quality.

Today, we think there is a better overall understanding of environmental issues and water quality. New information should help property owners understand the need for restoration of their lakeshore and the importance of compliance after exposure to better, updated educational methods and materials. Development around the lake has occurred, decreasing the natural wooded lakeshore on Little Birch Lake. One way that the property owners could improve the lake water quality is by restoring their property back to native vegetation (i.e., wooded and/or native grasses). This native habitat would help prevent sediment from entering the water, by stabilizing the shoreline and filtering the runoff water that enters the lake.

This research project will provide tools to better understand how property owners view the environmental issues facing lakes today. The results will also help to reinforce the importance of BMPs and how they can help improve water quality. Although, no lakeshore education will be available within the time frame of this study, the researcher will share the results with the Little Birch Lake Improvement Association and they will be available for property owners who may have questions before implementation of BMPs. As some property owners begin to implement BMPs, others will see the improvements along the lakeshore and might be more willing to find out more information to start their own restoration projects. The

implementation of BMPs will not show an immediate improvement of water quality. Although the property owners should see a decrease of runoff from their property flowing directly into Little Birch Lake as well as immediate decrease of erosion along their shoreline. These immediate observations will change depending on the type of BMPs installed. This allows Little Birch Lake to be a continuing source for study by others looking to collect water samples to see if over time the water quality improves in the lake.

With the information gained from this survey, other lake organizations can use these results to look at how to best affect the need for implementation of BMPs on their lakes. Their organizations can begin their own restoration projects by having their board discuss the importance of BMPs and how to receive monetary assistance or grants to implement BMPs, which will ultimately help improve water quality on their lakes as well as hopefully waters throughout the state.

Procedures/Methods

A survey was recognized as the best way to obtain information to answer the problem statement. A survey was then developed to answer the research questions. A pre-test of the survey was used to assure the survey would answer the research questions and that the participants would be able to easily understand the questions.

The Little Birch Lake property owners were chosen as the participants of the survey. The Little Birch Lake property owners mailing addresses where obtained from current tax records obtained through GIS (mapping software) layers for both Stearns and Todd Counties. A cover letter to introduce the research project was created which also included a thank you to

property owners for their time to complete the survey. Surveys were sent to all Little Birch Lake current property owners at the time of the survey.

Surveys were sent back to the researcher in a self-addressed envelope, mailed with the survey. Surveys were received mostly within the first month, with the last returned three months after the initial mailing. The results from the survey were compiled into an excel spreadsheet for data analysis (see Appendices C and D a-e).

The researcher worked with the St. Cloud State University (SCSU) Statistical Consulting Center to analyze results for frequencies and crosstabs, generating chi-squares results, which were used to evaluate relationships between descriptive information and test questions. These results were then put into table and chart forms, as shown in Chapter IV, Results and Discussion.

Assumptions

- Property owner's contact information was correct and letters were sent to current property owners on Little Birch Lake.
- The lakeshore property owners are concerned about the water quality of Little Birch Lake and will take the time to complete the survey and return it.
- Water quality is important to the lakeshore property owners on Little Birch Lake.
- Property owners have some knowledge of water quality issues and BMPs from owning lakeshore property.
- The results obtained from the survey will give a better understanding of how lakeshore property owners value the environment around the lake, including the importance of natural habitat for the plants and animals.

- Property owners around Little Birch Lake are typical of other lakeshore property owners throughout Minnesota, allowing the survey results to be used on other Minnesota lakes.
- The property owners that did not complete the survey were similar in ideology and demographics to the property owners that completed the survey.

Limitations

- There will most likely be a certain percentage of mistakes in the property owner's contact information with the survey and letter going to the wrong address or not to a present lakeshore owner, because of sold properties.
- The property could be part of a family owned cabin and the contacted owner does not spend as much time as other family members at their property on Little Birch Lake.
- Someone else in the family may better understand water quality issues than the property owner that fills out the survey.
- Discussing the study at the Little Birch Lake Improvement Association Annual Meeting could have influenced those members present to fill out the survey.
- If a lakeshore property owner received incorrect information from non-scholarly articles or from other trusted but misinformed sources, their responses on the survey could be affected in a negative way.
- If the lakeshore property owner does not care about water quality and/or implementing BMPs, they will not understand the importance in protecting Little Birch Lake for now and future generations.

- Ideally, it would be better to send surveys to multiple lakes, in different areas and counties of the state. This would give a larger and more diverse data set for analysis.

Definitions

Aquatic invasive species (AIS): Non-native plants or animals, which have populated lakes and river, and can cause damage to native plant and animal populations.

Best management practices (BMPs): Are techniques and practices that one can implement to protect and restore natural resources and reduce human impact on the environment (MNDNR, 2009).

Chi-square: A common statistical test used to analyze the comparison between observed data, with expected data to validate a specific hypothesis (Fisher & Yates, 1974).

Eutrophic lake: Lakes with excess nutrients (phosphorus & nitrogen), usually having excess algae blooms especially during the summer.

Filter strips: Areas of vegetation that absorb nutrients before they can reach a waterway.

Impervious surfaces: Areas that cannot absorb water (i.e., pavement, building roofs).

Mesotrophic lake: Lakes with average amounts of nutrients, mostly clear water with beds of submerged aquatic plants.

Native plants: Plants and flowers, which are indigenous to the area in which they are found.

Nonpoint source pollution: Pollution that runs off a landscape, this runoff collects pollutants, nutrients and sediment as it runs over land before entering waterways (i.e., runoff of sediment, or fertilizer) (MNDNR, 2009).

Riparian: Area of land, banks, directly adjoining lakes or rivers. This is the natural area around waterways, which naturally protect land from erosion and reduce runoff.

Riprap: Rock along the water's edge to protect shoreline from wave and ice damage.

Secchi disk: A white disk that is lowered into the water column to figure out the clarity of the lake.

Chapter II: Review of Literature

There is a need for water quality protection on Little Birch Lake as demonstrated by the data collected by Little Birch Lake Improvement Association volunteer lake monitors (Minnesota Pollution Control Agency [MPCA], 2017). The amount of phosphorus (P), nitrogen (N), and suspended solids entering the lake is lower than those same nutrient levels leaving the lake (MPCA, 2017), which means that extra nutrients, which is the limiting factor in Little Birch Lake, could be entering the water from somewhere around the lake. The exception to this is during high water events. It should be noted that a lake acts like a holding area for water, because the slowing of water through the lake can accumulate nutrients over time, but Little Birch Lake can also be receiving these nutrients through improper and/or unintentional uses by the property owners around or upstream from the lake. This is why it is difficult to identify where exactly the nonpoint source pollution originates. The implementation of BMPs around the lake will help control runoff and decrease nonpoint source pollution from entering the lake. Secchi readings from Little Birch Lake indicating the lake's clarity have shown a general upward trend from 1975 to 2016 (MPCA, 2017). This trend means that the lake has been making progress towards better water quality (MPCA, 2017). One of the possible reasons for the upward trend in water quality are the BMPs made along the inlets into the lake which have started to show their improvements in the concentrations of the collected data, or possibly the drier years recently have resulted in a decrease in the amount of water entering the lake.

Being a lake that is mesotrophic (MPCA, 2017), there is a need to protect this trophic status so that excess nutrients do not further damage the water quality of Little Birch Lake and

turn it into a eutrophic lake. Protecting the shorelines around the lake with native plants and trees, while also protecting and implementing BMPs upstream of the lake will help in preserving and improving the water quality of Little Birch Lake.

Little Birch Lake has shown an increase in median transparency from 1975-2016, which is increasing by 0.58 ft. per decade (MNPCA, 2017). The monitoring data shows the trophic status index (TSI), for Little Birch Lake is 44, which is considered mesotrophic, with a TSI range from 40-50 (MNPCA, 2017). Although most of the land around Little Birch Lake is forested, land upstream is cultivated, which could negatively affect the water quality in Little Birch Lake now and in the future if not protected properly. With this trend in water quality it puts Little Birch Lake in protection mode, keeping at its current or increasing status of the water quality, instead of full restoration, which would need to be done if the lake was impaired by excess nutrients. Installing more BMPs around Little Birch Lake will protect the water quality in the lake from deteriorating in the future.

Water Quality and BMPs

There are many types of lakeshore BMPs that could improve the water quality of Little Birch Lake. Each property owner will see greater improvement by implementing different BMPs depending on the type of lakeshore they presently have. Many properties will improve by adding native grasses, some with trees and shrubs, and some with riprap. Each situation will be individualized for BMPs that will work best depending on the current or original habitat. Types of shorelines presently seen on Little Birch Lake include: forest, grasslands, agricultural land, sandy beaches, and impervious areas; all of which can be affected by the amount of wave action hitting the shoreline. All of these conditions will

change the effectiveness of the type of BMPs used and/or implemented. These BMPs help protect against nonpoint source pollution from entering water bodies. The problem is that although there are regulations from the Clean Water Act, to reduce pollutants from entering water bodies from point sources, there are still water quality problems that come from nonpoint sources of pollution (Ribaudo & Horan, 1999). Using the correct BMPs and placing them in the right locations can help with nonpoint source pollution. Another consideration should be that correct BMPs for a particular area may not be affordable by the property owner, so alternative suggestions will also have to be given along with the information of where to obtain possible grants.

The Minnesota DNR published *A Guide for Buying and Managing Shoreland* (2009), that provides property owners information about the top BMPs for achieving highest water quality, which include: filter strips, upgrades to septic sewage treatment, reducing sediment from erosion, care of lawns and gardens, careful use of toxic chemicals, reducing storm water runoff, increasing native species and habitat diversity, and reducing eutrophication (MNDNR, 2009). Filter strips (natural buffers) will help with controlling runoff and reducing nutrients entering with that runoff. A properly maintained sewer system, making sure that a septic system is not failing, will help with reduction of excess nutrients entering the lake, through groundwater and surface water. Erosion and sediments can lead to adding nutrients and can decrease the clarity of the water, which can affect the plants and animals living in and near the water. Properly maintained lawns and gardens can affect water quality if too much fertilizer is used, which can enter the water body, reduce groundwater recharge and increase runoff. Any toxic chemicals entering the lake can decrease water quality; affect wildlife or people's

recreational use. Stormwater runoff can affect many of the factors already listed, the water might also contain pollutants and having proper filtration of the runoff can help improve the water quality. Eutrophication can affect a lake by having an overly abundant amount of nutrients, which can lead to algae blooms and affect the water clarity. Eutrophication is a hard process for a lake to reverse; it is better to keep a lake clean before this happens because after a lake becomes a eutrophic lake, it is hard and costly to reverse the process. By using BMPs and decreasing runoff, this can decrease the harmful nutrients from entering the lake; species and habitat diversity will therefore be maintained. Through education, property owners can use the information learned, which includes: substances that should not be entering a lake, habitat that will decrease pollutants that enter a lake, how their everyday land use affects water quality, and to make a better and informed decision about the use and implementation of BMPs.

BMPs are used to control nonpoint source pollution from entering our waterways. These best management practices have been an accepted way of controlling pollution from nonpoint sources (Ice, 2004). Some restrictions that can hinder implementation rates of BMPs are inadequate funding and staffing for BMP programs (Ice, 2004). Therefore, implementation may have to come from property owner's interest in water quality, because there might not be adequate funding available in all situations for cost share dollars. It is also hard to evaluate BMP effectiveness, but this can be done over time; by looking at data collected before BMP implementation, and then comparing it to data collected after implementation (Ice, 2004). BMPs are a primary tool in controlling water bodies from nonpoint source pollution (Ice, 2004). There is a difference in regulations from point sources

that may need a National Pollution Discharge Elimination System (NPDES) permit, but the property owner's do not need these permits for nonpoint source pollution (Ice, 2004). BMPs are one of the ways that we can control the nonpoint source pollution, but because there is no regulation for this type of pollution, the property owner needs to take the initiative in implementing BMPs.

There is a relationship between buffers and the decrease in nutrients, sediment and pesticides coming from agricultural fields (Anbumozhi, Radhakrishnan, & Yamaji, 2005). Anbumozhi et al. (2005) showed how riparian forest buffer systems that were put in place decreased the negative effects of the agriculture fields through surface water. They also show that property values increase around stream water where BMPs were used to change the land use. Further, the gradient of land to the water affects how well the buffers work; the lower the gradient the better. This type of BMP can affect the amount of sediment and nutrients removed from an agricultural field, although the slope and width of buffer also impacts effectiveness. For example, a vegetation buffer shows optimal sediment trapping with a 10 m buffer at a 9% slope (Liu, Zhang, & Zhang, 2008). Although there are only a few agricultural fields directly abutting Little Birch Lake, there are many small tributaries that drain from agricultural land into Little Birch Lake. There is a relationship shown that the slope and size of buffers around the lakeshore can affect the effectiveness of the BMPs (Liu et al., 2008).

Many types of lakeshore buffers, native grasses, forested land, and a mixture of both, all can impact the amount of nutrients and sediment that runoff into waterways. Lowrance and Sheridan (2005) found that grass buffer zones worked best at reducing the nutrients from entering the waterway and was the best at reducing the water flow. All of the buffers helped

in reducing the amount of nutrients entering the waterway, with a combined grass and forest buffer also shown to be a very effective buffer (Lowrance & Sheridan, 2005). This knowledge can be helpful in showing that mixing grasses along with a mostly forested shoreline will help in reducing runoff and nutrient loading. By adding native grasses to an already forested shoreline, could also be extra help to improve water quality. Some lakeshore property owners might think that because they have a forested shoreline that they are already helping with runoff, but by adding additional native grasses, would improve their shoreline even more.

Extra nutrients and pollutants are one of the causes of impairing water bodies, the use of BMPs helps to reduce these harmful substances from entering and harming the water body. There are many nutrients that can harm a water body, the most common nutrients that are monitored in lakes and are abundant in our environment are N and P. Phosphorus loading in lakes can be a large contributor to algae and excess plant growth, both of which can affect the water clarity and the amount of oxygen available for plants and fish. Inorganic, organic, and biological materials are contaminants that impact water quality directly and can indirectly affect physical, chemical, or biological changes in water quality (Pierzynski, Sims, & Vance, 2005). Phosphorus can enter a lake from many sources; it can be absorbed in the soil and runoff with erosion, and/or dissolved in the water and runoff with surface water (Pierzynski et al., 2005). Phosphorus is a major concern in surface water contamination, while N is more of a concern in groundwater contamination. Best management practices will also decrease the amount of sediment from entering the water body; this will help decrease the amount of suspended sediments in the water and also decrease the amount of nutrients that are attached to the sediment particles. This shows us that there is a major concern for P pollution entering

a lake by runoff, so by controlling this runoff through implementation of BMPs, the amount of P entering water bodies will decrease.

Buffer strips have been shown to help with increasing water quality and also increasing the amount of shoreline animal habitat. Muenz, Golladay, Vellidis, and Smith (2006) showed that water quality is more stable in buffered streams than in un-buffered streams. They found that the buffered area was also less vulnerable to excess nutrients, sediment concentrations and bacteria. Muenz et al. (2006) found that the type and amount of macroinvertebrates and amphibians changed whether or not an undisturbed buffer existed. This study was done on a stream site, but that does not change the effect that a buffer will have on any body of water by providing an increase in the habitat for amphibians and the essential habitat for macroinvertebrates.

Habitat

Some of the BMPs that are used for shorelines around lakes also increase habitat for animals that live in or around the waters' edge. This habitat can bring many benefits to these animals; it can provide a food source along with protection from their predators. This habitat will also filter the runoff water before it can enter the water body. Henning and Remsburg (2009) state that the abundance of a large variety of shoreline buffers increased the variety and number of birds and frogs on the lakeshore with more vegetation compared to non-vegetated shores. The study was done on multiple lakes with different amounts of native buffer, ranging from 30 m of lakeshore to an entire shoreline of 340 m. They found that the increase of native vegetation around the lakes, greatly favored the abundance of different species, but did not show the same effect by those lake property owners that mowed up to the

lake's edge. The Henning and Remsburg (2009) study suggests that the more natural habitats around the lake, the more wildlife will call it home. Environmental scientists agree restoring vegetation buffers back to their native state will help reduce negative impacts from lakeshore development (Shaw, 2015). If preserving our natural habitat can help solve problems like these, let us use BMPs to return the shoreline to its original state.

Visually Appealing and Property Values

There is a misunderstanding among property owners about BMPs, especially about native buffers. Most of the property owners do not understand what a native landscape should really look like; most of them just see a buffer and weeds. There will be weeds that will grow in a native buffer that will need to be removed. Native buffers are comprised of native grasses and flowers, which if properly maintained will over time (usually within 3 years) take over the weeds and flourish. There will be many flowers that will bloom at different times throughout the year making this type of buffer visually appealing to the owner, to wildlife, and to those sightseeing around the lake. A native buffer can be established by planting the buffer area or by seeding the area, then with proper maintenance and letting the plants grow will over time take over the weeds and lawn grass that may already be in place. Helfand, Sik Park, Nassauer, and Kosek (2006) found that people are willing to pay more money for a project that looks visually appealing and one that also improves the environment. This study shows that people with the right information are willing to spend more resources on a project that is well designed and includes native plants.

By increasing the water quality of a lake, there is a positive correlation with property values on the lake. A study at Delavan Lake in Wisconsin completed a rehabilitation program,

which increased water quality, thus increasing lakeshore property values (Kashian, Eiswerth, & Skidmore, 2006). The lake restoration costs were $7 million which translated to an overall increase of $99 million in total lakeshore property values. The lake project undertook major steps to rehabilitate the water quality. First, the lake was drained to remove the nutrients, algae, and undesirable fish species, and then the lake was filled and stocked with game fish. Although Little Birch Lake will not undergo this type of extreme restoration project, if the water quality in the lake does increase over time with BMP implementation the property values will also increase.

Krysel, Boyer, Parson, and Welle (2003) conducted a study on the positive relationship between water quality and property values. This study also showed that education is an important factor, which will help greatly to improve the quality of Minnesota lakes. The resulting correlations found relationships between water quality in Minnesota lakes and how they influenced property prices around given lakes (Krysel et al., 2003).

BMPs have been shown to improve water quality in water bodies. Having a lake with high water quality also promotes outdoor recreation, without this, the lake is not appealing to residents or the surrounding community (MNDNR, 2009). A lake with healthy water and an attractive environment will increase sustainable recreation on Little Birch Lake.

Education

One of the many factors in the proper use and implementation of BMPs is that the property owners need to become better informed and educated. Property owners might want to do something to help improve the water quality, but they might not know where to find information about BMPs or waterfront restoration. Options might need to be discussed with

property owners about implementation and they may need to be directed towards knowledgeable agencies in this geographical area, for example, watersheds or county offices. With proper education, the property owners will be able to see how these BMPs will help to improve water quality. Dietz, Clausen, and Filchak (2004) showed with education of property owners about BMPs in wastewater management or prevention, that the property owners reduced the amount of fertilizers that were applied to their lands after proper BMP education. This study shows that an educated property owner makes more of a conscious effort to work on improving overall and long-term water quality.

There has been a lot of work with organizations and farmers to help reduce the runoff of pollution from their fields into water bodies. Christensen and Norris (1983) found that there are many factors involved in the reasons why a farmer will or will not implement BMPs on their property: traditions, social pressures, personal values and beliefs, costs, and neighborhood pressures. All of these factors can impact whether or not a person implements BMPs. Christensen and Norris (1983) were looking at farmers' beliefs, but these same factors could also influence a lakeshore owner if they are or are not going to implement BMPs. There are many factors that influence farmer's adoption of BMPs, including differences between public officials and farmers (Christensen & Norris, 1983). These perceptions need to be changed by proper education of lakeshore property owners, so that they can see the benefits of these BMPs and not just see them as another regulation forced on the property owner.

There is a lot of information on how to correctly implement BMPs or restoration projects. A property owner also can receive cost share dollars for completing projects. The problem is that the property owners need a way to find out this information, there are many

ways to educate these property owners including; shoreline classes, pamphlets, online tools, or just word of mouth. The education of the property owners and finding out which type of education works best could be beneficial to lake associations and organizations that are working on improving water quality.

There is an understanding that environmental education is changing people's behavior, although it can be redundant (Bride, 2006). Bride (2006) also states that much of the research about what citizens already know about environmental issues is mostly quantitative based, he sees a need for more in-depth information about what the citizens know qualitatively. This qualitative information will help researchers understand more about the knowledge base of the people that they are working with, but also see what else needs to be covered for complete understanding of the importance and issues related to BMPs and their implementation.

The human population is ever increasing and this is putting a heavy toll on our natural resources. This is affecting our natural land and waterways. There is a need for education of people so that they can better understand how their actions impact our ecosystems (Sutherland, 1998). "The goals of environmental education are: to increase public knowledge so support can be given to management and conservation of environmental policies; increase conservation ethics, which will make people more responsible; decrease the consumption of natural resources; and increase the technical abilities for resource managers" (Sutherland, 1998).

Political and social impacts can affect how environmental education is perceived by someone or a group of people (Belanger, 1999). Social impacts can favor environmental education by people, with environmental views becoming a social function (Belanger, 1999).

This can be used to engage more people in environmental issues and can be advantageous for one's education. They can use their neighbors and friends to get someone interested in learning more about their environment, which will over time change the land use practices of these newly educated people. Belanger (1999) also states that much of the problem with environmental education is still science and technology based. This needs to change so property owners can better understand environmental education.

Jacobson, McDuff, and Monroe (2006) discuss that effective environmental education and outreach are the main points in changing behaviors, accruing funds and involving volunteers. The public is one of the factors that can either help or hinder environmental management (Jacobson et al., 2006). This shows the need for better understanding of what are the effective types of education and outreach. Jacobson et al. (2006) shows many techniques on educating and engaging the public in environmental education. There are many different ways in which an educator should work with property owners about environmental issues, but it is also important to know which of these techniques works best for changing the practices of the property owners.

One can see that the Little Birch Lake property owners who have taken their time and money to help collect samples and readings for the MPCA (2017) have an interest in the water quality of Little Birch Lake. What is now needed is to find these interested people to make land use changes and implement BMPs to help improve the water quality. Then, with their neighborly influence they can change the opinions of other property owners, giving them reasons to understand the importance of implementing changes on their own property. The ultimate goal of improving water quality on Little Birch Lake then becomes the combined

effort of all property owners working together to achieve the goal of everyone, better water quality and preserving the area for future generations.

Eurasian Watermilfoil (*Myriophyllum spicatum*)

The aquatic invasive species, Eurasian watermilfoil also exists in Little Birch Lake, although there is no indication that Eurasian watermilfoil is affecting the water quality in Little Birch Lake at the present time. Eurasian watermilfoil has been shown to alter pH, oxygen levels and affect temperature change under dense mats of milfoil (State of Washington, Department of Ecology, 2017). This data should be shared with the Little Birch Lake property owners so they know it could be a problem in the future. Little Birch Lake should work on controlling the Eurasian watermilfoil within the lake so this does not become an issue. The Little Birch Lake Improvement Association works each year to have sections of the lake treated for eradication of Eurasian watermilfoil. This can be done with chemical, manual removal or biological controls (State of Washington, Department of Ecology, 2017). Another reason to control milfoil, is to protect the biodiversity of aquatic plants in a water body, non-native plants also can affect recreation value and aesthetics of lakes (Haifeng Liao, Wilhelm, & Solomon, 2016).

Conclusion

By restoring to near native shoreline around Little Birch Lake, it can provide major impacts on many areas in and around the lake. Monitoring on Little Birch Lake has been very sporadic, and needs to be done more frequently to see if the BMP implementation is having a positive effect on the lake's water quality. BMP implementation will, over time, have a positive impact on the water quality, this will also help create a more scenic lake, with many

more flowers, plants and trees. Little Birch Lake will hopefully become more environmentally friendly to the neighbors living downstream in the watershed. The lake will also be a place where people can boat, swim, fish, and/or just enjoy the scenery, for generations to come.

