

# **Community Assistantship Program**

## **Analysis of Impacts of Land Use Patterns on General Development Lakes in Rice County, Minnesota**

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# **Analysis of Impacts of Land Use Patterns on General Development Lakes in Rice County, Minnesota**

Conducted on behalf of  
Rice County Planning and Zoning Department

Prepared by  
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**CURA RESOURCE COLLECTION**

**Center for Urban and Regional Affairs  
University of Minnesota  
330 Humphrey Center**

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## **CAP Acknowledgement/Disclaimer**

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## **Executive Summary**

This purpose of this project is to determine the impacts of land use patterns on the General Development Lakes (GDS) in Rice County. Due to the interest and concern of Rice County citizens to correct water quality problems in their lakes, the Rice County Planning and Zoning Department has implemented this study as a starting point for future research and planning projects. The goals of this project are the following:

- \* Determine the land use surrounding each GDS lake using aerial photography, site visits, and the best available information.
- \* Creation of a land use map for each individual GDS lake in Rice County.
- \* Report on the state of current land use for the GDS lakes in Rice County. With report, conduct a brief literature review of other studies that have looked at land use impacts around fresh water lakes with the emphasis on regional studies (Northern temperate freshwater lakes).
- \* Relate how land use around the 6 GDS lakes affects their watersheds, and more specifically the Cannon River watershed.
- \* Speak with local lake associations to obtain local input upon the project and the future development and protection of the GDS lakes.
- \* Develop a lake property owner's survey in order to gather information from community members regarding their concerns about the lakes. Communicate these findings in the report.

The results of this study indicate that there are many land use impacts affecting the GDS lakes of Rice County. The land use maps demonstrate that the increasing amount of land devoted to agricultural and residential uses are threatening these lakes. The citizen's comments from the property owner's survey reveal the many negative effects nutrient and contaminant runoff is having on the lakes. This study looks at these evident problems and offers suggestions for future development strategies as well as lake restoration efforts.

## **Analysis of Impacts of Land Use Patterns on General Development Lakes (GDS) in Rice County**

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### **Abstract**

Rice County, Minnesota is expanding, as are the development pressures placed on it. In efforts to study the effects of its growth, including the environmental and socio-economic impacts on the area lakes, the Rice County Planning and Zoning office is developing a Community Based Plan. This plan will include research into the general development lakes (GDS) in Rice County, the first lakes to be developed in the county. These lakes are threatened by the ever-increasing housing and recreation developments that have become commonplace in Rice County. Due to their agricultural and residential setting, the lakes are greatly impacted by upland runoff and shoreland practices, making most of them eutrophic or hypereutrophic. Many GDS lake lots are non-conforming in lot area and setback requirements since they were platted before zoning laws. Furthermore, all of the GDS lakes are located in the Cannon River watershed, which has been prioritized by State and Federal agencies due to its degraded water quality of its lakes and streams.

Rice County Planning and Zoning has implemented this study in order to research the land use impacts on the GDS lakes. Using Geographic Information Systems (GIS) and a property owner's survey as the main tools for collecting data, this study analyzes the effects of land use on the lakes both spatially, through GIS mapping, as well as verbally, through the comments and concerns of Rice County citizens. The results of this study will be used to identify land use patterns around the lake, and will guide future lake management plans and improvement projects. This evaluation will also be useful in developing the Rice County Comprehensive Land Use Plan.

The mapping results prove that the GDS lakes are greatly impacted by their surrounding land use. The results of the survey identify the problems occurring on the lakes. Due to increasing erosion, weed infestations, nutrient contamination and algal blooms, these lakes have become less desirable for the very reasons the people of Rice County live there. Rice County citizens and members of the local government are interested in determining the causes of the detrimental impacts on the water quality of the lakes, as well as how to correct them. Restoration, education on shoreland best management practices, and local government protection policies are the solution for restoring the lakes and the experiences one has there.

## Introduction

Minnesota is known for its many lakes and for their recreational and spiritual value. Throughout the state, people are drawn to their beauty, and for the experiences they have there. Rice County, Minnesota is no exception. Rice County is a diverse and valuable county, enriched with land and water resources for agriculture, as well as many recreational, residential and economic opportunities. Its landscape is a mosaic of unique patterns, consisting of flat grasslands in the east and rolling forested terrain in the north and west. The many lakes that are scattered throughout the county typify this region, and draw people to them for their beautiful scenery and recreational opportunities.

Throughout the county however, increasing development is threatening these lakes. Where once there were seasonal cabins and small resort communities, there now exist many year-round homes around the general development lakes (GDS) of Rice County. With this growth arise conflicting ideals about how to develop around these lakes. Where one family may choose to use the lake as a simple escape place, another family may prefer it to be their permanent residence. Since everything one does on his property affects the experience others may have there, differences may arise. This issue coupled with the increasing agricultural and residential pollution that has affected the quality of the lakes creates a problem in which the goal is to find a balance between the many differing values as well as a solution for restoring the lake to its historic condition.

Lakes are linked to a larger social and economic system. Regional effects of contaminant deposition and the potential effects of global climate change influence their quality (McKnight et al. 1996 in Carpenter and Cottingham 1997). The rural, agricultural and residential landscape surrounding each GDS lake has a direct influence on the quality of the lake. Agricultural runoff can lead to eutrophication of the lakes by adding herbicides, pesticides and nutrients into their waters. These contaminants inevitably lead to a disruption in the balance of the ecosystem, contributing to a change in the vegetation in and around the lake. This, in combination with a loss of game fish due to over-fishing can cause an increase in phytoplankton, which leads to algal blooms. Game fish are keystone predators that structure the food web below them (Kitchell and Carpenter 1993 in Carpenter and Cottingham 1997). They are important for grazing on forage fish and zooplankton, which in turn, feed off of phytoplankton. With a loss in these game fish, the phytoplankton isn't kept in check, and it ultimately increases, causing a depletion of macrophyte vegetation (beneficial aquatic plants), a depletion of oxygen and resulting algal blooms (Galatowitsch 2000, personal communication).

Residential shoreland practices also may decrease the water quality in the lake. The creation of beaches, removal of native vegetation, use of lawn fertilizers, and alteration along the shoreline all have negative impacts on the lake. Since the immediate edges of the GDS lakes are largely developed by residential land uses, it is important to look at where the negative impacts are occurring in order to educate property owners on the best lakescaping practices.

The focus of this study is to analyze the impacts of land use patterns on the six general development lakes (GDS) of Rice County. These lakes include: Cannon, Wells, Cedar, French, Roberds, and Shields. Through documentation of the existing land use surrounding these lakes, as well as of the concerns of Rice County citizens, this study aims to determine how the land use around the lakes and their associated problems have affected their watersheds, and most specifically the Cannon river watershed. Two data tools were used to analyze the impacts of land use on the GDS lakes. These are: the use of Geographic Information Systems (GIS) to map the land use around the lakes, and the analysis of 495 returned "lake property owner's surveys" used to identify concerns and pollution problems around the lakes. Both of these data tools are integral for the identification of land use patterns around the lake. This information can be used to guide future lake management plans and improvement projects, as well as preservation of remaining undeveloped land.

### **Literature Review:**

#### **Land Use Impacts on Northern Temperate Freshwater Lakes**

This Literature Review examines recent studies concerning land use impacts on other northern temperate freshwater lakes in Minnesota, and the surrounding Mid-Western region. In order to analyze the problems that the Rice County GDS lakes are encountering, it is important to research other cases that have researched similar issues. This section is organized into three categories: Minnesota Pollution Control Agency Studies, Other Studies Assessing Land Use and Water Quality, and Planning Strategies for Future Development. These resources provide information into scientific studies, community planning efforts, as well as future development ideas. These contemporary studies may serve as precedents for future studies into the GDS lakes, as well as development guides for Rice County.

