

### Introduction

The many lakes located in Minnesota have played a large role in building the culture and economic structure in towns across the state. This culture relies on the preservation of these lakes and maintaining their high water quality. Often, agriculture and urban pollution are thought of when it comes to the degradation of lake quality. However, another issue that threatens the integrity of water quality and lake ecosystems is shoreline alteration and the removal of aquatic plants. These actions can negatively affect water quality, as well as harm the biological inhabitants of the lake in various ways. This project explores the question of how these actions can affect lake ecosystems with the goal of identifying which removal methods are most beneficial for both the owner and the environment

### Methods

**Literature reviews** - These studies were reviewed to find general information on aquatic plants and what kind of negative impacts that the removal of these plants could have. They also provided information on removal techniques.

**Interviews** - Interviews with an aquatic botanist and an aquatic plant management specialist with the DNR provided information on the general benefits plants bring to freshwater ecosystems, what methods of removal are most common, and which are most environmentally friendly.

**Survey** - A survey was sent out to a number of lake property owners to gather data on why they alter their shorelines and to estimate the level of knowledge on this issue.

The scores given in Table 1 were determined based off of the data found in the literature reviews and the input from the professionals.

### Results

#### Biological Methods

- Biological methods are the use of certain species, like the grass carp, to remove the targeted plant species.
- Can be harmful to a lake if too many of a certain species are applied to the targeted area.
- Overall are the least harmful to the environment.

#### Chemical Methods

- Chemical methods use herbicides to kill off the targeted plant.
- They can be harmful to untargeted species when products with high toxicity are used.
- They are the least environmentally friendly method of removal.

#### Mechanical Methods

- Mechanical methods use tools like rakes to either pull or cut the plants out of the water.
- These methods disturb the lakebed, causing sediments to be suspended, hindering water clarity.
- Based off of it's environmental impacts and total cost and effectiveness , the mechanical methods should be used most by property owners .

**Table 1:** This table shows the environmental impacts of each category of removal methods on a scale from high to low.

	Biological Impact	Water Quality Impact	Human Health Impact
<b>Chemical</b>	High	Medium	Medium
<b>Mechanical</b>	Medium	Medium	Low
<b>Biological</b>	Medium	Low	Low



**Figure 1:** This image shows a before and after comparison of shoreline alteration and aquatic plant removal

Average Knowledge of Environmental Sustainability



Figure 2: This is a bar graph showing owners who have and have not removed plants from their property's average knowledge of environmental sustainability according to the survey.

Average Knowledge of Environmental



Figure 3: This is a bar graph showing owners who have and have not altered their shorelines' average knowledge of environmental sustainability according to the survey.

### Conclusion

The removal of aquatic plants by lake homeowners can have an impact on many aspects of lake ecosystems. It can have negative effects on the water quality within lakes, ultimately effecting those who live on the lake, as well as the species living in the lake. When done properly, there are techniques that can be used to avoid significant environmental harm. It would be extremely beneficial to implement systems within organizations like lake associations to improve the infrastructure for providing environmental information and knowledge to lake property owners. There are many motives for owners to alter their shoreline, including aesthetic appeal, accessibility and recreation, but with more knowledge of the topic, homeowners would be more likely to use precaution when managing their properties.