Chapter III: Methods

Introduction

A survey was determined to be the best way to answer the research questions and receive a large enough dataset to analyze the results. A letter with a survey (attached as Appendix A and B, respectively) was mailed to each lakeshore property owner on Little Birch Lake. Surveys have been shown to be a reliable and cost effective method to reach property owners (Welle & Hodgson, 2008). A survey was created to find out the level of knowledge of the property owners around Little Birch Lake to better understand if there is a relationship between water quality issues and BMPs implementation. The property owners were asked to fill out the survey and return it in the self-addressed envelope or use the link provided to fill out the survey online. Survey data was then analyzed to understand property owners knowledge of BMPs and their conception of water quality as well as its' importance to the life on and around the lake.

Problem Statement

Land use practices and the lack of knowledge and implementation of BMPs by lakeshore property owners often results in degradation of water quality. There is a need for better understanding the relationship between lakeshore property owners and their caring and protection of water quality. We need to better understand how caring about clean water, will make property owners implement BMPs on the landscape that will help protect our water resources. There needs to be a better understanding of what will change a property owner's willingness to implement these practices: better/more educational resources or classes, funds to implement BMPs, or other resolves. By understanding the lakeshore property owner's

knowledge and willingness to improve water quality will hopefully better influence their implementation of BMPs. Surveying these property owners to see if there are any relationships to their water quality ideals and how to get them to implement BMPs will help future restoration efforts.

Research Questions

1. Do lakeshore property owners understand how to protect the water quality of Little Birch Lake?
2. Is there a relationship between lakeshore property owners understanding of water quality and BMP implementation?
3. How does lakeshore property owner's conviction of water quality affect their land use practices?
4. Does previous environmental or lakeshore education affect property owner's willingness to implement BMPs?
5. If water quality is a concern to property owners why are they not implementing BMPs?
6. Does a person's demographics affect their understanding of water quality and/or BMP implementation?
7. Do lakeshore property owners understand what BMPs are and how they affect water quality?

Survey Participants

The survey was mailed to the permanent residence of the property owners on Little Birch Lake at the time of the survey to insure that everyone received the survey. The current

property tax record address information was used from the up-to-date property ArcGIS, mapping tool, layers from both Todd and Stearns Counties. An output from these ArcGIS layer addresses was used to create individual property owners labels for envelopes. Properties directly adjacent to Little Birch Lake and property owners with lakeshore access to Little Birch Lake were also selected for the survey.

During the annual Little Birch Lake Improvement Association meeting before the letters were sent out, the board gave the investigator some time to introduce the proposed study, explain that they would be receiving a letter and survey, and answered some general questions about the study.

The selected property owners were mailed the cover letter (Appendix A) and survey (Appendix B), the letter discussed the project and thanking them for their time. The property owners received a stamped return envelope to send back the completed survey. Along with the paper survey the property owners received a web link, detailed in the cover letter, to complete the survey digitally, for their convenience.

Survey Development

The survey included both quantitative questions and one open ended qualitative questions. There were questions used to assess the current BMP knowledge of the property owners. A question was also asked to see if a property owner had already installed BMPs, what type of BMPs were installed or if they had considered implementing BMPs. There was also an open-ended question to see what the property owners thought was affecting the overall water quality of Little Birch Lake.

A pre-test of the survey was used to ensure all of the questions were understandable. The pre-testing was done with key individuals, with a focus group and by interviewing some of the pre-testers (Welle & Hodgson, 2008). Both water resource professionals and non-water resource professionals were used to complete the pre-test survey. This was used to make sure that all questions were easily understandable and that quantitative analysis could be completed with the results of the survey.

Survey

Little Birch Lake survey questions and multiple-choice selections:

1) What is your age?
2) Gender: *Male, Female*
3) How long has your family owned property on the lake?

   1-5 yrs, 6-10 yrs, 11-25 yrs, 26-50 yrs, 51-75 yrs, >76 yrs
4) Household Income per year. *<$50,000, $50,000 – 100,000, $100,000 – 250,000, $>250,000, Wish not to answer*
5) How many days a year do you spend on your property on Little Birch Lake?

   Permanent resident (primary home), Cabin seasonal (summer), Cabin (weekends), Cabin (monthly or less)
6) What is your affiliation with the Little Birch Lake Association?

   Current Member, Not a member, Former member, Interested in becoming a member
7) What are your primary uses of the lake? (choose all that apply)

   Boating, Fishing, Swimming, Sightseeing, Other (please specify)

8) How important is the water quality of Little Birch Lake to you?

Very important, Important, Somewhat important, Not important

9) How do you perceive the *(Excellent, Good, Fair, Poor)*

- *Overall Water Quality?*
- *Health of your shoreline?*
- *Overall health of Little Birch Lake shoreline?*

10) Have you noticed a change in the lake's water quality since you have been an owner? Quality has: *Improved, Stayed the same, Decreased.*

11) Whom do you think should be responsible for improving water quality (choose all that apply)? *Lakeshore owners, Residents upstream from the lake, Government agencies (Watershed District, Soil and Water Conservation Districts, or Minnesota Pollution Control Agency), Visitors to the lake, It is fine the way it is*

12) How do you feel about local environmental agencies (Sauk River Watershed District, Todd and Stearns Soil and Water Conservation Districts, Minnesota Pollution Control Agency) *They are helping the owners of Little Birch Lake, They have too much control on what a landowner can do on their property, Do not have an opinion*

13) Do you believe *(Yes, No, Maybe, Not sure)*

- *Native aquatic plants affect water quality?*
- *Native aquatic plants affect the habitat for animal/fish around the lake?*
- *Native aquatic plants are visually appealing?*
- *Native shoreline plants affect water quality?*

- *Native shoreline plants would help your shoreline?*
- *Native Shoreline plants are visually appealing?*

14) What do you think could negatively impact the water quality?

15) What type of lakeshore do you have presently (choose all that apply) *Landscaped/ornamental plants, Trees and shrubs, Sandy (beach), Turf grass, Rip rap (rocky shoreline), Native perennials, trees and shrubs, No-mow zone (area next to the lake that you do not mow or weed whip)*

16) Have you ever looked for information on water quality Best Management Practices (an activity, device or behavior that is changed to help protect water resources) or shoreline restoration before? *Yes, No*. If Yes, Where: *internet, Brochures, Books, Magazines, Little Birch Lake Improvement Association, Other (please specify)*

17) Have you already completed Best Management Practices (BMPs) on your property? *Yes, No*. If yes, what did you do and when? *Rain garden, Shoreline buffer (not mowing or weed whipping your shoreline), Rain barrel, Low or no fertilizer on your lawn, Native plants on your shoreline*

18) How do you think runoff affects the Little Birch Lake's water quality? *Positive, Negative, Not at all, Not sure*

19) Do you think over fertilizing your lawn affects Little Birch Lake water quality? *Yes, No, Not sure*

20) Do you think reducing run-off from your property will affect the water quality of Little Birch Lake? *Yes, No, Not sure*

21) Do you think native plants protect the shoreline and filter run-off better than non-native plants/turf grass? *Yes, No, Not sure*

22) What types of BMPs would help decrease the runoff from the property around Little Birch Lake (choose all that apply)?

Rain gardens, Rain barrels, Native plant buffer, All of the above, None of the above, Other (please specify)

23) Would you be interested in implementing Best Management Practices?

Yes, No, Need more information

24) Contact information (optional)

Name, Address, Phone number, Email

Procedures

1. How to best obtain information to answer the problem statement.
2. Development of survey questions, that best answers the research questions.
3. Pre-test of survey. Both water quality and non-water resource professional used to assure survey would answer research questions and that questions were easily understood.
4. Obtain property owners address information. Mailing addresses where obtained from current GIS layers for both Stearns and Todd counties.
5. Write cover letter to introduce the research project and thanking property owners for their time to complete the survey.

6. Presented thesis project to some of the property owners at the Little Birch Lake Improvement Association annual meeting and asked for their help in completing the survey.
7. Print and stuff all materials in envelopes.
8. Mail surveys.
9. Collect completed surveys, most surveys returned within first month, last survey returned 3 months after initial mailing.
10. Enter completed surveys into excel spreadsheet.
11. Data analysis, with help from SCSU Statistical Consulting Center. Results were analyzed for frequencies and crosstabs were run to find chi-squares results, to evaluate relationships between descriptive information and test questions.
12. Create graphs and tables with analyzed data.
13. All surveys once entered were destroyed (shredded), along with all property owner contact information was deleted.

Data Analysis

After completed surveys were returned results were entered into an Excel spreadsheet. Each survey was entered with all property owners separated by rows and their answers put in the columns, for analysis. The data was analyzed, with the help of SCSU Statistical Consulting Center, to find any relationships from the surveys. Survey data was analyzed to look at frequencies and crosstabs were run to get chi-squares results from the survey data. The frequencies were used to find the total numbers for what was answered for each question and the frequency distributions were used to develop a histogram to be able to visualize the

results. The chi-squares test was used to find relationships between the answers to the survey questions compared to what results were expected. A chi-squares test is commonly used in statistics to analyze the comparison between observed data, with expected data to validate a specific hypothesis (Fisher & Yates, 1974). These results can be found in the results and discussion chapter.

Chapter IV: Results and Discussion

Introduction

Results from the survey are given in percent of those that answered each question, with the percentage used for analysis. There were some answers that responders left blank, so the percentage for each question may vary slightly from 100%. Only surveys that had answers on all pages were used in the final analysis, all survey results are shown in Appendices C and D a-e.

Frequency distributions were used to visualize the total results for each individual question. A frequency distribution, represented as a histogram, shows the number of responders answering each question on the survey, for example, how each respondent felt about the water quality of Little Birch Lake. To show if there was a significant difference in the answers to the questions a chi-square test was used, for example, was there a difference between respondents' age and their knowledge about runoff? Crosstabs were also used to show any relationship between different questions, with chi-squared results. Crosstab analysis by chi-square test was used to find relationships between the answers to the survey questions compared to what results were expected (Fisher & Yates, 1974). Chi-square results are considered significant if the p value results are less than or equal to 0.05 or 5% (Fisher & Yates, 1974). Practical significance was used to identify significantly observed data that was not shown to have statistically significant difference (University of Guelph, 2008).

Two hundred and forty two surveys were sent out to the lakeshore property owners on Little Birch Lake. Of those 242 surveys, 113 surveys (47%) were completed and returned, shown in Table 1. There were also 14 (6%) returned because of a change in address or the

recipients were no longer property owners on Little Birch Lake. Also those surveys sent back with only one or a few questions or pages completed were discarded from the analysis. The Little Birch Lake survey response rate was much better than the Watchic Lake Association Survey (2015), which had a 35% response rate with a mailing of 230 total surveys.

Of the surveys that were returned, 96% of the respondents were affiliated in some way with the Little Birch Lake Improvement Association; 91% were current members and 4% were past members, shown in Table 1. Watchic Lake Association Survey (2015), had more non lake association members complete their survey with only 75% of respondents being current members. This response rate could show a correlation between Little Birch Lake Improvement Association membership and a strong interest in the overall well-being of the lake. Little Birch Lake Improvement Association works to improve water quality and the area around the lake, which is also beneficial for the birds and animals. The survey results show that the property owners who took the survey rated the water quality of Little Birch Lake as a very important (86%) or important (13%) factor in living at the lake, shown in Table 2. No one who completed the survey responded with less than an 'important' response for the water quality of Little Birch Lake.

Background Demographics

Demographics (age, gender, yearly income, length of ownership, etc.) were asked to better understand who completed the survey. It is important to understand if demographics play a role in how property owners envision water quality and their understanding of how the landscape around the lake affects the water quality. The most consistent variable in the demographic area was the membership in the Little Birch Lake Improvement Association,

with 91% being present members, 4% being past members and 4% being non-members, shown in Table 1.

The demographics (Table 1) of those who completed the survey could be skewed toward older individuals with the survey being sent to the property owner on the tax record/file. Some younger families may use the lake more often than the property owner that is on the county tax statement. Another interesting fact about Little Birch Lake is that there are still families on the lake whose relatives were the first to build cabins in the 1890s, this information was given as a written comment on the survey.

Table 1

Respondents' demographic characteristics, including gender, age, household income, length of property ownership, duration of time spent at Little Birch Lake, Little Birch Lake Improvement Association membership, and returned survey totals.

Gender	Percent	How long has your family owned property on Little Birch Lake?	Percent
Males	66		
Females	30	< 10 Years	19
Age	Percent	11-25 Years	36
< 61 Years Old	47	26-50 Years	32
61-75 Years Old	30	> 50 Years	12
> 75 Years Old	12	How many days a year do you spend on your Little Birch Lake property?	Percent
Household income (per year)	Percent		
< $50,000	20	Cabin - monthly	5
$50,000-$99,999	27	Cabin - weekends	27
$100,000-$249,000	20	Cabin - seasonal	27
> $250,000	5	Permanent resident	39
Little Birch Lake Improvement Association membership	Percent	Completed surveys	Totals
Current member	91	Total surveys mailed	242
Past member	4	Surveys returned	113 (47%)
Non-member	4	Wrong address	14 (6%)

Table 1 gives information on who completed the survey. These results were used to examine relationships with how property owners answered other questions throughout the survey about water quality or best management practices (BMPs). The median for respondents' age was 60 years old, with a few people not willing to disclose their age on the survey. The Cannon River Watershed in Minnesota survey by Davenport, Pradhananga, and Olson (2014) shows approximately the same median age (61 years old) among its respondents. Wright, Caserta, and Lund (2003) survey had an average age of 70 for the respondents. Davenport et al. (2014) had 79% male respondents, while the Little Birch Lake survey only had 66% male respondents. This could have been affected by the ownership of the property or the name recorded for the property or by whom opened the mailed survey. It is interesting though that the survey by Davenport et al. (2014) had a lower percentage of respondents (38%) than the Little Birch Lake survey did as they surveyed the entire watershed, mailing a total of 1,082 surveys. Davenport et al. (2014) 73% of their survey respondents had an annual household income earning less than $100,000, while the Little Birch Lake Survey had 47% respondents in that range. It would be interesting to reevaluate these population demographics in the future to see if as property ownership changes over time the answers to the survey questions also change.

Lake Use

It was also important to understand why the property owners spend time at Little Birch Lake and how they use the lake. Over the years as more people have built cabins/homes on the lake the use and reasons for being there may have changed. However, the owners who responded to the survey seem to have a passion for being on the water as expressed by the

results given in Figure 1, which demonstrates how respondents use Little Birch Lake. The respondents could choose multiple answers for this question, answering 'Yes' if they participated in any of the stated activities. Most all property owners use Little Birch Lake for boating, fishing, swimming, and just enjoying the water and land around the lake. The property owners could also answer that they used the lake for other reasons than the stated ones.

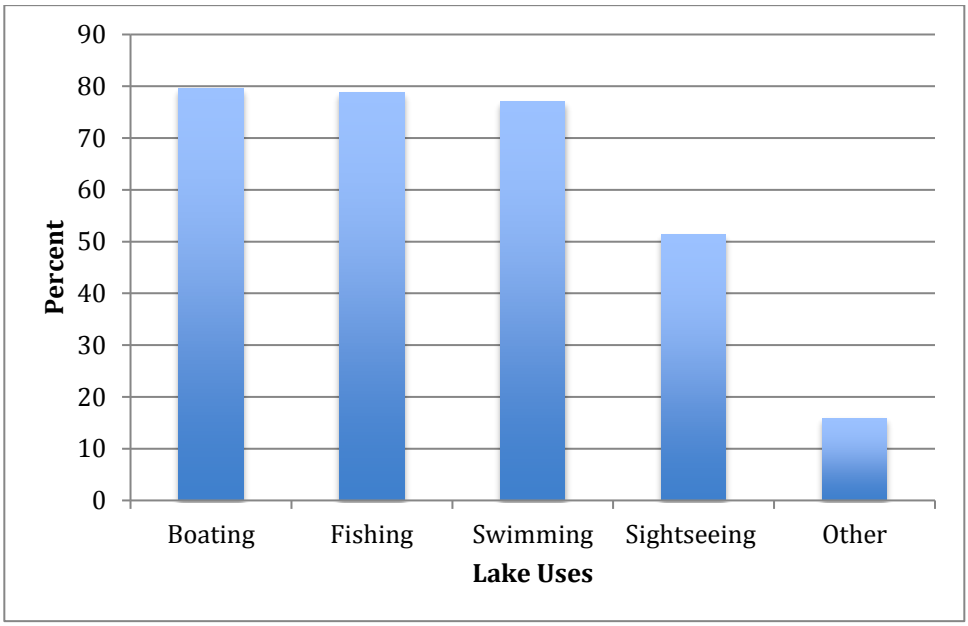

Figure 1. Respondents' primary recreational uses of Little Birch Lake for boating, fishing, swimming, sightseeing, or other uses (in percent). The respondents were able to choose all uses that pertained to them.

Most of the respondents did choose multiple lake uses. What a property owner uses the lake for could affect their responses to other questions in this survey. Someone that wants to swim in the lake may want better water quality than someone sightseeing from his or her property. Although there was no statistical significance found in the data analysis to substantiate this thought. Rice Lake, in central Minnesota, asked a similar question in which

they found a diversity of uses for their shoreline and lake, including beach activities (52%), fishing (63%), swimming (49%), socializing (60%), and water activities (56%) providing their primary recreational uses (Rice Lake Association, 2011). This shows common recreational uses in other central Minnesota lakes.

Water Quality

The respondents of this survey felt water quality was important to them with 86% responding that water quality was ‘very important’, and 13% reported that it was ‘important’, as shown in Table 2. No one that completed the survey responded with less than an ‘important’ response. Davenport et al. (2014) found that 94% of respondents, in the Cannon River Watershed, have a high level of concern about water pollution affecting future generations, including both the aquatic and wildlife in the area. These respondents concerned about water pollution in Minnesota expressed a great need to improve protection of these resources, but seemingly without much knowledge as to how to go about it (Davenport et al. 2014).

Table 2

The importance of the water quality of Little Birch Lake to the respondents.

Importance level	Percent
Very important	86
Important	13
Somewhat or not important	0

Both the Little Birch Lake and Cannon River Watershed surveys showed that property owners put a high level of importance for improved water quality. This is a great starting point for implementing BMPs and restoration work. If a property owner does not care about water quality, there may be a lower probability that they will take their time or money to protect the water resources with BMPs.

Most of the respondents of this survey believe that the water quality of Little Birch Lake has stayed the same (41%), or decreased (45%), while only 12% believe the water quality has improved over the years. According to the Minnesota Pollution Control Agency (MPCA) water quality information, Little Birch Lake has shown an increase in median transparency from 1975-2016, increasing by 0.58 ft. per decade (MPCA, 2017). This response can be greatly affected by how long the respondent has lived on the lake, the duration of ownership could affect short term perceived changes in water quality. Someone who has been on the lake for longer than 50 years has had more time to notice changes than someone who has only been on the lake for 5 or less years.

Property Owner Water Quality Concerns

There was one open-ended question in this survey that property owners were able to voice their concerns about what they felt contributed to water quality issues in Little Birch Lake, most common responses shown in Table 3. Those answers were then grouped into common responses; the most common responses to this question are reviewed below, all written answers are given in Appendix C.

Table 3

What the respondents thought is affecting the water quality of Little Birch Lake, respondents were able write in their answers, answers were grouped into comparable categories.

Water quality concerns	Percent
Runoff	34
Fertilizer	27
Farms/agriculture	21
Septic systems	18
Eurasian watermilfoil/invasive species/non natives	18
Mowing/lawns	14

Of the people who responded, 34% thought runoff was affecting the water quality of Little Birch Lake. The respondents thought runoff could be from multiple sources, including land adjacent to Little Birch Lake and/or land upstream. Runoff has been shown to negatively affect downstream water quality. Runoff encompasses some of the other answers from the respondents including, upstream farmland, fertilizers, and mowing lawns, which if these are not managed properly increase the nutrients entering the lake with runoff.

Aquatic invasive species (AIS), especially Eurasian watermilfoil (*Myriophyllum spicatum*), are one of the concerns for many residents, with 18% of the respondents believing that the Eurasian watermilfoil in Little Birch Lake has been affecting the water quality. Eurasian watermilfoil has been shown to alter pH, oxygen levels and cause temperature changes under dense mats of milfoil (State of Washington, Department of Ecology, 2017). Although there is no indication that the Eurasian watermilfoil in Little Birch Lake is affecting these parameters, further research would need to be conducted to confirm if this is occurring in Little Birch Lake.

Upstream farmland was also a concern, with 21% of the respondents believing the upstream farmland was contributing negatively to the water quality of Little Birch Lake. There is some recognition by respondents that runoff around the lake can affect the water quality of Little Birch Lake. Agricultural runoff has been shown to include pollution and nutrients. This runoff will negatively affect the water quality of the lake. Members of the Little Birch Lake Improvement Association that attend yearly meetings and are present during the Sauk River Watershed reports do hear about the changes in nutrients (Phosphorus (P), Nitrogen (N), *Escherichia coli (E. coli)*, etc.) that come from streams affected by agricultural runoff.

Other notable answers to respondent's water quality concerns included fertilizer (27%), leaky septic systems (18%), and mowing lawns up to the lake (14%). A survey of the Upper Muskegon River Watershed found that property owners believed the greatest threats to water impairments were, in order from most severe to not a problem: aquatic invasive species, algae, fish habitat alteration, *E. coli*, trash, water temperature, sediment in water and cloudiness of water (Upper Muskegon River Watershed Survey Results, 2013). This shows some relationship to the respondent's water quality concerns for both the Little Birch Lake Survey and the Upper Muskegon River Watershed Survey, although it also shows a need for better education effort for both survey respondents and others. Many of the issues are interconnected, for example, the effects from sediment entering a lake causes excess nutrients, which then creates excess algae blooms.

Responsibility of Water Quality Improvement

The results in Table 4 show that it is a cooperative effort to improve the water quality of Little Birch Lake. The respondents were able to answer this question with everyone that they think is responsible to help maintain and improve the water quality. Demonstrating that clean, clear water is a collaborative effort between property owners and visitors, individuals and agencies, everyone is able to help to conserve this important natural resource.

Table 4

The respondents think water quality improvement is the responsibility of many, shown in percent, respondents were able to choose one or more responsible parties.

Responsibility of Water Quality Improvement	Yes	No
Lakeshore owners	89	10
Government agencies	81	17
Residents upstream	71	27
Lake visitors	53	45
Water quality is fine the way it is	53	45

The survey respondents say lakeshore owners, residents upstream, lake visitors, and government agencies are all important and accountable for water quality as well as improvements. The results show that most of the respondents (89%) take some ownership in protecting the water quality around Little Birch Lake. Although most respondents think that water quality protection is a combined effort mostly between local residents and government agencies. Fifty-three percent of the respondents think that Little Birch Lakes water quality needs no improvement, this could affect BMP implementation, if the respondents do not think the water quality needs to be improved, then they may not take time or money to implement BMPs. Davenport et al. (2014) found that 97% of their respondents took ownership for how

their land impacted water quality. Davenport et al. (2014) also found that others in the watershed were responsible for protecting water quality, including 96% community, 95% lakeshore/streamside property owners, and 92% for upstream property owners. Both the Little Birch Lake and Cannon River Watershed survey respondents showed that there needs to be a collaborative effort from property owners around a lake and in the upper watersheds to protect water resources.

Table 5 shows how property owners feel the local environmental agencies, such as the Sauk River Watershed District, Todd and Stearns Soil and Water Conservation Districts, and Minnesota Pollution Control Agency, should play a role in the water quality of Little Birch Lake.

Table 5

How property owners feel about local environmental agencies (Sauk River Watershed District, Todd & Stearns Soil and Water Conservation Districts, and the Minnesota Pollution Control Agency).