I. Minnesota Pollution Control Agency (PCA) Lake Assessment Program (LAP) Studies on Lakes: Land Use and Water Quality  
([www.pca.state.mn.us/netscape.shtml](http://www.pca.state.mn.us/netscape.shtml))

*Lake Assessment Program: Effects of Land Use on Ground Water Quality, St. Cloud Area, MN – 1999 Results. July, 2000.*

The Ground Water Monitoring and Assessment Program (QWMAP) and the Minnesota Pollution Control Agency (MPCA) study began in 1996 to assess impacts of land use on ground water quality near St. Cloud, Minnesota which is experiencing rapid urbanization. A shallow sand and gravel aquifer underlies the study area, and is sensitive to land use change. Monitoring wells at the water table and in the aquifer helped indicate huge differences between undeveloped land use and other land uses.

The study indicated that human activity led to various problems in the ground water. Increased nitrate concentrations and herbicides were found in residential areas. Certain turf grass management practices and the extent of irrigation or watering in agricultural and residential areas led to water quality impacts. Furthermore, vulnerable



hydrogeologic setting, such as Karst bedrock aquifers or shallow, surficial sand and gravel aquifers were more likely to be impacted by human use.

Long-term studies in areas where specific land use changes occur, such as unsewered to sewer, nonirrigated to irrigated agriculture, or undeveloped to other land uses will be implemented. Fact sheets for local water planners and managers will also be produced. These will include issues like land use impact on ground water quality, patterns of recharge and implications for sampling and managing ground water, and the relationship between surface water and ground water quality. Modeling, bacteria sampling and possible additional monitoring wells are a part of the 2000 sampling objectives.

*Lake Assessment Program: Lake Minnewaska. Pope County, Minnesota. 1995.*

Lake Minnewaska is located near Glenwood and Starbuck in Pope County. It has a surface area of over 7700 acres, and has a maximum depth of 32 feet. Lake Minnewaska was sampled during the summer of 1995 by the MPCA and citizens from the Lake Minnewaska Improvement Association. Water quality data collected indicated that the lake was borderline mesotrophic-eutrophic. Two lake water quality models were used to determine recommendations for the lake.

Recommendations include:

- continued Citizen Lake-Monitoring Program (CLMP) to determine total phosphorus, chlorophylla, and Secchi transparency
- minimize water quality impacts on the lake in shoreland areas (setback provisions, urban stormwater routed through sedimentation basins) and other land management activities- using Protecting Minnesota's Waters: The Land-Use Connection as a guide.
- Examination of land use practices in watershed and identification of possible nutrient sources such as agricultural runoff, lawn fertilizer, and the effects of ditching and draining of wetlands. This will help determine areas where BMPs are needed.

*Lake Assessment Program: Sleepy Eye Lake (I.D. #08-0045) Brown County, MN. October 1996.*

This PCA study aimed to identify the sources of pollution to the lake by characterizing the quality of the lake, and developing a program to assist in future lake management. The Sleepy Eye Lake watershed is small, and so there were many opportunities for lake protection and improvement.

Sleepy Eye Lake lies in the Western Corn Belt Plains ecoregion, and is surrounded by 50% cultivated land and 26% urban land (this includes mostly residential). The study determined that better lawn, garden and urban "housekeeping practices" were essential for water quality improvement on the lake. Local government land use/zoning regulations as well as a citizen lake monitoring program (CLMP) were both recommendations for lake protection and improvement.

*Lake Assessment Program: Lake Waconia. Carver County, Minnesota. 1994. Contact: Dave Drieland #612-361-1820.*

Lake Waconia was sampled during the summer of 1994 by staff from the MPCA and Carver County Environmental Services. Phosphorus concentrations, Secchi transparency, and chlorophyll *a* helped to characterize the lake; the measures indicated borderline mesotrophic to eutrophic conditions. Land use in the watershed is mostly cultivated (49%) and water/marsh (29%). Recommendations were made based on the Lake Assessment Program (LAP) study.

Lake Waconia has relatively low phosphorus and chlorophyll concentrations, and so is therefore sensitive to any changes on the lake. Any minor alterations in nutrient loading could cause degradation. The potential for future development on the lake is great. So, it is recommended that lake protection efforts are conveyed through land use/planning regulations. This may be done through management plans.

Carver County must ensure that development occurs in a way that minimizes water quality impacts on the lake. Setback provisions and septic tank regulations should be enforced. Watershed activities that change drainage patterns should be discouraged, such as wetland removal and change in land use. Stormwater management practices should be designed to avoid direct discharge. It is also recommended that a more detailed examination of storm sewer loadings, feedlot runoff, runoff from cultivated areas, septic systems, lawn fertilizer, and the effects of ditching and draining of wetlands be implemented.

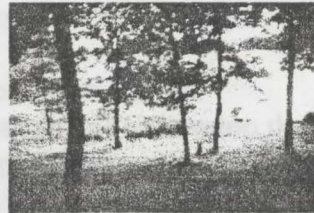
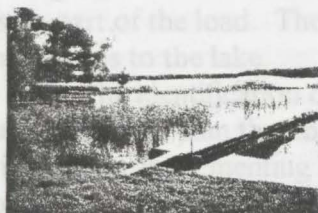
This study confirmed that changing land use practices, poor management of shorelands, draining of wetlands in the watershed, nonconforming septic systems, and runoff from feedlots provide the greatest likelihood for changes in phosphorus loading. It is also suggested that a reduction of amount of nutrients entering the lake would result in improved transparency and a reduction in algal blooms. Best Management Practices (BMPs) should be implemented to reduce these nutrient inputs. In addition, restoring wetlands in the watershed may also be beneficial for reducing sediments and nutrients that enter the lakes. According to Dave Drieland of Carver County, future development should be on a density-basis and development in general should be limited.

#### *Lakeshore Restoration Site Visit: Big Sandy Lake*

The PCA and University of Minnesota Extension Service ([www.extension.umn.edu](http://www.extension.umn.edu)) worked together to determine the source of algal blooms on the lake. The eutrophic nature of the lake was largely caused by residential land management practices along the shoreline. Septic non-compliance, fertilizer run-off, and lack of native aquatic vegetation all led to effects on the water quality of the lake.

The U of M Extension Service put together a guide to help educate property owners on revegetation and natural landscaping, "Shoreland Landscaping Series". Some property owners have chosen to restore their lakeshore to a natural landscape that preserves the aquatic zone, upland zone and the wet meadow zone (littoral edge). The design usually entails implementing off-shore wave-break structures that will reduce edge erosion. Moving the dock to the side of the property to allow for an extended area of natural vegetation is also an important step. All of these practices are essential for improving water quality on lakes, and should be recommended on lakes that are heavily impacted by run-off problems.

Photos of Lakeshore Restoration:



## II. Other Studies Assessing Land Use and Water Quality

*Barton, John, Hennepin County Parks. Contact. Lake Independence Diagnostic Feasibility Study. #612-476-463.*

The Lake Independence Diagnostic Feasibility Study is not yet finalized; this information is based on a phone interview with John Barton. He explained the land use issues that have affected Lake Independence, and what should be done in the future.

Lake Independence is surrounded mostly by agriculture and low-intensity residential (5-10 acre lot size). The town is undergoing urbanization that is leading to the problems in lake quality. The lakeshore is fully developed and the properties are sewered.

The study has included modeling, lake monitoring of in-flow streams, and GIS livestock studies. Through these various approaches, Hennepin Parks has determined that there is a combination of issues that have led to the Phosphorus and Nitrogen loading in the watershed. Horse livestock/small horse hobby farms have contributed the most to the loading. The number of livestock units makes the difference. In addition to this land use, shoreline impact, leaf litter, lawn fertilizers, and the elimination of the buffer zone by property owners has also contributed to the nutrient loading in the lake.

According to John Barton, the land use that is affecting the water quality of Lake Independence the most is agricultural run-off. Residential fertilizer run-off is a secondary issue of concern.

*Dindorf, Carolyn J. Lake Sarah Project phase 1 – Diagnostic Study Report and Implementation Plan. Hennepin Conservation District. October 1997. Contact #952-544-8572.*

Due to concerns about degrading water quality on Lake Sarah, this MPCA study was developed. The Pioneer-Sarah Creek Watershed Management Commission (Commission) had been monitoring the lake and noticed it was poor. Historically, Lake Sarah was a vacation area with many resorts. Currently, the lake consists mostly of single family residential homes, and is still a popular fishing and boating area. Agriculture makes up about 25% of the land use surrounding the lake in its watershed. Today, recreational use is becoming limited due to the degrading water quality from residential and agriculture land uses.

Two major inlets and the outlet were monitored between 1990 and 1991, with additional sampling in 1992. It was determined that a high load of phosphorus was coming from the watershed. Direct runoff from the area, including septic systems, was also a part of the load. The two major tributaries were the largest contributors of phosphorus to the lake.

The identification of the largest phosphorus contributors prompted an implementation plan that included a review of land uses and inspections to develop the priorities for implementing BMPs in the watershed. Potential projects to help reduce pollutant loading include wetland restorations, feedlot improvements, buffer strip installation, conservation tillage, and education. Education and stream improvement projects will be funded through grant funding.

*USEPA. "Watershed Protection: Clean Lakes Case Study Watershed and In-lake Practices Improve Green Valley Lake, IA." <[www.epa.gov/owow/lakes/clnlake.html](http://www.epa.gov/owow/lakes/clnlake.html)> September 1995. (Accessed 26 Sep. 2000)*

Green Valley Lake is an impoundment located in Southern Iowa. It was built in 1952 near the headwaters of the Platte River, and by the 1970's it was impacted by erosion from surrounding the agricultural watershed. Sedimentation, turbidity, excess growths of blue-green algae and low dissolved oxygen prompted a Diagnostic/Feasibility Study.

The study in the 1970's indicated excessive inputs of sediment and nutrients that affected recreation and aquatic life, oxygen sags in the mornings and fish kills. A Restoration/Implementation Project (Phase II) was then carried out between 1980 and 1986. Approaches for restoring the lake involved Best Management Practices (BMPs) and the installation of two sediment/nutrient retention dikes to retard water flow and cause sediment to settle out. Monitoring with the Clean Lakes Project also was implemented to analyze turbidity, nutrient loading, algal chlorophyll, blue-green algae, beach-use, and public use. A bottom profile of the lake has been produced every 5 years to determine the sedimentation rate.

In Phase III, the Post-Restoration Monitoring Project in 1991-1994, some additional BMPs were installed and monitoring was aimed at determining if the restoration techniques were working to improve the lake's water quality. The study did indicate that the water quality has improved, and will continue to improve due to in-lake and watershed restoration efforts.

### III. Planning Strategies for Future Development

*Arendt, Randall G. 1996. Conservation Design for Subdivisions – A Practical Guide to creating Open Space Networks. Natural Lands Trust, American Planning Association, and American Society of Landscape Architects. 91-96 p.*

In chapter seven, Arendt discusses conservation designs on seven different sites. "Site E: Lakefront site in the Northern Woods" is a useful example of conservation design that could be applied to Rice County Lakes future development.

The 46-acre site was owned by a family that wished to sell part of its lakefront property for development. They approached the process with conservation in mind. The hired design team came up with a conservation design that incorporated preservation of lakefront forested areas and public space, while at the same time, designing property lots with prominent viewpoints. An extensive network of footpaths, a public beach for all 18 families to share, a tennis court, a ball field, and 13 lots all exist on the development. Half of the site was determined potential open space by locating conservation areas (upland meadow, wooded lakeside greenway along shoreline, and certain viewpoints, as well as native plant species) around which development could occur. The most notable feature in this development is the public greenway that encircles the lake. The property owners in the development own the land, and everyone has access to these beautiful areas. This buffer prevents development impacts like shoreline erosion and fertilizer runoff, and it limits the amount of beachfront on the lake. The beach is concentrated in one area, and is accessible to everyone; this allows for less shoreline impact throughout the lake.

This case study gives insight to the type of conservation design that could take place in future developments around the GDS lakes.

*Arendt, Randall. 1994. Rural by Design: Maintaining Small Town Character. American Planning Association. Washington, D.C. 335-337, 347-348 p.*

In *Rural by Design*, Arendt discusses design criteria for conservation development in many types of landscapes. The following case studies involve lakefront development and the preservation of shoreline. These studies may serve as precedents for future developments on the GDS lakes.

#### Dunham Lake Estates:

Dunham Lake Estates, Michigan provides an example of a development that has preserved the lake's beauty and integrity by creating a 100'-400' greenbelt park along the lakeshore. The designers of this development have incorporated trails on the shoreline and on wooded ridges, two beaches, and a lakeside park. Despite lack of actual "lake frontage properties", the property values have remained very high. The arrangement of house lots allows all residents to enjoy the lake, while retaining the natural vegetation along the shoreline. This buffer protects the shoreline from erosion, nutrient run-off, and extensive beachfront development. It also helps preserve the lake's water quality.

#### Fields at Long Grove:

The design of Fields at Long Grove incorporates clustering techniques, and preservation of open space in a lake development. The open space consists of 50 acres of restored prairie, a 10-acre oak forest, 3 ½ miles of trails, a lake with a sandy beach, and ponds.

This conservation design is notable for its design standards that help protect the environmental integrity of the site as well as the lake's water quality. The designers have

reduced site disturbance and maximized the environmental benefits by limiting lot size to  $\frac{1}{4}$  acre. The cluster design allows for the preservation of a rural atmosphere, while protecting environmentally sensitive areas like steep slopes and natural vegetation. A 60-acre prairie restoration area contains native grasses and wildflowers. After the removal of drainage tiles, wetland species reemerged and are now a part of the wastewater treatment system. An aeration lagoon and spray irrigation over cultivated farmland are a part of the wastewater treatment system that treats the water on site, and continually recharges the groundwater. Limiting pavement width to 18-20 ft also reduces stormwater runoff. This design eliminates the curb and gutter system, and allows for drainage in grassy swales. All of these design standards contribute to the water quality of the lake.

The lake contains a buffer along its edge where no development may occur. Public trails extend along the lake, offering property owners access to the lake. The homes do not have lake frontage lots, but all share views of the lake. This helps preserve the integrity of the lake and the shoreline vegetation.