Local Environmental Agencies	Percent
They are helping	46
Don't have an opinion	29
The have too much control	19

Understanding the level of control helps us to understand whom a property owner might be willing to work with to help install BMPs. Less than 50% of the respondents think local agencies are helping the water quality of Little Birch Lake. This shows a need for local agencies to work better with property owners to show them what they are doing to help protect water quality. The major function of these local agencies is to protect the environment, including water quality and education. Upper Muskegon River Watershed Survey Results

(2013) found that 85% of their respondents trusted local governments as a resource for water information. Although this is a slightly different question, the Little Birch Lake survey was discussing if local government was helping with water quality and Upper Muskegon River Watershed was asking more if they trusted the local government as an educational source. Although, if a property owner does not trust the government unit, they also might think they have too much control of what they are allowed to do on their own property.

Current Water Quality and Health of Little Birch Lake Shoreline

How the property owner feels about the current water quality, the health of their shoreline and overall health of the Little Birch Lake shoreline is shown in Figure 2. This helps us better understand how respondents feel about the need for changes to improve the water quality of Little Birch Lake. Of the respondents, 80% think the water quality of Little Birch Lake is good to excellent. When asked about their own shoreline, 69% think their shoreline is good to excellent, while only 58% think the overall Little Birch Lake shorelines are good to excellent (Figure 2). Answers rating in the poor to fair categories were under 35% for the overall health of the Little Birch Lake shoreline and under 25% for the overall water quality and the health of the respondents own shorelines. However, with that many respondents giving low ratings shows a need for improvement and understanding through education, even if the property owner thinks that their shoreline is not changing the water quality of Little Birch Lake.

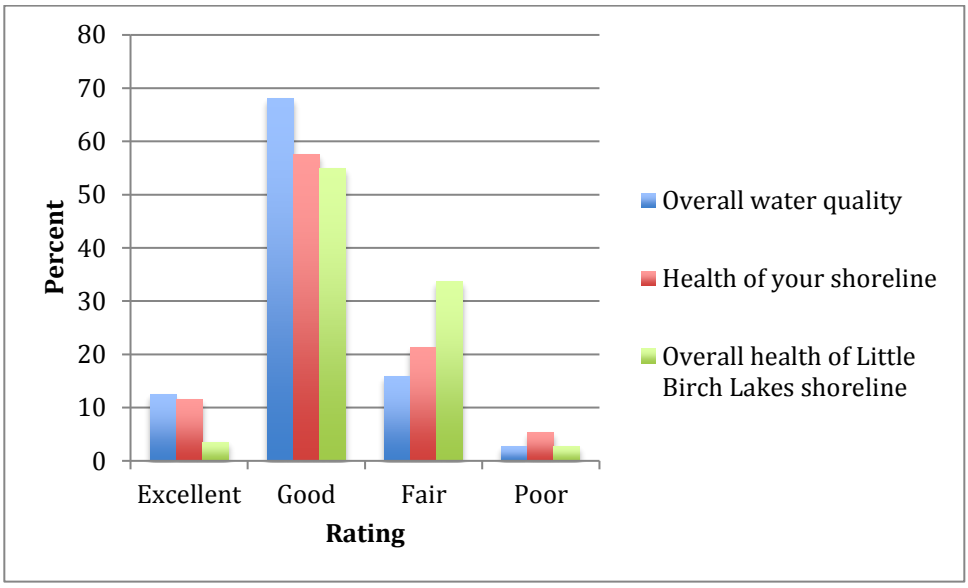

Figure 2. How property owners feel about water quality of Little Birch Lake, the health of their shoreline and overall health of Little Birch Lake shorelines.

Figure 2 shows that property owners felt good about the overall water quality of Little Birch Lake at the time of the survey, which is practically significant with 80% respondents thinking the overall water quality is good to excellent. They also feel that their shoreline is a little healthier than the overall health of the shoreline around Little Birch Lake. Property owners feel like they are doing better at protecting the water quality of Little Birch Lake than their neighbors.

BMPs/Habitat

Property owners answered a question about what their shoreline consisted of at the present time. Respondents were able to select multiple answers as many property shorelines on Little Birch Lake are not uniform, but can consist of different types of shoreline habitats. Table 6, shows the current shoreline habitats of the respondents.

Table 6

Type of current shoreline habitat for each respondent, with each respondent being able to choose all habitats that apply to their property, as most shorelines are not uniform (because of this percentages add up to more than 100%).

Shoreline type	Percent
Riprap	50
Native perennials	46
Trees & shrubs	34
Sand beach	31
Turf grass	28
No-mow	4
Landscaped	4

Knowing the current shoreline gives us a baseline of what is out there and what potentially needs to be focused on for adding BMPs. Areas of heavy riprap or turf grass could be a focus for restoration efforts, changing these two areas of lakeshore to native grass, would help in restoring altered shoreline habitat to more native, which will in turn help in filtering runoff entering Little Birch Lake. Little Birch Lakes native shoreline consists of native perennial plants, trees and shrubs. In restoration efforts, one tries to get the habitat back to as much as pre-settlement, before human interaction, as possible. One of the first areas to focus on in BMP implementation could be replacing the current turf grass, which has very little root structure, with native grasses. Turf grass may be suitable in some areas around the lakeshore, but having long rooted native plants around the lakeshore edge will help with erosion issues and water retention.

Of the respondents, 61% have already completed some type of BMPs on their property, with 44% of those property owners using more than one BMP. These could be any type of BMP that would help protect the shoreline and improve water quality by

treating/preventing runoff around the lake. These projects vary from: native shoreline plants (33%); shoreline buffers (31%); low or no fertilizer applied to lawns (53%); to installing a rain barrel (4%); or rain garden (2%), Figure 3. Some of these BMPs take time and money to implement, others, like a no-mow zone is a cheap way to protect the shoreline around the lake, decreasing or not applying fertilizer to lakeshore lawns protect the lake by potentially decreasing the nutrients entering the lake with runoff.

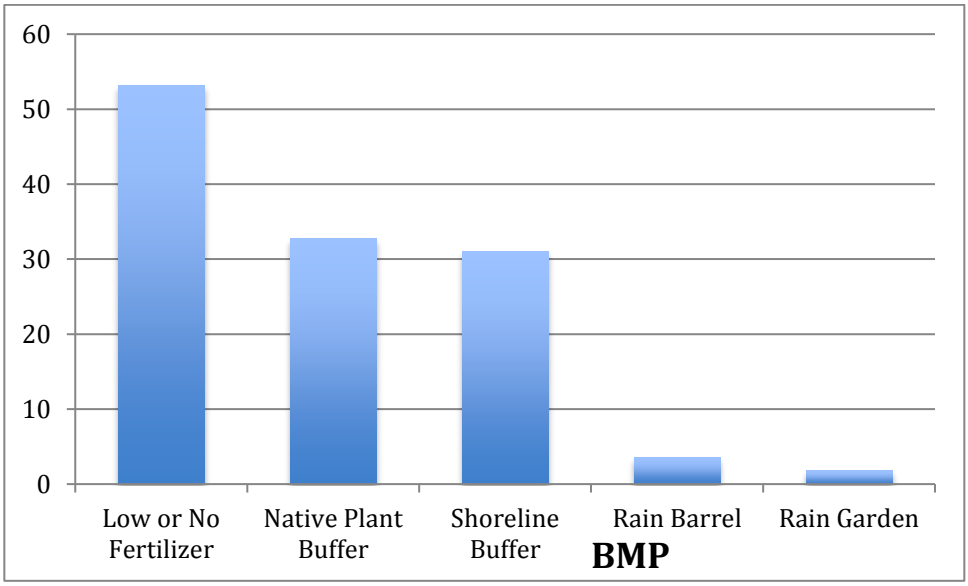

Figure 3. The types of BMPs (low or no fertilizer zones, native shoreline plants, shoreline buffers, rain barrels, or rain gardens) that the respondents have already implemented on their property.

Although most of the practices being used are the least expensive BMPs, like not using fertilizer or having a native plant buffer, over 60% of respondents are doing something to protect Little Birch Lake with BMPs. This is a great start to additional BMP implementation on the shorelines around Little Birch Lake, with the goal being protecting and preserving the water quality of the lake. Broussard Allred, Kurth, Klocker, & Chatrychan

(2011) found that 46% of property owners were currently leaving a native grass buffer next to the water's edge on their properties and of those not currently implementing this practice, 77% were willing to try it.

Of the people that responded, 22% would be interested in completing a BMP project on their property. Another 27% said they would not be interested in installing a BMP on their property, while some of these respondents may not want to install a BMP because they have already completed a project in the past. With 42% of the respondents needing more information, this shows a need for local government agencies (i.e., the watersheds, county agencies, etc.) and the lake associations to educate landowners to help them better understand how BMPs can improve their shoreline and the water quality of Little Birch Lake. Rice Lake Association (2011) found that 75% of respondents would be willing to improve their shoreline to protect water quality. This is a difference from what the respondents stated for the Little Birch Lake Survey. However, 61% of Little Birch Lake respondents have already installed at least one BMP, and 64% of property owners would either be interested or need more information before installing a BMP or additional BMPs. So, there is good chance that with the right educational effort, a majority of property owners in this group would still implement a BMP.

Figure 4 shows the results from questions about native shoreline and aquatic plants. Some of the respondents did not find a native shoreline or aquatic plants very visually appealing, 30% and 24%, respectively. Although, the respondents did see the link between native plants impact on water quality and improved habitat.

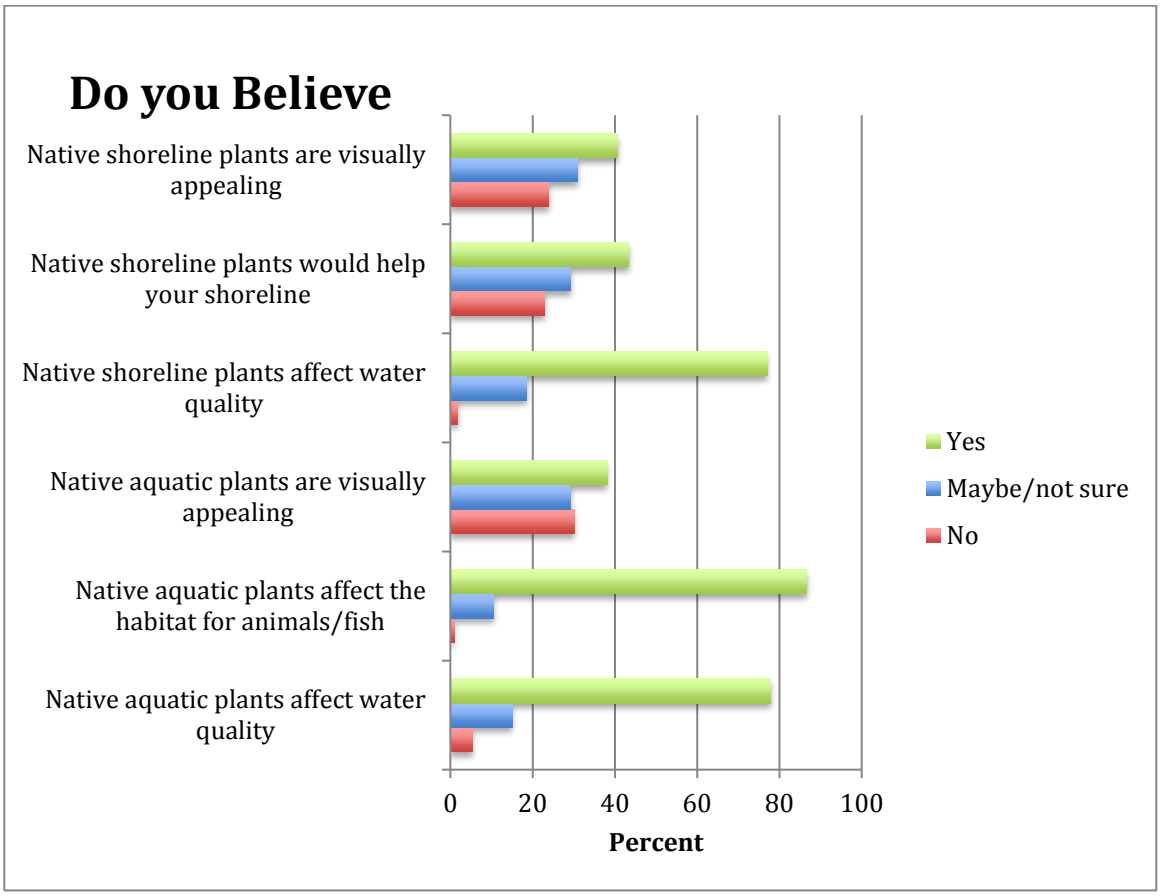

Figure 4. What do the property owners believe about native shoreline and aquatic plants; do they help water quality, are they visually appealing, do they affect habitat around Little Birch Lake.

These questions give us a better understanding of how the property owners feel about native plants on their shoreline. Over 75% of property owners understand the benefit of native aquatic and shoreline plants, showing practical significance for these two questions. While it is good that property owners understand the benefits of aquatic plants, there again shows a need for better education about native shoreline plants to convince some property owners about the importance of installing BMPs.

The respondents showed that they believe that over fertilizing lawns around Little Birch Lake can negatively affect the water quality, shown in Figure 5. This could be in part contributed to the Little Birch Lake Improvement Association and the Sauk River Watershed explaining at the annual meetings the importance of no mow zones and no to low fertilizer usage at the water's edge. Most respondents also believe that native plants help protect the shoreline more than non-natives or turf grass (60% and 10%, respectively). Reducing runoff is also seen as a way to protect the water quality, by most of the respondents.

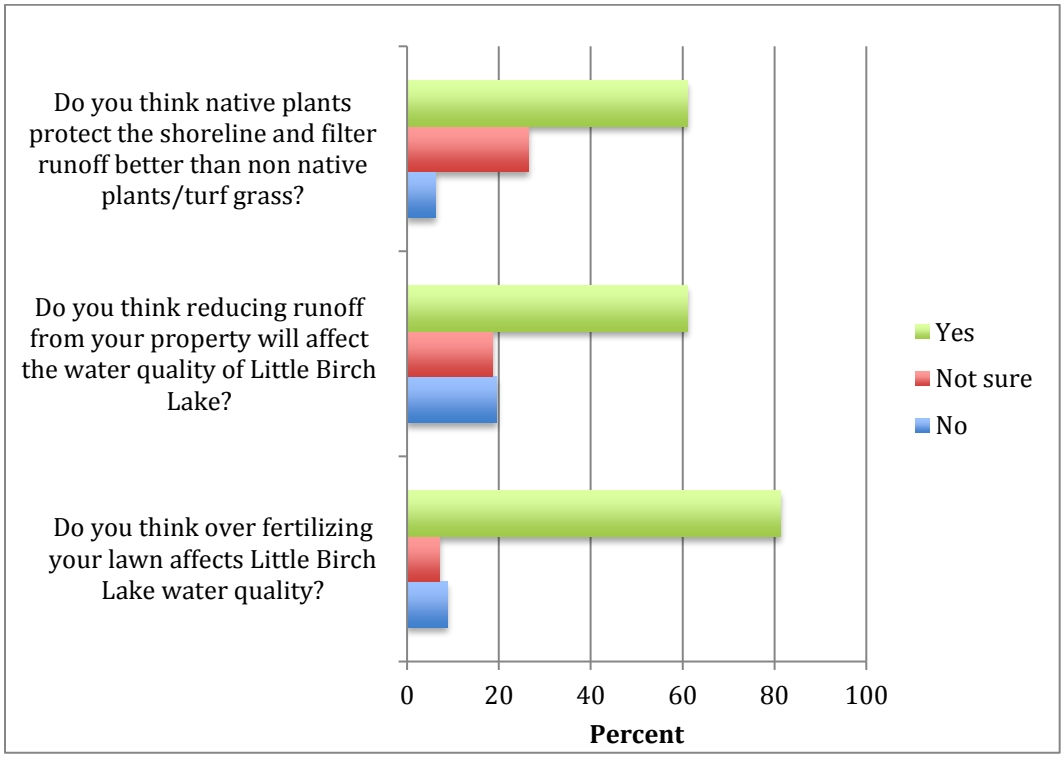

Figure 5. How the survey respondents see native plants (by helping filter runoff better than non-native plants and turf grass) and fertilizers (not using fertilizer near the water's edge) impacting water quality in Little Birch Lake.

There is a need for better education about the effects of runoff from land around Little Birch Lake and what type of shoreline buffer will protect the water quality of Little Birch Lake. Only 60% of property owners think that native plants are better than turf grass (10%) for protecting and improving water quality, but 25% of respondents are not sure what protects the shoreline better. Also, 60% of property owners think that runoff from their property affects water quality; although if a property owner has already implemented BMPs they could think that their runoff is not a problem. This 60% could be improved through more education of property owners, they need to understand that the way to protect water quality is from reducing runoff and filtering that runoff before it can enter Little Birch Lake. The best protection for the water would be that all runoff is filtered before entering the lake. Of property owners, 80% think that fertilizing their lawns have an impact on the Little Birch Lake water quality, which shows practical significance from the respondents this shows that some educational efforts are working. The landowners seem to understand that fertilizer can affect the water quality of Little Birch Lake. If fertilizer is properly applied, it should not runoff into the lake, but if any of the fertilizer runs into the lake, it will negatively affect the water quality of Little Birch Lake. Wisconsin Department of Natural Resources and University of Wisconsin Extension (2010) found that between 30-40% of property owners did not see issues with runoff. This shows that the respondents do not understand what runoff is, because they did see problems with the harmful things that runoff brings into a water body including, sediment (85%), fertilizer (94%), and herbicides (94%). Seventy percent thought runoff can affect/change the water temperature (Wisconsin Department of Natural Resources and University of Wisconsin Extension, 2010). This shows a need for better education about

the effects of runoff or maybe even just a better explanation of runoff, to the respondents and others. They understand that the impact of runoff can harm water quality, but perhaps they do not fully understand the definition of runoff. Runoff is the reason that the sediment, fertilizers, and herbicides are getting into the lake.

Education

Of the property owners responding, 54% had previously researched BMPs, 46% have not looked for information. Of those that had researched most of them received their education from the Little Birch Lake Improvement Association (Figure 6).

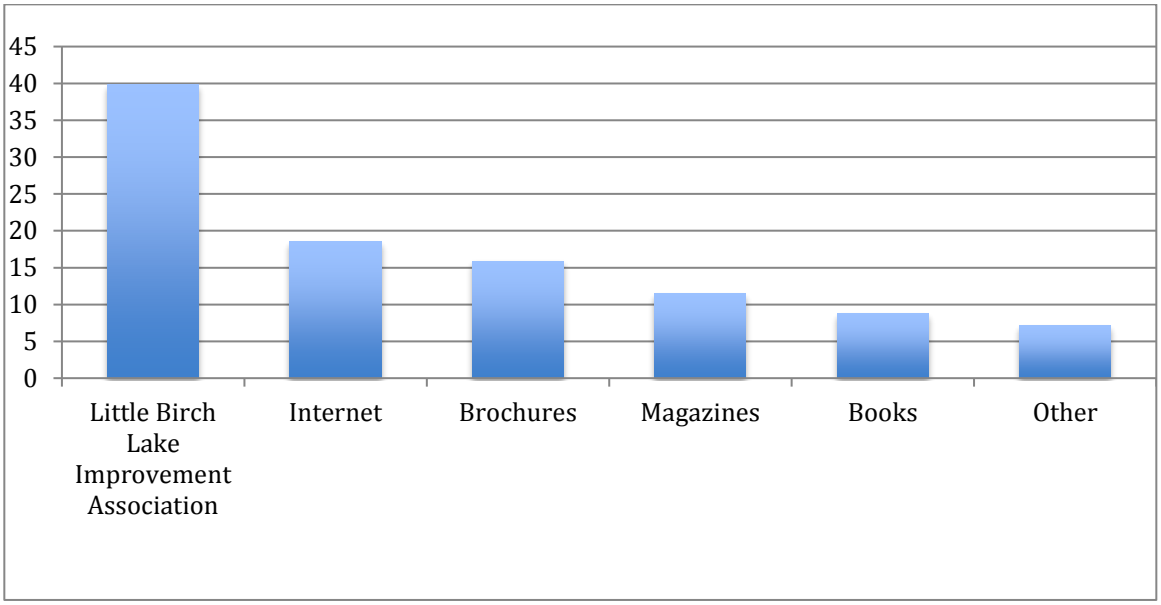

Figure 6. Where respondents have already researched BMPs information (shown in percent).

Figure 6 shows a need to educate property owners through the Little Birch Lake Improvement Association, with that being a common BMP educational source of information for nearly 40% of respondents. By better education through the Little Birch Lake Improvement Association, there is a better chance of implementing more BMPs around Little

Birch Lake. Upper Muskegon River Watershed Survey Results (2013) respondents would look for water quality information on the internet. Although, Flynn (1999) found that property owners were interested in education packets, 58% wanted something written, 29% wanted videos, 30% wanted field days, and 37% wanted a combination of these three types. Although this is an older survey, it shows respondents want different types of educational material. In the Little Birch Lake survey, 36% found information from written brochures, books, and magazines, 19% from the internet, and 7% from other sources. The Little Birch Lake, the Upper Muskegon River Watershed (2013) surveys and data from Flynn (1999) all show that there needs to be diverse types of educational materials available for property owners to be able to educate as many property owners as possible.

Relationships

Crosstabs were run to get chi-squares results, to look for relationships between survey questions. The chi-squares test was used to find relationships between the answers to the survey questions compared to what results were expected. A chi-squares test is commonly used in statistics to analyze the comparison between observed data, with expected data to validate a specific hypothesis (Fisher & Yates, 1974). With the help of the SCSU Statistical Consulting Center age groups were set for chi-square analysis, with the youngest respondent being 36 and the oldest being 84. These results can give a better understanding of the respondents' answers to a question depending on another variable or demographic. These results may help local governments, focus educational efforts about water quality and BMPs.

There is a relationship, shown in Figure 7, between a responders age and how the water quality has changed since they have owned their property ($p = 0.045$ by chi-square).

The younger the responder the more likely they think the water quality has decreased since they have owned property. The older the responder the more likely they were to answer that the water quality has improved or did not change than the water quality has declined.

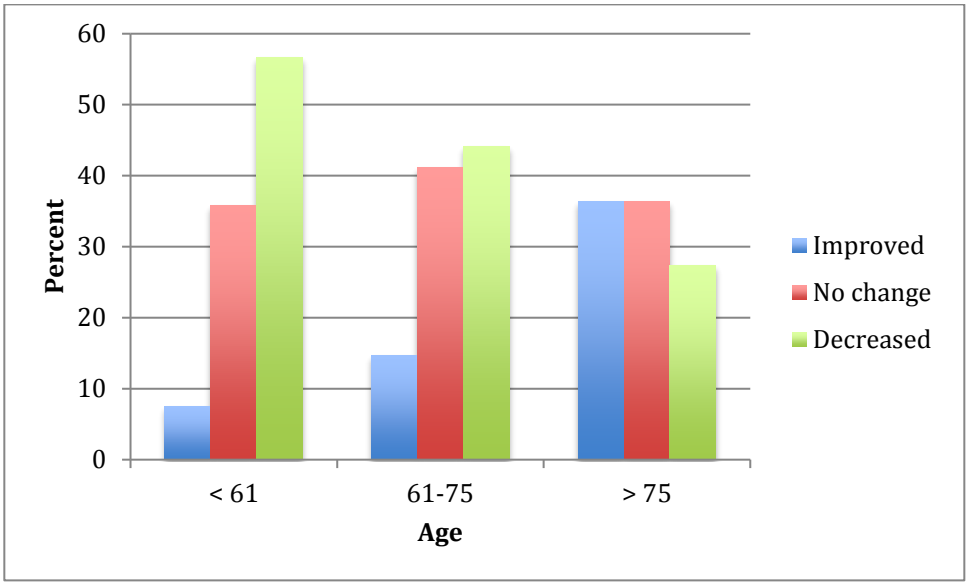

Figure 7. What was the perceived water quality change of Little Birch Lake vs. the respondent's age. The younger the age, the more they responded that the water quality had decreased or remained the same since they have owned property on Little Birch Lake.

According to the MPCA (2017), data shows the water quality of Little Birch Lake has actually increased by 0.58 ft. per decade over the last 41 years. There might need to be more research to find out what is the difference in age vs. actual change in water quality. It may be necessary to examine the recent changes in water quality further. Yearly variations could change how someone feels about water quality. Their answers also may have been skewed by how water quality was the year of the survey, which may have influenced or changed someone's overall opinion of water quality.

Figure 8 shows a relationship between a respondent's age and how they think runoff affects the water quality of Little Birch Lake ($p = 0.011$ by chi-square). Although most respondents think that runoff negatively affects the water quality of Little Birch Lake. The responders over the age of 75 (33%) think that runoff has a positive effect on the water quality, while at the same time 50% in this age group feel it negatively affected water quality. In the other two age groups combined only 10% think runoff affects water quality positively. In both age groups < 75 years old a little over 80% answered that runoff has a negative impact on water quality while in those over 75 years old only 50% believe that runoff has a negative impact.

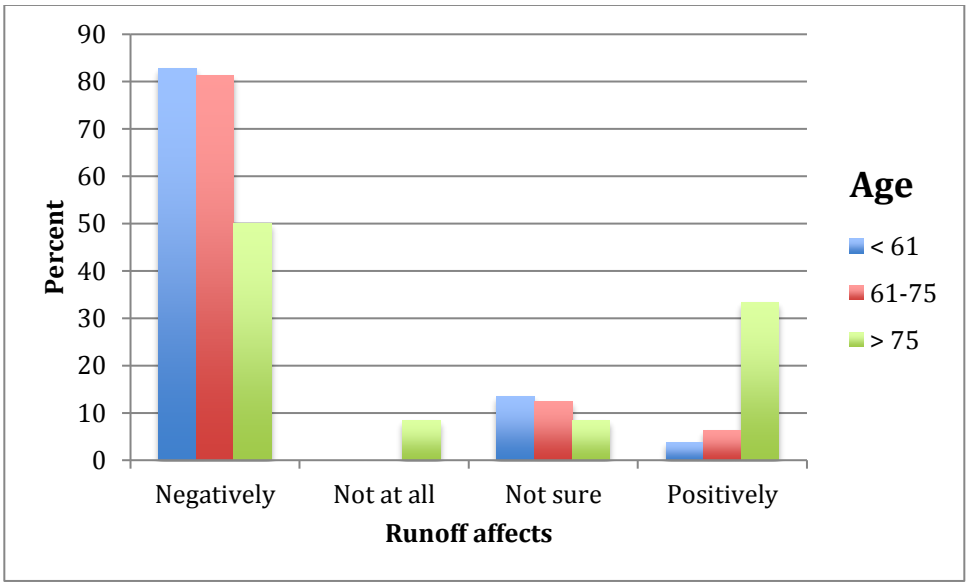

Figure 8. How property owners age affects how they think the runoff into the lake affects the water quality. They were asked if runoff negatively or positively affected water quality, but with an option to say runoff had no effect on water quality or they just were not sure.

Figure 8 shows a need to better educate property owners on what the definition of runoff is and especially in the older than 75 age group what the effects of runoff are on the

water quality of Little Birch Lake. Wright et al. (2003) found that a majority of older adults believe that environmental issues are not worth the economic tradeoff. A respondent's age could affect how they respond to environmental issues, including runoff affecting water quality. Wright et al. (2003) also found that there were mixed results about the respondents' knowledge of environmental issues, with 34% not understanding and 16% not sure. This shows a large portion of the population not understanding environmental issues, and the need for better education of all ages.

Evaluating the time spent at the lake, if the lakeshore owners were less than 61 years old they were more likely to spend weekends at the lake compared to all respondents over 61 year olds, where they are more seasonal or permanent residents, shown in Figure 9.

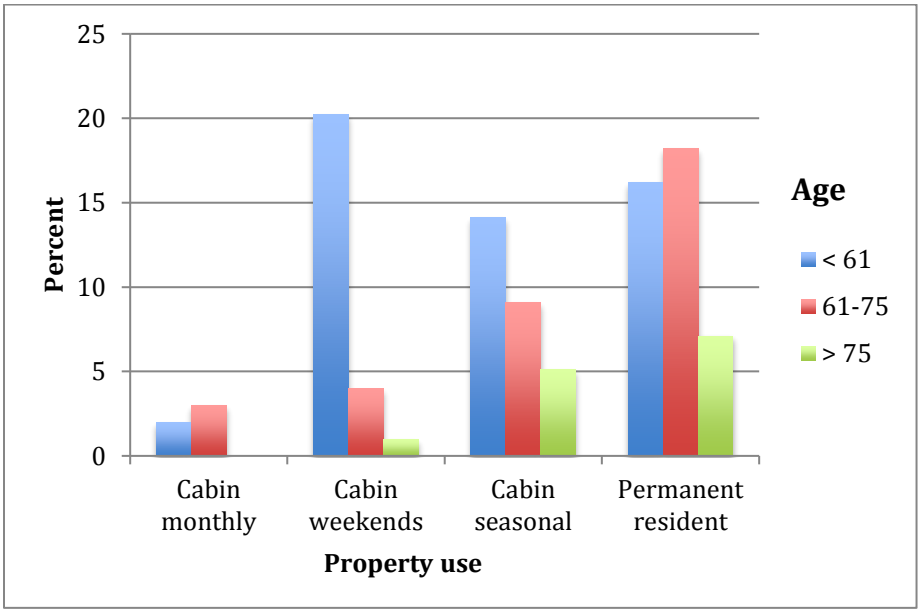

Figure 9. Time the respondent spends at Little Birch Lake as once a month, weekends, seasonally or permanent resident, in relationship to the age of the respondent.

This could be affected by work age, and retired residents spending more time at the lake than working in different areas other than their lake home. This also shows us that the property owners who completed the survey spend a lot of time at Little Birch Lake, with most of them spending at least weekends at the Little Birch Lake. Little Birch Lake has many full time residents with over 40% of respondents calling Little Birch Lake their home.

The more the time spent per year at Little Birch Lake, the more they think the water quality has either stayed the same or decreased (Figure 10), this relationship is confirmed by chi-square ($p = 0.033$).

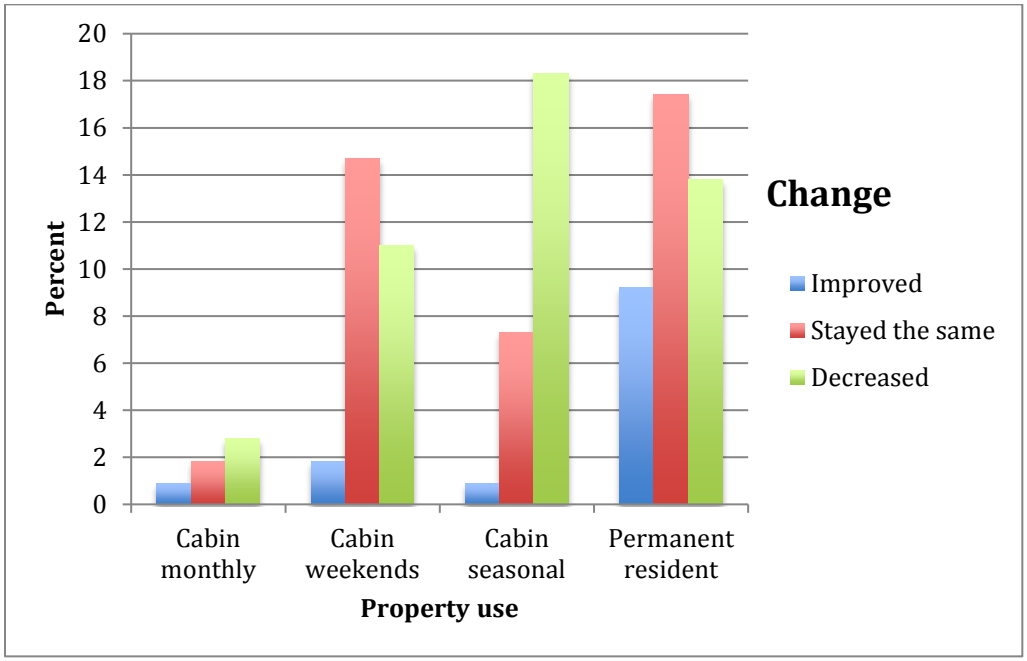

Figure 10. Time the respondent spends at Little Birch Lake (once a month, weekends, seasonally or permanent resident) compared to the observed changes in water quality.

Figure 10 shows permanent residents have a varied response in what was changing or remaining the same with water quality. This is interesting, it is likely that property owners that spend more time at Little Birch Lake see a variation because of where their property is located

on the lake. If the property owner lives near a stream that has agricultural runoff coming into it, their view of water quality may be very different from someone who lives in the middle of the lake without any streams running in near their property. The seasonal property owners see more of a decrease in water quality. Monthly residents could also be skewed, one-way or the other, to what time of the year they spend at the lake, with water clarity changing over the summer. There has been an increase in water quality in Little Birch Lake over the last 41 years (MPCA, 2017).

Figure 11 shows a relationship between the property owner's length of ownership and their feelings about the effect of runoff on water quality ($p = 0.019$ by chi-square). Property ownership on Little Birch Lake from 1-75 years thinking that runoff negatively affects water quality. With property ownership over 75 years not understanding the effects of runoff.

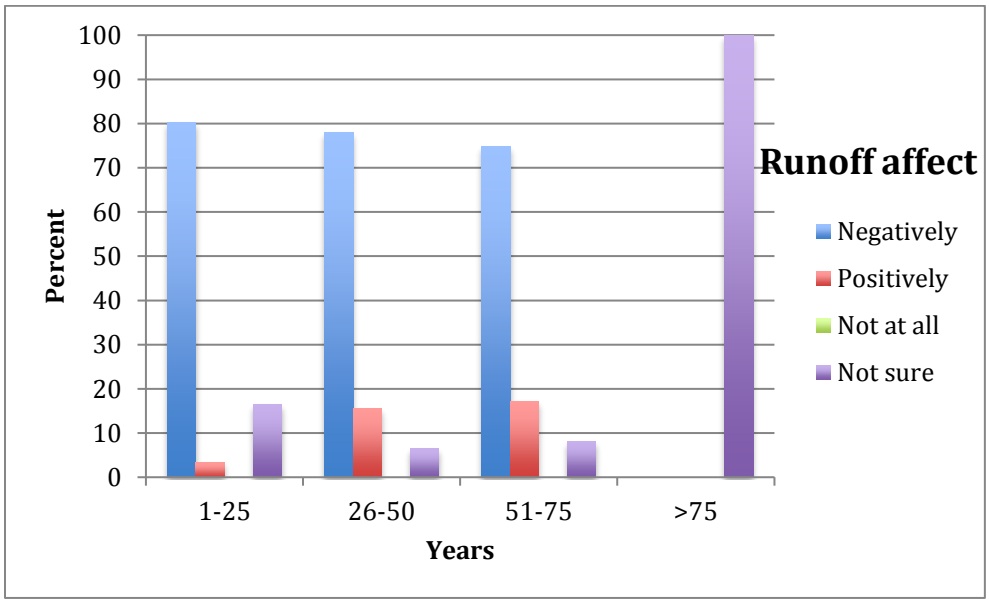

Figure 11. How does the respondents' duration of ownership impact how they think runoff affects Little Birch Lake water quality. Each ownership timeframe was compared to itself, resulting in 100 % for each timeframe.

Most of the respondents understand that runoff has a negative effect on Little Birch Lake. The property owners in the middle time frames also are more likely to think that runoff positively affects the water quality of Little Birch Lake. This indicates a need for education and a definition of what runoff is and how it affects water quality. No one in any of the groups answered that runoff had no impact on Little Birch Lake at all.

Figure 12 shows a relationship to Little Birch Lake Improvement Association membership and what type of BMPs they feel will help improve the water quality of Little Birch Lake ($p = 0.003$ by chi-square). Almost 60% of Little Birch Lake Improvement Association members feel that all types of BMPs will improve water quality of Little Birch Lake.

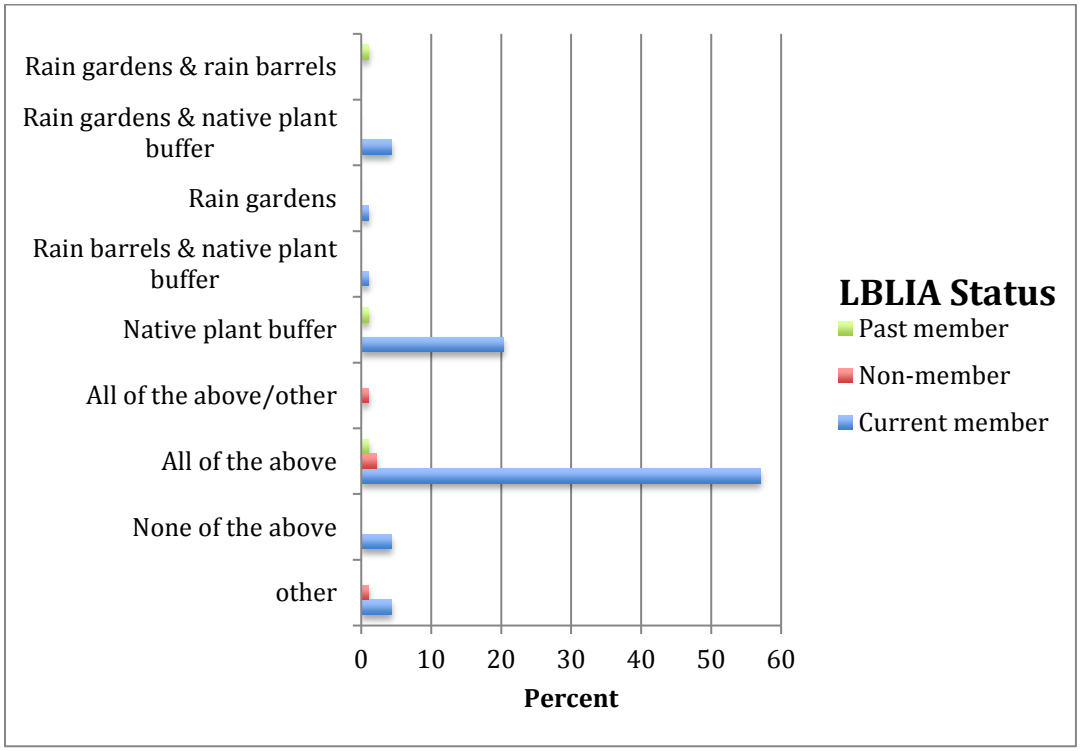

Figure 12. Types of BMPs that could improve water quality vs. Little Birch Lake Improvement Association member status.

This shows the benefit of having lakeshore property owners' belong to and attend their lake association meetings. Most of the current property owners have a good understanding of the different types of BMPs that can increase water quality. This could be affected by the high percentage of property owners that responded were lake association members (91% present members and 4% past members) vs. non-members (4%).

Summary

The survey gave a good picture to whom the property owners around Little Birch Lake are, their perception of water quality, and if they have or would implement BMPs. The majority of the responders were members of the Little Birch Lake Improvement Association and they also hold water quality in high importance. The survey results will better help in suggesting educational efforts for the property owners about water quality, BMPs and especially the effects of runoff. The findings can also be used to focus educational efforts and money to certain groups of property owners, including both members and especially non-members of the Little Birch Lake Improvement Association. The survey data shows that some educational efforts are working with most of the respondents understanding the effects of fertilizer on water quality but the respondents still need to be better educated about the effects of runoff on water quality. After completion of this project, other researchers could expand the survey for additional lakeshore participants for better data or continued analysis. The results can be used for more cost effective education efforts to get BMPs implemented to protect the water quality of Little Birch Lake.

Chapter V: Conclusions

Most Little Birch Lake property owners who completed and returned the survey are presently members of the Little Birch Lake Improvement Association, an organization "dedicated to water quality", Little Birch Lake Improvement Association, (2017), which shows they are concerned or have an interest in Little Birch Lake. It would be interesting to know if other lake property owners throughout the state of Minnesota are also members of their lake associations and are interested in the water quality of their lakes.

Many of the Little Birch Lake property owners get their education/information about water quality through the Little Birch Lake Improvement Association, although not all of them could answer the water quality or best management practice (BMP) questions correctly. This shows a need to better educate the leaders of Little Birch Lake Improvement Association to help provide members better information of water quality issues. There was no way to tell which members of the Little Birch Lake Improvement Association completed the surveys; if they were active members of Little Birch Lake Improvement Association, or if they just pay yearly dues but do not attend meetings. There is also no way to tell if non-Little Birch Lake Improvement Association members did not care about completing the survey, or if they did not care about water quality and if that is why they did not take time to fill out the survey. By being a member of the Little Birch Lake Improvement Association, the property owners are already showing a willingness to understand and respect the lake for their needs and the continuation of the quality of Little Birch Lake for future generations.

Answers to Research Questions

1. Do lakeshore property owners understand how to protect the water quality of Little Birch Lake?
    - Yes, but the respondents still need to better understand what runoff is and its effects on water quality of Little Birch Lake.
2. Is there a relationship between lakeshore property owners understanding of water quality and BMP implementation?
    - Yes, because of 61% of respondents have already implemented BMPs, which help protect and improve the water quality of Little Birch Lake.
3. How does lakeshore property owner's conviction of water quality affect their land use practices?
    - They hold water quality in great importance, although not all understand how they personally impact the water quality of Little Birch Lake.
4. Does previous environmental or lakeshore education affect property owner's willingness to implement BMPs?
    - Yes there is some, with 61% of respondents' having already implemented BMPs, although there was no direct correlation found in the data, supporting BMP implementation from previous educational information.
    - There was also more than a majority, 64%, of respondents' interested or needing more information to implement BMPs on their property.
5. If water quality is a concern to property owners why are they not implementing BMPs?

- Some respondents' are implementing BMPs, especially no or low fertilizer along their lakeshore.
- All respondents thought water quality was important to them.
- Some need more education to understand why BMPs are important.

6. Does a person's demographics affect their understanding of water quality and/or BMP implementation?
    - Yes, they understand the importance of water quality but not all understand how to protect it.
    - Although there were still respondents over 75 year olds that thought runoff was positively affecting the water quality of Little Birch Lake, which shows there is a need to educate all age groups about the importance of implementing BMPs and the effects of runoff.
7. Do lakeshore property owners understand what BMPs are and how they affect water quality?
    - Mostly, there seems to a good understanding about the effects of fertilizer, but reducing runoff and those effects needs to be part of the educational effort going forward.

What was Learned from the Little Birch Lake Survey?

If 99% of the lakeshore property owners thought that water quality was important to them, then there is a need to figure out what will motivate them to implement BMPs or continue to on their lakeshore to further improve water quality. Many property owners have already implemented some kind of BMP. Although there are still some property owners that

responded that they did not understand how BMPs affect water quality, shown by their survey responses. Further research needs to be done to see if it matters where property owners receive their education; the Little Birch Lake Improvement Association, local government, watershed districts, internet searches, or potentially from neighbors installing BMPs. There was not a significant relationship between a landowner doing research or receiving education on BMPs and implementing those BMPs. It is probably not as important to know why someone is willing to implement BMPs and conservation practices to avoid harmful procedures; i.e. fertilizing to the shoreline, allowing runoff of fertilizers into the lake, etc., as long as they are implementing BMPs. Further studies could specifically ask those property owners on Little Birch Lake why they have already implemented BMPs. They may have implemented BMPs to increase the beauty of their lakeshore, because they know it would actually benefit the water quality and habitat around Little Birch Lake or both.

Many survey respondents have completed some type of BMP. These property owners could potentially do more, but future research could ask if these already installed BMPs were done to improve water quality or just because they are visually appealing. Future research also needs to be done to see if the respondents are actually using low to no fertilizers or if they just responded that they were thinking it was the correct answer. It is a practice that is not visual, like a native buffer or rain garden, so it is hard to know for sure if the practice is being utilized. There needs to be a better understanding of the type of shoreline and BMPs used from the property owners that did not fill out the survey. The shorelines could be about the same as of the respondents to the survey, but there is no way to actually know this. This shoreline could also have more turf grass, if the landowner does not have interest in water

quality, they potentially do not have a native shoreline, which would reduce and filter runoff, more than turf grass.

The survey respondents were overwhelmingly members of the Little Birch Lake Improvement Association. Discussing the study at the Little Birch Lake Improvement Association Annual Meeting could have influenced those members present to fill out the survey. This could have skewed the numbers of who filled out the survey, but also could have affected the total number of respondents. Either way it shows that Little Birch Lake Improvement Association members are willing to take their time to complete a survey about the water quality of Little Birch Lake, and the non-members were not or just did not take the time.

The respondents all seemed to care greatly about water quality, but some did not know how to protect the water quality with BMPs. There needs to be a better education program to reach these property owners and teach them about BMPs. The education that had been done at the time of the survey, although some people did install BMPs, was not enough so that all the property owners could answer the questions correctly, showing a need for better educational programs, which should also explain some new techniques.

What is Next for Little Birch Lake?

Interested property owners wanting to implement BMPs need to be directed toward the local watershed districts or counties to learn what they can do to protect Little Birch Lake. This could be done with direct mailings to all property owners, discussion at Little Birch Lake Improvement Association meetings, Little Birch Lake Improvement Association newsletters

or social media sources. These agencies can then work with landowners to implement BMPs on their property, which will help improve and protect the water quality of Little Birch Lake.

Property owners need to be better educated about what affects the water quality of Little Birch Lake. The Little Birch Lake Improvement Association would be a good way to get the word out to the majority of property owners. This could be accomplished through direct mailings, workshops, or individual meetings, or online resources, or a combination of all of four. The Little Birch Lake Improvement Association annual meeting could be a good way to get the message out to property owners, who have shown interest through the survey that water quality is important to them. The survey results will also be available to Little Birch Lake property owners, through the Little Birch Lake Improvement Association.

The lakeshore owners need to better understand how their own property is impacting the water quality of Little Birch Lake, and not always point a finger at someone upstream. Although that is another impact on the water quality of Little Birch Lake, as part of the education efforts, the property owners upstream of the lake should find out how their practices affect the water quality on Little Birch Lake. They may or may not change their ways; this is another reason that property owners on the lake need to implement BMPs on their property because it is something that they can control.

Non-respondents for this study were assumed to have similar ideology and demographics to the property owners that completed the survey. This could be researched more to reach out to the property owners of Little Birch Lake that did not fill out the survey. Discuss with them about their knowledge about water quality and BMPs. This research could better understand if these property owners care as much about the water quality as those that

filled out the survey. The non-respondents could not care about water quality, because they did not take the time to fill out a survey about water quality. The respondents were very heavily affiliated with the Little Birch Lake Improvement Association, we do not know the affiliation of the non-respondents. The Little Birch Lake Improvement Association should reach out to these non-respondents to help them better understand the importance of water quality and BMPs.

Another research project could be to follow-up to educate property owners and implement BMPs around Little Birch Lake. The first step would be to find out what type of education works best for property owners to implement BMPs around the lake: face-to-face interaction, workshops, social media or direct mailings. The next step would be to work with those interested property owners to implement BMPs. This would be a good way to use the Little Birch Lake survey and educational efforts, as a reference lake for other Minnesota lakes. This would be a cost savings in educational efforts, to find the best educational method to get BMPs implemented to many lakes around Minnesota.

With this additional research, the researcher could also research why the non-Little Birch Lake Improvement Association property owners did not complete the survey. There probably are property owners that are not going to implement BMPs whatever information is given to them. It is not right to just keep "preaching to the choir" about the issues, others need to listen to the issues and information about the importance of water quality on Little Birch Lake. There needs to be outreach to get the non-members more involved and educated about water quality issues. Maybe they do care about water quality but just do not show it by becoming members of the Little Birch Lake Improvement Association. There needs to be a

better understanding if the non-responders have property that is not used often or for only a short time at one part of the summer or if they are just not willing to change anything on their property. Maybe their limited use of Little Birch Lake does not give them any reason to think water quality is an issue. This information could be vital to helping to protect the water quality in other lakes throughout Minnesota.