## Methods

Two main data collection methods were used for this study: creation of Geographic Information Systems (GIS) land use maps and lake property owner's survey results. Site visits were also incorporated in to the study to better identify areas affected by erosion, contamination, and over-use, providing a visual understanding of the area. The analysis of land use within a 1320 ft buffer around each GDS lake was conducted using GIS software and aerial photographs of the region. In order to realize what actually is occurring in the landscape surrounding the lakes, 1200 "lake property owner's surveys" were sent out to every property owner whose parcel fell within or partially within the 1320 ft buffer around the GDS lakes. 495 surveys were returned, providing this study with ample feedback on the quality of the water, as well as individual concerns and suggestions about future development for the lakes. This section will outline how each method was developed and used to analyze the land use impacts on the lakes.

### *Geographic Information Systems (GIS)*

Since agricultural runoff and residential shoreland practices can greatly impact the quality of the lake and the experience one has there, it is necessary to analyze the spatial quality of the landscape by creation of land use maps through Geographic Information Systems (GIS). A geographic mapping tool used to analyze, store, generate, and output spatial data, GIS is useful in determining what actually exists on the land surrounding each GDS lake. Analyzing Rice County aerial photographs of the lakes and recreating what exists on the land by digitizing land features, land use maps were developed. These are visual tools that can be used to research more closely the negative impacts on the lakes, by determining their location and cause.

Data coverages and aerial photographs were obtained from the Rice County Planning and Zoning offices. All themes existed in the Rice County State Plains Coordinate System. These sources were used in ArcView to develop shapefile land use files for each of the

six lakes. This visual representation of the landscape, both in aerial and map format, is helpful for understanding the land in Rice County.

### *Lake Property Owner's Survey*

Understanding the concerns and needs of the people who use the lakes is essential for understanding the problems that exist on the lakes, and how to remedy them. The large number of returned surveys, over 40 %, exemplifies the amount of concern vested in the community. 495 families in Rice County are interested in the quality of their lakes and the experiences they have there. Using the Minnesota Lakes Association sample survey (Minnesota Lakes Association 2000) as a template, a lake property owner's survey was created and sent to 1200 families who lived within 1320 ft of any of the six GDS lakes. The survey was four pages long, included twenty questions and thirteen spaces for commentary. An Access database was set up to inventory the returned surveys, and to begin analysis. Using Access and Excel software, the data was organized into analytical tables and charts, and used to determine the most common concerns, residence type and recreational activities of the community.

## **Results**

### *Geographic Information Systems (GIS)*

(Refer to Figs. 1-6)

The land use around the GDS lakes is very distinctive. All six lakes share very similar land use patterns. For all of the lakes, a common ring of residential land use can be found adjacent to most of the shoreline. Oftentimes agricultural land extended from these residential areas and occupied much of the remaining land to the border of the 1320 ft. buffer. These agricultural and residential lands are sources of contaminants and nutrients that are pouring into these lakes. Despite the significant areas devoted to residential and agricultural uses however, large pockets of wetlands and forests still occupy portions of the landscape neighboring the agricultural and residential landscape. It is here where the focus of this section will turn. As important land for future open space as well as beneficial sinks for nutrient uptake, these lands must be preserved.

Forests, grasslands, and wetlands are important systems that can help preserve lake quality. Riparian forests and grasslands prevent nutrient transport from uplands to streams and lakes by taking the contaminants up into their roots and leaves (Osborne and Kovacic 1993 in Carpenter and Cottingham 1997). Wetlands function as sponges and sinks that delay the transport of water to downstream lakes, thereby reducing the risk of flooding. They also modulate nutrient transport from uplands to streams and lakes, preventing their direct flow into the lakes. Wetlands are a major source of organic humic substances for lakes, which help maintain the balance of the lake system and provide shading effect (Hemond 1990, Wetzel 1992 in Carpenter and Cottingham 1997).

Residential, agricultural and natural landscape can exist in harmony if managed properly. It is important to understand that where high intensity uses meet natural wetlands and forests, best management practices will need to be implemented, and people will need to be educated on how to preserve and care for these lands. Since the existence of natural wetlands, forests and grasslands can effectively help the lake's condition; there should be a common interest in preserving these areas. Preservation should be mandated where wetlands exist near the source of a river that drains into the lake. Shields and French lakes, and the others to a lesser extent, offer extensive wetland resources around the lakes. These vital natural areas not only offer scenic value but they offer important stormwater management possibilities as well as a means for contaminant uptake before they enter the lake.

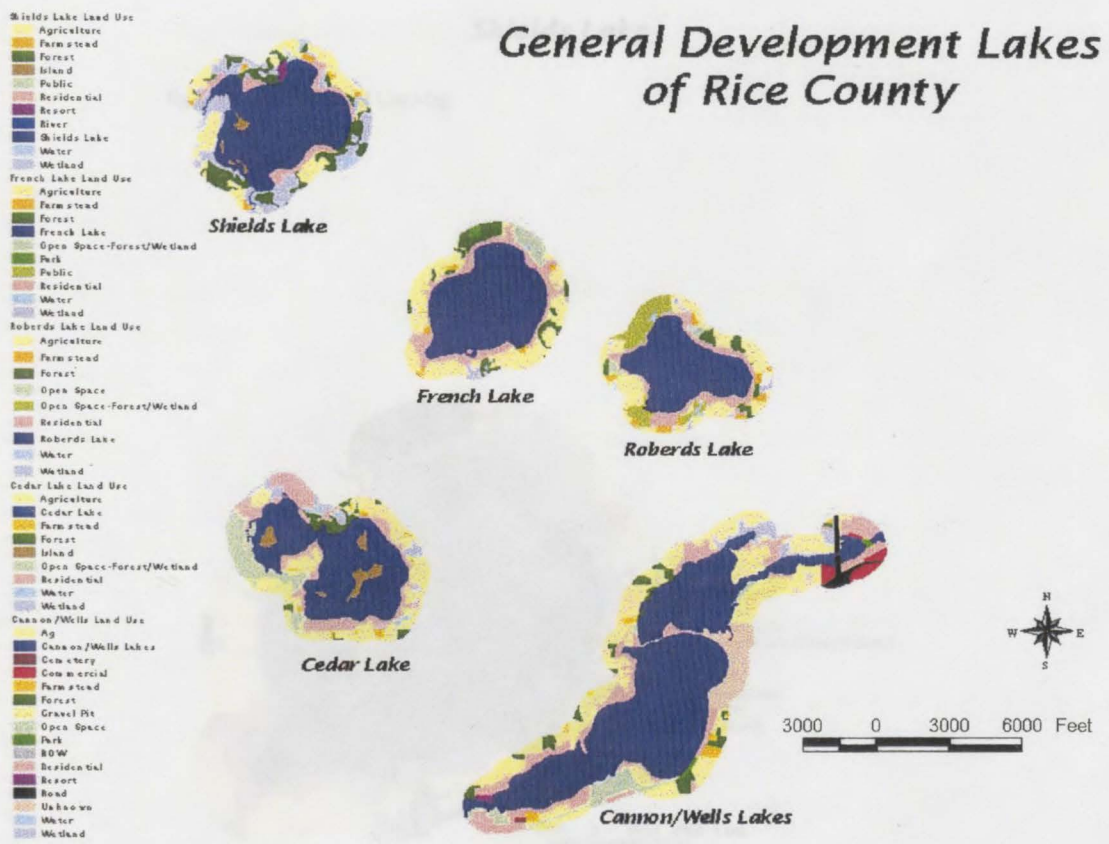


fig.1 Land Use of the General Development (GDS) Lakes in Rice County



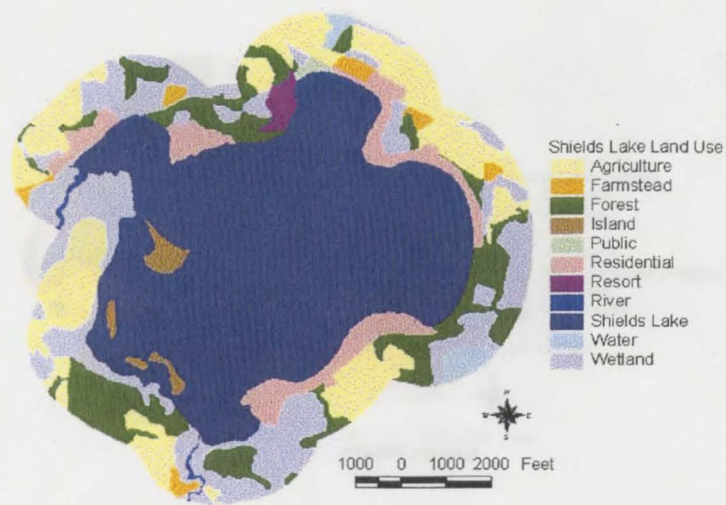


fig. 2. Shields Lake Land Use Map

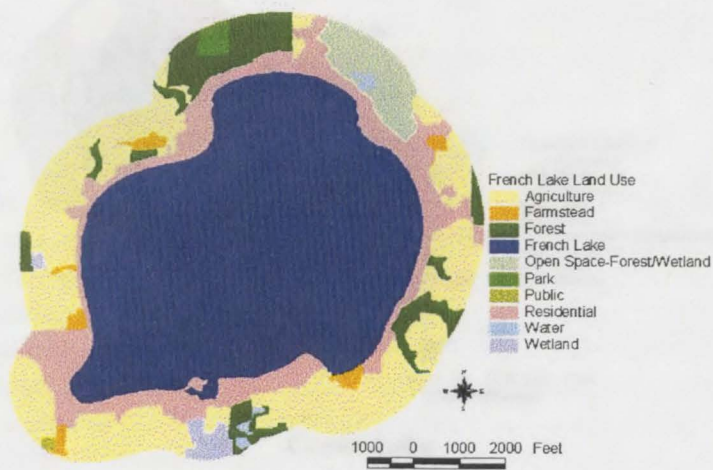
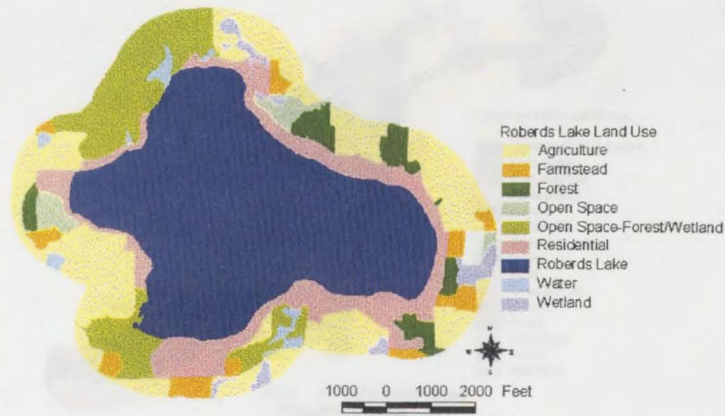


fig. 3. French Lake Land Use Map



**Roberds Lake**

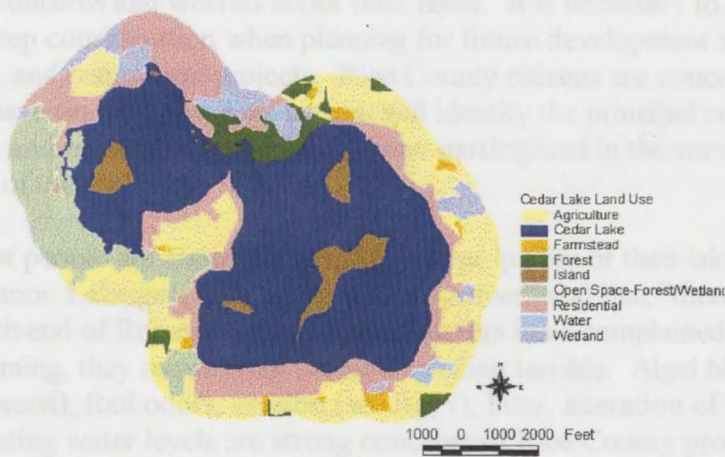
fig.4. Roberds Lake Land Use Map

*Rice County Water Quality Survey*

*Lake Property Owner's Survey*

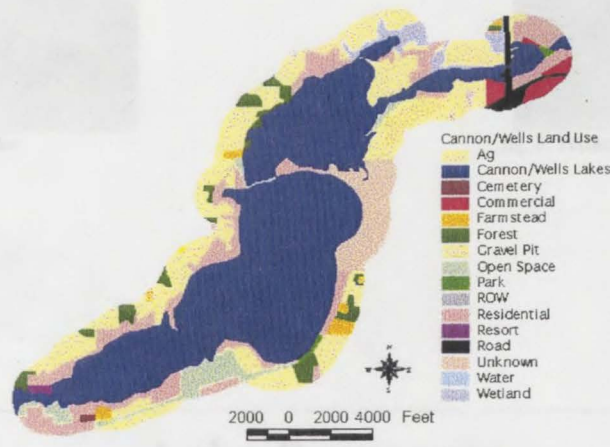
The comments raised in the property owner's survey were evocative. Many families shared the same concerns and worries about their lakes. It is necessary to take these comments into deep consideration when planning for future development strategies, education efforts, and other programs. Rice County citizens are concerned with the experience they have on their lakes. The survey identified the principal concerns, recreation habits, and other issues that were mentioned in the survey and discuss the ramifications of these concerns.

A large number of property owners claimed that "Cannon" weeds in the south-end of Rice County lakes are too many. They have explained that when their children go swimming, they are often bothered by the presence of algae blooms, which are a common problem in the area. A large number of property owners also mentioned the presence of shoreline erosion (see fig. 5) and fluctuating water levels are strong concerns among property owners. Many go into detail about where the erosion is occurring and how it is affecting their property. Others offer suggestions for dealing with erosion and water level fluctuations. These comments are evidence of the problems in the GPS lakes of Rice County, and should be taken into consideration.



**Cedar Lake**

fig.5. Cedar Lake Land Use Map



**Cannon and Wells Lakes**

fig.6. Cannon and Wells Lakes Land Use Map

### *Lake Property Owner's Survey*

The comments raised in the property owner's survey were revelatory. Many families shared the same concerns and worries about their lakes. It is necessary to take these comments into deep consideration when planning for future development strategies, education efforts, and restoration projects. Rice County citizens are concerned with the experience they have on the lake. This section will identify the principal concerns, recreation habits, and residence types of those who participated in the survey and discuss the ramifications of these results.