How Surveys Could be Used for Other Minnesota Lakes

Although this or a similar survey should be sent out to other lakeshore property owners throughout Minnesota before any overall conclusions can be made. The survey results can be used to generally understand how property owners think about the water quality on their particular lake and their knowledge about the effects that BMPs will have on improving water quality. More of an effort needs to be made to help lakeshore property owners understand what types of practices they should be doing on their property. They need to understand that by implementing BMPs and avoiding harmful practices, i.e. over fertilizing their shoreline will help improve water quality over time.

It would be interesting to use this survey throughout Minnesota to see if there is a difference in answers from the different regions throughout the state, from the southern shallow lakes, all the way to the northern-forested lakes or river property owners. These data could then be analyzed to find out the best way to protect lakes in different regions of the state. There also may be a more efficient educational strategy for different areas.

Final Conclusions

Since members of the Little Birch Lake Improvement Association care about water quality, getting non-members to join the Little Birch Lake Improvement Association could

increase the chances to educate them and change their opinion about water quality issues. If these results are found to correlate to other lakes in Minnesota, working on getting the most number of property owners to join lake associations, there is a better chance of protecting water quality.

Better education about water quality issues and BMPs, need to be completed for the property owners around Little Birch Lake. As shown from this survey and other surveys, a varied approach needs to be completed to interact with and educate the most number of property owners possible. Through face-to-face interactions, workshops, internet, social media, mailings, and handouts, all should be used to reach the most number of property owners. Although more education will not get every property owner to implement BMPs, it could change some practices and get more projects implemented around Little Birch Lake.

Research why property owners do not install BMPs to protect water quality, when they say they care so much about water quality. Property owners may need more education or funds to implement BMPs on their own property. These topics need to be looked into further for answers and one answer may not work for each property owner.

There needs to be a better understanding by what manner of education and understanding of the importance of water quality can change property owners' habits and have them implement BMPs. If they care about water quality, they need to do something to help protect it. It is not only the responsibility of every property owner on Little Birch Lake, but also every property owner on every lake in Minnesota as well as all waterways in the United States. Water resources need to be carefully monitored and continually improved, to

protect them for generations to come. Minnesota is, after all, the state of 10,000 lakes; BMPs will hopefully help Minnesota continue to be known for our many clear and clean lakes.

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Appendix A: Survey Letter

Dear Little Birch Lake Lakeshore Owner,

My name is Chris and I am a Graduate student at St. Cloud State University currently working towards a Master's degree in Environmental Studies. My graduate thesis research is focused on identifying environmental impacts directly affecting the water quality of Little Birch Lake. The results of my study will assist in developing viable solutions for water quality improvement efforts, allowing Little Birch Lake to continue to be a beautiful place for you and your family to live and/or visit for generations to come. Best Management Practices (BMPs), such as lakeshore restoration or rain gardens; have proven to be effective methods for reducing polluted runoff to lakes and streams. Other successful strategies for reducing pollutants to lakes include "no mow-zones" and controlled fertilizer application. The implementation of BMPs on Little Birch Lake has the potential to decrease nutrients like phosphorus and pollutants entering the lake. Excessive nutrients can cause a decrease in water quality for example by making the lake green (from an algae bloom) during the summer.

Enclosed is a survey that will give a better understanding how each of you as individuals and property owners can help to improve the water quality of Little Birch Lake. If you would please take a couple of minutes to fill out the survey, it would be much appreciated. If you have any questions or comments please feel free to call or email.

Thank You,
Chris
Luch0801@stcloudstate.edu or (651) 328-3115

Appendix B: Little Birch Lake Survey

1) What is your age?
2) Gender: *Male, Female*
3) How long has your family owned property on the lake?
   1-5 yrs, 6-10 yrs, 11-25 yrs, 26-50 yrs, 51-75 yrs, >76 yrs
4) Household Income per year. *<$50,000, $50,000 – 100,000, $100,000 – 250,000, $>250,000, Wish not to answer*
5) How many days a year do you spend on your property on Little Birch Lake?
   Permanent resident (primary home), Cabin seasonal (summer), Cabin (weekends), Cabin (monthly or less)
6) What is your affiliation with the Little Birch Lake Association?
   Current Member, Not a member, Former member, Interested in becoming a member
7) What are your primary uses of the lake? (choose all that apply)
   Boating, Fishing, Swimming, Sightseeing, Other (please specify)
8) How important is the water quality of Little Birch Lake to you?
   Very important, Important, Somewhat important, Not important
9) How do you perceive the *(Excellent, Good, Fair, Poor)*
   - *Overall Water Quality?*
   - *Health of your shoreline?*
   - *Overall health of Little Birch Lake shoreline?*
10) Have you noticed a change in the lake's water quality since you have been an owner? Quality has: *Improved, Stayed the same, Decreased.*
11) Whom do you think should be responsible for improving water quality (choose all that apply)? *Lakeshore owners, Residents upstream from the lake, Government agencies (Watershed District, Soil and Water Conservation Districts, or Minnesota Pollution Control Agency), Visitors to the lake, It is fine the way it is*
12) How do you feel about local environmental agencies (Sauk River Watershed District, Todd and Stearns Soil and Water Conservation Districts, Minnesota Pollution Control Agency) *They are helping the owners of Little Birch Lake, They have too much control on what a landowner can do on their property, Do not have an opinion*
13) Do you believe *(Yes, No, Maybe, Not sure)*
    - *Native aquatic plants affect water quality?*
    - *Native aquatic plants affect the habitat for animal/fish around the lake?*
    - *Native aquatic plants are visually appealing?*
    - *Native shoreline plants affect water quality?*
    - *Native shoreline plants would help your shoreline?*
    - *Native Shoreline plants are visually appealing?*
14) What do you think could negatively impact the water quality?
15) What type of lakeshore do you have presently (choose all that apply)
    Landscaped/ornamental plants, Trees and shrubs, Sandy (beach), Turf grass, Rip rap (rocky shoreline), Native perennials, trees and shrubs, No-mow zone (area next to the lake that you do not mow or weed whip)

16) Have you ever looked for information on water quality Best Management Practices (an activity, device or behavior that is changed to help protect water resources) or shoreline restoration before? *Yes, No*. If Yes, Where: *internet, Brochures, Books, Magazines, Little Birch Lake Improvement Association, Other (please specify)*

17) Have you already completed Best Management Practices (BMPs) on your property? *Yes, No*. If yes, what did you do and when? *Rain garden, Shoreline buffer (not mowing or weed whipping your shoreline), Rain barrel, Low or no fertilizer on your lawn, Native plants on your shoreline*

18) How do you think runoff affects the Little Birch Lake's water quality? *Positive, Negative, Not at all, Not sure*

19) Do you think over fertilizing your lawn affects Little Birch Lake water quality? *Yes, No, Not sure*

20) Do you think reducing run-off from your property will affect the water quality of Little Birch Lake? *Yes, No, Not sure*

21) Do you think native plants protect the shoreline and filter run-off better than non-native plants/turf grass? *Yes, No, Not sure*

22) What types of BMPs would help decrease the runoff from the property around Little Birch Lake (choose all that apply)?

Rain gardens, Rain barrels, Native plant buffer, All of the above, None of the above, Other (please specify)

23) Would you be interested in implementing Best Management Practices? *Yes, No, Need more information*

24) Contact information (optional) *Name, Address, Phone number, Email*

Appendix C: What Respondents Thought was Negatively Impacting Water Quality of Little Birch Lake

	What do you think negatively impacts the water quality?
LBL22	A 500 hear milking farm adjacent to the creek, Its ruining the lake and has turned a pristine sand bar into a knee high pile of muck.
LBL1	Agricultural runoff, invasive species (Eurasian milfoil), leaky septic systems
LBL46	agriculture mostly (99%), poor septic systems, yard fertilizers
LBL56	bringing in vegetation on boats, beveling lakeshore - we need to keep the 37 1/2ft from share native
LBL103	chemical use on lawns, non native plants, lack of sewage system, nearby agriculture
LBL5	chemicals used that was into the lake
LBL81	excessive boating, visitors carrying invasive species, farm and agriculture run-off
LBL65	farm land run-off is big on the NE side
LBL74	farm run-off, lawn fertilizer, sewer leaks, out board motors
LBL59	farm runoff, fertilizer, farm animal waste, lose of plant life
LBL64	fertilized lawns that have runoff going into the lake
LBL43	fertilizer
LBL73	fertilizer from lawns and too heavy of boat traffic: is washing out shore line
LBL39	Fertilizer fun-off, Overuse?
LBL98	fertilizer run-off
LBL110	fertilizers, manure, gas and oils
LBL101	grass clippings, fertilizer run-off, boat motors, invasive species
LBL7	Home owners: too much fertilizer, mow right to the water, they dot get it
LBL93	I do not like farm run-off (animals, manure, fertilizers). I do not like fishermen dumping fish guts remains back in water
LBL77	imported foreign plants, litter, bumped waste, hampering natural springs feeding lake
LBL90	invasive plants, ex. milfoil
LBL95	invasive plants/animals
LBL3	Invasive Species, Runoff, esp a wet rainy, hot season such as 2011
LBL52	Invasive species - i.e.: Eurasian milfoil
LBL105	large gas motors, septic systems, run-off
LBL63	lawn fertilization and runoff
LBL20	Lawn fertilizer, septic damage, farm runoff of all types, filling in wetlands close to lakes and streams (they clean water)
LBL13	lawn fertilizer. farm run-off. crop fertilizer, sprays
LBL88	loons, lots of boats running around, amount of rain
LBL53	manicured lawns down to lakeshore!! To much fertilizer. Lake traffic form people who do not live on the lake - trash, cigarettes, fishing tackle, alum cans
LBL12	milfoil
LBL45	milfoil
LBL54	milfoil

LBL60	milfoil
LBL85	milfoil
LBL33	milfoil and other transferrable species, liter, fertilizer run-off and pesticide run-off, leaking septic's
LBL48	mowing and fertilizing grass up to the lakes edge, run-off, septic systems
LBL30	native weeds are taking over the lake is something is not done soon the lake won't be good for anything swimming is getting questionable now with all the weeds
LBL51	no opinion
LBL27	non native invasive species of plants, People who put trash in the lake, chemical run-off that enters the lake
LBL15	oil spills
LBL86	over fertilization, mowing of cutting grass/plants to shoreline, farm land run-off into creeks, wave action from large boat erodes the shoreline
LBL17	poor septic systems, not allowing people to clean up shorelines
LBL31	possible old septic systems
LBL78	public access visitors
LBL44	public landings (people don't care), jet skis (run to close to shore), runoff from roads and famers fields, milfoil-mussels
LBL83	removal of native plants, hi speed water craft that tear up native shoreline plants
LBL113	removal of native shoreline plants affect the quality. Pollutants from unprotected creeks empty into the lake. Pollutants coming from farm run-off and up creek residences. Destruction of bird and fish habitats and boat motors either too large for the lake side or in properly cared for spill the fuel exhaust onto the lake
LBL42	run-off
LBL111	run-off
LBL72	run-off and Eurasian milfoil
LBL37	run-off form farm lands - spreading manure to close to lake, neighbor who fertilized and even spread fertilizer into lake
LBL92	run-off from farms and fields
LBL19	Run-off from farms and lakeshore properties, run-off from upstream sources, fertilizer use, mowing right up to the shoreline, non-compliant septic systems, invasive plants (Eurasian milfoil), excessive power boating, etc.
LBL76	Run-off from farms, fertilizer use, out house run-off - most of us have septic's now.
LBL38	run-off from farms, toxic cleaning products, fertilizers - farms and private homes
LBL66	run-off from lawns and fields, leaking/faulty septic tanks
LBL106	run-off of commercial fertilizer used on lawns, run-off from dairy barn yards and feed lots into streams, etc. septic systems no up to date
LBL18	runoff
LBL58	runoff producers from shorelines-fertilizers, farm animals, people, grass clippings, erosion, milfoil-excessive growth, septic systems.
LBL9	Runoff, Aquatic Hitchhikers
LBL80	sand filled beaches, over fertilizing, boat engines, run-off (fertilizer, ect.) from upstream fields
LBL108	septic and ag. run-off, lack of control on visitors to the lake
LBL2	Septic systems, erosion, trash, engine oil/gasoline, sewage and chemicals from farm lots, fertilizers
LBL96	septic systems, farms

LBL99	septic systems, fertilizers
LBL70	the manicured lawns down to the water
LBL8	to much rain. people mowing clear to the lakes edge. no natural buffer (no mow no fertilize) zones mandated/required for every property. Every one. To many people want that urban lawn look.
LBL36	Too many Water ???? that don't us the lake efficiently ?
LBL41	upstream farming in lass?, development
LBL68	water from road drains directly into lake- from drainage system-very poorly designed
LBL21	water runoff
LBL6	we have a direct road runoff into the lake several cabins form us which was ok'd by DNR when road was paved. not a good situation. The drain also overflows creating problem wash outs in road. Non-native plants species "milfoil" is growing and rapidly. Spreading which will affect the lake in years to come. The chemicals used to stop spread "milfoil" may affect impact for years to come.
LBL107	we have a road running between cabin and lake open to the public, too much run-off of all pollutant, etc, into lake and High safety hazard to children and people

Appendix D: Survey Results a-e

a:

ID #	**What is your age?**	**Gender**	**years family have owned property on LBL?**	**Household Income per year?**	**family's primary uses of LBL** (Choose all that apply)	**Days a year spent on your property on LBL?**	**Affiliation with the LBLIA?**
LBL1	52	Male	1-5 yrs	> $250,000	Boating, Fishing, Swimming, sightseeing	Cabin (weekends)	Current Member
LBL2	51	Female	11-25 yrs	$100,000-250,000	Boating, Fishing, Swimming	Cabin (weekends)	Current Member
LBL3	44	Male	6-10 yrs	$100,000-250,000	Boating, Swimming, sightseeing	Permanent resident (primary home)	Current Member
LBL4	78	Male	11-25 yrs	$50,000 - 100,000	Fishing	Permanent resident (primary home)	Current Member
LBL5	78	Male	26-50 yrs	wish not to answer	Boating, Fishing	Permanent resident (primary home)	Current Member
LBL6	81	Female	26-50 yrs	$50,000 - 100,000	Boating, Fishing, Swimming, sightseeing , Other	Permanent resident (primary home)	Current Member
LBL7	65	Male	11-25 yrs	$50,000 - 100,000	Boating, Swimming	Permanent resident (primary home)	Current Member
LBL8	54	Male	11-25 yrs	$50,000 - 100,000	Swimming, sightseeing	Cabin (weekends)	Not a member
LBL9			11-25 yrs	wish not to answer	Boating, Fishing, Swimming	Cabin (weekends)	Current Member
LBL10	80		26-50 yrs	< $50,000	Boating, Fishing, sightseeing	Cabin Seasonal (summer)	Current Member
LBL11	84	Male	11-25 yrs	< $50,000	Boating, Fishing, Swimming, sightseeing	Permanent resident (primary home)	Current Member

LBL12	36	Male	11-25 yrs	$100,000-250,000	Boating, Swimming	Permanent resident (primary home)	Current Member
LBL13	36	Female	6-10 yrs	wish not to answer	Boating, Fishing, Swimming, sightseeing	Permanent resident (primary home)	Current Member
LBL14	65	Male	26-50 yrs	wish not to answer	Fishing, sightseeing	Permanent resident (primary home)	Former member
LBL15	83	Male	26-50 yrs		Boating, Fishing, Swimming, sightseeing, Other	Permanent resident (primary home)	Current Member
LBL16	54	Male	11-25 yrs		Boating, Fishing, Swimming, sightseeing	Permanent resident (primary home)	Current Member
LBL17	57	Male	11-25 yrs	wish not to answer	Fishing, Swimming	Permanent resident (primary home)	Current Member
LBL18	59	Male	11-25 yrs	wish not to answer	Boating, Swimming	Cabin Seasonal (summer)	Current Member
LBL19	57	Female	26-50 yrs	$100,000-250,000	Boating, Fishing, Swimming	Cabin Seasonal (summer)	Current Member
LBL20		Male	26-50 yrs	< $50,000	Swimming		Former member
LBL21	70	Male	26-50 yrs	$50,000 - 100,000	Boating, Fishing, Swimming, sightseeing	Permanent resident (primary home)	Current Member
LBL22	53	Male	26-50 yrs	$50,000 - 100,000	Boating, Fishing, Swimming	Cabin Seasonal (summer)	Current Member
LBL23	76	Male	26-50 yrs	wish not to answer	Boating, Fishing, Swimming, sightseeing	Permanent resident (primary home)	Current Member
LBL24		Male	11-25 yrs		Boating, Fishing, sightseeing	Permanent resident (primary home)	Current Member

LBL25	65	Female	6-10 yrs	$100,000-250,000	Boating, Fishing, Swimming	Cabin Seasonal (summer)	Current Member
LBL26		Male	26-50 yrs	wish not to answer	Boating, Other	Cabin (weekends)	Current Member
LBL27	55	Female	51-75 yrs	$100,000-250,000	Boating, Swimming, sightseeing	Cabin (weekends)	Current Member
LBL28	51	Female	26-50 yrs	$50,000 - 100,000	Boating, Fishing, Swimming	Permanent resident (primary home)	Current Member
LBL29	53		6-10 yrs	$50,000 - 100,000	Boating, Fishing, Swimming	Permanent resident (primary home)	Current Member
LBL30	36	Female	1-5 yrs	> $250,000	Boating, Fishing, Swimming, sightseeing	Cabin (monthly or less)	Current Member
LBL31	59	Male	11-25 yrs	< $50,000	Boating, Fishing, Swimming, sightseeing, Other	Permanent resident (primary home)	Current Member
LBL32	78	Male	26-50 yrs	< $50,000	Boating, Swimming, sightseeing	Cabin Seasonal (summer)	Current Member
LBL33	42	Female	26-50 yrs	$100,000-250,000	Boating, Fishing, Swimming	Cabin Seasonal (summer)	Former member
LBL34	75	Male	11-25 yrs	< $50,000	Boating, Fishing, Swimming, Other	Permanent resident (primary home)	Current Member
LBL35	64	Male	11-25 yrs	$50,000 - 100,000	Swimming	Cabin Seasonal (summer)	Not a member
LBL36	75	Male	26-50 yrs	< $50,000	Fishing, Swimming	Permanent resident (primary home)	Current Member
LBL37	70	Male	51-75 yrs	< $50,000	Boating, Fishing, Swimming, sightseeing	Cabin Seasonal (summer)	Current Member

LBL38	49	Female	11-25 yrs	< $50,000	sightseeing, Other	Permanent resident (primary home)	Current Member
LBL39		Female	26-50 yrs	wish not to answer	Boating, Fishing, Swimming	Cabin (weekends)	Current Member
LBL40	66	Male	26-50 yrs	$100,000-250,000	Swimming	Cabin (weekends)	Current Member
LBL41	53	Male	51-75 yrs	$100,000-250,000	Boating, Fishing, Swimming, sightseeing, Other	Permanent resident (primary home)	Current Member
LBL42	74	Male	51-75 yrs	< $50,000	Boating, Fishing, Swimming, sightseeing, Other	Permanent resident (primary home)	Current Member
LBL43	73	Male	11-25 yrs	$50,000 - 100,000	Boating	Permanent resident (primary home)	Current Member
LBL44	78, 70	Male	26-50 yrs	wish not to answer	Boating, Fishing, Swimming, sightseeing, Other	Cabin Seasonal (summer)	Current Member
LBL45	45	Female	6-10 yrs	> $250,000	Boating, Swimming, Other	Cabin Seasonal (summer)	Current Member
LBL46	45	Male	6-10 yrs	$100,000-250,000	Boating, Fishing, Swimming, sightseeing	Cabin (weekends)	Current Member
LBL47	40>	Male	1-5 yrs	$100,000-250,000	Boating, Fishing, Swimming	Cabin Seasonal (summer)	Current Member
LBL48	64	Male	11-25 yrs	$50,000 - 100,000	Boating, Fishing, Swimming, sightseeing	Permanent resident (primary home)	Current Member
LBL49	47	Female	26-50 yrs	$50,000 - 100,000	Boating, Fishing, Swimming, sightseeing	Cabin Seasonal (summer)	Current Member
LBL50		Male	51-75 yrs	< $50,000	Boating, Fishing, Swimming, sightseeing	Cabin (weekends)	Current Member

LBL51	62	Male	11-25 yrs	< $50,000	Swimming, sightseeing	Cabin (monthly or less)	Not a member
LBL52	67	Male	26-50 yrs	$100,000-250,000	Boating, Fishing, Swimming	Cabin Seasonal (summer)	Current Member
LBL53	65	Female	26-50 yrs	< $50,000	Boating, Fishing, Swimming	Permanent resident (primary home)	Current Member
LBL54	62	Male	> 76 yrs	< $50,000	Fishing, Swimming	Cabin (monthly or less)	Former member
LBL55		Male	6-10 yrs	$50,000 - 100,000	Boating, Fishing, Swimming	Permanent resident (primary home)	Current Member
LBL56	59	Female	11-25 yrs	$100,000-250,000	Boating, Fishing, Swimming, sightseeing, Other	Cabin (weekends)	Current Member
LBL57	51	Male	11-25 yrs	$100,000-250,000	Boating, Fishing, Swimming sightseeing		Current Member
LBL58	53	Female	26-50 yrs	wish not to answer	Boating, Fishing, Swimming, sightseeing, Other	Cabin Seasonal (summer)	Current Member
LBL59	55	Male	11-25 yrs	$50,000 - 100,000	Boating, Fishing	Cabin (weekends)	Current Member
LBL60	47	Female	6-10 yrs	wish not to answer	Fishing, Swimming, sightseeing	Cabin (weekends)	Current Member
LBL61	63	Male	11-25 yrs	$50,000 - 100,000	Boating, Fishing, Swimming, sightseeing	Cabin Seasonal (summer)	Current Member
LBL62	58	Female	6-10 yrs	$100,000-250,000	Boating, Fishing, Swimming, sightseeing	Cabin Seasonal (summer)	Current Member

LBL63	52	Female	11-25 yrs	$100,000-250,000	Boating, Fishing, Swimming, sightseeing	Permanent resident (primary home)	Current Member
LBL64	83	Male	11-25 yrs	< $50,000	Fishing, sightseeing	Permanent resident (primary home)	Current Member
LBL65	65	Female	26-50 yrs	$50,000 - 100,000	Boating, Fishing, Swimming, sightseeing, Other	Cabin Seasonal (summer)	Current Member
LBL66	55	Male	11-25 yrs	< $50,000	Boating, Swimming, sightseeing	Cabin (weekends)	Current Member
LBL67	47	Male	11-25 yrs	wish not to answer	Boating, Fishing, Swimming	Permanent resident (primary home)	Current Member
LBL68	62	Male	26-50 yrs	$50,000 - 100,000	Boating, Fishing, Swimming, sightseeing	Cabin (weekends)	Current Member
LBL69	83	Male	51-75 yrs	wish not to answer	Boating, Fishing, Swimming	Cabin (weekends)	Current Member
LBL70	62	Female	11-25 yrs	wish not to answer	Boating, Fishing, Swimming	Cabin (monthly or less)	Current Member
LBL71	54	Male	11-25 yrs	$50,000 - 100,000	Boating, Fishing, Swimming, sightseeing	Cabin Seasonal (summer)	Current Member
LBL72	46	Female	26-50 yrs	$100,000-250,000	Boating, Fishing, Swimming, Other	Cabin Seasonal (summer)	Current Member
LBL73	46	Male	11-25 yrs		Boating, Swimming	Cabin (weekends)	Former member
LBL74	66	Male	26-50 yrs	$50,000 - 100,000	Boating, Fishing, sightseeing	Permanent resident (primary home)	Current Member