A large number of people are concerned with the water quality of their lakes. They have claimed that "Cannon Lake gets very green in late summer" and that "there are too many weeds in the south end of Roberds Lake". Some parents have complained that when their children go swimming, they return from the lake smelling terrible. Algal blooms, weeds (curly leaf pond weed), foul odors, erosion (see fig. 7), litter, alteration of shoreline (see fig. 8) and fluctuating water levels are strong concerns of Rice County property owners. Many go into detail about where the contaminants may be coming from. Others offer suggestions for dealing with erosion and agricultural runoff. These comments are evidence of the problems in the GDS lakes of Rice County, and should be taken into consideration.



fig. 7. Erosion on Roberds Lake



fig. 8. Terracing of shoreline on Roberds Lake

### The Response

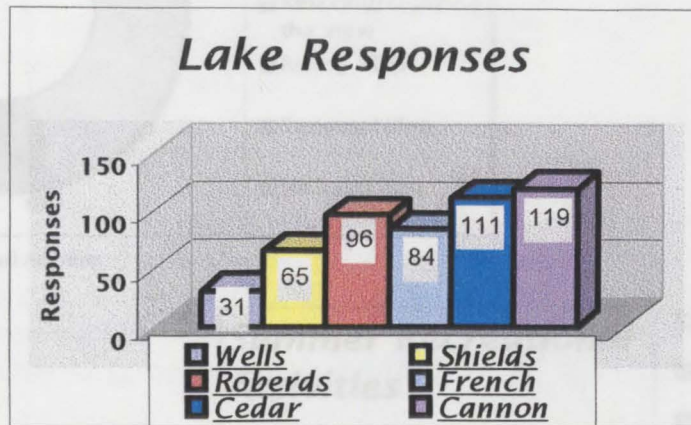


fig. 9. Lake Responses to Lake Property Owner's Survey

The citizens of Rice County are very interested in what is happening with their lakes, and they are concerned about what they can do to improve the quality of their waters. As seen in the lake responses, there was over a 40% return. The largest return came from the largest lake in the county, 119 surveys out of 495, providing 24% of the surveys. Cedar Lake supplied the study with an additional 111 surveys, another 23%. Roberds Lake came in third with 96 surveys, offering 19% of the survey turnout. French, Shields, and Wells Lakes provided an additional 84, 65, and 31 surveys, respectively. Overall, it was a substantial turnout, which contributed useful information to the study.

### The Citizens Who Responded

The citizens who responded to the survey are from diverse backgrounds. They also practice varied careers, and enjoy different activities. However, there seemed to be several trends with regard to how they use the lakes. The recreational activities that people enjoy during both winter and summer were polled. From these results, it is evident that these people use their lakes, and they enjoy them throughout all seasons of the year. Several activities were more popular than others. During the winter, ice fishing

(34%) is the most popular activity, followed by snowmobiling (16%)(see fig. 10). In the summer, fishing is again the most loved sport (31%), followed by boating (27%) and waterskiing (14%)(see fig. 11).

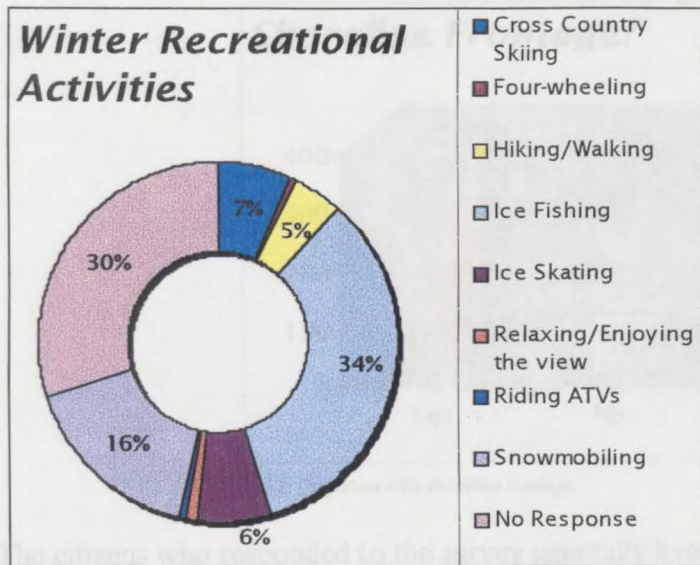


fig.10. Winter Recreational Activities

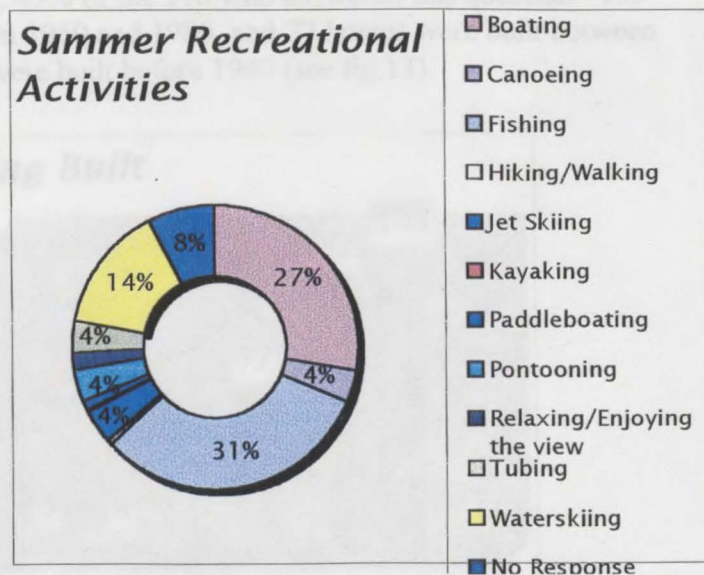


fig.11. Summer Recreational Activities

### The Properties Around the Lakes

The survey was mailed to property owners whose parcels fell within the 1320 foot buffer study area around the lakes. Some landowners hold lakeshore property, and others do not. Some spend time on the lakes in the summer only, and others live on their property year-round. And still, some citizens own the land on their property, but do not have a

dwelling. The demographics of this community are what create the culture around the lakes in Rice County. The majority of those who responded to this survey own lakeshore property. 393 out of the 495 families that responded have shoreline frontage (see fig.12). This means that 80% of the property owners who responded live right on the lake. They are actively concerned about their property, and the quality of the lakes.

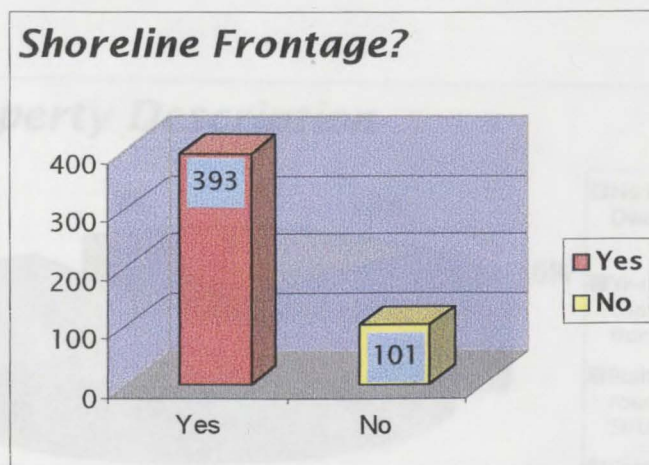


fig.12. Properties with shoreline frontage

The citizens who responded to the survey generally live in fairly new homes. When asked what year their dwelling was built, 143 property owners responded that their home was built between 1980 and 2000, 45% of the 318 who answered this question. 133 citizen's homes were built between 1960 and 1980, and 77 homes were built between 1940 and 1960. Only 42 homes were built before 1940 (see fig.13).

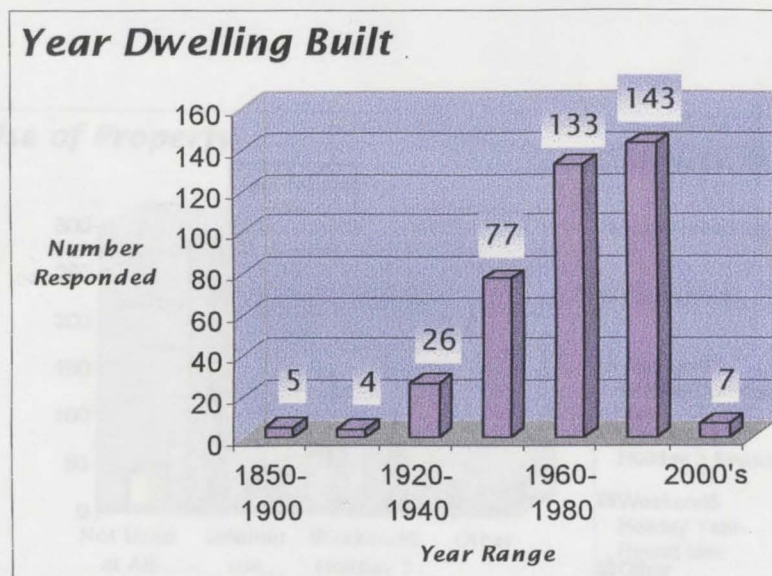


fig.13. Years of Dwelling Development

The citizens who responded to the survey inform us that their properties around the GDS lakes are mostly year-round structures, and many families use them throughout the year.

62% of those who responded said that their homes are built as year-round structures (see fig. 14). In addition, 275 families out of 495 who responded use their home throughout the entire year (see fig. 15). This by no means reflects the entire population around the GDS lakes. However, it is informative of the citizens who responded to the survey, and allows us to understand the atmosphere around these lakes.