LBL75	76	Female	26-50 yrs	< $50,000	Fishing, Swimming, sightseeing	Cabin Seasonal (summer)	Current Member
LBL76	74	Female	51-75 yrs	< $50,000	Boating, Fishing, Swimming, sightseeing	Permanent resident (primary home)	Current Member
LBL77	59	Female	> 76 yrs	wish not to answer	Boating, Fishing, Swimming, sightseeing	Cabin Seasonal (summer)	Current Member
LBL78	56	Female	51-75 yrs	wish not to answer	Boating, Fishing, Swimming	Cabin Seasonal (summer)	Current Member
LBL79		Male	26-50 yrs	wish not to answer	Boating, Fishing, Swimming	Cabin Seasonal (summer)	Current Member
LBL80	57	Female	11-25 yrs	$100,000-250,000	Boating, Fishing, Swimming	Cabin Seasonal (summer)	Current Member
LBL81	53	Male	26-50 yrs	wish not to answer	Fishing, Swimming	Cabin (monthly or less)	Current Member
LBL82	61	Male	11-25 yrs	$50,000 - 100,000	Boating, Fishing	Cabin (weekends)	Current Member
LBL83	64	Female	11-25 yrs	$50,000 - 100,000	Fishing	Cabin Seasonal (summer)	Current Member
LBL84	52	Female	6-10 yrs	$100,000-250,000	Boating, Swimming, Other	Permanent resident (primary home)	Current Member
LBL85	54	Female	11-25 yrs	$100,000-250,000		Permanent resident (primary home)	Current Member
LBL86	81	Male	26-50 yrs	$50,000 - 100,000	Boating, Fishing, Swimming, Other	Cabin Seasonal (summer)	Current Member
LBL87	78	Male	26-50 yrs	$50,000 - 100,000	Boating, Fishing, Swimming	Cabin Seasonal (summer)	Current Member

LBL88	40	Male	1-5 yrs	> $250,000	Boating, Fishing, Swimming, sightseeing	Cabin (weekends)	Not a member
LBL89	75	Male	26-50 yrs	< $50,000	Other	Permanent resident (primary home)	Current Member
LBL90	47	Male	11-25 yrs	$100,000-250,000	Boating, Fishing, Swimming	Cabin (weekends)	Current Member
LBL91	65	Male	26-50 yrs	$50,000 - 100,000	Fishing	Permanent resident (primary home)	Current Member
LBL92	54	Male	1-5 yrs	$100,000-250,000	Boating, Fishing, Swimming, sightseeing, Other	Cabin (weekends)	Current Member
LBL93	72	Female	26-50 yrs	wish not to answer	Boating, Fishing, Swimming, sightseeing	Cabin (weekends)	Current Member
LBL94	73	Male	51-75 yrs	$50,000 - 100,000	Boating, Fishing	Permanent resident (primary home)	Current Member
LBL95	49	Male	11-25 yrs	$100,000-250,000	Boating, Fishing, Swimming	Cabin (weekends)	Current Member
LBL96	49	Male	1-5 yrs	> $250,000	Boating, Fishing, Swimming	Cabin (weekends)	Current Member
LBL97	65	Male	1-5 yrs	wish not to answer	Boating, Fishing, Swimming	Cabin Seasonal (summer)	Current Member
LBL98	59	Male	1-5 yrs	$50,000 - 100,000	Boating, Fishing, Swimming, sightseeing	Cabin (weekends)	Current Member
LBL99	51	Male	26-50 yrs	wish not to answer	Boating, Fishing, Swimming, sightseeing	Permanent resident (primary home)	Current Member
LBL100		Male	11-25 yrs	< $50,000	Boating, Fishing, Swimming	Cabin (weekends)	Current Member

LBL101	50	Male	11-25 yrs	wish not to answer	Swimming, sightseeing	Cabin (weekends)	Not a member
LBL102	57	Female	6-10 yrs	$50,000 - 100,000	Boating, Fishing, Swimming	Cabin Seasonal (summer)	Current Member
LBL103	42	Male	6-10 yrs	> $250,000	Swimming	Permanent resident (primary home)	Current Member
LBL104	73	Male	11-25 yrs	$50,000 - 100,000	Boating, Fishing, Swimming	Cabin Seasonal (summer)	Current Member
LBL105			6-10 yrs	wish not to answer	Boating, sightseeing	Cabin (monthly or less)	Current Member
LBL106	56	Female	11-25 yrs	wish not to answer	Boating, Fishing, Swimming, sightseeing	Cabin (weekends)	Current Member
LBL107	68	Male	51-75 yrs	< $50,000	Boating, Fishing, Swimming, sightseeing	Permanent resident (primary home)	Current Member
LBL108	64	Male	11-25 yrs	< $50,000	Fishing	Permanent resident (primary home)	Current Member
LBL109	68	Male	51-75 yrs	wish not to answer	Boating, Fishing, Swimming, sightseeing	Permanent resident (primary home)	Current Member
LBL110	60's	Male	51-75 yrs	$50,000 - 100,000	Boating	Cabin (weekends)	Current Member
LBL111	50	Male	11-25 yrs	wish not to answer	Boating, Fishing, Swimming	Cabin (weekends)	Current Member
LBL112	67	Male	1-5 yrs	wish not to answer	Fishing	Permanent resident (primary home)	Current Member
LBL113		Female	26-50 yrs	$50,000 - 100,000	Boating, Fishing, sightseeing	Permanent resident (primary home)	Current Member

b:

ID #	**Importance of water quality of LBL to you?**	**Overall water quality of Little Birch Lake?**	**Health of your shoreline?**	**Overall health of LBL shoreline?**	**Water Quality has**	**Whom do you think should be responsible for improving water quality (choose all that apply)?**
LBL1	Very important	Good	Good	Good	Stayed the same	Lakeshore owners, Residents up-stream from the lake, Government Agencies (Watershed District, Soil and Water Conservation Districts, or Minnesota Pollution Control Agency), Visitors to the lake
LBL2	Very important	Excellent	Good	Good	Stayed the same	Lakeshore owners, Residents up-stream from the lake, Government Agencies (Watershed District, Soil and Water Conservation Districts, or Minnesota Pollution Control Agency), Visitors to the lake
LBL3	Very important	Excellent	Excellent	Good	Stayed the same	Lakeshore owners, Residents up-stream from the lake, Government Agencies (Watershed District, Soil and Water Conservation Districts, or Minnesota Pollution Control Agency)
LBL4	Important	Good	Good	Good	Stayed the same	Lakeshore owners, Residents up-stream from the lake, Government Agencies (Watershed District, Soil and Water Conservation Districts, or Minnesota Pollution Control Agency)
LBL5	Very important	Good	Good	Fair	Decreased	Lakeshore owners, Visitors to the lake
LBL6	Very important	Good	Fair	Poor	Improved	Lakeshore owners, Residents up-stream from the lake, Government Agencies (Watershed District, Soil and Water Conservation Districts, or Minnesota Pollution Control Agency), Visitors to the lake
LBL7	Very important	Good	Fair	Fair	Stayed the same	Lakeshore owners, Residents up-stream from the lake, Government Agencies (Watershed District, Soil and Water Conservation Districts, or Minnesota Pollution Control Agency), Visitors to the lake
LBL8	Very important	Good	Excellent	Excellent	Decreased	Lakeshore owners, Residents up-stream from the lake, Government Agencies (Watershed District, Soil and Water Conservation Districts, or Minnesota Pollution Control Agency)
LBL9	Very important	Fair	Good	Good	Decreased	Lakeshore owners, Residents up-stream from the lake, Government Agencies (Watershed District, Soil and Water Conservation Districts, or Minnesota Pollution Control Agency), Visitors to the lake
LBL10	Very important	Fair	Good	Fair	Decreased	Lakeshore owners, Government Agencies (Watershed District, Soil and Water Conservation Districts, or Minnesota Pollution Control Agency), Visitors to the lake

LBL11	Important	Good	Good	Good	Stayed the same	Lakeshore owners, Residents up-stream from the lake, Government Agencies (Watershed District, Soil and Water Conservation Districts, or Minnesota Pollution Control Agency)
LBL12	Very important	Good	Good	Good	Stayed the same	Government Agencies (Watershed District, Soil and Water Conservation Districts, or Minnesota Pollution Control Agency)
LBL13	Very important	Fair	Fair	Fair	Decreased	Lakeshore owners, Residents up-stream from the lake, Government Agencies (Watershed District, Soil and Water Conservation Districts, or Minnesota Pollution Control Agency), Visitors to the lake
LBL14	Very important	Excellent	Good	Good	Improved	Lakeshore owners, Residents up-stream from the lake, Visitors to the lake
LBL15	Very important	Good	Good	Good	Stayed the same	Lakeshore owners, Residents up-stream from the lake, Government Agencies (Watershed District, Soil and Water Conservation Districts, or Minnesota Pollution Control Agency)
LBL16	Important	Excellent	Excellent	Excellent	Stayed the same	It is fine the way it is
LBL17	Very important	Good	Fair	Good	Stayed the same	Lakeshore owners, Residents up-stream from the lake, Government Agencies (Watershed District, Soil and Water Conservation Districts, or Minnesota Pollution Control Agency), Visitors to the lake
LBL18	Very important	Good	Good	Good	Stayed the same	Lakeshore owners, Government Agencies (Watershed District, Soil and Water Conservation Districts, or Minnesota Pollution Control Agency)
LBL19	Very important	Fair	Good	Fair	Decreased	Lakeshore owners, Residents up-stream from the lake, Government Agencies (Watershed District, Soil and Water Conservation Districts, or Minnesota Pollution Control Agency), Visitors to the lake
LBL20	Very important	Good	Good	Good	Stayed the same	Lakeshore owners, Residents up-stream from the lake, Government Agencies (Watershed District, Soil and Water Conservation Districts, or Minnesota Pollution Control Agency)
LBL21	Very important	Good	Good	Good	Decreased	Lakeshore owners, Residents up-stream from the lake, Government Agencies (Watershed District, Soil and Water Conservation Districts, or Minnesota Pollution Control Agency), Visitors to the lake
LBL22	Very important	Fair	Fair	Fair	Decreased	Residents up-stream from the lake, Government Agencies (Watershed District, Soil and Water Conservation Districts, or Minnesota Pollution Control Agency)
LBL23	Very important	Fair	Fair	Fair	Stayed the same	Lakeshore owners, Residents up-stream from the lake, Government Agencies (Watershed District, Soil and Water Conservation Districts, or Minnesota Pollution Control Agency)

LBL24	Very important	Fair	Fair	Fair	Stayed the same	Residents up-stream from the lake
LBL25	Very important	Good	Good	Fair	Decreased	Lakeshore owners, Residents up-stream from the lake, Government Agencies (Watershed District, Soil and Water Conservation Districts, or Minnesota Pollution Control Agency), Visitors to the lake
LBL26	Very important	Good	Good	Fair	Stayed the same	Government Agencies (Watershed District, Soil and Water Conservation Districts, or Minnesota Pollution Control Agency)
LBL27	Important	Fair	Fair	Fair	Decreased	Lakeshore owners, Residents up-stream from the lake, Government Agencies (Watershed District, Soil and Water Conservation Districts, or Minnesota Pollution Control Agency), Visitors to the lake
LBL28	Very important	Good			Decreased	Lakeshore owners, Residents up-stream from the lake, Government Agencies (Watershed District, Soil and Water Conservation Districts, or Minnesota Pollution Control Agency), Visitors to the lake
LBL29	Very important	Good	Good	Good	Improved	Lakeshore owners, Residents up-stream from the lake
LBL30	Very important	Fair	Poor	Fair	Decreased	Lakeshore owners, Residents up-stream from the lake, Government Agencies (Watershed District, Soil and Water Conservation Districts, or Minnesota Pollution Control Agency)
LBL31	Very important	Excellent	Good	Good	Improved	Lakeshore owners, Residents up-stream from the lake, Government Agencies (Watershed District, Soil and Water Conservation Districts, or Minnesota Pollution Control Agency), Visitors to the lake
LBL32						
LBL33	Very important	Fair	Good	Good	Decreased	Government Agencies (Watershed District, Soil and Water Conservation Districts, or Minnesota Pollution Control Agency)
LBL34	Very important	Good	Good	Good	Stayed the same	Lakeshore owners, Government Agencies (Watershed District, Soil and Water Conservation Districts, or Minnesota Pollution Control Agency)
LBL35	Very important	Good	Poor	Fair	Decreased	Lakeshore owners, Residents up-stream from the lake, Government Agencies (Watershed District, Soil and Water Conservation Districts, or Minnesota Pollution Control Agency)
LBL36	Very important	Good	Good	Good	Stayed the same	Lakeshore owners, Government Agencies (Watershed District, Soil and Water Conservation Districts, or Minnesota Pollution Control Agency)
LBL37	Very important	Good	Excellent	Good	Decreased	Lakeshore owners, Residents up-stream from the lake, Government Agencies (Watershed District, Soil and Water Conservation Districts, or Minnesota Pollution Control Agency), Visitors to the lake

LBL38	Very important	Fair	Good	Good	Decreased	Lakeshore owners, Residents up-stream from the lake, Government Agencies (Watershed District, Soil and Water Conservation Districts, or Minnesota Pollution Control Agency), Visitors to the lake
LBL39	Very important	Excellent	Excellent	Excellent	Stayed the same	Lakeshore owners, Residents up-stream from the lake, Government Agencies (Watershed District, Soil and Water Conservation Districts, or Minnesota Pollution Control Agency)
LBL40	Important	Good	Good	Good	Improved	Lakeshore owners
LBL41	Very important	Good	Good	Good	Stayed the same	Lakeshore owners, Residents up-stream from the lake, Government Agencies (Watershed District, Soil and Water Conservation Districts, or Minnesota Pollution Control Agency), It is fine the way it is
LBL42	Very important	Good	Excellent	Fair	Decreased	Lakeshore owners, Residents up-stream from the lake, Government Agencies (Watershed District, Soil and Water Conservation Districts, or Minnesota Pollution Control Agency), Visitors to the lake
LBL43	Very important	Good	Excellent	Good	Stayed the same	Lakeshore owners
LBL44	Very important	Good	Good	Good	Decreased	Government Agencies (Watershed District, Soil and Water Conservation Districts, or Minnesota Pollution Control Agency), Visitors to the lake
LBL45	Very important	Fair	Fair	Good	Decreased	Lakeshore owners, Government Agencies (Watershed District, Soil and Water Conservation Districts, or Minnesota Pollution Control Agency), Visitors to the lake
LBL46	Very important	Good	Good	Good	Stayed the same	Lakeshore owners, Residents up-stream from the lake, Government Agencies (Watershed District, Soil and Water Conservation Districts, or Minnesota Pollution Control Agency)
LBL47	Very important	Good	Good	Good	Decreased	Lakeshore owners, Government Agencies (Watershed District, Soil and Water Conservation Districts, or Minnesota Pollution Control Agency)
LBL48	Very important	Good	Excellent	Good	Decreased	Lakeshore owners, Residents up-stream from the lake, Government Agencies (Watershed District, Soil and Water Conservation Districts, or Minnesota Pollution Control Agency), Visitors to the lake
LBL49	Important	Poor	Poor	Fair	Decreased	Lakeshore owners, Residents up-stream from the lake, Government Agencies (Watershed District, Soil and Water Conservation Districts, or Minnesota Pollution Control Agency), Visitors to the lake

LBL50	Important	Good	Fair	Fair	Stayed the same	It is fine the way it is
LBL51	Very important	Excellent	Excellent	Excellent	Improved	Lakeshore owners, Residents up-stream from the lake, Government Agencies (Watershed District, Soil and Water Conservation Districts, or Minnesota Pollution Control Agency)
LBL52	Very important	Good	Good	Good	Decreased	Lakeshore owners, Residents up-stream from the lake, Government Agencies (Watershed District, Soil and Water Conservation Districts, or Minnesota Pollution Control Agency)
LBL53	Very important	Good	Fair	Poor	Decreased	Lakeshore owners, Government Agencies (Watershed District, Soil and Water Conservation Districts, or Minnesota Pollution Control Agency), Visitors to the lake
LBL54	Very important	Excellent	Excellent	Good	Stayed the same	Lakeshore owners, Residents up-stream from the lake, Government Agencies (Watershed District, Soil and Water Conservation Districts, or Minnesota Pollution Control Agency), Visitors to the lake
LBL55	Very important	Excellent	Good	Good	Stayed the same	Lakeshore owners, Residents up-stream from the lake, Government Agencies (Watershed District, Soil and Water Conservation Districts, or Minnesota Pollution Control Agency), Visitors to the lake
LBL56	Very important	Good	Excellent	Good	Decreased	Lakeshore owners, Government Agencies (Watershed District, Soil and Water Conservation Districts, or Minnesota Pollution Control Agency), Visitors to the lake
LBL57	Very important	Fair	Good	Fair	Decreased	Lakeshore owners, Residents up-stream from the lake, Government Agencies (Watershed District, Soil and Water Conservation Districts, or Minnesota Pollution Control Agency)
LBL58	Very important	Good	Fair	Fair	Decreased	Lakeshore owners, Residents up-stream from the lake, Government Agencies (Watershed District, Soil and Water Conservation Districts, or Minnesota Pollution Control Agency), Visitors to the lake
LBL59	Very important	Good	Good		Stayed the same	Lakeshore owners, Residents up-stream from the lake
LBL60	Important	Good	Good	Good	Decreased	Lakeshore owners, Residents up-stream from the lake, Government Agencies (Watershed District, Soil and Water Conservation Districts, or Minnesota Pollution Control Agency), Visitors to the lake
LBL61	Important	Good	Fair	Good	Stayed the same	Lakeshore owners, Government Agencies (Watershed District, Soil and Water Conservation Districts, or Minnesota Pollution Control Agency)
LBL62	Very important	Good	Poor	Fair	Decreased	Lakeshore owners, Government Agencies (Watershed District, Soil and Water Conservation Districts, or Minnesota Pollution Control Agency)

LBL63	Very important	Good	Good	Good	Decreased	Lakeshore owners, Residents up-stream from the lake, Government Agencies (Watershed District, Soil and Water Conservation Districts, or Minnesota Pollution Control Agency), Visitors to the lake
LBL64	Very important	Good	Good	Fair	Improved	Lakeshore owners
LBL65	Very important	Fair	Poor	Poor	Decreased	Lakeshore owners, Residents up-stream from the lake, Government Agencies (Watershed District, Soil and Water Conservation Districts, or Minnesota Pollution Control Agency), Visitors to the lake
LBL66	Very important	Good	Good	Good	Stayed the same	Lakeshore owners, Residents up-stream from the lake, Government Agencies (Watershed District, Soil and Water Conservation Districts, or Minnesota Pollution Control Agency), Visitors to the lake
LBL67	Very important	Good	Good	Good	Improved	Lakeshore owners, Government Agencies (Watershed District, Soil and Water Conservation Districts, or Minnesota Pollution Control Agency), Visitors to the lake
LBL68	Very important	Good	Fair	Fair	Decreased	Lakeshore owners, Residents up-stream from the lake, Government Agencies (Watershed District, Soil and Water Conservation Districts, or Minnesota Pollution Control Agency)
LBL69	Very important	Excellent			Improved	Lakeshore owners, Residents up-stream from the lake
LBL70	Very important	Good	Good	Fair	Decreased	Lakeshore owners, Residents up-stream from the lake, Government Agencies (Watershed District, Soil and Water Conservation Districts, or Minnesota Pollution Control Agency)
LBL71	Very important	Good	Good	Good	Stayed the same	Lakeshore owners, Residents up-stream from the lake, Government Agencies (Watershed District, Soil and Water Conservation Districts, or Minnesota Pollution Control Agency), Visitors to the lake
LBL72	Very important	Fair	Poor	Fair	Decreased	Lakeshore owners, Residents up-stream from the lake, Government Agencies (Watershed District, Soil and Water Conservation Districts, or Minnesota Pollution Control Agency), Visitors to the lake
LBL73	Very important	Good	Fair	Fair	Decreased	Lakeshore owners, Residents up-stream from the lake, Government Agencies (Watershed District, Soil and Water Conservation Districts, or Minnesota Pollution Control Agency), Visitors to the lake
LBL74	Very important	Poor	Good	Good	Decreased	Lakeshore owners, Residents up-stream from the lake, Government Agencies (Watershed District, Soil and Water Conservation Districts, or Minnesota Pollution Control Agency), Visitors to the lake

LBL75	Important	Good	Good	Fair	Decreased	Lakeshore owners, Government Agencies (Watershed District, Soil and Water Conservation Districts, or Minnesota Pollution Control Agency), Visitors to the lake
LBL76	Very important	Good	Good	Good	Improved	Lakeshore owners, Residents up-stream from the lake, Government Agencies (Watershed District, Soil and Water Conservation Districts, or Minnesota Pollution Control Agency), Visitors to the lake
LBL77	Very important	Good	Excellent	Good	Stayed the same	Lakeshore owners, Residents up-stream from the lake, Government Agencies (Watershed District, Soil and Water Conservation Districts, or Minnesota Pollution Control Agency), Visitors to the lake
LBL78	Very important	Good	Fair	Fair	Decreased	Lakeshore owners, Government Agencies (Watershed District, Soil and Water Conservation Districts, or Minnesota Pollution Control Agency)
LBL79	Important	Good	Good	Fair	Stayed the same	Lakeshore owners, Residents up-stream from the lake
LBL80	Very important	Good	Excellent	Good	Stayed the same	Lakeshore owners, Residents up-stream from the lake, Government Agencies (Watershed District, Soil and Water Conservation Districts, or Minnesota Pollution Control Agency), Visitors to the lake
LBL81	Very important	Good	Good	Fair	Decreased	Lakeshore owners, Residents up-stream from the lake, Government Agencies (Watershed District, Soil and Water Conservation Districts, or Minnesota Pollution Control Agency), Visitors to the lake
LBL82	Very important	Good	Good	Good	Stayed the same	Lakeshore owners, Visitors to the lake
LBL83	Very important	Good	Good	Good	Decreased	Lakeshore owners, Residents up-stream from the lake, Government Agencies (Watershed District, Soil and Water Conservation Districts, or Minnesota Pollution Control Agency), Visitors to the lake
LBL84	Very important	Good	Good	Good	Decreased	Lakeshore owners, Residents up-stream from the lake, Government Agencies (Watershed District, Soil and Water Conservation Districts, or Minnesota Pollution Control Agency), Visitors to the lake
LBL85	Important	Good	Good	Good	Decreased	Lakeshore owners, Residents up-stream from the lake, Visitors to the lake
LBL86	Very important	Good	Fair	Fair		Lakeshore owners, Residents up-stream from the lake, Government Agencies (Watershed District, Soil and Water Conservation Districts, or Minnesota Pollution Control Agency)
LBL87	Very important	Excellent	Good	Good	Improved	Lakeshore owners, Government Agencies (Watershed District, Soil and Water Conservation Districts, or Minnesota Pollution Control Agency)

LBL88	Important	Good	Good	Good	Stayed the same	Lakeshore owners, Residents up-stream from the lake, Government Agencies (Watershed District, Soil and Water Conservation Districts, or Minnesota Pollution Control Agency), Visitors to the lake
LBL89	Very important	Good	Good	Good	Improved	Lakeshore owners, Government Agencies (Watershed District, Soil and Water Conservation Districts, or Minnesota Pollution Control Agency)
LBL90	Very important	Good	Good	Good	Decreased	Lakeshore owners, Residents up-stream from the lake, Government Agencies (Watershed District, Soil and Water Conservation Districts, or Minnesota Pollution Control Agency), Visitors to the lake
LBL91	Very important	Good	Good	Good	Stayed the same	Lakeshore owners, Residents up-stream from the lake, Government Agencies (Watershed District, Soil and Water Conservation Districts, or Minnesota Pollution Control Agency), Visitors to the lake
LBL92	Very important	Excellent	Good	Fair	Decreased	Lakeshore owners, Residents up-stream from the lake, Government Agencies (Watershed District, Soil and Water Conservation Districts, or Minnesota Pollution Control Agency), Visitors to the lake
LBL93	Very important	Good	Good	Fair	Stayed the same	Lakeshore owners, Residents up-stream from the lake, Government Agencies (Watershed District, Soil and Water Conservation Districts, or Minnesota Pollution Control Agency)
LBL94	Very important	Good			Stayed the same	Lakeshore owners, Residents up-stream from the lake, Government Agencies (Watershed District, Soil and Water Conservation Districts, or Minnesota Pollution Control Agency), Visitors to the lake
LBL95	Very important	Good	Fair	Fair	Stayed the same	Lakeshore owners, Government Agencies (Watershed District, Soil and Water Conservation Districts, or Minnesota Pollution Control Agency), Visitors to the lake
LBL96	Very important	Fair	Fair	Fair	Stayed the same	Lakeshore owners, Residents up-stream from the lake
LBL97	Important	Good	Good	Good	Stayed the same	
LBL98	Very important	Good	Fair	Fair	Stayed the same	Government Agencies (Watershed District, Soil and Water Conservation Districts, or Minnesota Pollution Control Agency)
LBL99	Very important	Good			Improved	Lakeshore owners, Residents up-stream from the lake
LBL100	Important	Good	Good	Good	Stayed the same	Residents up-stream from the lake, Government Agencies (Watershed District, Soil and Water Conservation Districts, or Minnesota Pollution Control Agency)
LBL101	Very important	Poor	Fair	Fair	Decreased	Lakeshore owners

LBL102	Very important	Excellent	Good	Good	Decreased	Lakeshore owners, Residents up-stream from the lake, Government Agencies (Watershed District, Soil and Water Conservation Districts, or Minnesota Pollution Control Agency), Visitors to the lake
LBL103	Very important	Good	Good	Good	Decreased	Lakeshore owners, Residents up-stream from the lake, Government Agencies (Watershed District, Soil and Water Conservation Districts, or Minnesota Pollution Control Agency)
LBL104	Very important	Good	Good	Fair	Stayed the same	Lakeshore owners, Residents up-stream from the lake, Government Agencies (Watershed District, Soil and Water Conservation Districts, or Minnesota Pollution Control Agency), Visitors to the lake
LBL105	Very important	Good	Good	Good	Stayed the same	Lakeshore owners, Residents up-stream from the lake, Government Agencies (Watershed District, Soil and Water Conservation Districts, or Minnesota Pollution Control Agency)
LBL106	Very important	Good	Good	Good	Stayed the same	Lakeshore owners, Residents up-stream from the lake, Government Agencies (Watershed District, Soil and Water Conservation Districts, or Minnesota Pollution Control Agency)
LBL107	Very important	Good	Good	Good	Stayed the same	Lakeshore owners, Residents up-stream from the lake, Government Agencies (Watershed District, Soil and Water Conservation Districts, or Minnesota Pollution Control Agency), Visitors to the lake
LBL108	Very important	Excellent	Fair	Good	Stayed the same	Lakeshore owners, Residents up-stream from the lake, Government Agencies (Watershed District, Soil and Water Conservation Districts, or Minnesota Pollution Control Agency), Visitors to the lake
LBL109	Very important	Good	Fair	Fair	Decreased	Lakeshore owners, Residents up-stream from the lake, Government Agencies (Watershed District, Soil and Water Conservation Districts, or Minnesota Pollution Control Agency), Visitors to the lake
LBL110	Very important	Good	Good	Good	Decreased	Lakeshore owners, Residents up-stream from the lake, Government Agencies (Watershed District, Soil and Water Conservation Districts, or Minnesota Pollution Control Agency), Visitors to the lake
LBL111	Very important	Good	Good	Good	Decreased	Lakeshore owners, Government Agencies (Watershed District, Soil and Water Conservation Districts, or Minnesota Pollution Control Agency)
LBL112	Very important	Fair	Good	Good	Decreased	Visitors to the lake
LBL113	Very important	Fair	Fair	Fair	Improved	Lakeshore owners, Residents up-stream from the lake, Visitors to the lake

c:

ID #	How do you feel about local environmental agencies	Do you bel... Native aquatic plants affect WQ?	Do you bel... NAP affect the habitat for animals/fish at LBL?	Do you bel... Native aquatic plants are visually appealing?	Do you bel... Native shoreline plants affect water quality?	Do you bel... Native shoreline plants would help your shoreline?	Do you bel... Native shoreline plants are visually appealing? (see picture)
LBL1	They are helping the owners of Little Birch Lake	Yes	Yes	Yes	Yes	Yes	Yes
LBL2	They are helping the owners of Little Birch Lake	Yes	Yes	Yes	Yes	Maybe	Maybe
LBL3	They are helping the owners of Little Birch Lake	Yes	Yes	Maybe	Maybe	No	No
LBL4	They are helping the owners of Little Birch Lake	Yes	Yes	Yes	Yes	Yes	Maybe
LBL5	Do not have an opinion	Yes	Yes	Maybe	Yes	Yes	Maybe
LBL6	They are helping the owners of Little Birch Lake	Yes	Yes	Yes	Yes	Not sure	Not sure
LBL7	They are helping the owners of Little Birch Lake	Yes	Yes	Yes	Yes	Yes	Yes
LBL8	They are helping the owners of Little Birch Lake	No	Yes	Yes	Yes	No	Yes
LBL9	They have too much control on what a landowner can do on their property	Yes	Yes	Not sure	Yes	No	Not sure
LBL10	Do not have an opinion	No	No	Yes	No	Yes	Yes
LBL11	They are helping the owners of Little Birch Lake	Yes	Yes	Not sure	Yes	Yes	Maybe
LBL12	They are helping the owners of Little Birch Lake	Yes	Yes	No	Yes	Maybe	No
LBL13	They are helping the owners of Little Birch Lake	Yes	Yes	Maybe	Yes	Maybe	No
LBL14	Do not have an opinion	No	Yes	No	Yes	No	Yes
LBL15	They are helping the owners of Little Birch Lake	Maybe	Yes	Yes	Maybe		Maybe
LBL16	They have too much control on what a landowner can do on their property						

LBL17	They have too much control on what a landowner can do on their property	Yes	Yes	Yes	Yes	Maybe	Yes
LBL18	Do not have an opinion	Yes	Yes	Yes	Yes	No	Yes
LBL19	They are helping the owners of Little Birch Lake	Yes	Yes	Yes	Yes	Yes	Yes
LBL20	Do not have an opinion	Yes	Yes	Maybe	Yes	Not sure	Maybe
LBL21	They are helping the owners of Little Birch Lake	Yes	Yes	Maybe	Yes	Maybe	Maybe
LBL22	They have too much control on what a landowner can do on their property	Not sure	Not sure	Maybe	Not sure	Not sure	Maybe
LBL23		Maybe	Yes	No	Not sure	Yes	Yes
LBL24	They have too much control on what a landowner can do on their property	Not sure	Maybe	No	Yes	Maybe	Maybe
LBL25	Do not have an opinion	Yes	Yes	No	Yes	No	No
LBL26	They are helping the owners of Little Birch Lake	Yes	Yes	Maybe	Yes	Not sure	Maybe
LBL27	They are helping the owners of Little Birch Lake	Yes	Yes	No	Yes	Yes	Yes
LBL28	They are helping the owners of Little Birch Lake	Yes	Yes	No	Yes	Maybe	No
LBL29	Do not have an opinion	Yes	Yes	Maybe	Yes	Yes	Maybe
LBL30	They are helping the owners of Little Birch Lake	Yes	Yes	No	Yes	No	No
LBL31	They are helping the owners of Little Birch Lake	Yes	Yes	Yes	Yes	Yes	Yes
LBL32							
LBL33	They are helping the owners of Little Birch Lake	Yes	Yes	Yes	Yes	No	Yes
LBL34	They are helping the owners of Little Birch Lake	Yes	Yes	Maybe	Yes	Maybe	Yes
LBL35	They are helping the owners of Little Birch Lake	Yes	Yes	Yes	Yes	No	No
LBL36	They have too much control on what a landowner can do on their property	Yes	Yes	No	Yes	Yes	No
LBL37	They are helping the owners of Little Birch Lake	No	Yes	Maybe	Yes	Maybe	Maybe

LBL38	They have too much control on what a landowner can do on their property	Yes	Yes	Yes	Yes	Yes	Maybe
LBL39	Do not have an opinion	Yes	Yes	Yes	Yes	Yes	Yes
LBL40	Do not have an opinion	Yes	Yes	No	Yes	No	Yes
LBL41	They are helping the owners of Little Birch Lake	Yes	Yes	Maybe	Yes	Maybe	Maybe
LBL42	They are helping the owners of Little Birch Lake	Yes	Yes	Yes	Yes	Yes	Yes
LBL43	They are helping the owners of Little Birch Lake	No	Yes	Yes	Yes	No	Yes
LBL44	They have too much control on what a landowner can do on their property	Not sure	Not sure	Not sure	Not sure	Not sure	Not sure
LBL45	Do not have an opinion	Yes	Yes	No	Yes	No	Maybe
LBL46	They have too much control on what a landowner can do on their property	Yes	Yes	No	Maybe	No	No
LBL47	Do not have an opinion	Yes	Yes	No	Yes	No	No
LBL48	They are helping the owners of Little Birch Lake	Yes	Yes	Yes	Yes	Yes	Yes
LBL49	Do not have an opinion	Yes	Yes	Maybe	Yes	Not sure	Maybe
LBL50	Do not have an opinion	Yes	Yes	No	Yes	No	No
LBL51	Do not have an opinion	Yes	Yes	Not sure	Yes	Not sure	Not sure
LBL52	Do not have an opinion	Yes	Yes	Yes	Yes	Yes	Yes
LBL53	They are helping the owners of Little Birch Lake	Yes	Yes	No	Yes	Yes	Yes
LBL54	They are helping the owners of Little Birch Lake	Yes	Yes	Yes	Yes	Yes	Yes
LBL55	Do not have an opinion	Yes	Yes	Yes	Yes	Yes	No
LBL56	They are helping the owners of Little Birch Lake	Yes	Yes	Yes	Yes	Yes	Yes
LBL57	Do not have an opinion	Maybe	Yes	Maybe	Yes	Yes	Yes
LBL58	They are helping the owners of Little Birch Lake	Yes	Yes	Yes	Yes	Yes	Yes
LBL59	Do not have an opinion	Yes	Yes	Yes	Yes	Yes	Yes
LBL60	Do not have an opinion	Maybe	Not sure	No	Maybe	Not sure	No
LBL61	Do not have an opinion	Yes	Yes	Yes	Yes	Yes	Yes

LBL62	They have too much control on what a landowner can do on their property	Yes	Maybe	No	Yes	Yes	Yes
LBL63		Yes	Yes	No	Maybe	Yes	Yes
LBL64	They have too much control on what a landowner can do on their property	Yes	Yes	Yes	Yes	Yes	Yes
LBL65	Do not have an opinion	Yes	Yes	Not sure		No	No
LBL66	They are helping the owners of Little Birch Lake	Yes	Yes	Maybe	Yes	Maybe	Maybe
LBL67		Yes	Yes	Yes	Yes	No	Yes
LBL68	They have too much control on what a landowner can do on their property	Yes	Yes	No	Yes	No	No
LBL69	They are helping the owners of Little Birch Lake	Maybe	Yes	Maybe	Maybe		
LBL70	Do not have an opinion	Yes	Yes	No	Yes	Yes	Yes
LBL71	They have too much control on what a landowner can do on their property	Yes	Yes	Maybe	Yes	Maybe	Maybe
LBL72	They are helping the owners of Little Birch Lake	Yes	Yes	No	Yes	Maybe	Maybe
LBL73	Do not have an opinion	Not sure	Not sure	Maybe	Maybe	Maybe	Maybe
LBL74	They are helping the owners of Little Birch Lake	Yes	Yes	Yes	Yes	Yes	Yes
LBL75	They are helping the owners of Little Birch Lake	Yes	Yes	Maybe	Yes	No	No
LBL76	They are helping the owners of Little Birch Lake	No	Yes	No	No	No	No
LBL77	Do not have an opinion	Yes	Yes	Maybe	Yes	Maybe	Maybe
LBL78	They are helping the owners of Little Birch Lake	Yes	Yes	No	Yes	Maybe	No
LBL79	Do not have an opinion	Yes	Yes	Yes	Yes	Yes	Yes
LBL80	They are helping the owners of Little Birch Lake	Yes	Yes	Yes	Yes	Yes	Yes
LBL81	They are helping the owners of Little Birch Lake	Yes	Yes	Yes	Yes	Yes	Yes

LBL82	They are helping the owners of Little Birch Lake	Yes	Yes	Yes	Yes	Yes	Yes
LBL83	They are helping the owners of Little Birch Lake	Yes	Yes	Yes	Yes	Yes	Yes
LBL84		Yes	Yes	Yes	Yes	Yes	Yes
LBL85	They have too much control on what a landowner can do on their property	Yes	Yes	No	Yes	No	No
LBL86	Do not have an opinion	Maybe	Yes	Maybe	Yes	Yes	Maybe
LBL87	They are helping the owners of Little Birch Lake	Yes	Yes	Maybe	Yes	Yes	Maybe
LBL88	Do not have an opinion	Yes	Yes	No	Yes	No	No
LBL89	They are helping the owners of Little Birch Lake	Yes	Yes	Yes	Yes	Yes	
LBL90	Do not have an opinion	Yes	Yes	No	Yes	No	No
LBL91	They have too much control on what a landowner can do on their property	Yes	Yes	No	Maybe	Maybe	No
LBL92	They have too much control on what a landowner can do on their property	Maybe	Maybe	No	Maybe	Maybe	Maybe
LBL93	They are helping the owners of Little Birch Lake	Maybe	Maybe	Maybe	Maybe	No	No
LBL94	They are helping the owners of Little Birch Lake	Yes	Yes	Yes	Yes	Maybe	Yes
LBL95		Yes	Yes	Yes	Yes	Yes	Yes
LBL96	They have too much control on what a landowner can do on their property	Yes	Yes	No	Maybe	No	No
LBL97	Do not have an opinion	Maybe	Maybe	Not sure	Not sure	Not sure	Not sure
LBL98	Do not have an opinion	Yes	Yes	Not sure	Not sure	No	Not sure
LBL99	They have too much control on what a landowner can do on their property	Yes	Yes	No	Yes	Yes	No
LBL100	Do not have an opinion	Maybe	Maybe	Maybe	Not sure	Maybe	Maybe
LBL101	They have too much control on what a landowner can do on their property	Yes	Yes	Yes	Yes	Yes	Yes
LBL102	Do not have an opinion	Maybe	Maybe	Maybe	Maybe	Maybe	Maybe
LBL103	Do not have an opinion	Yes	Yes	Yes	Yes	Yes	Yes

LBL104	They are helping the owners of Little Birch Lake	Yes	Yes	Yes	Yes	Yes	Yes
LBL105	They are helping the owners of Little Birch Lake	Yes	Yes		Maybe		
LBL106	They are helping the owners of Little Birch Lake	Yes	Yes	Yes	Yes	Yes	Yes
LBL107		Not sure	Yes	No	Yes	Not sure	No
LBL108	They are helping the owners of Little Birch Lake	Yes	Yes	Maybe	Yes	Yes	Maybe
LBL109	They are helping the owners of Little Birch Lake	Yes	Yes	Yes	Yes	Yes	Yes
LBL110	They have too much control on what a landowner can do on their property	Yes	Yes	Maybe	Maybe	Maybe	Maybe
LBL111	They are helping the owners of Little Birch Lake	Yes	Yes	No	Yes	Yes	Maybe
LBL112	They have too much control on what a landowner can do on their property	Not sure	Maybe	No	Not sure	Maybe	No
LBL113	They are helping the owners of Little Birch Lake	Yes	Yes	No	Yes	Yes	Yes

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ID #	**What type of lakeshore do you have presently (choose all that apply)**	**Have you ever looked for information on water quality best management practices (BMPs)?**	**Have you already completed best management practices (BMPs) on your property?**	**Have you ever attended a water quality or BMPs workshop before?**	**If Yes, where and who put on the workshop?**	**How do you think runoff affects the LBL's water quality?**
LBL1	Trees and shrubs, Rip Rap (Rocky shoreline), Native perennials, trees and shrubs, No-mow zone (area next to the lake that you do not mow or weed whip)	If yes, where?, Internet, Magazines	If yes, what did you do and what year?, Shoreline Buffer (not mowing or weed whipping your shoreline), Low or no fertilizer on your lawn, Native Plants on your shoreline	Yes	Minnehaha WSD	Negatively
LBL2	Trees and shrubs, Sandy (beach), Rip Rap (Rocky shoreline), No-mow zone (area next to the lake that you do not mow or weed whip)	Yes, Internet, Little Birch Lake Improvement Association	Yes, Shoreline Buffer (not mowing or weed whipping your shoreline), Low or no fertilizer on your lawn	Yes	LBLA several years ago	Negatively
LBL3	Sandy (beach), Rip Rap (Rocky shoreline)	Yes	Low or no fertilizer on your lawn	No		Negatively

LBL4	Native perennials, trees and shrubs, No-mow zone (area next to the lake that you do not mow or weed whip)	No	No	No	Positively
LBL5	No-mow zone (area next to the lake that you do not mow or weed whip)	Little Birch Lake Improvement Association	No	No	Negatively
LBL6	Sandy (beach)	No	Low or no fertilizer on your lawn	No	Negatively
LBL7	Sandy (beach), Rip Rap (Rocky shoreline), No-mow zone (area next to the lake that you do not mow or weed whip)	Yes, Internet, Little Birch Lake Improvement Association	Yes, Low or no fertilizer on your lawn, Native Plants on your shoreline	No	Negatively
LBL8	Rip Rap (Rocky shoreline), Native perennials, trees and shrubs, No-mow zone (area next to the lake that you do not mow or weed whip)	No	Yes, If yes, what did you do and what year?, Shoreline Buffer (not mowing or weed whipping your shoreline), Low or no fertilizer on your lawn, Native Plants on your shoreline	No	Negatively
LBL9	Rip Rap (Rocky shoreline)	No	Low or no fertilizer on your lawn	No	Negatively
LBL10					Positively
LBL11	Sandy (beach), Turf grass	Yes, Little Birch Lake Improvement Association	No	No	Negatively
LBL12	Sandy (beach)	No	No	No	Negatively
LBL13	Native perennials, trees and shrubs	No	No	Yes	Negatively
LBL14	Landscaped/ornamental plants, Trees and shrubs, Rip Rap (Rocky shoreline), Native perennials, trees and shrubs	No	Yes, Low or no fertilizer on your lawn	No	Negatively
LBL15	Landscaped/ornamental plants, Trees and shrubs, Turf grass, Native perennials, trees and shrubs	Yes, Little Birch Lake Improvement Association	Yes, Shoreline Buffer (not mowing or weed whipping your shoreline), Rain Barrel, Low or no fertilizer on your lawn, Native Plants on your shoreline	No	Not at All
LBL16	Sandy (beach)	No	No	No	Not Sure
LBL17	Native perennials, trees and shrubs	No	No	No	Negatively
LBL18	Rip Rap (Rocky shoreline), Native perennials, trees and shrubs, No-mow zone (area next to the lake that you do not mow or weed whip)	No	Shoreline Buffer (not mowing or weed whipping your shoreline), Low or no fertilizer on your lawn, Native Plants on your shoreline	No	Negatively

LBL19	Trees and shrubs, Native perennials, trees and shrubs, No-mow zone (area next to the lake that you do not mow or weed whip)	Yes, Internet, Brochures, Magazines, Little Birch Lake Improvement Association	Yes, Shoreline Buffer (not mowing or weed whipping your shoreline), Low or no fertilizer on your lawn, Native Plants on your shoreline	No		Negatively
LBL20	Turf grass, Native perennials, trees and shrubs, No-mow zone (area next to the lake that you do not mow or weed whip)	No	No, Low or no fertilizer on your lawn, Native Plants on your shoreline	No		Negatively
LBL21	Trees and shrubs, Sandy (beach), Rip Rap (Rocky shoreline)	No	No	No		Negatively
LBL22	Trees and shrubs, Turf grass	No	No	No		Positively
LBL23	Trees and shrubs, Rip Rap (Rocky shoreline), Native perennials, trees and shrubs, No-mow zone (area next to the lake that you do not mow or weed whip)	No	Yes, Shoreline Buffer (not mowing or weed whipping your shoreline), Low or no fertilizer on your lawn	No		Positively
LBL24	Trees and shrubs, Rip Rap (Rocky shoreline), No-mow zone (area next to the lake that you do not mow or weed whip)	Yes, Little Birch Lake Improvement Association	Yes, Shoreline Buffer (not mowing or weed whipping your shoreline), Low or no fertilizer on your lawn	Yes	County?	Negatively
LBL25	Rip Rap (Rocky shoreline)	No	No	No		Negatively
LBL26	Trees and shrubs, Rip Rap (Rocky shoreline), No-mow zone (area next to the lake that you do not mow or weed whip)	Yes, Little Birch Lake Improvement Association	Yes, Shoreline Buffer (not mowing or weed whipping your shoreline), Low or no fertilizer on your lawn	No		Negatively
LBL27	Rip Rap (Rocky shoreline), Native perennials, trees and shrubs	Yes, Little Birch Lake Improvement Association	Yes, Low or no fertilizer on your lawn, Native Plants on your shoreline	No		Negatively
LBL28	Native perennials, trees and shrubs	No	No	No		Negatively
LBL29	Rip Rap (Rocky shoreline)	No	No	No		Not Sure
LBL30	Sandy (beach), Native perennials, trees and shrubs	Yes, Internet	Rain Garden, Low or no fertilizer on your lawn, Native Plants on your shoreline	No		Negatively
LBL31	Native perennials, trees and shrubs, No-mow zone (area next to the lake that you do not mow or weed whip)	No	No	No		Positively
LBL32	Rip Rap (Rocky shoreline), No-mow zone (area next to the lake that you do not mow or weed whip)	Yes, Little Birch Lake Improvement Association	No	No		

LBL33	Rip Rap (Rocky shoreline), Native perennials, trees and shrubs	No	No	No		Negatively
LBL34	Rip Rap (Rocky shoreline)	Yes	Yes	Yes	state and county	Negatively
LBL35	Trees and shrubs	No	Yes, Low or no fertilizer on your lawn	No		Negatively
LBL36	Trees and shrubs	No	No	No		Negatively
LBL37	Sandy (beach), No-mow zone (area next to the lake that you do not mow or weed whip)	Yes, Little Birch Lake Improvement Association	Yes	Yes	SRWD	Negatively
LBL38	Sandy (beach), Rip Rap (Rocky shoreline), Native perennials, trees and shrubs, No-mow zone (area next to the lake that you do not mow or weed whip)	Yes, Brochures, Magazines, Little Birch Lake Improvement Association	Yes, Low or no fertilizer on your lawn, Native Plants on your shoreline	No		Negatively
LBL39	Rip Rap (Rocky shoreline), Native perennials, trees and shrubs, No-mow zone (area next to the lake that you do not mow or weed whip)	No	No	No		Negatively
LBL40	Rip Rap (Rocky shoreline), Native perennials, trees and shrubs, No-mow zone (area next to the lake that you do not mow or weed whip)	No, Little Birch Lake Improvement Association	No	No		Not Sure
LBL41	Turf grass	Yes, Brochures, Books, Little Birch Lake Improvement Association	Yes, Shoreline Buffer (not mowing or weed whipping your shoreline), Low or no fertilizer on your lawn	Yes		Negatively
LBL42	Native perennials, trees and shrubs, No-mow zone (area next to the lake that you do not mow or weed whip)	Yes, Internet, Brochures, Little Birch Lake Improvement Association	Yes, Native Plants on your shoreline		LBL meetings	Negatively
LBL43	Native perennials, trees and shrubs, No-mow zone (area next to the lake that you do not mow or weed whip)	Yes, Brochures, Little Birch Lake Improvement Association	Yes, Shoreline Buffer (not mowing or weed whipping your shoreline), Low or no fertilizer on your lawn, Native Plants on your shoreline	Yes		
LBL44	Trees and shrubs, Sandy (beach), Rip Rap (Rocky shoreline)	No	Yes, If yes, what did you do and what year?, Low or no fertilizer on your lawn	No		Positively