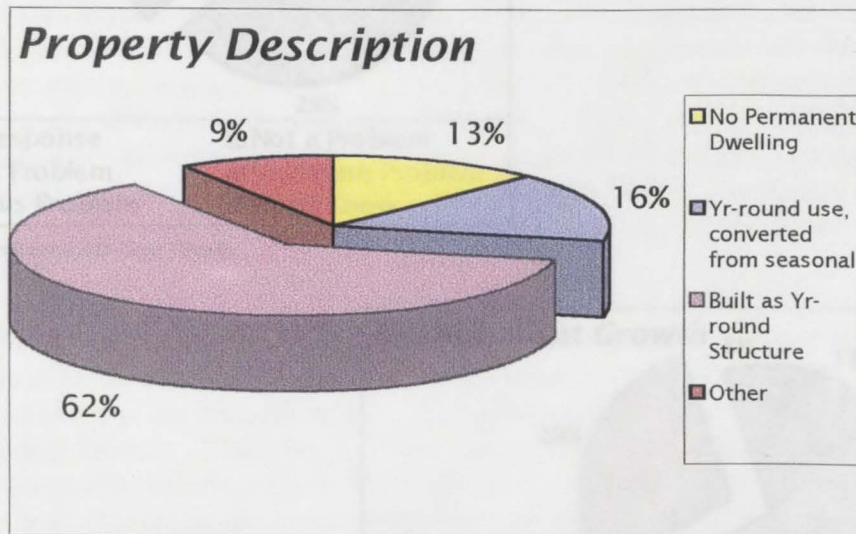


fig.14. Description of Property

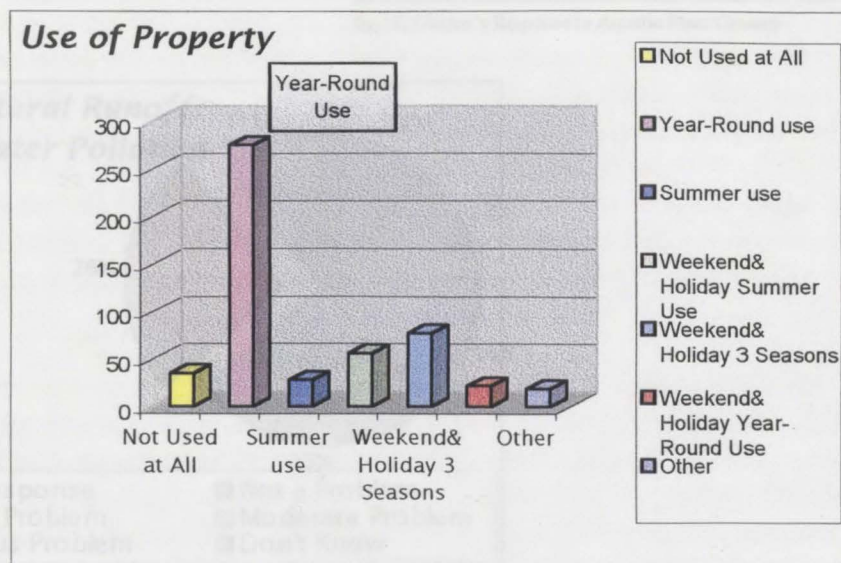


fig.15. Time of year Property is used

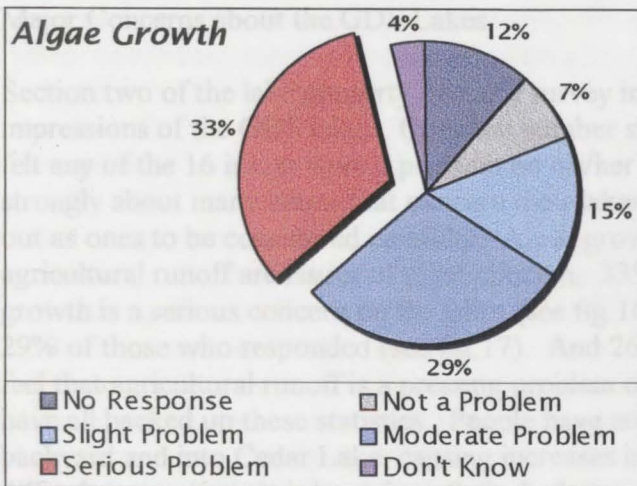


fig.16. Citizen's Response to Algae Growth

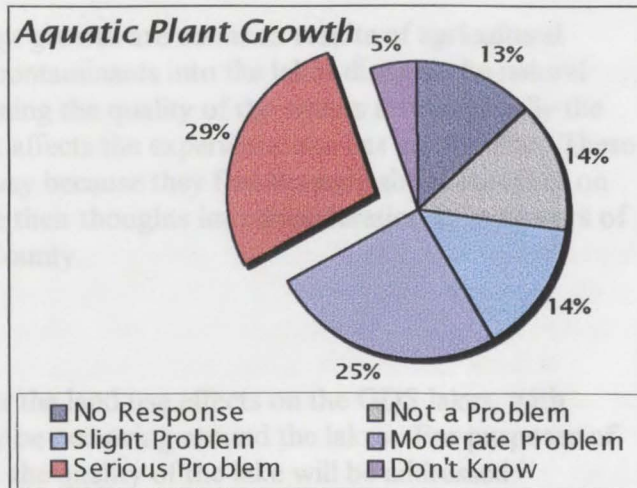


fig.17. Citizen's Response to Aquatic Plant Growth

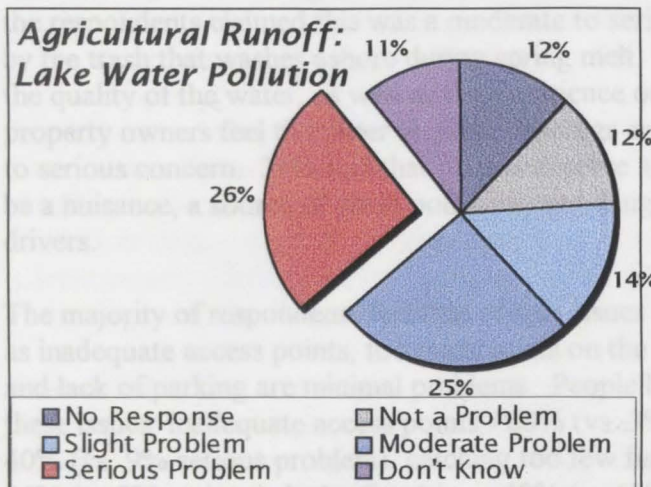


fig.18. Citizen's Response to Agricultural Runoff



## Major Concerns about the GDS Lakes

Section two of the lake property owner's survey includes questions on general impressions of the GDS lakes. Question number six asks the property owner if he/she felt any of the 16 issues were a problem on his/her lake. The citizens of Rice County feel strongly about many issues that concern their lakes, but three issues in particular stand out as ones to be considered carefully. Algae growth, aquatic plant growth, and agricultural runoff are issues of great concern. 33% of the respondents claimed that algae growth is a serious concern on the lakes (see fig.16). Aquatic plant growth is bothering 29% of those who responded (see fig.17). And 26% of the Rice County property owners feel that agricultural runoff is a pressing problem on the lakes (see fig.18). Comments have all backed up these statistics. People have seen herbicide runoff flow through their backyard and into Cedar Lake, causing increases in algal blooms. One family has difficulty removing their boat from their dock because of curly leaf pondweed infestations.

Algae growth and invasive aquatic plant growth are common results of agricultural runoff. The addition of nutrients and contaminants into the lakes disrupts the natural dynamic that exists in the lake, threatening the quality of the waters and eventually the fish and wildlife habitats. Ultimately it affects the experience one has on the lake. These property owners responded to the survey because they feel strongly about the lakes on which they live. It is important to take their thoughts into consideration as indicators of what is threatening the lakes of Rice County.

## General Problems on the Lakes

The purpose of this study is to uncover the land use effects on the GDS lakes, with concern for specific problems that may be occurring around the lakes. For purposes of this study, only those issues that affect the quality of the lake will be addressed.

Litter on the lakes during the winter due to ice fishermen is a common concern. 25% of the respondents claimed this was a moderate to serious problem. They are discouraged by the trash that washes ashore during spring melt. Littering can have adverse effects on the quality of the water, as well as the experience one has at the lake. 22% of the property owners feel that litter at public landings and access points are also of moderate to serious concern. 31% feel that jet skis deserve a moderate to serious rating. They can be a nuisance, a source of noise pollution, and dangerous when operated by unskilled drivers.

The majority of respondents feel that certain issues are not serious problems. Issues such as inadequate access points, too many boats on the lake, catching too few fish, vandalism, and lack of parking are minimal problems. People have responded "not a problem" to these issues: inadequate access points - 60% (vs. 3% serious problem) too many boats - 40% (vs. 9% serious problem), catching too few fish - 39% (vs.10% serious), vandalism - 46% (vs.3% serious), lack of parking - 48% (vs.6% serious). It is clear to see that the

most pertinent problems are those regarding the quality of the waters. So it is there where community members and local government officials should focus their energy.

## **Discussion**

The GDS lakes of Rice County are affected by development growth and changes in their surrounding landscapes. The negative impacts on water quality, recreational activities, and the experience of being on the lake are becoming more evident. As more people wish to live near these lakes and use them for recreational purposes, the lakes will become more endangered. It is necessary to understand that it is up to the communities to set up programs to solve these issues. Restoration, education on shoreland best management practices, and local government protection policies are needed to revitalize the lake experience that drew people to live here in the first place. The awareness and concern is present among the citizens of Rice County; this is evident in the 40% survey turn out. In order to put these ideas into action, it is necessary to set up goals among community members and local government officials. Community based planning is essential in order for this to be successful. Cooperation and a love for the lake will bring people together to create a healthy environment where everyone can enjoy the lakes.

In order to recover the lost experiences on the lakes, education and restoration are needed. Rehabilitation of these lake systems will require restoration of riparian, wetland, and macrophyte vegetation, a reduction of phosphorus imports from farms, and reduced harvests of game fish (Carpenter and Cottingham 1997). These changes are linked to socioeconomic issues locally and regionally. The restoration should aim to recreate a lake system that is self-regulating, and integrated ecologically with its surrounding landscape (National Research Council 1992 in Carpenter and Cottingham 1997). So, in the case of the GDS lakes in Rice County, it is essential to change the agricultural and shoreland practices that are harming the lake, as well as preserve the undeveloped natural ecosystems in order to reduce the human impacts on the watershed as well as provide for places of open space and wildlife habitat. These changes do not require that people change their lifestyles, just simply readjust to new practices that will enable them, and those around them to enjoy the lakes fully.

In addition to the essential water quality benefits and increase in recreation, the economic benefits are substantial. Flood control, pollution dilution, reduced costs of purifying drinking water, increased utility of cleaner water for irrigation and industry, and increase in tourism all provide a community with economic benefits (Wadler et al. 1993 in Carpenter and Cottingham 1997). Rice County is a prime candidate for lakeshore restoration and shoreland best management practices.

Restoration efforts of the lakes will need to be followed up with policy measures for future sustainable development practices. Several options may be regarded in order to protect vital natural communities, while at the same time allowing for sustainable future growth. Practices such as Transfer of Development Rights (TDR), Purchase of Development Rights (PDR), Local Government Land Acquisitions, and Conservation

Easements should be considered as valuable options. General land use controls such as preservation overlay zoning, conservation district establishment, open space zoning, subdivision requirements, and performance zoning are good options for the lake region of Rice County. Education should be an overarching goal in order to provide landowners, community leaders, and local government staff with an understanding of the value of natural areas, the basic needs of natural communities characteristic of the region, the impacts of varying land uses, optional protection tools, and appropriate conservation practices (Allmann 1997).

In Rice County today, there are currently 29,700 acres set aside in the Conservation Reserve Program (CRP), 531.6 acres in Perpetual (PWP) Easements, and 979.1 acres in Reinvest in Minnesota (RIM) Reserve Easements (Allen and Rice County Water Plan Advisory Committee 1997). This is a start. However, government-owned property accounts for only 6,995 acres in Rice County, only 2.2% of the total land area. With the remaining land existing on private property, there is a need for cooperation between landowners and local government members. A governmental policy such as Transfer of Development Rights (TDR) may be an appropriate measure to implement in Rice County. In this instance, landowners in a designated preservation ("sending") zone may sell his development rights to a broker or land developer, who then uses the purchased rights to increase their allowable building density in another area, a "receiving" zone. This policy ensures preservation of natural areas and open space lands, while enabling the landowner to develop land at an increased density. This ultimately compensates the landowner for relinquishing development rights to their property. A TDR program thus shifts development to the areas that are most suitable for growth, and away from valued lands that the community wishes to preserve, like lakeshores, wetlands, forests, and open space areas.

Over recent years, Rice County has not maintained adequate information regarding land use trends. The impacts of development on the GDS lakes have not been monitored appropriately. As a result, the lakes are deteriorating, and citizens are becoming discouraged by the resulting negative experiences on the lakes. In addition, there are conflicting values regarding future development practices. Some lake property owners do not want further development, whereas others who have a development base would prefer to develop their properties. The problem may only be exacerbated if the development is not limited or redirected to a "receiving" zone, and if natural areas are not preserved for future open space. The solution relies on the citizens of Rice County. If people can come together under a common interest to preserve the quality and experience of the lakes they all love, the result will be successful, and future generations will be able to enjoy the landscape just as they once did.

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