LBL45	Sandy (beach), Rip Rap (Rocky shoreline), No-mow zone (area next to the lake that you do not mow or weed whip)	No	Yes, Low or no fertilizer on your lawn	No		Not Sure
LBL46	Trees and shrubs, Sandy (beach), Turf grass	No	No	No		Negatively
LBL47	Turf grass, Rip Rap (Rocky shoreline), Native perennials, trees and shrubs, No-mow zone (area next to the lake that you do not mow or weed whip)	No	No	No		Not Sure
LBL48	Sandy (beach), Rip Rap (Rocky shoreline), No-mow zone (area next to the lake that you do not mow or weed whip)	Yes, Brochures, Books, Magazines, Little Birch Lake Improvement Association	Yes, Shoreline Buffer (not mowing or weed whipping your shoreline), Low or no fertilizer on your lawn, Native Plants on your shoreline	No		Negatively
LBL49	Trees and shrubs, Sandy (beach), Native perennials, trees and shrubs	No	No	No		Negatively
LBL50	Trees and shrubs, Sandy (beach), Rip Rap (Rocky shoreline)	No, Little Birch Lake Improvement Association	Yes, Low or no fertilizer on your lawn	No		Not Sure
LBL51	Trees and shrubs, Sandy (beach), Rip Rap (Rocky shoreline)	No	Yes, Low or no fertilizer on your lawn	No		Not Sure
LBL52	Turf grass, Native perennials, trees and shrubs, No-mow zone (area next to the lake that you do not mow or weed whip)	Yes, Little Birch Lake Improvement Association	No	No		Negatively
LBL53	Rip Rap (Rocky shoreline), Native perennials, trees and shrubs, No-mow zone (area next to the lake that you do not mow or weed whip)	Yes, If yes, where?, Brochures, Little Birch Lake Improvement Association	Yes, If yes, what did you do and what year?, Shoreline Buffer (not mowing or weed whipping your shoreline), Low or no fertilizer on your lawn, Native Plants on your shoreline	Yes	U of M	Negatively
LBL54	Rip Rap (Rocky shoreline)	No	No	No		Not Sure
LBL55	Turf grass, Rip Rap (Rocky shoreline)	No	No	No		Negatively
LBL56	Trees and shrubs, Turf grass, Rip Rap (Rocky shoreline), Native perennials, trees and shrubs	Yes, Internet, Books, Magazines, Little Birch Lake Improvement Association, Other	Yes, Shoreline Buffer (not mowing or weed whipping your shoreline), Low or no fertilizer on your lawn, Native Plants on your shoreline	Yes	SRWD	Negatively

LBL57	Trees and shrubs, Turf grass, Native perennials, trees and shrubs	Yes, Internet, Brochures, Books	Yes, Low or no fertilizer on your lawn	Yes		Negatively
LBL58	Sandy (beach), Turf grass, Rip Rap (Rocky shoreline)	Yes, Little Birch Lake Improvement Association	No	Yes	LBLA Meetings	Negatively
LBL59	Native perennials, trees and shrubs, No-mow zone (area next to the lake that you do not mow or weed whip)	No	Yes, Shoreline Buffer (not mowing or weed whipping your shoreline), Low or no fertilizer on your lawn, Native Plants on your shoreline	No		Negatively
LBL60	Turf grass, Rip Rap (Rocky shoreline)	No	No	No		Not Sure
LBL61	Native perennials, trees and shrubs, No-mow zone (area next to the lake that you do not mow or weed whip)		Yes, Shoreline Buffer (not mowing or weed whipping your shoreline), Rain Barrel, Low or no fertilizer on your lawn	No		Negatively
LBL62	Sandy (beach)	Little Birch Lake Improvement Association, Other	Yes, Rain Garden, Rain Barrel	No		Negatively
LBL63	Sandy (beach), Native perennials, trees and shrubs, No-mow zone (area next to the lake that you do not mow or weed whip)	Yes, Internet, Brochures, Books, Magazines, Little Birch Lake Improvement Association	Rain Garden, Shoreline Buffer (not mowing or weed whipping your shoreline), Rain Barrel, Low or no fertilizer on your lawn, Native Plants on your shoreline	No		Negatively
LBL64	Trees and shrubs, No-mow zone (area next to the lake that you do not mow or weed whip)	Yes, Internet, Little Birch Lake Improvement Association	Yes, Low or no fertilizer on your lawn, Native Plants on your shoreline	No		Negatively
LBL65	Trees and shrubs, Rip Rap (Rocky shoreline)	Yes, Internet, Brochures, Books, Magazines		No		Negatively
LBL66	Trees and shrubs, Sandy (beach), Turf grass, Native perennials, trees and shrubs	Yes, Little Birch Lake Improvement Association, Other	Low or no fertilizer on your lawn, Native Plants on your shoreline	No		Negatively
LBL67	Sandy (beach)	Yes, Internet, Little Birch Lake Improvement Association	Yes, Shoreline Buffer (not mowing or weed whipping your shoreline), Low or no fertilizer on your lawn, Native Plants on your shoreline	No		Negatively
LBL68	Trees and shrubs, Sandy (beach)	No	No	No		Negatively
LBL69	Trees and shrubs, Rip Rap (Rocky shoreline), Native perennials, trees and shrubs, No-mow zone (area next to the lake that you do not mow or weed whip)	Yes, Books, Magazines, Little Birch Lake Improvement Association	Yes, Native Plants on your shoreline	No		Positively

LBL70	Rip Rap (Rocky shoreline), Native perennials, trees and shrubs, No-mow zone (area next to the lake that you do not mow or weed whip)		Yes, Shoreline Buffer (not mowing or weed whipping your shoreline), Low or no fertilizer on your lawn, Native Plants on your shoreline	No	Negatively
LBL71	Turf grass	Yes, Internet, Books, Magazines	No, Low or no fertilizer on your lawn	No	Negatively
LBL72	Rip Rap (Rocky shoreline), Native perennials, trees and shrubs	No	Yes, Low or no fertilizer on your lawn	No	Negatively
LBL73	Turf grass, Native perennials, trees and shrubs	No	Yes, Low or no fertilizer on your lawn	No	
LBL74	Landscaped/ornamental plants, Trees and shrubs, Rip Rap (Rocky shoreline), Native perennials, trees and shrubs, No-mow zone (area next to the lake that you do not mow or weed whip)	Yes, Internet, Brochures, Books, Magazines, Little Birch Lake Improvement Association	Yes, Shoreline Buffer (not mowing or weed whipping your shoreline), Low or no fertilizer on your lawn, Native Plants on your shoreline	No	Negatively
LBL75	Trees and shrubs, Turf grass	No	No	No	Not Sure
LBL76	Sandy (beach), No-mow zone (area next to the lake that you do not mow or weed whip)	No	Yes, Shoreline Buffer (not mowing or weed whipping your shoreline), Low or no fertilizer on your lawn	No	Negatively
LBL77	Rip Rap (Rocky shoreline), Native perennials, trees and shrubs, No-mow zone (area next to the lake that you do not mow or weed whip)	No	No	No	Not Sure
LBL78	Sandy (beach), Turf grass, Rip Rap (Rocky shoreline)	No	No	No	Negatively
LBL79	Rip Rap (Rocky shoreline), No-mow zone (area next to the lake that you do not mow or weed whip)	Yes, Little Birch Lake Improvement Association	Yes, Shoreline Buffer (not mowing or weed whipping your shoreline), Low or no fertilizer on your lawn, Native Plants on your shoreline	No	
LBL80	Turf grass, Native perennials, trees and shrubs, No-mow zone (area next to the lake that you do not mow or weed whip)	Yes, Magazines, Little Birch Lake Improvement Association	Yes, Shoreline Buffer (not mowing or weed whipping your shoreline), Low or no fertilizer on your lawn, Native Plants on your shoreline	No	Negatively
LBL81	Trees and shrubs, Rip Rap (Rocky shoreline), No-mow zone (area next to the lake that you do not mow or weed whip)	No	Yes, Shoreline Buffer (not mowing or weed whipping your shoreline), Low or no fertilizer on your lawn, Native Plants on your shoreline	No	Negatively

LBL82	Turf grass, Native perennials, trees and shrubs, No-mow zone (area next to the lake that you do not mow or weed whip)	Yes, Brochures, Little Birch Lake Improvement Association	Yes, Low or no fertilizer on your lawn	No		Negatively
LBL83	Trees and shrubs, No-mow zone (area next to the lake that you do not mow or weed whip)	Yes, Magazines, Little Birch Lake Improvement Association	Yes, Shoreline Buffer (not mowing or weed whipping your shoreline), Low or no fertilizer on your lawn, Native Plants on your shoreline	No		Negatively
LBL84	Turf grass, Native perennials, trees and shrubs, No-mow zone (area next to the lake that you do not mow or weed whip)	Yes, Internet, Little Birch Lake Improvement Association	Yes, Shoreline Buffer (not mowing or weed whipping your shoreline), Low or no fertilizer on your lawn, Native Plants on your shoreline	No		Negatively
LBL85	Rip Rap (Rocky shoreline)	No	No	No		Negatively
LBL86	Trees and shrubs, Rip Rap (Rocky shoreline), No-mow zone (area next to the lake that you do not mow or weed whip)	No	Yes, Shoreline Buffer (not mowing or weed whipping your shoreline)	No		Negatively
LBL87	Sandy (beach), Turf grass	Yes, Little Birch Lake Improvement Association	Yes, Low or no fertilizer on your lawn	No		Negatively
LBL88	Trees and shrubs, Sandy (beach), Rip Rap (Rocky shoreline)	No	No	No		Negatively
LBL89	Trees and shrubs, No-mow zone (area next to the lake that you do not mow or weed whip)	Yes, Little Birch Lake Improvement Association	Yes, Shoreline Buffer (not mowing or weed whipping your shoreline), Low or no fertilizer on your lawn, Native Plants on your shoreline	Yes	Former lake assn president	Positively
LBL90	Rip Rap (Rocky shoreline)	No	No	No		Negatively
LBL91	Landscaped/ornamental plants, Trees and shrubs, Turf grass, Rip Rap (Rocky shoreline), No-mow zone (area next to the lake that you do not mow or weed whip)	No	Yes, Shoreline Buffer (not mowing or weed whipping your shoreline), Rain Barrel	No		Negatively
LBL92	Trees and shrubs, Rip Rap (Rocky shoreline), Native perennials, trees and shrubs	Yes, Internet, Other	Yes, Low or no fertilizer on your lawn, Native Plants on your shoreline	No		Negatively
LBL93	Sandy (beach), Native perennials, trees and shrubs	No	No, Low or no fertilizer on your lawn	No		
LBL94	Turf grass, No-mow zone (area next to the lake that you do not mow or weed whip)	No	No	Yes	SRWD	Negatively

LBL95	Rip Rap (Rocky shoreline)	Yes, Little Birch Lake Improvement Association	Yes, Shoreline Buffer (not mowing or weed whipping your shoreline), Low or no fertilizer on your lawn			Negatively
LBL96	Native perennials, trees and shrubs, No-mow zone (area next to the lake that you do not mow or weed whip)		Yes, Shoreline Buffer (not mowing or weed whipping your shoreline), Low or no fertilizer on your lawn, Native Plants on your shoreline	No		Negatively
LBL97	Sandy (beach), Turf grass, Native perennials, trees and shrubs	No	No	No		Negatively
LBL98	Rip Rap (Rocky shoreline)	No	No	No		Not Sure
LBL99	Trees and shrubs, Native perennials, trees and shrubs, No-mow zone (area next to the lake that you do not mow or weed whip)	Other	No, Shoreline Buffer (not mowing or weed whipping your shoreline), Low or no fertilizer on your lawn	Yes	back in school years ago	Negatively
LBL100	Trees and shrubs, Sandy (beach)	No	No	No		Not Sure
LBL101	No-mow zone (area next to the lake that you do not mow or weed whip)	No	Yes, Shoreline Buffer (not mowing or weed whipping your shoreline), Low or no fertilizer on your lawn, Native Plants on your shoreline	No		Negatively
LBL102	Sandy (beach), Rip Rap (Rocky shoreline), Native perennials, trees and shrubs	Yes, Internet, Brochures, Little Birch Lake Improvement Association	Yes, Low or no fertilizer on your lawn	No		Not Sure
LBL103	Sandy (beach), Native perennials, trees and shrubs, No-mow zone (area next to the lake that you do not mow or weed whip)	Yes, Brochures, Books	Yes, Shoreline Buffer (not mowing or weed whipping your shoreline), Low or no fertilizer on your lawn, Native Plants on your shoreline	No		Negatively
LBL104	Turf grass, Rip Rap (Rocky shoreline), Native perennials, trees and shrubs	Yes, Little Birch Lake Improvement Association	Yes, Low or no fertilizer on your lawn	No		Negatively
LBL105	Turf grass	Yes, Little Birch Lake Improvement Association	No	No		Negatively
LBL106	Trees and shrubs, Rip Rap (Rocky shoreline), Native perennials, trees and shrubs	Yes, Brochures, Little Birch Lake Improvement Association, Other	Yes, Shoreline Buffer (not mowing or weed whipping your shoreline), Low or no fertilizer on your lawn, Native Plants on your shoreline	Yes	at out annual meeting	Negatively
LBL107	Sandy (beach), Rip Rap (Rocky shoreline)	No	Yes, Low or no fertilizer on your lawn	No		Negatively

LBL108	Native perennials, trees and shrubs	Yes, Internet, Brochures, Little Birch Lake Improvement Association	No	Yes	Stearns co. soil and water conservation	Negatively
LBL109	Rip Rap (Rocky shoreline), Native perennials, trees and shrubs, No-mow zone (area next to the lake that you do not mow or weed whip)	Yes, Internet, Brochures, Little Birch Lake Improvement Association, Other	Yes, Shoreline Buffer (not mowing or weed whipping your shoreline), Native Plants on your shoreline	Yes	LBLA	Positively
LBL110	Sandy (beach), Turf grass, Native perennials, trees and shrubs	Yes, Magazines, Little Birch Lake Improvement Association	No, Low or no fertilizer on your lawn, Native Plants on your shoreline	No		Negatively
LBL111	Landscaped/ornamental plants, Trees and shrubs, Native perennials, trees and shrubs, No-mow zone (area next to the lake that you do not mow or weed whip)	Yes, Internet	Yes, Low or no fertilizer on your lawn, Native Plants on your shoreline	No		Negatively
LBL112	Turf grass	Yes	No	No		Not Sure
LBL113	Trees and shrubs, Rip Rap (Rocky shoreline)	Yes, Internet, Brochures, Little Birch Lake Improvement Association, Other	No	No		Negatively

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ID #	**Do you think over fertilizing your lawn affects LBL water quality?**	**Do you think reducing runoff from you property will affect the water quality of LBL?**	**Do you think native plants protect the shoreline and filter runoff better than non-native plants/turf grass?**	**What types of BMPs would help decrease the runoff from the property around LBL (choose all that apply)?**	**Would you be interested in implementing BMPs?**
LBL1	Yes	No	Yes	Native Plant Buffer, All of the above	Yes
LBL2	Yes	Yes	Yes	Native Plant Buffer	Need more information
LBL3	Yes	Not Sure	Not sure	Rain Gardens, Rain Barrels, Native Plant Buffer	Need more information
LBL4	Yes	No	Yes	Native Plant Buffer	No
LBL5	Yes	Yes	Yes		No
LBL6	Yes	No	Yes		
LBL7	Yes	Yes	Yes	Rain Gardens, Rain Barrels, Native Plant Buffer, All of the above	Yes
LBL8	Yes	Yes	Yes	Rain Gardens, Rain Barrels, Native Plant Buffer, Other	Need more information

LBL9	Yes	Not Sure		All of the above	
LBL10	Yes	Yes	Yes	Rain Gardens, Rain Barrels, Native Plant Buffer	Yes
LBL11	Not Sure	Yes	Yes	Native Plant Buffer	No
LBL12	Yes	Yes	Yes	Rain Gardens	Need more information
LBL13	Yes	Yes	No	Rain Gardens, Rain Barrels, Native Plant Buffer, All of the above	No
LBL14	Yes	No	No	Rain Gardens, Rain Barrels	Need more information
LBL15	No	Not Sure		Native Plant Buffer	Need more information
LBL16	Not Sure	Not Sure	No	None of the above	No
LBL17	Yes	Yes	No	All of the above	Need more information
LBL18	Yes	Not Sure	Not sure	Native Plant Buffer	Need more information
LBL19	Yes	Yes	Yes	All of the above	Need more information
LBL20	Yes	Yes	Yes	Native Plant Buffer	No
LBL21	Yes	Yes	Not sure	None of the above	Need more information
LBL22	Yes	No	Not sure	Other	Need more information
LBL23	Yes	Yes	Yes	All of the above	Yes
LBL24	Yes	No	Yes		Need more information
LBL25		Yes	Not sure	None of the above	Need more information
LBL26	Yes	Yes	Not sure	All of the above	Need more information
LBL27	Yes	Not Sure	Yes	Native Plant Buffer	Yes
LBL28	Yes	Yes	Yes	All of the above	Yes
LBL29	Yes	Not Sure	Yes	Native Plant Buffer	Need more information
LBL30	Yes	Yes	Not sure	All of the above	Yes
LBL31	Yes	Yes	Yes	Rain Gardens, Rain Barrels, Native Plant Buffer, All of the above	Yes
LBL32					
LBL33	Yes	No	Yes		Need more information
LBL34		Yes	Not sure	Rain Gardens, Native Plant Buffer	Need more information
LBL35	Yes	Yes		All of the above	No
LBL36	Yes	Yes	Yes	All of the above	Yes
LBL37	Yes	Yes	Yes	Rain Barrels, All of the above	Yes
LBL38	Yes	Yes	Yes	Rain Gardens, Rain Barrels, Native Plant Buffer, All of the above	Need more information
LBL39	Yes	Yes	Yes	All of the above	

LBL40	Yes	Yes	Yes	Native Plant Buffer	No
LBL41	No	Yes	Yes	All of the above	No
LBL42	Yes	Yes	Yes	Rain Gardens, Rain Barrels, Native Plant Buffer, All of the above	
LBL43	No	No	Yes	Native Plant Buffer, All of the above	
LBL44	Yes	Yes	Not sure	Other	No
LBL45	Yes	Not Sure	Yes	Native Plant Buffer	No
LBL46	Not Sure	No	Not sure	All of the above	Need more information
LBL47	Yes	Yes	No		Yes
LBL48	Yes	Yes	Yes	Rain Gardens, Rain Barrels, Native Plant Buffer, All of the above	Yes
LBL49	Yes	Not Sure	Not sure		No
LBL50	Yes	Yes	Yes	All of the above	No
LBL51	Not Sure	Not Sure	Not sure		Need more information
LBL52	Yes	No	Yes	All of the above	Yes
LBL53	Yes	Yes	Yes	Rain Barrels, Native Plant Buffer	No
LBL54	Yes	Not Sure	Yes	All of the above	Need more information
LBL55	Yes	Yes	Yes	All of the above	No
LBL56	Yes	Yes	Yes	Rain Gardens, Rain Barrels, Native Plant Buffer	Yes
LBL57	Yes	Not Sure		Native Plant Buffer, All of the above	Need more information
LBL58	Yes	Yes	Yes	All of the above	Yes
LBL59	Yes	Yes	Yes	All of the above	Yes
LBL60	Yes	Not Sure	Not sure		Need more information
LBL61	Yes	Not Sure	Yes	Rain Gardens, Rain Barrels, Native Plant Buffer, All of the above	
LBL62	Not Sure	No	Not sure		No
LBL63	Yes	Yes	Not sure	All of the above	Yes
LBL64	Yes	Yes	Yes	Rain Gardens, Native Plant Buffer	Need more information
LBL65	Yes	Yes	Yes		Need more information
LBL66	Yes	Yes		Rain Gardens, Rain Barrels, Native Plant Buffer	No
LBL67	No	No	Yes	Rain Gardens, Rain Barrels, Native Plant Buffer, All of the above	Need more information
LBL68	No	Yes	Yes	None of the above	No
LBL69	No	Yes	Not sure	All of the above	
LBL70	Yes	Yes	Yes	Native Plant Buffer	Need more information
LBL71	Yes	Not Sure	Yes	All of the above	Yes
LBL72	Yes	Yes	Not sure	Rain Gardens, Rain Barrels, Native Plant Buffer, All of the above	Yes
LBL73	Yes	Not Sure	Not sure		Need more information
LBL74	Yes	Yes	Yes	Rain Gardens, Rain Barrels, Native Plant Buffer, All of the above	Yes

LBL75	Yes	No	Yes		
LBL76	No	No	No		No
LBL77	Yes	Yes	Not sure	Other	Need more information
LBL78	Yes	Not Sure	Yes	Native Plant Buffer	Need more information
LBL79	Yes	Yes	Yes	All of the above	Need more information
LBL80	Yes	Yes		All of the above	Yes
LBL81	Yes	Yes	Yes	All of the above	Yes
LBL82	Yes	Yes	Yes	Rain Gardens, Rain Barrels, Native Plant Buffer, All of the above	Yes
LBL83	Yes	Yes	Yes	Native Plant Buffer	No
LBL84	Yes	No	Yes	All of the above	Yes
LBL85	Yes	Yes	Not sure		No
LBL86	No	No	Yes	Native Plant Buffer, Other	Need more information
LBL87	Yes	Yes	Not sure	All of the above	No
LBL88	No	Yes	No	Other	Need more information
LBL89	Yes	No	Yes	Rain Gardens, Rain Barrels, Native Plant Buffer	Yes
LBL90	Yes	Yes	Yes	Native Plant Buffer	No
LBL91	Yes	Yes	Yes	Rain Gardens, Rain Barrels, Native Plant Buffer, All of the above	Yes
LBL92	No	No	Yes	Rain Barrels, All of the above	Need more information
LBL93	Yes	Yes	Not sure		No
LBL94	Yes	Not Sure	Yes	Native Plant Buffer	Need more information
LBL95	Yes	Yes	Yes	All of the above	Yes
LBL96	Not Sure	Yes	Yes	Native Plant Buffer	No
LBL97	Yes	Yes	Not sure		Need more information
LBL98	Yes	No	Not sure		Need more information
LBL99	Yes	Yes	Yes	Native Plant Buffer, Other	Yes
LBL100	Yes	No	Not sure	Rain Gardens, Native Plant Buffer	Need more information
LBL101	Yes	Yes	Yes	All of the above	Yes
LBL102	Yes	Not Sure	Not sure	All of the above	Need more information
LBL103	Yes	Yes	Yes		Need more information
LBL104	Yes	Not Sure	Yes	All of the above	Need more information
LBL105	Yes	Yes	Yes	Native Plant Buffer	Need more information
LBL106	Yes	Yes	Yes	Rain Gardens, Rain Barrels, Native Plant Buffer, All of the above	
LBL107	Not Sure	No	Not sure	Other	Need more information
LBL108	Yes	Yes	Yes	Rain Gardens, Rain Barrels, Native Plant Buffer	Yes
LBL109	Yes	Yes	Yes	All of the above	Need more information

LBL110	Yes	No	Not sure	Native Plant Buffer	Need more information
LBL111	Yes	Yes	Not sure	All of the above	Need more information
LBL112	Not Sure	Not Sure	Not sure		Need more information
LBL113	Yes	Yes	Yes	Rain Gardens, Native Plant Buffer	Yes